GOVERNMENT OF PAKISTAN
Ministry of Housing & Works
Environment & Urban Affairs
Division

NATIONAL REFERENCE MANUAL ON PLANNING AND INFRASTRUCTURE STANDARDS

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CONSULTANTS

PEPAC

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PREFACE

In May 1983, Government of Pakistan, Ministry of Housing & Works, Environment & Urban Affairs Division, initiated the arduous but necessary work of preparing the National Reference Manual on Planning & Infrastructure Standards. The objectives of Government were :

i) To obtain a consistent basis for review of existing standards of land use, housing, infrastructure and services.

ii) To frame standards and guidelines which could be used by Federal, Provincial and Local Government agencies for preparing area plans for housing, commerce, industry, community and other common land uses alongwith associated physical infrastructure.

Realizing that a realistic and relevant Manual required extensive data collection on current standards and practices, an informed critique of these practices as well as meticuluous structuring of recommendations, Government commissioned Pakistan Environmental Planning & Architectural Consultants Ltd (PEPAC) to undertake the collation, analysis and presentation. To guide and supervise the work of the Consultants, the Ministry constituted an Experts Committee, (composition as on pages ii to iv). The Committee met 8 times between 1983 and 1986 in sessions extending over 2 to 3 days to consider and examine the recommendations of the Consultants. It labouriously went over each item and its ramifications in order to ensure suitability and consistency. Deliberations upon basic premises and appropriateness of recommendations entailed further explication and elaboration and often recourse to second round data collection, analysis and synthesis as well as generation of indigenous standards from first principles.

Immense labour and attention has been devoted to the framing and finalisation of this Manual. My thanks are due to all members of the Experts Committee and the Consultants' team for bringing this assignment to a meaningful conclusion.

It is hoped that the Manual will be a useful consolidated reference to the planning community in solving the immense problems of the built-environment facing the country.

Abdur Rahim Mahsud
Secretary,
Ministry of Housing & Works.

April, 1986

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CHAPTER -1 : BASIC CONCEPTS

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CHAPTER 1 : BASIC CONCEPTS

1.0 GENERAL

By rationalising land uses and organising space, an efficient and more equitable physical framework for human settlements can be created. This is the fundamental tenet of physical planning. If properly carried out, it should effectively contribute to meeting peoples' habitational needs within available resources and an acceptable time-frame. However, land uses cannot be organized simply by colouring maps.

Physical planning is essentially a decision-making process, whose outcomes take the form of policies, programmes and designs. The components of policies and programmes, which can be applied to multiple concrete situations are expressed as design criteria, standards and guidelines. This is the rational approach, which uses the distilled experience of the discipline, saves time on each project, (by avoiding tedious recourse to first principles), increases their comparability and facilitates evaluation. Thus, guidelines and standards are both the"end products" and"means" of the planning process. They come into play at all stages of physical planning.

Appendix 1.1. Glossary defines the terms used in this Manual in addition to the basic concepts explained in this Chapter.

1.1 SCALES OF PHYSICAL PLANNING

Direct intervention by public agencies in the human use of physical space has been found both desirable and practical within a defined range of scales. Use of in-door space is normally governed by personal or cultural criteria, though the form of indoor space may be regulated by public law or defined by a designer/builder. Broad parameters of individual building structures are controlled for collective/public purposes through bye-laws and regulations. At the other extreme, the structure of national space is indirectly influenced through macro and micro-economic instruments, although national land use plans have been attempted in some countries with questionable success.

Physical planning is used for organising space at the intermediate scales. Activities ranging from policies for spaces as large as multi-metropolitan regions down to detailed designs for neighbourhoods and streets define the practice of the physical planning profession.

A human settlement may be viewed as a hierarchy of communities of varying scales. The smallest community is a cluster of dwellings along with commercial and institutional facilities for day to day living. This is the Mohalla*. At the second level, a number of Mohallas combine to form a Neighbourhood. At the third level, Neighbourhoods alongwith commercial and industrial establishments and higher order institutional facilities group together to constitute wards, sectors, or what are popularly called Communities. At the apex of the hierarchy is a city or town which is a conglomeration of wards, sectors or communities.

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*It may occasionally be subdivided into distinct clusters formed by closed street systems, generically term Sub-Mohalla in this Manual.

These human agglomerations of varying scales serve as analytical categories. In this Manual, they are used as reference points for prescribing standards and guidelines.*

Transportation planning equally relies on the concept of hierarchy, both in terms of categories of roads, (Primary, Secondary, Local) and areas served, (Geographical District, Locality).**

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* This Manual uses following broad population/service equivalences for these analytical categories:

Category	Pop.equivalance	Characteristic Service
Sub Mohalla	2000-3000	3-4 Khokhas for petty trade.
Mohalla	6000-8000	Primary School/ Local Mosque.
Neighbourhood	25,000	Secondary School (Boys)/Jumma Mosque.
Community	100,000	Markazi Mosque.

** As far as physical scale and population served are concerned, this Manual treats the Geographical District as broadly equivalent to the Community, and the Locality as equivalent to Neighbourhood. However, their delimitations are not likely to match. A community is usually bounded by primary and secondary roads, while a geographical district may be envisaged as a tree-like form, with the secondary road analogous to tree-trunk.

1.2 PARAMETERS FOR STANDARDS AND GUIDELINES

A human settlement may be perceived as organised along three dimensions i.e.

i) Function
ii) Space
iii) Inter-linkages and Accessibility, including the obverse concept of Incompatibility.

Physical planning involves deliberate ordering of each of these dimensions, and planning guidelines and standards are meant to lay down norms for them.

1.2.1 Functional Requirements

Diverse and myriad activities are carried out in a human settlement. It is the place for making a home, earning a living, buying and selling, learning and teaching, etc. Each of these activities give rise to a function broadly categorised as residential, commercial, industrial, recreational and educational. Community planning in the first instance consists of analytically and deliberately arriving at an appropriate functional mix. Thus planning standards and guidelines prescribe "allocational criteria", expressed as numbers of facilities and services per household or population cohort, for communities of varying scales. These are the elements of one set of planning guidelines and standards.

1.2.2 Space Requirements

The above mentioned functions and activities require space to be carried out. How much land per person is required for residential purposes, for example? Answers to such questions underlie a human settlement plan. Defining space requirements by function and number of persons is the second element of planning guidelines and standards, expressed either as land use percentages or as areas per population cohort, or more specifically as the standard size for a particular class of facility.

1.2.3 Inter-linkages & Accessibility

Human activities do not merely co-exist in space. They are dependant and inter-linked. A home is bound to a work place and a school is tied to a playfield. These functional inter-relations are concretely manifested in the relative locations of various land uses and in the transportation and utility networks. Optimizing accessibility between inter-related activities is a major task of settlement planning. The need for space is controlled and held in tension by the need for accessibility. Once again planning guidelines are the instruments of bringing about orderly inter-relations and optimal patterns of accessibility. Distance criteria are therefore the third set of planning standards.

1.2.4 Incompatibility

There is a converse side of functional inter-linkages. It is the incompatibility of certain activities. Physical planning consists of segregating incompatible activities as much as it is comprised of relating the interlinked ones. In fact, the obvious incompatibility of certain uses brought together in the urban nexus by the general need for accessibility has provided the strongest rationale for public intervention.

Traditionally, planners have recognised major incompatibilities between different activity groups, for example between polluting industrial processes and residential uses, or between large commercial areas having high volume of traffic and amenities catering for small children. This has led to the concept of zoning, which promotes segregated districts of uniform land uses. However, it has come to be realised that too strict zoning also results in uneconomical patterns of development.

1.3 INSTRUMENTS OF PHYSICAL PLANNING

The basic instruments of physical planning are:

i) The Master Plan or more recently the Structure Plan*

ii) The Local Plan, including the sub-category termed Detailed Development/Layout Plan.

iii) The bye-laws and regulations of the municipality/development authority/zone; and

iv) Design criteria and planning standards.

Ideally, all four instruments are inter-related in the form of a feedback loop. (Fig. 1.1).

1.3.1 Master/Structure Plan

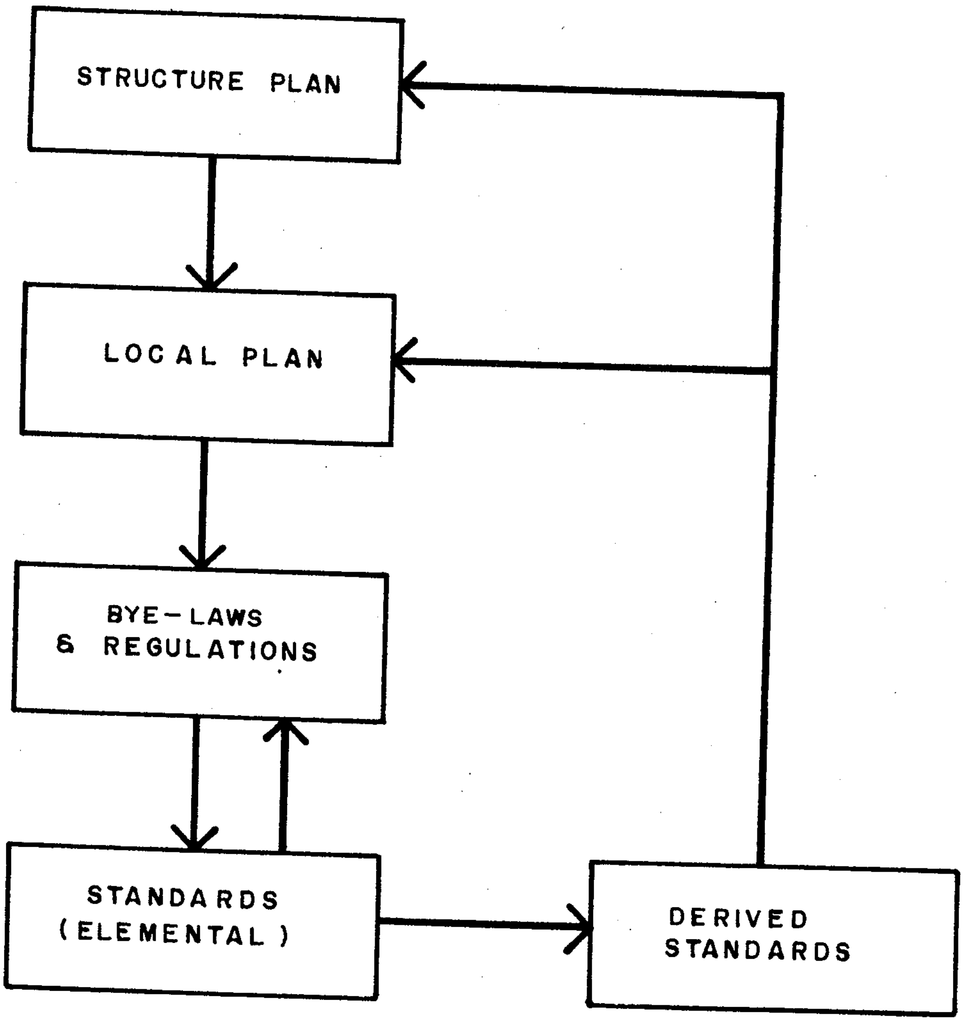
The Master Plan is the traditional method for presenting a set of landuse allocation and control measures in the form of a map. This essentially graphical form is supported by a written statement of goals and objectives, strategies and financial implications, etc. In modern practice, it has tended to be superseded at the urban and regional scales by the Structure Plan, which is a statement of priorities, plans and programmes supported by a Key Diagram, a schematic illustration of the spatial implications of the policy propsals, (HMSO, 1970). The difference is a change of emphasis. Both methodologies are based on projections of population, employment, income, traffic, etc., which in turn are related to proposed landuse and circulation patterns, through standards and guidelines. However, the Structure Plan with its focus on policy issues is a much more flexible and dynamic framework for channellising development at urban scale.

1.3.2 Local Plan

The Local Plan should be nested within a Structure Plan. The term is applied to all forms of local

* The term "Development Plan" is also used, but is more vague, specially about the scale of plan.

FIG. 1·1 INTER-RELATIONSHIP BETWEEN PLANNING INSTRUMENTS



development, re-development, renewal, upgrading and conservation proposals. Its sub-category, the Detailed Development/Layout Plan, is specifically applied to area development/sub-division schemes, drawn to a scale, giving precise proposals for plot demarcation and location of service networks, enabling commencement of engineering designs and physical implementation.

1.3.3 Bye-laws and Regulations

Bye-laws and Regulations are control instruments, in quasi-legal written form. Controls are usually framed in simple physical unit terms, such as maximum heights of buildings, minimum setbacks, etc., though physical ratios may also be used, such as floor area ratio or density. Use of fiscal and monetary incentives/disincentives is rare. The use of indirect fiscal controls is not yet widespread even in developed industrial nations as they require sophisticated understanding of the interface between economic forces and physical forms. Such measures can be considered premature in the Pakistani context. Thus, bye-laws and regulations are based on empirically evolved physical standards. Because of diversity of conditions within an urban area, it is usual to frame zone-specific bye-laws and regulations.

1.3.4 Standards as Planning Instruments

Allocation, space and distance standards are also the "means" of planning. Most standards are built-up from elemental units. For example, space standards for stadiums are generated by considering dimensions of play-fields, areas needed for seating and vehicle parking, while parking space in turn is derived from vehicle dimensions, inter-vehicle distances, turning circles, entry/exit lanes, etc. Such derived standards and criteria are inputs into structure and local planning processes.

1.4 PLANNING STANDARDS & GUIDELINES

1.4.1 Standards

The term 'Standard' has ambiguous meaning. It can mean the measure to which others conform or by which the accuracy of others is judged. It can mean a thing serving as basis for comparison. It connotates the degree of excellence etc., required for a particular purpose, or a thing recognised as a model for imitation. But it also has connotations of a thing of average quality. Planning standards at different times and places have encompassed all these diverse connotations which is the reason for the wide-spread use of the term. However, this ambiguity makes its operational application difficult.

To concretise the definition for the purposes of this Manual, the system used by the American Public Health Asssociation Committee on the Hygiene of Housing has been adopted which envisages three types of standards as follows:

i) Lowest tolerable minimum:

A level of attainment below standard but tolerable where local physical or economic limitations prevent the immediate attainment of standard conditions. The minimum tolerable limit corresponds to the level which from the standpoint of health should, in all communities, be enforced by legal limitation. Where a condition is described as "tolerable" or as one which "must" be attained, that condition is considered to be the lowest tolerable minimum.

ii) Standard:

The conditions normal to a decent and healthful housing environment. This is essentially the level which should be provided in any new housing, and should wherever possible be reached in existing housing. Where it is stated that a given condition "should" be obtained, that condition is considered to be standard.

iii) Optimum or goal:

Desirable of attainment for the normal community. They may be slightly or significantly higher than standard conditions. Conditions described as "desirable" are optimum. The optimum level should be sought wherever economic limitations and existing conditions permit.

1.4.2 Guidelines

In many areas of physical planning, it is not possible to quantify requirements. For such essentially relational phenomena, (e.g. relative locations), broad guidelines or criteria have been suggested.

1.4.3 Variable Standards

Finally, there may be such marked range of variations in circumstances within national space, that a single range of standards/guidelines cannot encompass all the objective situations. Residential densities that may be the optimum or goal in Karachi may not be tolerable in Kohlu and vice-versa in the case of sewage disposal. In such cases, variable standards/guidelines are proposed with annotation to the area/income category to which they are applicable.

REFERENCES

- Ministry of Housing and Local Government, (1970) **Development Plans**, HMSO, London.
- American Public Health Association Committee on the Hygiene of Housing, (1960) **Planning the Neighbourhood**, Public Administration Service, Illinois.

CHAPTER - 2 : PHYSICAL PLANNING PROCESS

2.1 GENERAL

2.1 OUTLINE BRIEF

2.1.1 Inception Instructions
2.1.2 Reviewing the Outline Brief.

2.2 DETAILED BRIEF

2.2.1 Check-list
2.2.2 Producing a sketch design
2.2.3 Developing the design in detail.

CHAPTER 2 : PHYSICAL PLANNING PROCESS

2.0 GENERAL

In so far as this Manual is intended for use in the preparation of local plans, (at scales of 1:2000, 1:1000 or 1:500), it is concerned with subdivision layout and provides dimensions of plots, wayleaves and reservations. It also describes various layout principles and concepts, and describes how the different elements of the plan can be coordinated. Where standards are subject to interpretation, Planners should learn to use their own discretion by referring to the "guidelines" in the Manual, but it is important to consult the appropriate authorities.The following sections describe the typical stages of preparing local plans.

2.1 OUTLINE BRIEF

2.1.1 Inception Instructions:

The Client Federal Division , Provincial Housing & Physical Planning or Town Planning Department, the local development authority or municipality at the Federal, Provincial and Local Government levels respectively or the client Autonomous Body should normally provide an outline brief for a given site in terms of the main types of land use required with an indication of number of units to be provided. Where the client is routinely sponsoring area development, it should have a separate department/cell for preparing briefs and establish a Land Allocation Committee and/or a Planning Technical Committee to oversee the plan.

2.1.2 Reviewing the Outline Brief:

The Planner should review the brief with appropriate authorities in the Federal, Provincial and Local Governments. He should check in particular for PC-I approval status with Planning & Development Division/P&D Department. For areas near old and monumental sites, he should consult with Department of Archaeology. At the provincial level, he should consult the Board of Revenue for land ownership/acquisition and with Health, Education, Social Welfare and Industries Departments, for their programmes. For areas in or near Waqf land, he should consult with Auqaf Department. The plan for the site itself would have to be scrutinised and approved by Local Authority i.e. the concerned Municipal Corportion / Committee, Town Committee, Development Authority or Cantonment Board. Where Railway track, H.T. electric lines, trunk gas pipelines and highways are passing through or near the site, exact wayleaves should be confirmed from Railways, WAPDA, SNGPL (or other Gas Company), and concerned Highway Circle, C&W Department. WAPDA may also be consulted to ascertain plans for electricity distribution to the area. The review should encompass the adjacent areas so that provisions can be coordinated in a wider context. The review should broadly cover:

a) Legal	-	check ownership
	-	identify wayleaves and reservations.
	-	refer to existing plans & regulations
b) Ground Conditions	-	ensure adequate bearing capacity.
	-	ensure adequate natural drainage.
	-	identify flood hazards.
	-	identify slopes and gradient.
	-	study soil characteristics.
c) Environment	-	maintain top soil
	-	respect vegetation
	-	consider orientation (sun,wind,views).
	-	respect acquifers
	-	respect buildings of historic interest.
d) Location	-	relate to surrounding areas
	-	identify adjacent uses and facilities
	-	identify adjacent and planned infrastructure.
e) Access	-	ensure access available other than from Highway
	-	identify bus routes
	-	identify pedestrian routes

f) Structure	-	identify major road structure
	-	locate major facilities
	-	define broad housing area.
g) Capacity	-	identify developable area unhindered by constraints.
h) Population	-	consider population characteristics
	-	family size/structure
	-	household income
	-	vehicle ownership/ usage
	-	school age population
i) Mix/ Densities	-	consider mix of land uses
	-	review densities
	-	consider mix of plot sizes
	-	consider mix of dwelling types (houses, terraces, apartments).

2.2 DETAILED BRIEF

2.2.1 Check-list

Government of Pakistan, Planning and Development Division has circulated a check list of basic data required for appraisal of general housing projects. The check list is given at Appendix 2.1. The project justification and technical data requirements should be kept in mind while defining the detailed project brief. While costs and sale prices can be estimated only after the design has been developed in detail, (section 2.2.3 below), comparison with similar (model) projects will facilitate iterative changes in the detailed design to achieve appropriate and economical standards.

2.2.2 Producing a sketch design

In order to consult the relevant authorities, the Planner should produce a sketch design at a scale and in sufficient detail to illustrate the main principles of the layout and content. This may be at 1:10,000 or 1:5000 for major projects or 1:2000 for smaller schemes. Appendix 2.2 gives an example.

2.2.3 Developing the design in detail

Using scale, set square, T-equipped drafting table or drafting machine, the Planner should in-fill the plots of required dimensions within the zones demarcated by him at sketch stage. (Appendix 2.2). Minor adjustments in zone/plot dimensions may be necessitated to assure mutual consistency. Attention to detail is essential, such as chamfering of corners, correct spacing and indication of U-turns, correct lengths of acceleration/right - turn lanes, demarcating building lines in addition to plot lines. Detailed design should be supported by typical road cross-sections, showing relative placement of footpaths, service lanes and services, and by sketch perspectives of important vistas.

Resulting area under each use may be calculated and total land use percentage presented in tabular form. Lengths of various types of roads and services should be separately presented alongwith preliminary estimates of costs as per standard format given in Table 2.1. The standard format relies on the use of parametric quantities which can be established in the initial stages of engineering design.

TABLE 2.1 STANDARD FORMAT FOR UNIT COST ESTIMATES FOR LOCAL PLANS

No.	Description	Capital Cost: Total Capital (Rs)	Capital Cost: Parametric Quantity	Standard Unit Cost	Cost of Development: Gross Area Basis (Rs/m2)	Cost of Development: Saleable/Leaseable Area Basi (Rs/m^2)
1.	Land Acquisition		Total Site Area, m^2	Rs/m^2		
2.	Roads		Area under carriageways,m2	Rs/m2		
3.	Service Roads		Area under carriageways,m^2	Rs/m^2		
4.	Water Supply System.		-	-		
4.1	Tubewells		Capacity,ML/day	Rs/L-day		
4.2	Water Treatment Plant		Max.day demand, ML/day	Rs/L-day		
4.3	Overhead Storage		Capacity,m3	Rs/m3		
4.4	Water Supply Network		Service Area,m2	Rs/m2		
5.	Waste Water System		-	-		
5.1	Sewage Network		Service Area,m2	Rs/m2		
5.2	Sewage Lifting		Pump Capacity, (Peak Sewage Flow),ML/day	Rs/L-day		
5.3	Sewage Treatment & Disposal.		Capacity,ML/day	Rs/L-day		
6.	Storm Water Drainage and Culverts		Total Site Area m^2	Rs/m2		
7.	Electrification	L.S.	-	-		
8.	Gas Distribution	L.S.	-	-		
9.	Landscaping		Open/Green Area,m^2	Rs/m^2		
10.	Contingencies		-	-		
	Total:		-	-		

L.S. = Lumpsum
M.L. = Million Litres.

PRELIMINARY SURVEYS & INVESTIGATIONS - CONTENTS

CHAPTER - 3 : PRELIMINARY SURVEYS & INVESTIGATIONS

3.0 SCOPE OF PRE-INVESTIGATIONS

3.1 TOPOGRAPHIC SURVEYS

3.2 GEOTECHNICAL SURVEYS

- 3.2.1 Local Investigation
- 3.2.2 Seismic Activity

3.3 MORPHOLOGIC IMPLICATIONS OF CLIMATIC CONDITIONS

- 3.3.1 General Guidelines
- 3.3.2 Methodology for Incorporating Climatic Impact in plans/planning regulations

CHAPTER 3 : PRELIMINARY SURVEYS & INVESTIGATIONS

3.0 SCOPE OF PREINVESTIGATIONS.

Typical primary surveys for urban and regional planning are the following:

1. Housing, economic and demographic survey.
2. Landforms and landuse surveys.
3. Transport network, capacities and traffic surveys.
4. Surveys of large and small scale manufacturing activities.
5. Surveys of community facilities and institutions.
6. Survey of commercial activity.
7. Survey of physical infrastructre and services.

Standard methodologies for urban and regional planning surveys are available in textbooks. Chapters 4 to 10 contain standards and guidelines for evaluating the results of such surveys against norms. This chapter deals with surveys and investigations necessary for local planning. The following surveys and investigations are pre-requisite to local planning:-

i) Topographic Survey
ii) Geotechnical Appraisal
iii) Study of Morphological Implications of Climatic Conditions.

3.1 TOPOGRAPHIC SURVEYS

For most of the country, Geodetic Triangulation Survey Maps of Survey of Pakistan at a scale 1:50,000, are available. As they are remarkably accurate, the Planner should use them as initial base, except in areas of extensive recent development. By pentographic or photographic enlargement, they also obviate the need for surveys at a scale smaller than 1:10,000.

The scale of the survey will depend upon the nature and extent of the work. Structure Plans can be prepared from survey at scales 1:2000 to 1:10,000, whereas Detailed Layout Plans require scale of 1:2000 or larger. In certain cases e.g. urban renewal, areas of difficult topography, monumental works etc., larger scales of 1:1000 and 1:500 are appropriate.

As a guideline for vertical scale selection, Table 3.1 gives the generally accepted relationship between horizontal and vertical scales in relatively plain areas.

TABLE 3.1: GUIDELINE FOR SELECTION OF VERTICAL SCALE*

Scale of Map	Appropriate Contour intervals**	
	Metres	Feet
1:20,000	5	20
1:10,000	3	10
1: 2,000	1	2
1: 1,000	0.5	1

Source: Adapted from Survey of Pakistan.

* Considering the caliberation of the older stock of survey equipment, appropriate contours intervals have also been given in feet, the Planner should encourage the use of metric scale.

** Multiply by 2 or 2.5 to get appropriate vertical scale for hilly/gullied areas.

Surveyors should be instructed to tie in the survey to the national grid through nearest class I or class II monument of Survey of Pakistan. If no monument is located within convenient distance, the surveyor should be instructed to prepare his own grid. In latter case, a minimum of 3 bench marks in the site are required for proper triangulation.

Existing land use should be shown according to conventional symbols and notations, (as per Survey of Pakistan maps).

For detailed development planning, it is important to demarcate the surveyed area with boundary pillars and to close the traverse of the survey around this boundary. Boundary pillars should be erected at an average distance of 150 meters in straight stretches and on every bend and corner.

The arbitrary level (R.L.) assigned to the main bench mark should be round figure not very different from estimated height above sea level.

3.2 GEOTECHNICAL SURVEYS

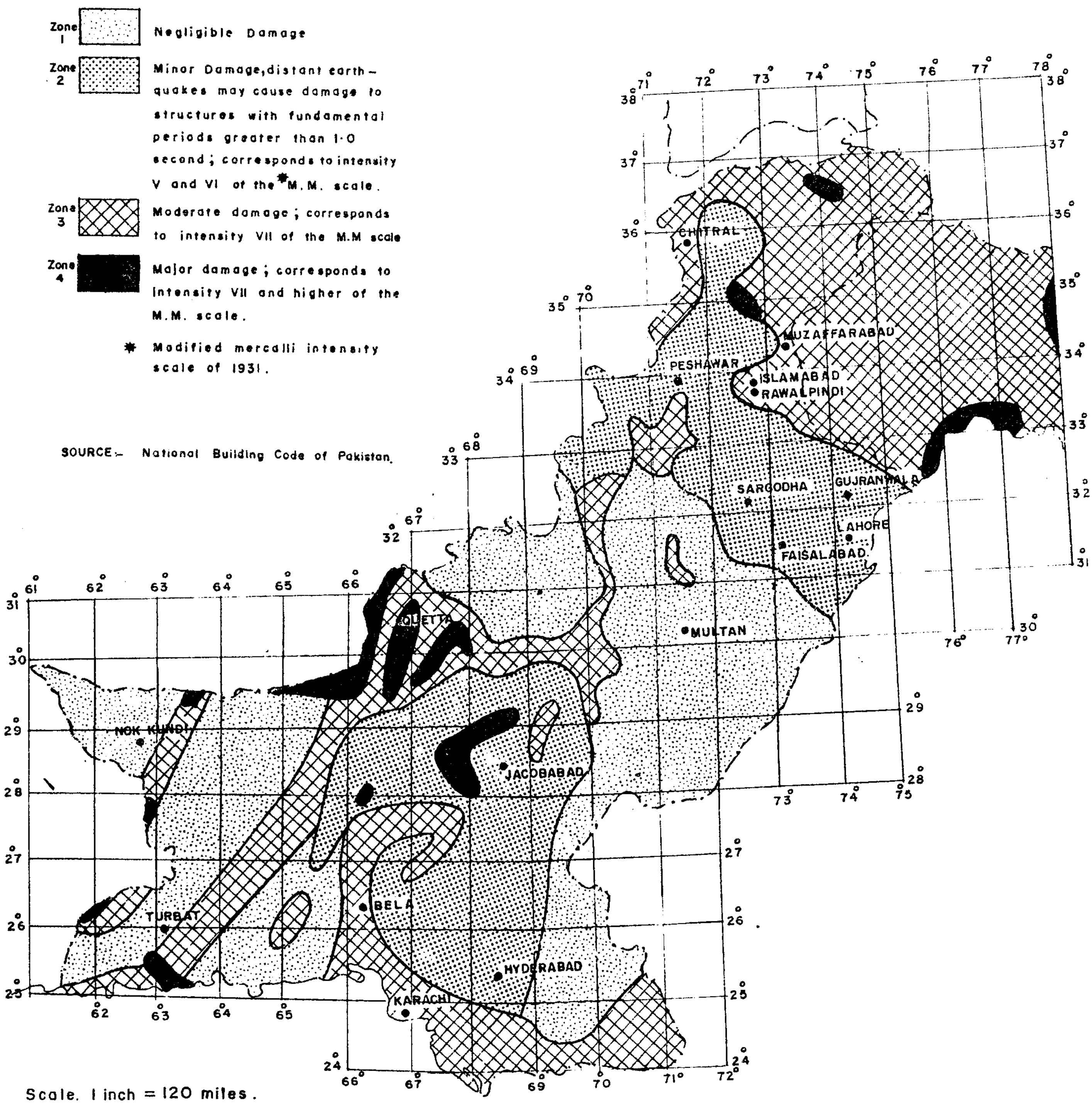
3.2.1 Local Investigation

Geotechnical Investigation prior to local planning is a standard practice in industrialised countries. Unfortunately owing to shortage of professional know-how, the bulk of area development in Pakistan is presently taking place without any proper geotechnical investigations. However, the Planner has to carefully assimilate potential and constraints of the area from the geotechnical aspect. No doubt this is the work of specialists who have to be consulted while designing engineering works, but if the Planner follows the procedure given in Appendix 3.1, serious mistakes can be avoided.

3.2.2 Seismic Activity

While development must continue in all regions of the country, including seismical activity zones, the Planner should have a clear notion of the incidence of seismic activity, as this affects Building Codes and therefore costs. A map of Pakistan showing broad seismic activity zones, is reproduced for ready reference (Map 3.1). While standards and costs of infrastructure are not generally affected, costs of buildings in active zones can increase by 20 to 40%.

MAP 3·1



SEISMIC ZONING MAP OF PAKISTAN

DEVELOPMENT PLANNING UNIT

3.3 MORPHOLOGIC IMPLICATIONS OF CLIMATIC CONDITIONS:

3.3.1 General Guidelines

Certain general principles for built-form and preferable orientation can be induced from traditional building types in various regions of the country, as these are adapted to the significant climatic elements of their areas. Map 3.2 shows the climatic regions of Pakistan as relevant to built-form*. Districts and significantly different Sub-divisions in each climatic region are given in Table 3.2. Traditional design elements and their influence on the size, shape and orientation of plots in each climatic zone are given in Table 3.3. Figures 3.1 to 3.7 illustrate the considerations relevant to each climatic zone.

3.3.2 Methodology for incorporating climatic impact in plans/planning regulations:

Climatic considerations affect morphology of buildings and the size, shape and orientation of plots. Following steps are suggested before designing layouts/prescribing regulations:

---

*. There are many systems of climatic classification, (e.g. Trewartha, Koppen, Thornthwaite, Blair, Kendrew and Miller), none of which are entirely satisfactory, even from purely geographical viewpoint. Furthermore,owing to the paucity of meteorological stations, the boundaries of climatic zones in Pakistan are open to debate. Third, the planner is specifically interested in the impact of climate on the built-environment. In each traditional building region, certain climatic elements are more important than others. As such, a specific purpose map of climatic regions relevant to built-form is required. Such maps have been attempted by architects/planners, but unfortunately betray an ignorance of modern classificatory technique as well as substantive climatic parameters. This Manual has therefore generated a map which is a composite derivation from two sources i.e. Qazi S.Ahmad's delimitations for geographical purposes and the National College of Arts delimitation for built-form purposes. Undoubtedly, time series from a generation of satellite reconnaissance, their computer mapping and improved communication of respective purposes between geographers and planners will lead to a more accurate map before the end of this century, interalia allowing valid inferences for transitional zones.

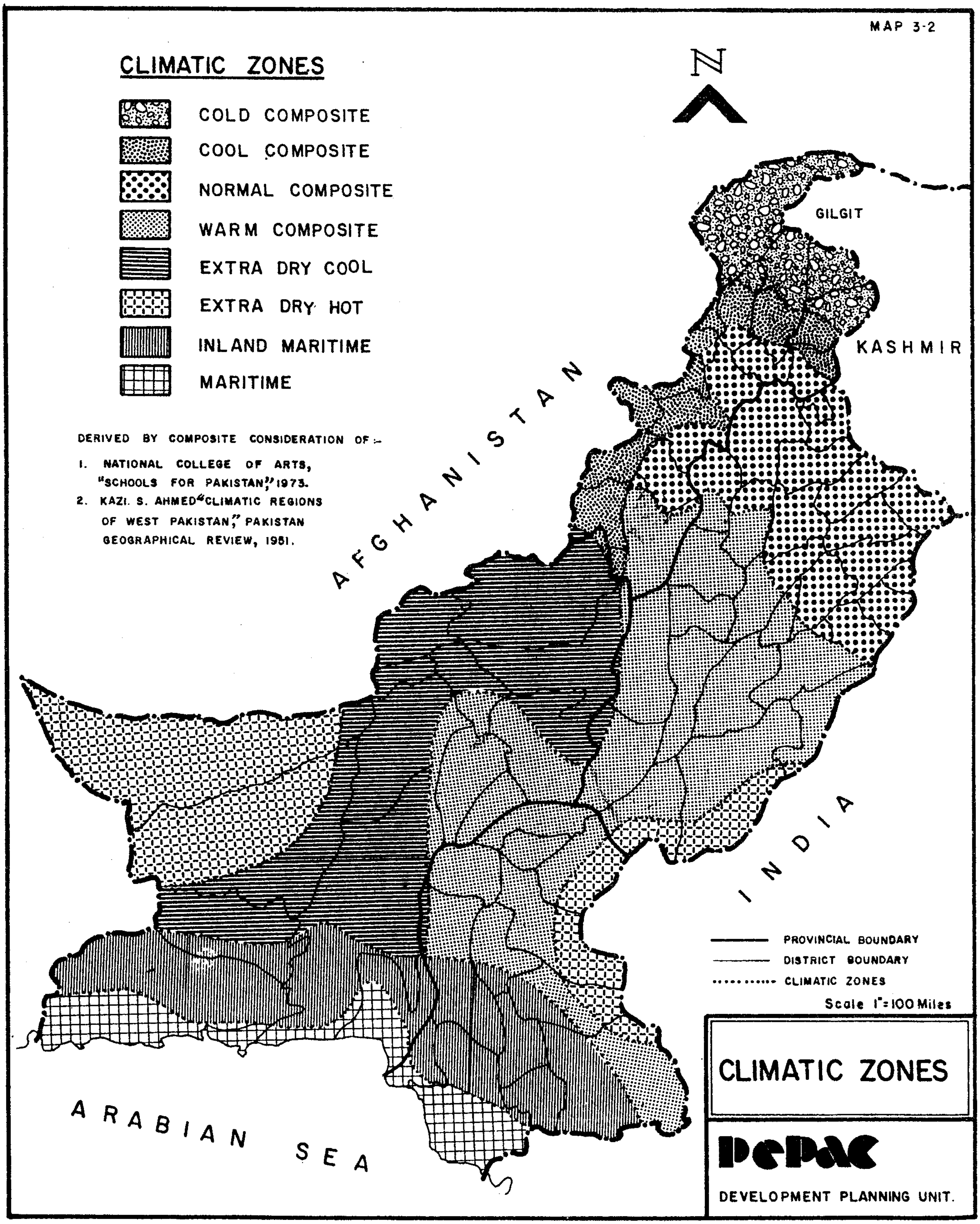

MAP 3-2
CLIMATIC ZONES
COLD COMPOSITE
COOL COMPOSITE
NORMAL COMPOSITE
WARM COMPOSITE
EXTRA DRY COOL
EXTRA DRY HOT
INLAND MARITIME
MARITIME
DERIVED BY COMPOSITE CONSIDERATION OF :-
1. NATIONAL COLLEGE OF ARTS, "SCHOOLS FOR PAKISTAN," 1973.
2. KAZI. S. AHMED "CLIMATIC REGIONS OF WEST PAKISTAN," PAKISTAN GEOGRAPHICAL REVIEW, 1951.
N
GILGIT
KASHMIR
AFGHANISTAN
INDIA
ARABIAN SEA
PROVINCIAL BOUNDARY
DISTRICT BOUNDARY
CLIMATIC ZONES
Scale 1" = 100 Miles
CLIMATIC ZONES
DePAC
DEVELOPMENT PLANNING UNIT.

TABLE 3.2 : DISTRICTS ACCORDING TO CLIMATIC ZONES
(Source Map 3.2)

Province/ Climatic Zone	Sind	Punjab	Baluchistan	N.W.F.P. (including F.A.T.A)
1. Cold Composite				Chitral, Dir, Swat, Kohistan, Mansehra
2. Cool Composite				Abbottabad, Mansehra, Swat, Kohat & Malakand, Bajaur, Mohmand Khyber, Adam Khel, Kurram, S.& N. Waziristan Agencies.
3. Normal Composite		Rawalpindi/ Islamabad, Jhelum, Gujrat, Sialkot, Gujranwala, Sheikhupura, Lahore, Kasur, Okara, Faisalabad, Jhang, Sargodha, Khushab, Mianwali, Attock.		Haripur*, Mardan, Peshawar, Kohat, Bannu
4. Warm Composite	Tharparkar, Sanghar, Khairpur, Sukkur, Nawabshah, Dadu, Larkana, Shikarpur, Jaccobabad.	Bahawalnagar, Vehari, Multan, Muzaffargarh, Rajanpur, Bahawalpur, Rahim Yar Khan, D.G. Khan, Bhakkar, Toba Tek Singh, Leiah, Khushab, Sahiwal; Mianwali, Sargodha, Jhang.	Nasirabad, Kachhi, Kohlu, Sibi.	D.I.Khan
5. Extra Dry Cool			Zhob, Loralai, Pishin, Kalat, Quetta, Kohlu, Sibi, Khuzdar, Kharan, Panjgur.	
6. Extra Dry Hot	Naru*	Cholistan*	Chagai, Kharan	
7. Inland Maritime	Tharparkar, Badin, Hyderabad, Dadu, Thatta, Karachi.		Turbat, Lasbela, Khuzdar.	
8. Maritime	Karachi, Thatta		Gawadar, Lasbela	

*. Large distinct Sub-Divisions.

i) Assimilate implications of Table 3.3 for the climatic region in which site area is located.

ii) Obtain data from the nearest meteorological station to prepare a climograph. The climograph will help understand requirements of human comfort. Also, from first hand observations about any large topographical or ecological elements, such as water bodies, sandy plain, forest preserve, mountain or hill, draw inferences about any peculiar meso-climatic effect on the site.

iii) If the site is not located in a large urban centre, careful evaluation of existing traditional buildings and street orientations will allow inferences regarding preferable plot/street orientation.

iv) Obtaining data from nearest meteorological station prepare a wind-rose. Note the direction of the critical breeze, (sea breeze in Maritime and Inland Maritime Zones, monsoon breeze in Composite Zones).

v) Using the wind-rose, locate obnoxious uses like sewage treatment plants at downwind sites with reference to dominant wind direction. In case of contiguous development, the location of obnoxious uses should be with reference to the entire current and proposed residentiary area.

vi) Consolidate the general and local inferences for use as an aid in the sketch designing of layouts/prescription of planning regulations. As a general rule, it should be possible for around 70% of plots to achieve the preferred shape and orientation.

TABLE 3.3:GUIDELINES FOR BUILT-FORM BY CLIMATIC REGION

Climatic Zone	Building Design Guidelines from Traditional Solutions.	Implications for Plot Shape, Size & Orientation
1. Extra Dry Hot	Observation of traditional solutions can furnish good guidelines. The orientation of external walls & openings are of marginal importance. External openings should be reduced to an absolute minimum. External walls should have adequate mass to enable an appropriate thermal time lag. Light for most daylight functions may be obtained from a shaft-like courtyard, surrounded by rooms, in which direct solar radiation from overhead should be minimised to only 3-4 hours a day. The courtyard may be suitably landscaped.	Squarish plots, with no setbacks from any side, inducing people to build right upto the plot boundary & in that process creating the courtyard. To enable the creation of a courtyard with a suitable height, the plot size may be restricted in relation to the anticipated covered area, thereby inducing people to build on more than a single storey. (Figs.3.1 and 3.2).
2. Warm Composite	In otherwise arid regions affected by the monsoons, the building solutions for arid climates may be suitably and only marginally modified to permit the passage of any prevalent breezes. The preferred orientation of any openings in the courtyard or into streets and roads must be determined by the prevalent breeze during the monsoon part of the year.	

(Contd...)

3. Normal Composite	The layout should take the following desirable criteria into account: i) The winter sun should be allowed to penetrate to the maximum in the part of the year characterised as"cold". ii) All habitable rooms should be protected from East and West orientation by means of thick walls or ancillary rooms. iii) Habitable rooms should be exposed to the prevalent breeze direction during the wet months where this does not conflict with(i) and (ii) above. Verandahs are an important building element for use in winter as well as the monsoon months.	In addition to internal courtyard, use of the roof top is traditional during the wet months. Long narrow lots oriented to face North or South,may be prescribed particularly for low-rise, low density settlements. The orientation (North or South) is of cardinal importance, for the purpose of the shape of the plot will be defeated if they are oriented more than 20 degree off the North-South Meridian (Fig. 3.3)
4. Cool & Cold Composite	Winter solar radiation is an important factor, but may be compromised by the need to restrict the window sizes to prevent excessive heat loss. Where fenestration is to be restricted to an absolute minimum,such as in Cold Composite climate, the use of verandahs is again indicated for gaining access to winter sun.In mountainous topography in the Cold Composite region, the orientation of slope	The exposure to solar radiation is maximised if the south exposure is made as expansive as possible. In the colder zones, therefore, shallow depth of the plot may be more desirable as compared to its width(Fig.3.4). However, these criteria will re-

5.

(Contd...)

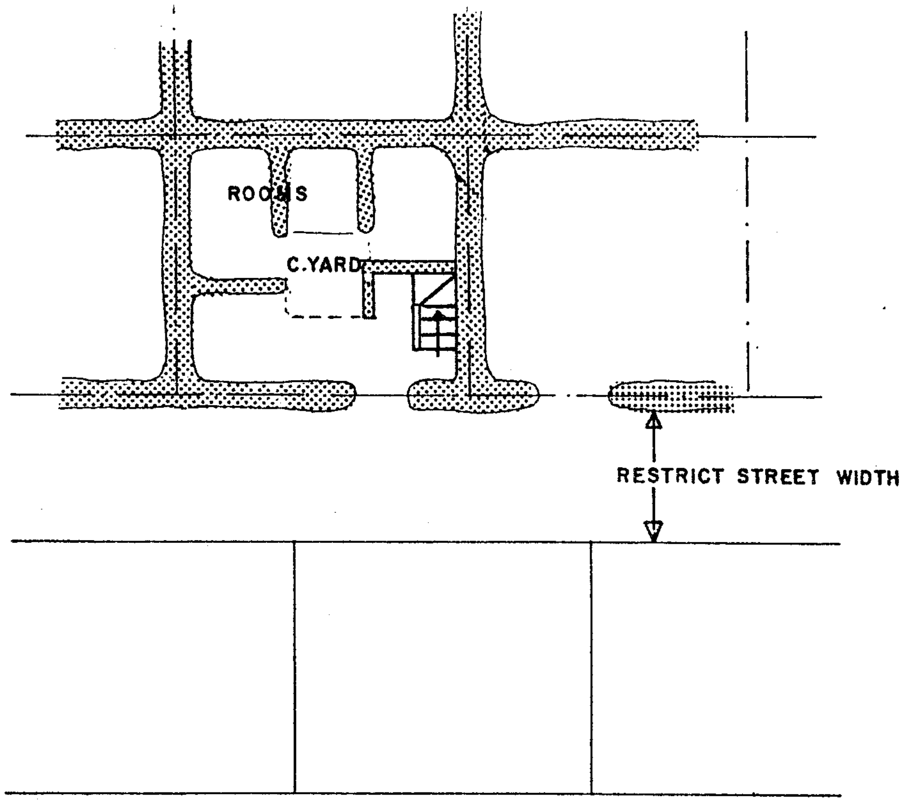
	must be taken into account. Subject to water availability, the development may be sited on a south facing slope where winter solar radiation is available for longer than north facing slopes. Traditionally too, north exposure is avoided due to the bitter northerly winter winds.	quire to be reconciled with the inefficiencies in service runs thus generated;multi-storey houses/ buildings may be a suitable answer. Where narrower plots are necessitated for other reasons, increased winter solar exposure mayh be obtained by mandating: i) low rise construction; and ii) the construction of at least 2 courtyards within the plot.
5. Maritime	Preference for inviting breeze into the houses and for minimizing houses at the leeward site of the breeze	Orientation of openings/plots directed to admit the prevalent breeze suggests wide streets,squarish plots, opposed building control lines & staggered openings in multistorey development & long narrow plots with staggered openings for single storey development. (Fig.3.5).

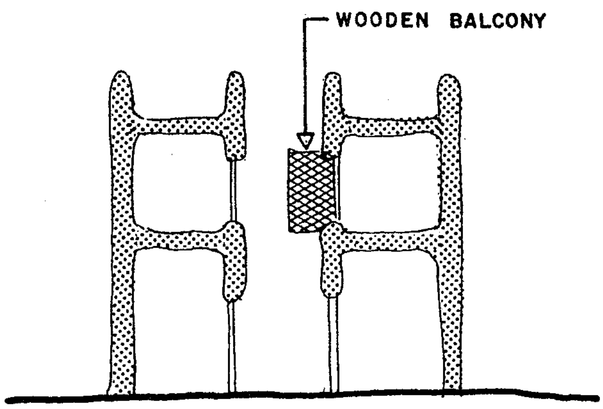
(Contd...)

6. Inland Maritime	Inland Maritime conditions necessitate care to minimize direct solar gains from the arid conditions all year round. Suitable wind channelling devices are indicated. Where windows are to be avoided, the wind-catcher installed on the roof is a traditional solution.	A street orientation that facilitate passage of breeze while reducing ingress of direct/indirect solar radiation is to be preferred (Fig.3.6).
7. Extra Dry Cool	Extreme seasonal/diurnal ranges necessitate minimizing exposure from bitter north winds, reducing summer insolation by means of thermal mass, while allowing ingress to winter sun. Traditional building practices include thermal mass in walls and roofs/high plot enclosing walls to achieve thermal/wind protection. Enclosed rooms are placed windward to protect courtyards, while verandahs are south facing to catch low winter sun.	South facing plots should have sufficient depth to enable low winter sun to penetrate courtyards. On the other hand, in north facing plots, the windward rooms may reduce courtyard width. Thus shape should be elongated for plots having ingress from south and squarish for plots having entry from north (Fig. 3.7).

Fig. - 3·1

HOUSE/PLOT MORPHOLOGY IN EXTRA DRY HOT CLIMATE (e.g. Kharan)

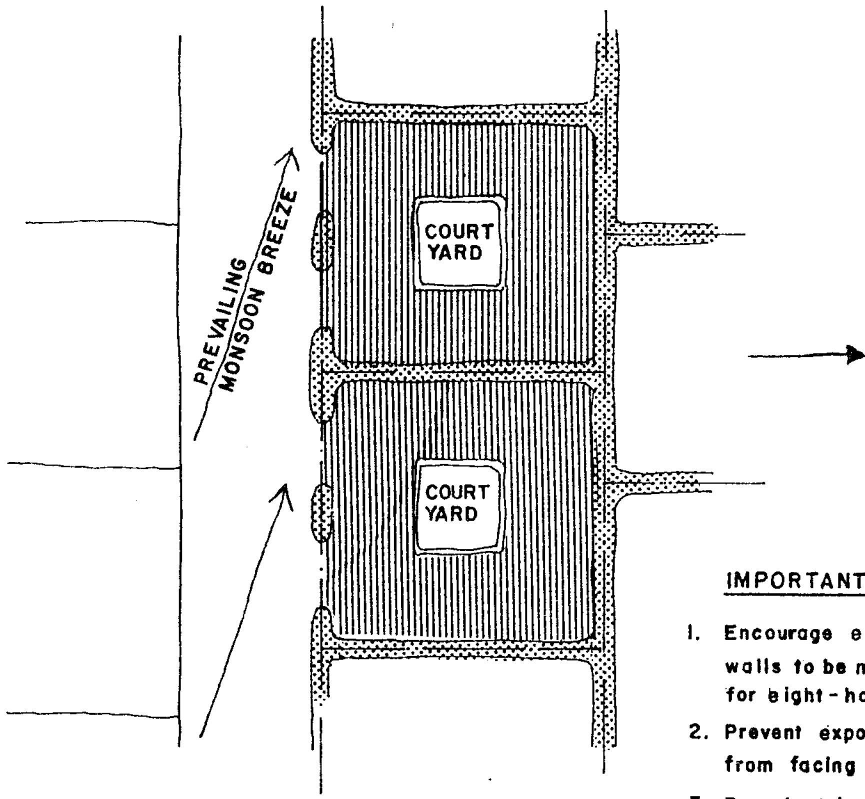




SECTION

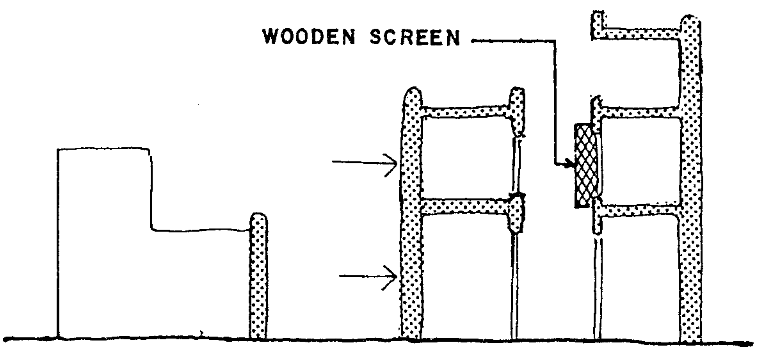
Fig. - 3·2

HOUSE/PLOT MORPHOLOGY IN WARM COMPOSITE (e.g. Rahim Yar Khan)



IMPORTANT

1. Encourage exposed ext. walls to be massive enough for eight-hour thermal lag.
2. Prevent exposed ext. walls from facing East or West.
3. Prevalent breeze factor generally of marginal importance.
4. Encourage use of devices* to screen out difuse and scattered solar radiation.



SECTION

* Glass-less wooden shutters, wooden/brick/stone grills or jafris, slatted louvred shutters etc.

Fig. - 3·3

HOUSE/PLOT MORPHOLOGY IN NORMAL COMPOSITE (e.g. Lahore).

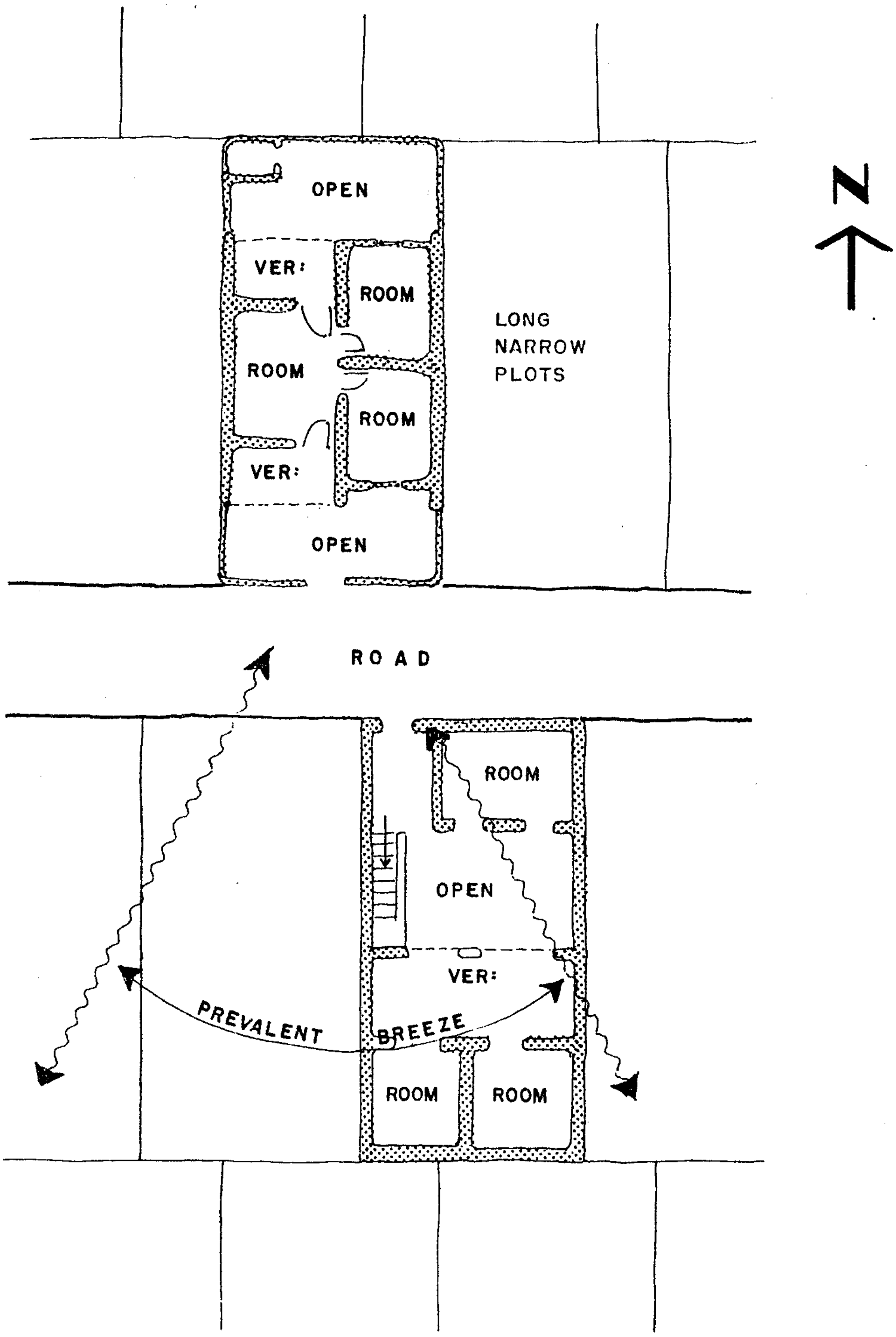


Fig. - 3·4

HOUSE ASPECTS IN COOL/COLD COMPOSITE CLIMATE

(e. g. Dir)

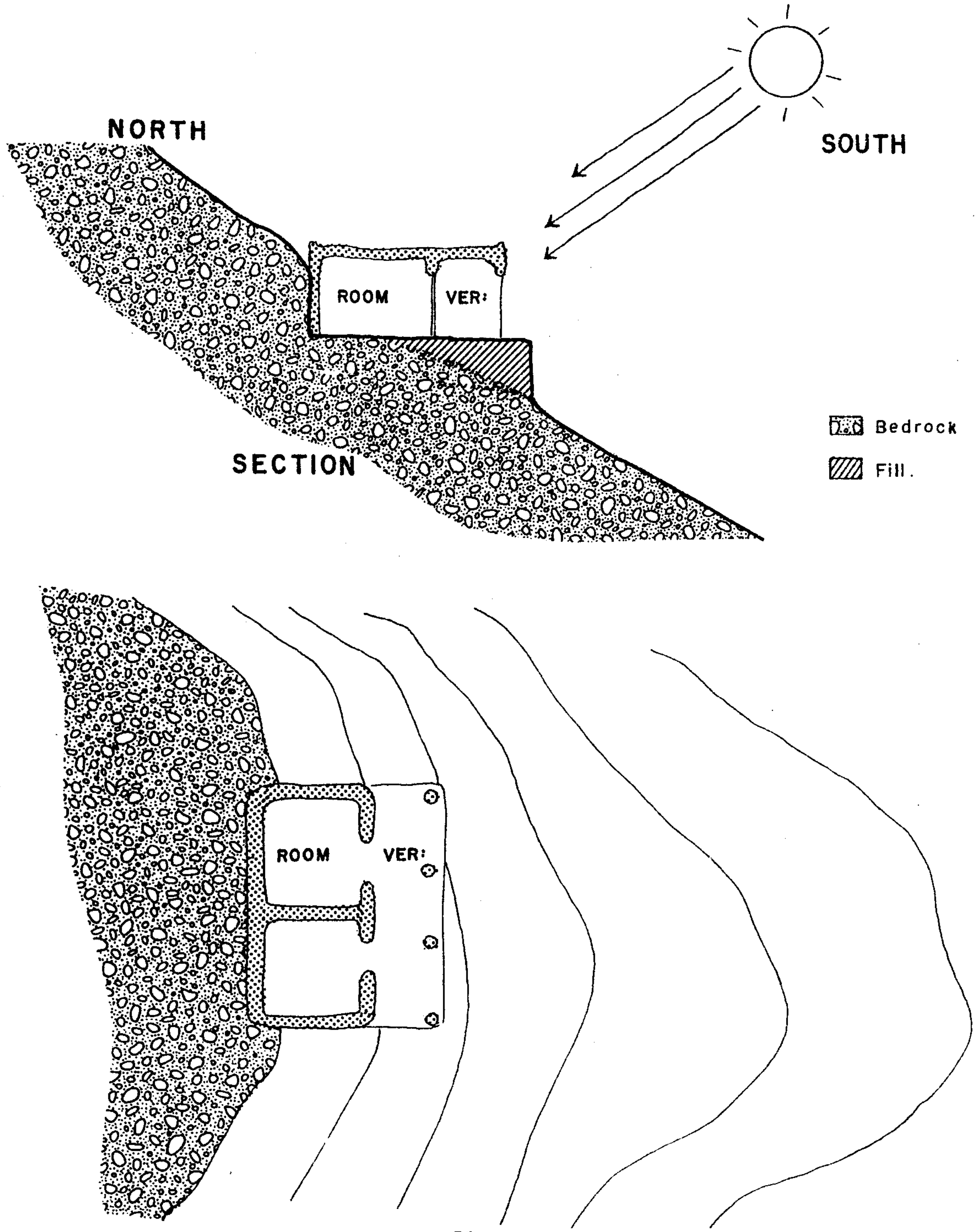
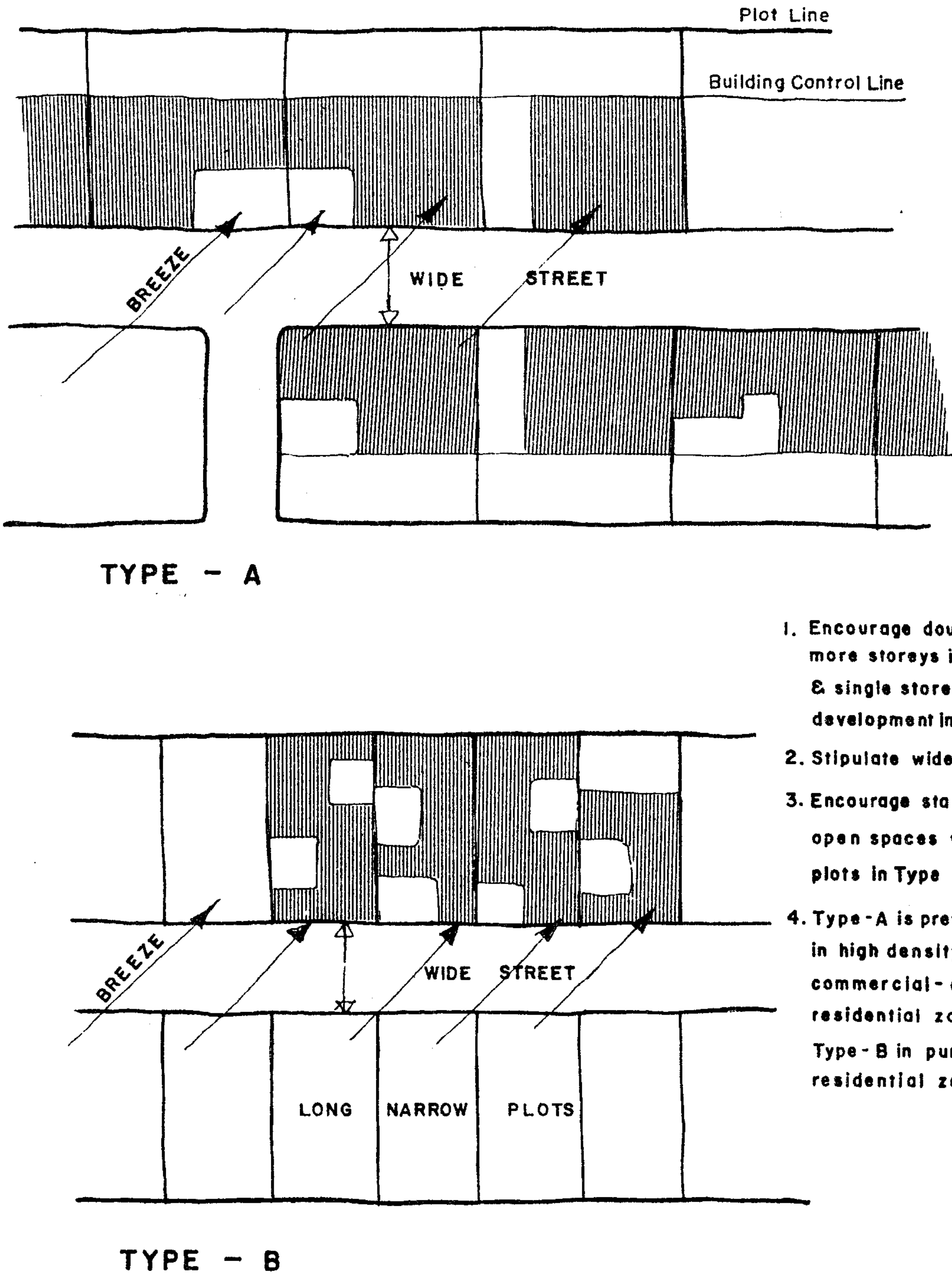


Fig.- 3·5

HOUSE/PLOT MORPHOLOGY IN MARITIME CLIMATE

(e.g. Karachi)

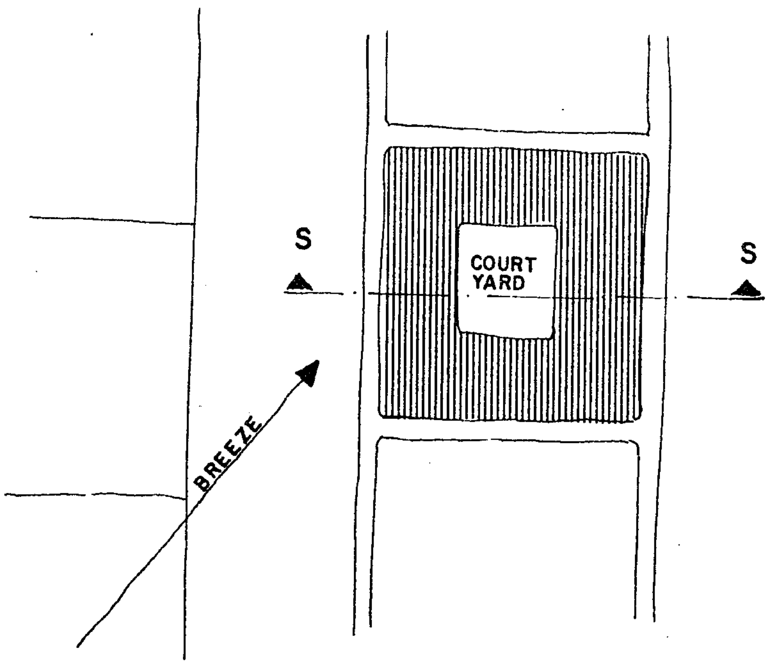


1. Encourage double or more storeys in Type-A & single storeyed development in Type-B
2. Stipulate wide streets.
3. Encourage staggered open spaces with in plots in Type A & B.
4. Type-A is preferable in high density commercial-cum residential zones; Type-B in purely residential zones.

Fig. - 3·6

HOUSE / PLOT MORPHOLOGY IN INLAND MARITIME

(e.g. Hyderabad)



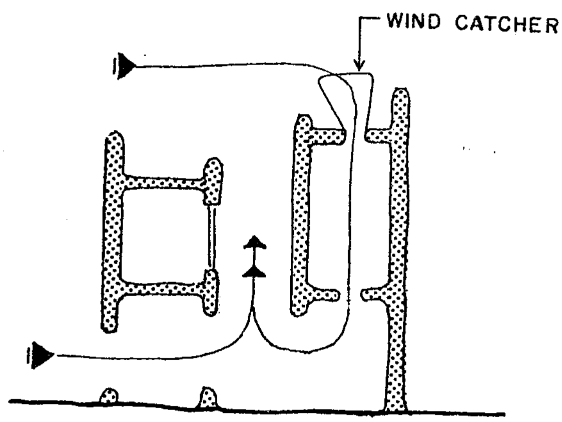


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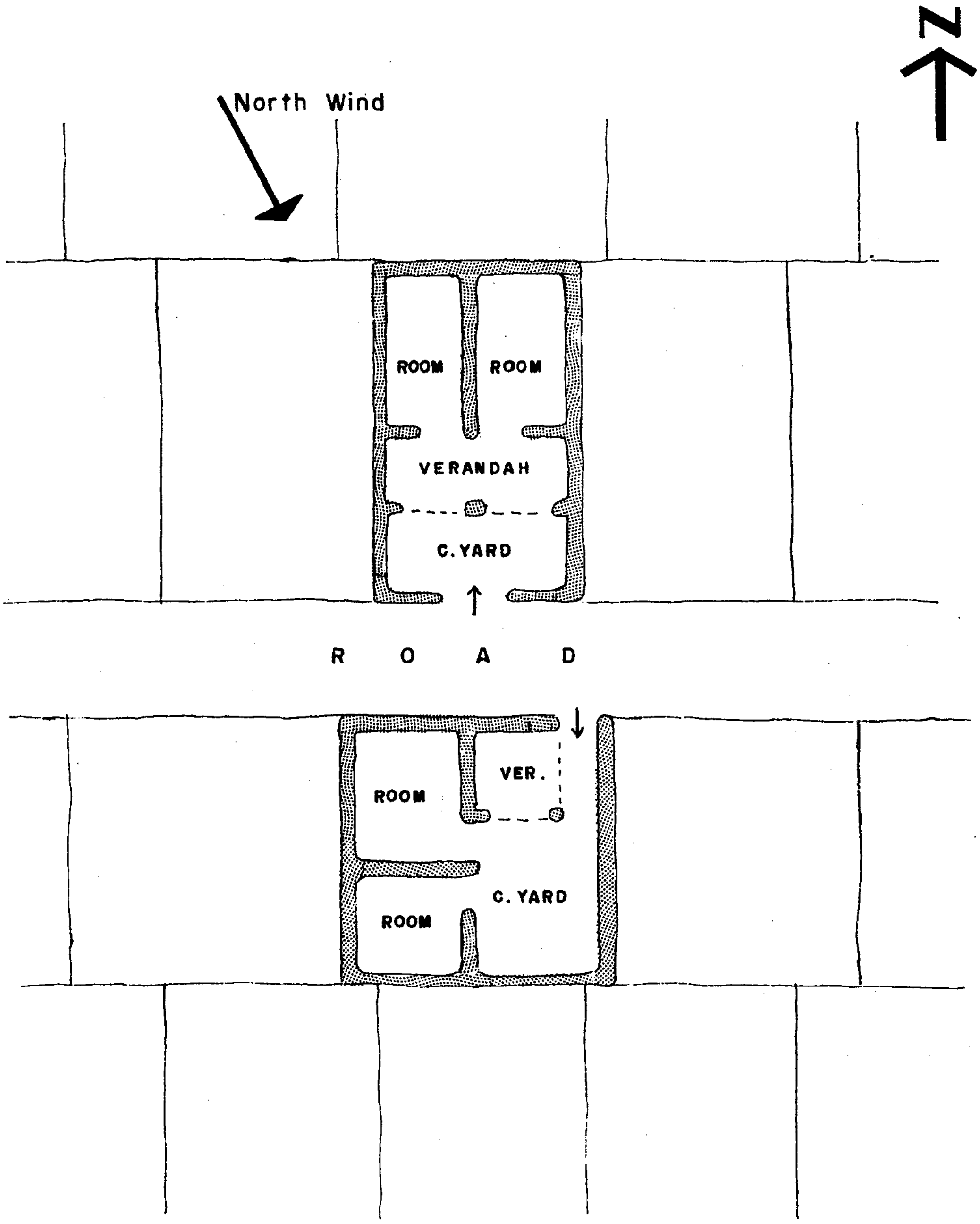
FIG. 3·7

HOUSE/PLOT MORPHOLOGY IN EXTRA DRY COOL (e.g. Quetta).



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CHAPTER 4: HOUSING

4.0 GENERAL

4.1 AFFORDABILITY

4.2 STANDARDS

4.2.1 Single Dwellings
4.2.2 Multi Unit Dwellings
4.2.3 Composition of Plots
4.2.4 Building Heights
4.2.5 Plot Chamfering

4.3 GUIDELINES

4.3.1 Layout Principles
4.3.2 Plot Relationships
4.3.3 Plot Arrangements
4.3.4 Siting Service Connections
4.3.5 Backlanes
4.3.6 Car Parking
4.3.7 Type of Enclosures
4.3.8 Residential Density
4.3.9 Floor Area/Plot
4.3.10 Some Basic Layouts
4.3.11 Existing Areas

CHAPTER 4 : HOUSING

4.0 GENERAL

Shelter is one of the basic necessities of life. It is a place for privacy, a protection against weather, and a repository for possessions. It can be a source of immense and varied psychic satisfactions. Constructing a shelter is also a capital intensive once-in-a-life-time investment for most households, for which they are willing to expend the maximum resources at their command, usually entailing institutional/personal loans in addition to individual savings.

Housing is more than mere shelter. Access to work, shopping, education and recreational facilities as well as availability of utilities are integral elements of urban housing. Therefore, housing as a concept, includes the physical fabric of a neighbourhood and the social millieu of a community, all impinging heavily on the quality of individual and collective life.

Facilitation of housing is also important for public authorities as in most cases they have to provide developed land and services, being classical public goods,(Lumpy, non-substitutable, with many non-attributable benefits). Outlays on land development and services form a large component of the total development expenditure of local and provincial governments.

4.1 AFFORDABILITY

The policy of Federal and Provincial Governments for general public housing is to provide developed land i.e. sites and services to be allotted to applicants on the basis of ballot. The price is fixed on "No - Profit No-Loss Basis" by the concerned development authority. (However, in some cases, limited cross subsidization between large and small plots has been practised). In view of the above, affordability is a basic consideration for most standards related to housing.

Detailed financial models have been constructed to determine affordability, (Wakely et al, 1976). These take into account household propensity to save, duration and interest rates of loans, etc. The resultant is affordable investment measured in years of household income. The rule of thumb is that a household can afford a total outlay on housing not exceeding 2.7 times its annual income. This is derived from financial analysis of HBFC loan conditions, which are more favourable than commercial bank loans. If past personal savings and zero/low interest loans from relatives, etc., are included, the rule of thumb for affordability may be stretched to a capital investment equal to 3.5 times the annual household income. The affordable investment for land and structure in turn dictates the area of plot purchaseable, given land prices in large cities, intermediate and small towns.

The lot sizes and other standards stipulated in this Manual have been related to affordability as per stretched criteria, given the current income distribution of households in the country and land prices at the fringes of human settlements of various sizes.

4.2 STANDARDS

4.2.1 Single Dwellings

Owing to the primitive state of the capital market in the construction sector in the country as a whole, as well as social preferences, it is anticipated that the bulk of residential development will be of the single dwelling unit (D.U.) type. However, given the pressure on housing, the average occupancy is likely to exceed 1.5 households (HH) per DU. Except in large cities, many households will comprise extended or joint families.

4.2.1.1 Lot Sizes:

Table 4.1 recommends standard lot sizes for new residential areas for single dwellings. The standards may have to be varied to suit local circumstances in exceptional cases.

TABLE 4.1 : PLOT CATEGORIES BY INCOME GROUPS

Income Groups	Plot Catego-ries*	Area sq.m	Area Approx.eq.sq.yds.
High	A**	500	600
	B	312	375
Middle	C	250	300
	D	160	190
Low	E	105	125
	F	72	85

Source: Approved by Federal Government on recommendation of Inter-Provincial Conference, 1979.

* In private housing schemes, no plot should exceed 1000 sq. metres.
** Plot category "A" may also be 420 sq.m.(500 sq.yds)..

4.2.1.2 Standard dimensions:

Front-depth ratios in the range of 1:2 to 1:2.5 are generally recommended to minimise lengths of service runs. However, plot dimensions need to be considered in relation to climatic zone, topography, permissible building area, and stipulated building lines. The need to minimize service lengths, is constrained by the objective avoiding "railway carriage" layout of dwellings. Recommended front depth dimensions in the light of above considerations for each category of single dwelling units are given in Table.4.2

TABLE 4.2 : STANDARD PLOT DIMENSIONS FOR SINGLE DWELLINGS WITH VARIANTS FOR CLIMATE & TOPOGRAPHY.

Plot Cate-gory	Size sq.m	Plot Dimensions Front X Depth(Metres)		
		Standard	In Extry Dry Hot, Warm Composite & Inland Maritime Climates*	Hill Side Plots**
A	500	15.50x32.25	15.50x32.25	32.25x15.50
A1	420	14 x 30	14 x 30	30 x 14
B	312	12 x 26	12 x 26	26 x 12
C	250	10 x 25	10 x 25	25 x 10
D	160	8 x 20	10 x 16	20 x 8
E	105	7 x 15	10 x 10.5	15 x 7
F	72	6 x 12	8 x 9	12 x 6

*Large plots governed by services length minimization criterion, small plots by internal courtyard criterion.
**High percentage of hill side plots may be irregular owing to topography.

of

4.2.1.3 Maximum coverage of lot sizes:

i) Maximum percentage of coverage of plot is related to plot sizes.

ii) Small plots necessitate a higher percentage of covered area to meet minimum indoor space requirements. Because views are usually restricted, higher permitted coverage does not cause visual intrusion on neighbouring plots.

iii) On large plots, maximum covered area may be restricted to 65% in order to achieve lower densities in keeping with higher income residential zones to allow spaces for outdoor activity, landscaping, gardening and onsite vehicle parking.

iv) However, maximum coverage should also be related to climatic zones.

v) As plot sizes will generally become smaller as a result of economic forces, and as recommended in this manual, in addition to ground area covered, consideration will also have to be given to total mass of housing. While it is not necessary to use a complex measure like the plot ratio or F.A.R., total permissible floor area as percentage of plot may be prescribed for volume control in residential areas.

Table 4.3 gives the maximum ground and aggregate floor area coverage permissible by various categories of plots.

TABLE 4.3: MAXIMUM PERMISSIBLE COVERAGE, (GROUND AND TOTAL)

Category	Area sq.m.	Most Prevailing Bye-laws (%age)	Recommended maximum ground coverage (%age)	Recommended maximum aggregated floor area (%age)
A	500	50 - 60	60-65	125
A1	420	50 - 60	65	130
B	312	60	65	130
C	250	60	65	130
D	160	70	70	140
E	105	70	75	150
F	72	70	75	150

4.2.1.4 Building Lines and Spaces around Buildings:

A Building Line is one beyond which the outer face of any building except compound wall, may not project in the direction of any street, existing or proposed.

Building lines are thus used to define spaces or widths of land, parallel to the road line, inside which habitable rooms are not allowed to be built.

Spaces around the buildings are used to achieve the following objectives:

a) All buildings can be erected along a common line thus improving the general vista of the road.

b) The spaces can be used for parking and/or gardening.

c) The indoor light and air circulation etc., can be increased wherever desired.

d) The fire risk can be reduced by stipulating distance between neighbouring buildings.

e) Street noise and dust is reduced.

i) Building Lines in general:

In case of plot categories A and B, a front space of 3m, a rear space of 3m and a single side space of 1.5 m are recommended. For category C plots, the front, rear and single side spaces should be 3m, 1.5m and 1.5m respectively. In case of categories D, E and F, building lines are optional.

ii) Building lines in relation to climatic zones:

a) Spaces around single dwelling units in Warm Composite, Extra Dry Hot and Inland Maritime Climates are not required where courtyard houses are designed/provided. Courtyards are located in the centre of the dwelling unit and the living rooms, kitchen and bath etc., are built around it.

b) In Maritime Climatic Zone, either large front or rear spaces are required. The depth of one of these spaces should be 4.5m (15') and the other 1.5m (5') for plot categories A and B. For plot category C, either front or rear space 4.5m (15') deep should be stipulated. Side space may be provided by staggered openings to maximize breeze.

c) In Cool/Cold Composite and Extra Dry Cool Zones, only south facing spaces are required in order to invite sun rays into the house. The space should be 3m (10') deep in case of plot categories A and B and 1.5m (5') in case of category C. Smaller hillside plots being shallow do not afford spaces around buildings.

4.2.2 Multi- Unit Dwellings:

Because multi-unit dwellings need to be constructed either by public authorities which face severe constraints on resources or private real estate developers, who are presently concentrated in large cities, their widespread emergence is not anticipated. Multi dwelling units have caught on in Karachi because they are suitable to local climatic conditions as well as social living habits. Multi-unit dwellings may also be anticipated in the other large cities, where they need to be encouraged, because of less use of precious land, decreased aggregate travel demand, and reduced development costs per inhabitant. Height and setback restrictions on multi-unit dwellings are of critical importance for sound development

4.2.2.1 Heights and Building Lines:

i) The general principle for multi unit dwellings is that it is convenient to construct 1+2 storeys without lifts. In areas, where land prices are high and access to jobs and shopping highly desired, 1+3 storeys may be permitted without installation of lifts.

ii) To ensure adequate light and air, privacy and fire break, the general rule for minimum horizontal distance between two multi-unit dwellings is

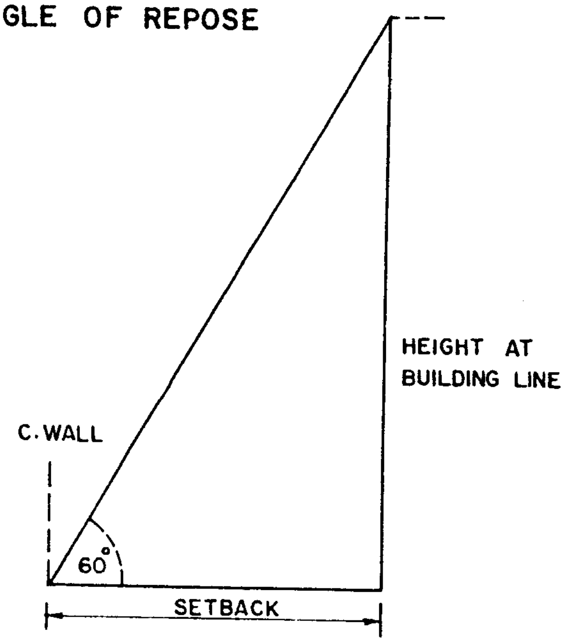
height of building"A" + height of building "B" divided by 2.

iii) Angle of repose may be used to determine the setback of multi-unit dwellings from edge of road way-leave (Fig. 4.1). The general rule is:

Setback from plot line = height of building divided by tan 60

Fig: 4.1

ANGLE OF REPOSE



For example, if height = 15 m then setback from plot line = 15 divided by 1.732 = 8.66 m approx.

iv) Angle of respose formula does not apply to residential flats on top of commercial outlets in commercial-cum-residential zones. In such cases, the primary consideration in determining requisite setback is adequate vehicle parking space. Alternatively basement/sub-basement parking may be stipulated.

4.2.3 Composition of Plots:

The standard composition of plots is given below in Table 4.4.

TABLE 4.4 : COMPOSITION OF PLOTS:

Sr. No.	Categories of plots	Areas of plots (sq.m.)	Percentage of plots required.
1.	A/A1	500/420	) 5%
2.	B	312	)
3.	C	250	) 20%
4.	D	160	)
5.	E	105	) 75%
6.	F	72	)

- This composition will vary where return emigrees form a high percentage of prospective residents.
- It does not apply to GOR's/Cantonments.
- Provision of plots for multi-unit dwellings may be adjusted against the % of single unit plots of the income group for which apartments/flats are being provided, on D.U. basis.

Residential communities tend to be segregated by income while the standard composition is applicable to the aggregate of area development schemes being undertaken. Individual schemes may be targetted for upper, middle and lower income groups. The composition of plots may therefore vary, according to the designation of the scheme, provided always that overall urban provision of plots matches the standard composition.

4.2.4 Building Heights:

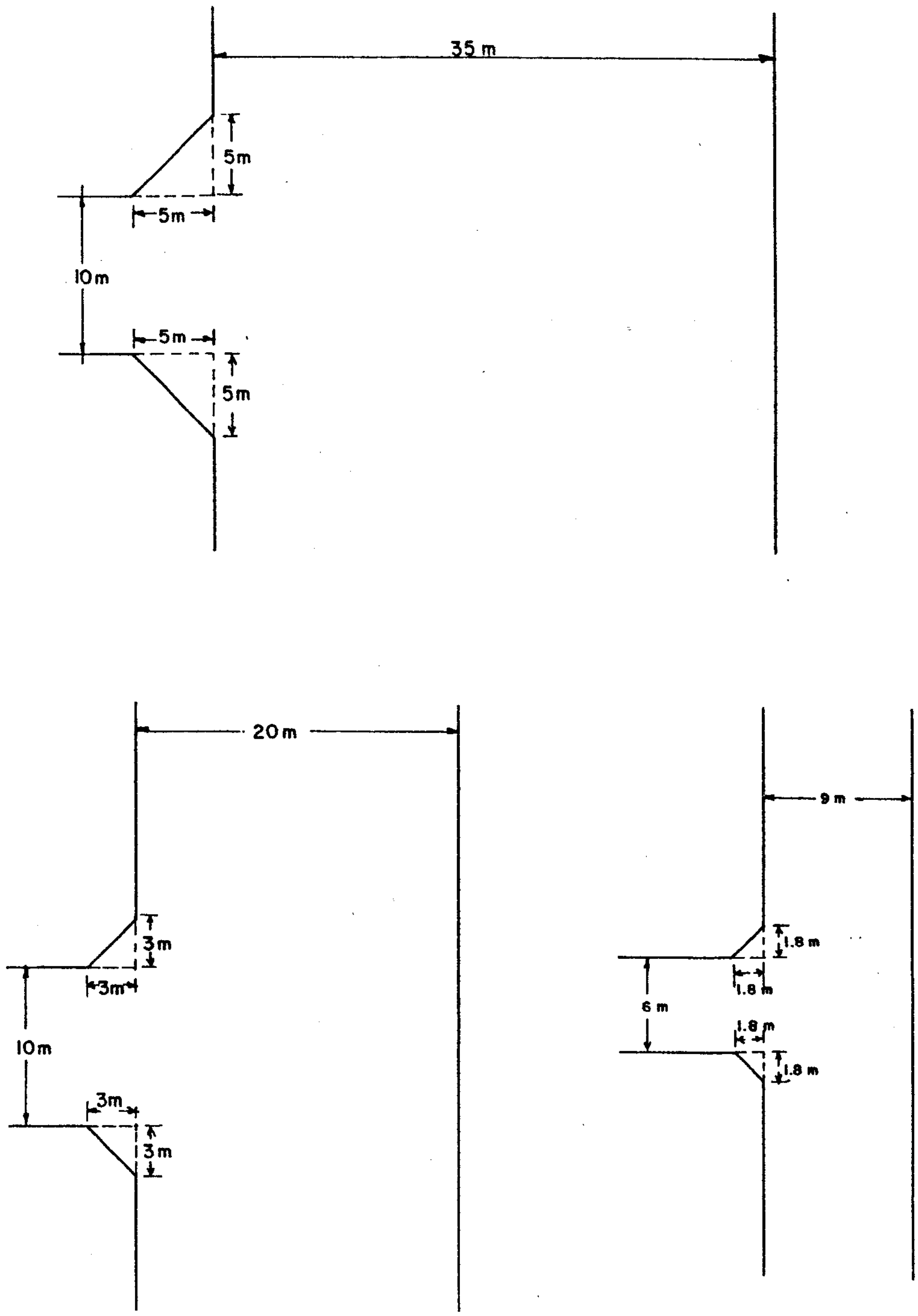
Minimum clear floor to ceiling heights shall be 3.0 metres (9' - 10") for main habitable rooms to allow for proper clearance for air circulation by ceiling fan. Minimum floor to ceiling height of out-houses, stores and bathrooms shall be 2.3m (7'-6"). Maximum floor to floor height of a single storey should not exceed 4.25 (14'), except in case of sloped roof, because ambient temperature does not decrease in higher ceilings. Two storey dwellings should not exceed 7.6 metres (25') and three storey dwellings should not exceed 11.6 m (38') including parapet wall.

4.2.5 Plot Chamfering:

To provide round the corner visibility to motorised traffic on primary secondary, local and access roads, chamfering of corner plots is the traditional solution. For convenience of setting out and to minimise loss of utilizable space inside plots, a diagonal cut or visibility splay may be preferred.

The extent of cut depends on road category and junction type, as shown in Fig. 4.2. Height restriction zones for visibility at junctions are given in Section 7.2.4.

FIG. 4·2 PLOT CHAMFERING AT ROAD JUNCTIONS OF VARIOUS RIGHT-OF-WAYS



4.3 GUIDELINES

4.3.1 Layout Principles

The main layout principles are as under:

i) Housing layout cannot be considered in isolation. They must be related (both in terms of content and physical form) to a broader context.

ii) Housing layout cannot be considered without incorporating other components of the plan such as community or commercial facilities, roads and traffic and infrastructure.

iii) Housing layouts should try to achieve a balance between efficiency (setting out, surveying, installing infrastructure) and the desire to create an attractive place to live (safety, a healthy environment, maintenance of views and natural features, interest and variety).

4.3.2 Plot Relationships

i) Adjacent plots should share boundary walls as this is more efficient, limits lengths of infrastructure and avoids the accumulations of rubbish between plots.

ii) As a guide, a continuous row of plots should not exceed 150 metres because of monotony and blockading effect. Beyond 100 metres, a break by cross walks is desirable. There may be cases where these guidelines cannot be achieved.

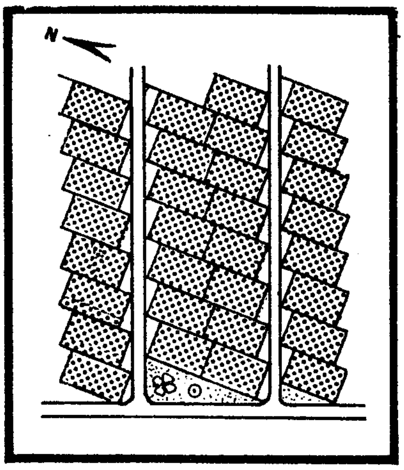
iii) As a guide, a straight row of plots should not be less than 75 m as this increases the number of sewer man-holes unnecessarily.

4.3.3 Plot Arrangements

i) Plots need not be grouped in single rows. Various alternative arrangements should be attempted, such as rows at right angles, housing around a central green in low density development, and around central square in medium/high density development.

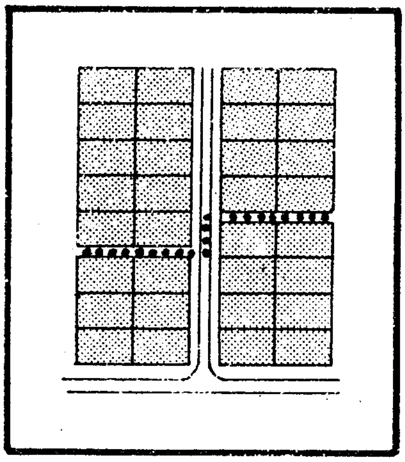
ii) Angular setbacks specially where they improve orientation, can be introduced to give variety to long runs while remaining efficient (Fig. 4.3). Long straight rows of plots are most efficient in terms of infrastructure and setting out, but give a monotonous and unattractive environment.

Fig.4.3 : Plot Arrangement with angular setbacks:



iii) Staggered cross-walks should be provided at regular intervals.(Fig. 4.4).

Fig. 4.4 Traditional Plot Arrangement with staggered cross-walks.



4.3.4 Siting Service Connections

Water supply, electricity and gas connections are normally provided to the front of the plot from the overhead/underground services running along the local/access road or street. The meter reader/repairman has easy approach. Sewer connection is also usually provided from front, (except where back-lanes exist, when it is better provided from rear of plot). Sewer lines should avoid crossing the trench of water supply lines. Where services crossing is unavoidable, the water supply line should come on top. In small sub-divisions, with no side-setbacks and sewer line from front, the W/C is best located in one front corner.

4.3.5 Backlanes

Backlanes have not been successful in the country. They are most needed on small sub-divisions, provided with water-borne underground sewerage system but no side setbacks to allow external access to choked sewers/soakage pits. Unfortunately, low income communities are also normally illiterate and unaware of public hygiene. Back-lanes become rubbiush dumps and create health hazards.

Back-lanes may be considered under the following stringent conditions:

i) The community is highly literate with advanced civic consciousness.

ii) The front road is a high capacity secondary road with no service lane or unusually wide distributor road, making road cuts and across - road house connections expensive, and public utility agencies collectively agree in advance to provide water supply, electricity, sewer and gas lines through back-lanes.

iii) It is a commercial-cum-residential locality, with the fronts of plots devoted to small industrial/commercial activity, and lavatories have to be located to the rear of plots having no side setbacks.

The minimum wayleave for back-lane should be 2 m to accommodate services. Wayleaves may range upto 5 metres, but 2-3m width is to be preferred because back-lanes are usually un-paved and greater width will only increase dust in most climatic zones.

4.3.6 Car Parking

Each plot of categories A, B and C should have one car parking space. For residents of categories D, E and F, and for visitors and service vehicles for all categories, car parking will have to be found elsewhere. However, all plots must have emergency access to vehicular traffic.

As a general guide, parking spaces should not be provided in large groups. As preferences will naturally favour parking close to destinations, it is better to provide many (but small) parking areas rather than few (but large).

On-street parking should be avoided on all distribution roads and kept to a minimum on local access roads.

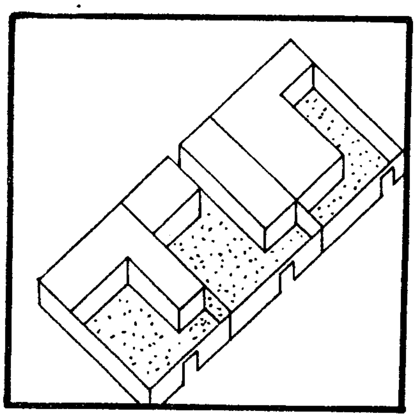
4.3.7 Types of Enclosures

Privacy in residential layouts can be achieved in a variety of ways:

i) boundary wall treatment
ii) house siting
iii) house type
iv) window design

Overlooking can be reduced by adopting L-shaped plans, courtyard designs, and setbacks in the form of staggered terraces. (Fig. 4.5). Parapet walls also help reducing visual intrusion from roof-tops.

Fig. 4.5 L-Shaped Housing:



4.3.8 Residential Density

Residential density is defined as people per unit area. The number of dwelling units permitted per hectare is the method of controlling density. Unit plot sizes are generally expected to be larger in the low and medium density areas and smaller in higher density areas. The range of residential densities envisaged to result from adoption of standard plot sizes are given in Table 4.5.

TABLE 4.5 : RANGE OF RESIDENTIAL DENSITIES*

Density Zone	Residential Type	Dwellings/ hectare	People/hectare
Low	Mainly large plots	14-20	70-160
Medium	Mainly medium plots	20-44	120-396
High	Mainly small plots	44-69	264-690

(Average household size ranges from 5 to 8 in upper income communities and 6 to 10 in low income communities).

4.3.9 Floor Area Ratio

The floor area ratio of a plot is obtained by dividing the gross floor space (minus all enclosed parking) by the total plot area. Use of floor area ratio as a regulatory device in conjunction with overall height limits will encourage a varied skyline, long views and the circulation of cooling breeze. Rigid application of a simple height limit policy will result in a uniform skyline, poor control of density and few possibilities for long views. When designing an area, the planner should envisage an optimum height for all adjacent properties, assign a floor area ratio number based on the number of floors (Also refer Chap.10 - Landuse).

4.3.10 Some Basic Layouts

Layouts should be related to road hierarchy:

i) The full hierarchy of roads provides a standard structure with most houses served

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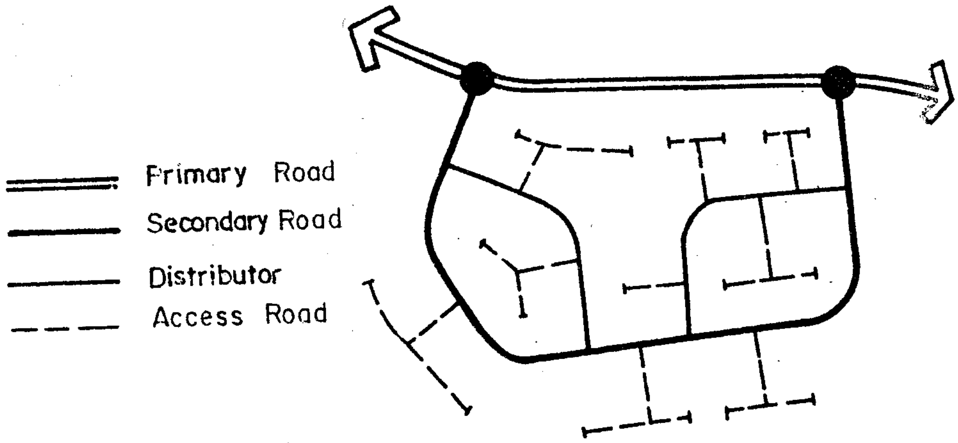
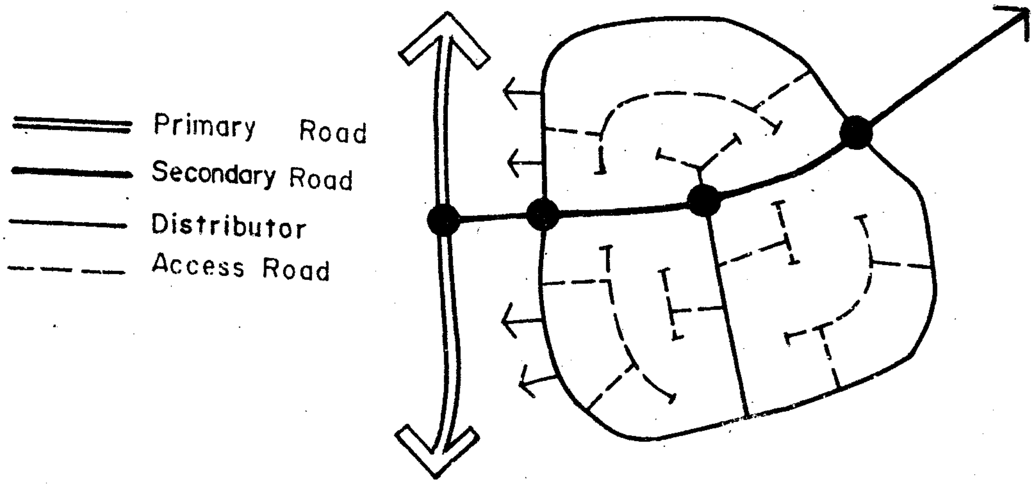
* Appendix 4.1 gives the methodology to determine lots per unit area, as a function of plot sizes and percentage area under roads, parking and community uses.

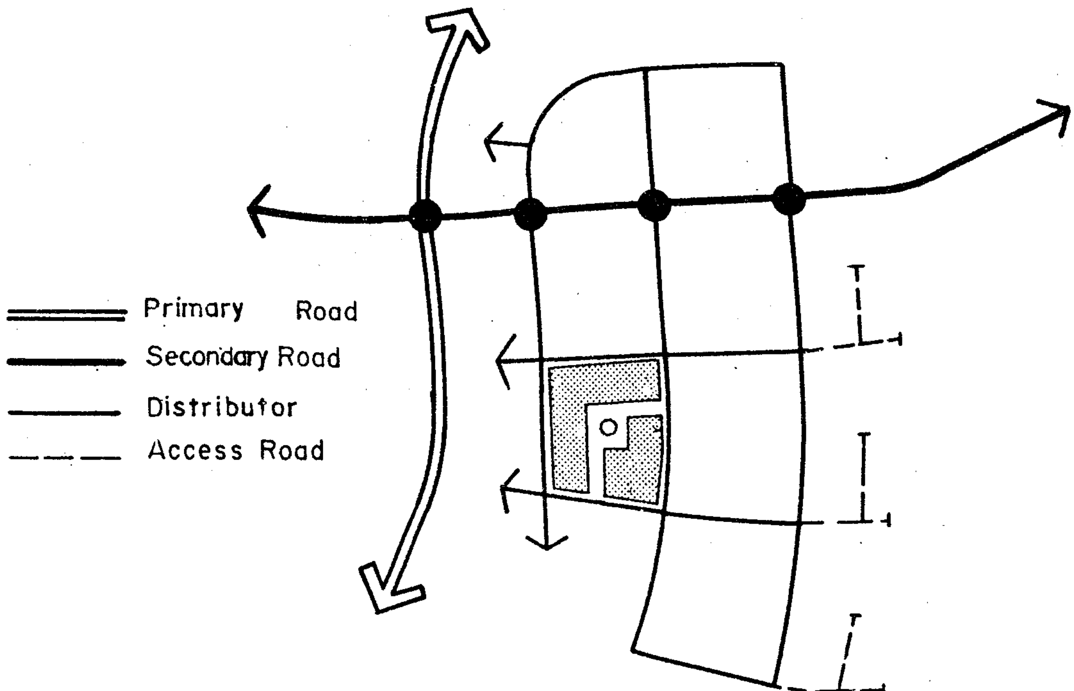
from cul-de-sacs so that housing groups are formed around safe environments with no extraneous traffic. The primary road roundabouts serve to complete the loop and disperse traffic. All intersections are staggered favouring easy pedestrian access through the neighbourhood. Vehicular access shoduld not be allowed directly on to the primary road. It should be through service lane.



ii) When a secondary road divides the neighbourhood, traffic should be dispersed through roundabouts and key local roads in order to provide for safe residential areas around cul-de-sacs. In this example, major commercial or government facilities would be provided along the primary road with their own access.



iii) Again with major commercial or government facilities along the primary road, the residential area would be set behind with controlled intersections on to the secondary road. This layout may be very advantageous for courtyard housing concepts within each grid, as illustrated in the diagram, which may ease the problems of the relatively unsafe cross intersections.



4.3.11 Existing Areas

i) When the planner has to insert a new road, infrastructure reservation or open space through the old areas, care must be taken to minimize the adverse effect on existing buildings. Consultations with the concerned authorities would assist in preparing a detailed Conservation Plan to protect buildings of historic or architectural importance.

ii) In the old areas of existing towns, applications for new developments must always be considered in the light of the area, dictating the style of architecture, use of materials, door and window shapes, sizes and locations and the size and bulk of the building.

REFERENCE

Wakely, Schmetzer, Mumtaz, (1976),
Urban Housing Strategies, Pitman, Bath.

CHAPTER - 5 : COMMERCE, OFFICES AND INDUSTRY

5.1 COMMERCE

5.1.1 Planning New Commercial Centres.
5.1.2 Markets
5.1.3 Shops
5.1.4 Guidelines

5.2 OFFICES

5.2.1 Office Zones
5.2.2 Office Buildings

5.3 INDUSTRY

5.3.1 Standards
5.3.2 Guidelines

CHAPTER 5 : COMMERCE, OFFICES AND INDUSTRY

5.1 COMMERCE

This section presents planning standards for new commercial centres and descriptions of existing markets. It provides standards for shop sizes and allocation at different levels, and associated parking requirements. Guidelines for new centres, existing markets and shops are also given.

5.1.1 Planning New Commercial Centres:

When undertaking a new township or large area development scheme, the planner needs robust criteria for allocation of space for commercial activity.

5.1.1.1. Levels of Commercial Centres

Text-books on city planning, (e.g. Chapin, 1965), accept as given a 3 level hierarchy of neighbourhood serving, community serving, and region or city serving shopping centres, plus a special class of ribbon development associated with one genre of goods, (e.g. automobile spare parts). In Pakistan, owing to restricted mobility of the buyer, (specially females), lack of alternative occupation and limited capital with the small shopkeeper, one may also recognise the 4th and 5th levels i.e. the Mohallah Centre with a small cluster of shops and Sub-Mohallah Centre comprising 3 to 4 Khokhas. The task of land-use planning is to establish location and space requirements for all such types of centres.

5.1.1.2 Location Criteria:

Location requirements include:

(i) City and regional business centres: location on main arterials, site adequate for peak parking and sufficient varieties of goods and services to fill several hours of a shopper's time.

(ii) Community serving centres: adjacent to major thoroughfare, located in the centre of community/city district. (Also Town Centre of an intermediate town).

(iii) Neighbourhood, Mohallah and Sub-Mohallah Centres: within convenient walking distance of families served.

5.1.1.3 **Sales and Site Area Standards**

Space requirements are computed by determining the:

i) rupee demands accruing to the centres
ii) sales area* needed to meet the demands
iii) gross site area** needed to support the given sales areas.

Unfortunately, in Pakistan, the relationship between rupee demands and sales area has not been extensively

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* Sales Area is defined as the ground floor area of shops, whether used for trading, display or storage purposes. It also includes area under Arcades provided the same are partially used for petty trading in addition to circulation.

** Gross Site Area is defined as the entire tract in which commercial activity is located. It includes, adjacent 6 m of primary road or half of secondary/local road along commercial frontage located on one side and the full road width if commercial activity occurs on both sides. It includes streets/backlanes and green/open spaces within the tract. It includes space for vehicles parking for goods delivery/shopping.

investigated. The few studies which exist relate to Karachi (Stubbs, 1973). Recourse has to be made to a criteria based on population served. However, this conceals quite marked variation between rich and poor communities.

Fig.5.1 presents a nomograph setting on parallel scales of outcome of a survey (PEPAC,1978) carried out for Commercial Centres, with catchments exceeding 35,000 population, in high, middle and low income communities of Karachi. The nomograph helps to determine the needed sales area and other corresponding characteristics of a viable commercial centre.

The relationship between sales area and site area depends upon local bye-laws for setbacks and road widths, upon vehicle ownership rates and parking needs, and the design of commercial centre*. The broad ratios given in Table 5.1 may be used for preliminary planning:

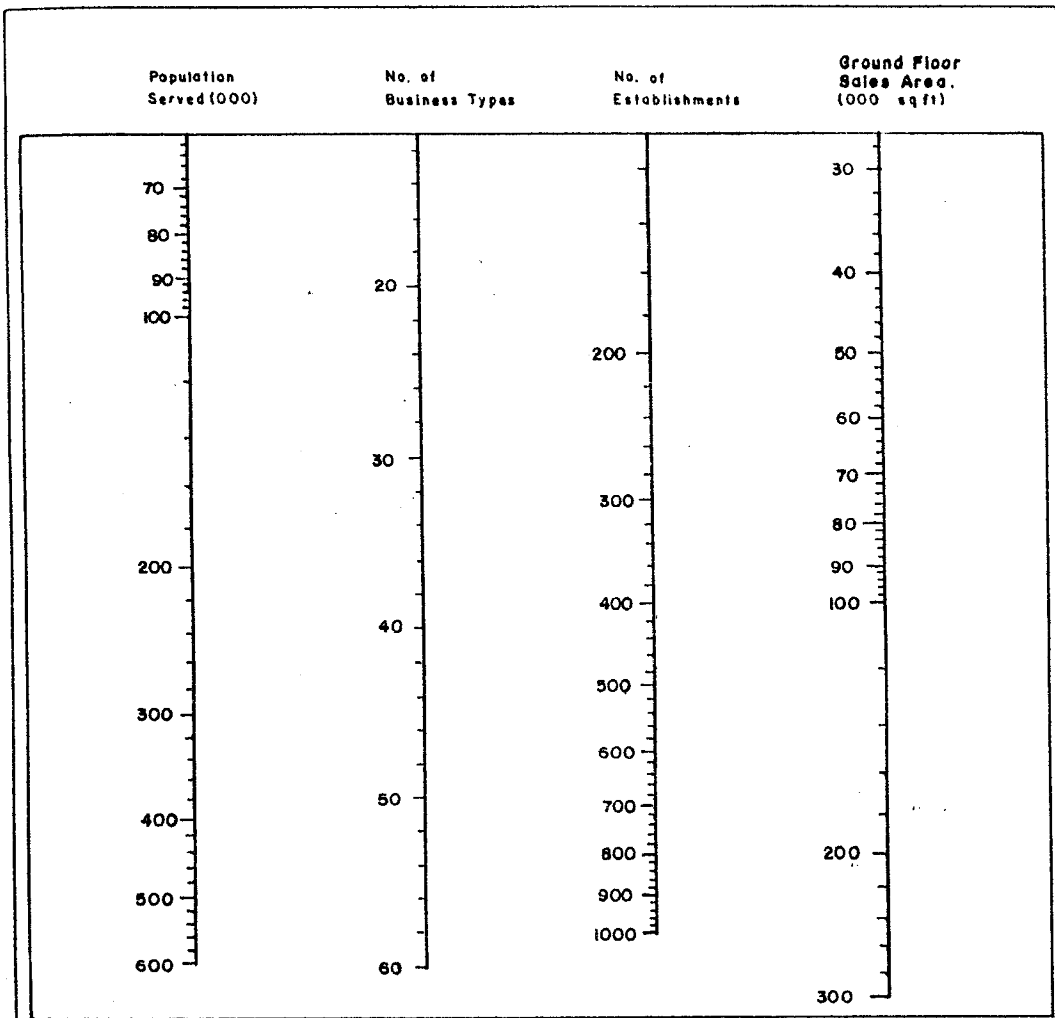
TABLE 5.1 : RATIOS BETWEEN GROUND FLOOR SALES AREA AND GROSS SITE AREA:

Design	Sales area (ground floor)	Site area
1. Linear :		
i) Arcade included	1	3.25
ii) Arcade excluded	1	4.00
iii) Without Arcade	1	3.70
2. Grid Iron	1	5.00
3. Circular with central green space	1	6.75-10.00

Source: PEPAC Survey of 15 Commercial Centres (1985).

* Where even these preliminary information/decisions are not available, the planner may set aside upto 3% of the total area of Area Development Scheme for commercial activity. This area should be judgementally distributed among mohallah, neighbourhood and community level commercial centres.

Fig : 5.1 Nomograph for Commercial Centre Planning



SOURCE :- PEPAC Survey of relations between market area characteristics, (KARACHI 1978.)

NOTE : A HORIZONTAL LINE DRAWN ACROSS THE FIGURE FOR ANY MARKET SIZE WILL PRODUCE THE NEEDED SALES AREA AND OTHER CORRESPONDING CHARACTERISTICS OF A VIABLE COMMERCIAL CENTRE. SOME DOWNWARD ADJUSTMENT MAY BE MADE FOR CITIES AND TOWNS OTHER THAN KARACHI AND ISLAMABAD

PEPAC
DEVELOPMENT PLANNING UNIT

It would be seen that a linear shopping centre is most economical in use of space. However, shopping blocks with grid iron paths segregating pedestrian/vehicular traffic ensure greater safety, whereas a shopping centre laid out along the fringes of a central green space enhances its aesthetic unity and minimizes walking during the multipurpose shopping trip.

5.1.1.4 **Determining Trade Area and Population**

The above space standards operate on the basis of population served. In the case of isolated new townships the population to be served may be simply calculated by multiplying the number of residential plots by average household size. However, for developments contiguous to existing built-up area or where regional shoppers are important, the trade area of the proposed commercial centre has to be determined and a population figure derived before space standards can be used. Numerous techniques are available for this purpose. One simple model which can be used in conjunction with an adequate map is given below:

Reilly's Law of Retail Gravitation.

$$\frac{TA}{TB} = \frac{P_A}{P_B} \left[\frac{D_B}{D_A}\right]^2$$

Where

T_A, T_B = proportions of trade from the intermediate place attracted by centres A and B

P_A, P_B = Sizes of A and B

D_A, D_B = distances of A and B from the intermediate place.

Operation against all competing centres, will yield trade area breaking point (50:50) boundary from which the catchment population can be determined.

5.1.1.5 Limitations

The nomograph methodology is not fully tested for small catchments nor does it capture the full diversity of existing markets. As such, the rest of this section is devoted to traditional analysis of the types of markets and shops. The standards and guidelines recommended are collated from master plans recently prepared in the country.

5.1.2 Markets

A market may be defined any spatially bounded assemblage of sales units, which may or may not have located together for reasons of complementarity, monopsony, exchange of information, safety or compliance with land use plans/regulations. Nevertheless, market formation does result in individual outlets enjoying external economies of scale accruing from the multipurpose shopping trip and shared infrastructure. On the other hand, it offers consumers the advantage of comparative shopping.

5.1.2.1 Types of Markets

Markets may be classified by planners in at least ten different ways:

1. By client type (up-market, mixed, low end of trade).

2. By place in hierarchy of catchments (local, city, regional).

3. By variety of goods sold (specialised, heterogeneous).

4. By dominant good/service offered. (A two level sub-classification may be discerned, at the first level, by product categories like foods and cloth, while at a second level, one may identify fruits and vegetables markets and these for printed cloth and second hand garments, etc.)

5. By nature of business transactions (wholesale/retail, credit/cash).

6. By location, (CBD, highway orientated, old city, new planned).

7. By duration, (permanent versus weekly/seasonal).

8. By morphology, (linear, compact).

9. By type of structure (shopping plaza, covered, partially open, open).

10. By legal status (tax-paying versus Baras).

None of the above systems of classification are comprehensive and wholly satisfactory. Nevertheless some form of categorisation is necessary for descriptive purposes and to form a base for qualitative policy guidelines. A matrix (Appendix 5.1) of relationships between the elements of the above classification systems allows ranking by degree of cross-explanation to yield 9 Market Types.

These are not mutually exclusive, (Bara Markets may be Highway Ribbons) or even, strictly speaking, comparable, (Shopping Plazas may be elements of the CBD or Up-Market). However, they are strongly descriptive labels, which allow specification of planning guidelines.

i) The CBD Market:

Characterised by its location in/near the CBD, it is a heterogeneous market, catering to all kinds of clientele and attracting regional, city and local trade, providing a large variety of goods and services, but specialising in rare commodities and professional and business services.

ii) Local Retail Markets:

Stocking a limited range of frequently demanded heterogeneous items, the quality and type of goods offered vary distinctly with the income group of proximate consumers.

iii) Wholesale Markets:

Wholesale Markets are usually associated with bulk disposal of grains, fruits, vegetables and meats. Large warehousing and storage facilities are usually found in close vicinity.

iv) Specialised Markets:

These have their origin in the crafts guild tradition and persist either because of continued vitality of the craft or formation of cartels. Typically originating along the lengths of a particular street of the Old City and adjacent areas, these usually have a low/mixed income regional clientele.

Specialised Markets may have both wholesale and retail modes of transaction. In both modes, specialised markets have strong interlinkages with processing and production activities at the rear of the shopping outlets. The residences of production and sales workers are also usually intimately interlinked. Thus specialised markets are residential, production and sales complexes, which make relocation policies difficult and of questionable merit.

v) Bara Markets:

These are specialised in smuggled goods and are normally found just outside municipal/legal jurisdictions.

vi) Highway Orientated Ribbons:

Highway orientated ribbons are characterised by goods and services attracting through traffic. The goods and services provided may range from low market repairs and eatables to up-market supply of smuggled items.

vii) Jumma Bazar & Other Occasional Markets:

These have recently been revitalised in order to by- pass the retailers mark-up. They are located on large central open spaces which are used for other activities during the rest of the week/year.

viii) The Up-Market:

Located on/adjacent to the main road of the largest planned high income community of the city, it provides quality consumeables and durables to rich, motorised, westernised clientele at 15-50% mark-up from other markets. It is a spin-off of trade from CBD Market, flowering fully in metropolitan cities (e.g. Tariq Road, Karachi).

ix) The Shoping Plaza:

A Shopping Plaza, distinguished by covered circulation, is the modern form of Specialised Market providing a selected range of quality goods, located in or near the CBD Market or the Up-Market. It caters almost exclusively to upper income clientele. It provides collective security to the shop owners. Its multistorey version provides the exception to the rule that commercial outlets must be on the ground floor. It is a capital intensive but space saving, specially frontage saving, form of market.

5.1.2.2. **Planners Agenda for Existing Markets**

This can only be descriptive and general, because of the rich diversity of markets in their sizes, locations and traffic generation:

i) Guidelines for the market in CBD may be found in Chapter 10 - Landuse.

ii) The prime issue regarding the Wholesale Markets is their relocation in expanding towns. Traditionally, they tend to be close to the CBD where they cause traffic congestion, sewage disposal problems and smell nuisances. As towns expand, the relocation of Wholesale Markets to the fringes becomes imperative. In order for this major operation to be successful, it is necessary to provide good level of access and infrastructure in the reception area. Close linkages with bus and truck stands must be ensured.

iii) The Specialised Market is a residential, production and sales complex. Attempts to shift it out of its Old City location are not likely to be successful, except for the high end of trade, such as jewellery, which is already relocating in the Up-Markets and in Shopping Plazas. For the problems of severe congestion caused by mixed traffic, the creation of one way street couplets, closing certain streets to vehicular traffic at shopping hours and removal of encroachments are the indicated policy solutions.

iv) Control over goods sold in Bara Markets i.e. drugs and other obnoxious items has become the prime social concern. It is essentially a law and order issue.

v) The prime problem with Highway Ribbons is the generation of pedestrian cross traffic which impedes the primary function of the highway. The Planner should encourage proposals which give depth to Highway Ribbons, (such as providing services along side roads) as well as initiate engineering solutions, (such as pedestrian overhead bridges and Zebra Crossings).

vi) In the case of the Up-Market and Shopping Plaza, the primary issue is that of vehicular parking. The Planner should envisage that in future vehicular ownership and parking space demand is going to increase manifold. Generous provision of parking lots is necessary to ensure continued vitality of these markets.

5.1.3 Shops

5.1.3.1 Types of Shops & their usual location:

1. Convenience Shop:

   Shops stocking staple items of standard quality for the convenience of the shopper, are called convenience shops.Essential goods, such as groceries, bread, newspapers, medicines, toilet requisites, stationery, tobacco and sweets are bought daily/frequently, as most are perishable or consumed quickly. (Only in rich communities, with deep freezers does this pattern change somewhat). Obviously they form the backbone of retail trade.

   Convenience shops are usually located in a local shopping centre, or at the corner of a row of residential plots.

2. Demand Shop:

   Goods which are for the most part

necessities, but which are not purchased at frequent or regular intervals by any one household e.g. furniture, made-up garments, shoes, clocks, cycles, etc., are termed demand goods, as the customer usually specifies the particular item desired to be purchased.

Shops selling such range of items are found in the Local Retail Market for the low end of trade, and in the Specialised and Up-Market for mixed and high end of trade.

3. Impulse Shops:

Luxury goods, which are bought suddenly on impulse, goods which the purchaser often had no intention of buying, like jewellery, perfumes, expensive foods and flowers, etc., are termed impulse goods.

Impulse shops may be part of a community scale market but are mostly found in the Up-Market or the Central Business District.

4. Departmental Stores.

These maximise the variety of goods offered to take advantage of the multi-purpose shopping trip. In Pakistan, such stores tend to be distributed along the important roads of Central Business District and Up-Market.

5. Showrooms:

Showrooms display samples of high value items which are usually space-occupying. It is usual for orders to be booked in addition to cash/immediate sales. Like departmental stores, showrooms tend to be distributed along important roads of the CBD and the Up-Market.

5.1.3.2 Standard Categories & Dimensions

Recommended dimensions and areas are as follows:

TABLE 5.2 : STANDARD PLOT DIMENSIONS FOR SHOPS:

Sr. No.	Categories	Dimensions (Metres)	Total area (Sq.Metres)
1.	Convenience Shop	2.5x3.0	7.50
2.	Demand Shop	3.0x5.0	15.00
3.	Impulse Shop	3.0x7.5	22.50
4.	Departmental Store		Min. 57.00
5.	Commercial Showrooms		Min. 70.00

The dimensions allow modular arrangements of shops of the first three categories,(for example 2 Convenience Shops on one side of Demand Shop in a frame of 6 x 5 m, or 3 Convenience Shops on one side and one Demand Shop and one Convenience Shop on the other side on an Impulse Shop in a frame of 9 x 7.5 m.

Shops in relation to hierarchy of shopping centres and number of residential plots per shop are given in Table 5.3.

TABLE 5.3 : NUMBER OF SHOPS AS A FUNCTION OF POPULATION*

Sr. No.	Level	Population	No. of Shops	No. of residential plots to a shop
1.	Regional Shopping Centre	5,00,000	450-500	150-175
2.	Town Centre	1,00,000	125-150	100-125
3.	Neighbourhood Centre	25,000	40-50	75-95
4.	Mohallah Centre	6,000	10-12	75-90
5.	Sub-Mohallah Centre	3,000	3-4	115-150

* Source: Collated from various master plans. The standards are not additive e.g. Town Centre population served includes population also served at lower levels.

Regional Shopping Centre contains a full range of shopping facilities and generally supports a population of 5,00,000 or more. Number of shops may range between 450-500, (upto 900 in Karachi - Ref. Fig. 5.1).

To be viable, a shop in Neighbourhood and Mohallah Centres should serve a minimum of 75 dwelling units, while provision of shopping outlets should not decrease below one per 115 dwelling units in case of Sub-Mohallah Centre.

The number of shops suggested in the above Table may be exceeded in case of CBD.

5.1.3.3 **Standard & Non-Standard Shops**

A shopping unit on small commercial plot in a residential area is termed a standard shop, while shopping unit on residential plot is a non-standard unit.

Non-standard shops are undesirable as they create disharmony in the landuse pattern. In practice, the standard shop will be concentrated in a local shopping centre whereas the non-standard shops tend to be distributed in a dispersed fashion. Such non-standard shops should be incorporated within standard residential plots in addition to the house on the plot. The total built-up area, (of shop and house combined) should not exceed that which would be permitted if a house only occupied the plot.

5.1.3.4 **Height & Bulk Control Standards**

The following control standards may be applied:

a) **Height of Buildings**

i) The level difference between arcade and shopping floor shall not exceed 45 cms (1' 6") whereas the level of arcade from the centre of the road crest shall not exceed 15cms (6").

ii) The height of any building, including parapet wall in a Central Area shall not exceed 1.5 times the adjacent road right-of-way plus the width of setback, if any, subject to a maximum height of 36.60 m,(120 feet), or F.A.R limits (Section 10.3.2) whichever is lower.

iii) The height of any building, including parapet, in a Community and Neighbourhood Comercial Centres shall not exceed 1.5 times the adjacent road right-of-way plus width of setback, if any, subject to a maximum of 27.50 m (90 ft.) or F.A.R. limits (Section 10.3.2.) whichever is lower.

b) **Height of individual storey**

i) Minimum floor to ceiling height of arcade shall not be less than 3 m (10 feet).

ii) Minimum floor to ceiling height of any shop shall not be less than 2.9 m (9'-6") without any gallery (storage space) or 4.75 m (15'-6") with gallery (storage space).

iii) Minimum effective height of parapet wall shall be 83 cm (2'-9").

c) **Side Spaces**

No open space on either side of building shall be required.

5.1.4 Guidelines

In addition to quantitative standards and descriptive agenda, the following broad guidelines are relevant to new commercial centres, existing markets and shops.

5.1.4.1 Location

Local shopping centres are formed from the concentration of different types of shops at a central and accessible location in the planned area. The following three factors should be considered while locating such local centres:

i) the need to provide a reserved area for expansion

ii) the need to consider adjacent shopping areas

iii) the mix of different types of shops.

i) Reserved Area:

A reserved area for expansion of the local centre should be provided adjacent to the first phase sufficient to allow the centre to grow in size, if required.

ii) Adjacent Shopping Areas:

When the new planned area is adjacent to an existing housing area containing a local centre, which has the capacity to expand the following provisional standards should be applied to the area as a whole:

a) Local shopping centres should be located as centrally as possible in the residential areas they serve, in order to minimize the distance which the residents need to walk.

b) Consideration should be given to phasing so that the local centre remains accessible to later phases and not just the first phase.

c) Local shopping centres should have immediate access to a secondary or local road which does not pass through a residential area.

d) Local Shopping Centres should be as close as possible to complementary central community facilities, such as schools, clinics and sports facilities.

iii) Mix:

Most of the local shopping centres will require a mix of different types of shops to ensure that a variety of enterprises is provided. For this purpose the planner should examine the local market conditions and decide on an approximate ratio between different categories of shops (i.e. convenience, demand, etc). Their actual business functions (i.e. grocery, butcher, etc) should be left to determination by market forces.

5.1.4.2 **Recommended Storeys**

While two or more storeys are common in larger units/plazas, height shall be as allowed under the relevant bye-laws (which would vary with size and type of city, as well as location within each city). The rooms on the first and second floor may be permitted for uses other than shopping, such as offices or residence.

5.1.4.3 **Car Parking and Access**

Standards for parking may be as follows:

i) One motor car space for every 93 sq m (1000 sq.ft) of floor area.

ii) One motor cycle/scooter space for every 27 sq.m.(300 sq.ft) of floor area.

iii) One cycle space for every 23 sq.m. (250 sq.ft) of floor area.

iv) In addition, spaces are required for loading/unloading bays and ramps.The bay dimensions and ramp gradients are given in Section 7.5.

Some general guidelines for commercial parking are:

i) Kerb side parallel parking on main carriageway of primary and secondary roads of cities should be discouraged, (by double yellow lines). Parallel parking may be àllowed on service lanes.

ii) Car parking areas should be as close as possible to shop fronts to minimise walking distances.

iii) Access for service vehicles should be separate from access for shoppers.

5.1.4.4 Commercial Show-Rooms

These may be divided into hazardous and non-hazardous showrooms. Hazardous showrooms impede road traffic as the exhibits and sale items overspill on to road side. Showrooms for cars and certain steel products like cupboards, trunks etc., are examples.

In case of non-hazardous showrooms there is no overspill on roads and. thus no encroachments. Showrooms for quality furniture, electric goods, etc., are non-hazardous.

Hazardous showrooms should be located on in-town edge of trade area or on primary and secondary roads. In no case should these be located on local roads.

It is also necessary that service lanes should be provided for these so that the general traffic on the main road remains uninterrupted. The service lanes may be physically separated from rest of the road by a kerbed median.

Non-hazardous showrooms may be located in general commercial areas subject to adequate provision for parking.

5.1.4.5 **Conversions**

When considering change of use applications from residential to commercial, the following stepwise questions are pertinent:

i) Is there need for commercial expansion? This will depend on the extent of overcrowding in existing commercial centres.

ii) Is the proposed site adjacent to current commercial use? Contiguous expansion is generally more tolerable than leap-frog conversion.

iii) Is there some other more suitable site to which the demand could perhaps be diverted?

iv) What are the traffic implications of the proposal? Does the site have direct access to primary/secondary roads?

v) Are the subdivisions of roads, buildings and open spaces in the proposal, satisfactory?

5.2 OFFICES

It is difficult to relate office space demand at settlement scale to any population parameter. The requirement for office space in a city/town depends more upon the function of the settlement than upon its size or density. Efforts should however be made to locate all or most offices in one zone, easily accessible and associated with the city/town centre.

5.2.1 Office Zones

Government Secretariats and Headquarters, containing all or most of the administrative, judicial and nation-building departments, broadly require the space allocated in Table 5.4.

TABLE 5.4. SECRETARIAT GROSS AREA STANDARDS

	Hectares
1. Federal Secretariat.	Special Case
2. Provincial Secretariat	20-50
3. Division Headquarters	15
4. District Headquarters	10
5. Tehsil Headquarters	5

Source: PEPAC sample survey of existing sites & demands.

Private offices do not require special provision in a local plan. They normally occupy the upper floors of commercial buildings used as shops or showrooms.

5.2.2. Office Buildings

Regarding individual office buildings, it is proposed that in central areas, not more than 7/8th of the area of each plot should be covered on the ground floor including arcade and not more than 3/4th on the subsequent floors subject to the condition that Floor Area Ratio does not exceed 1:5.*

In other than central areas, not more than 3/4th of the area of each plot should be covered on the

* Source: LDA Building Regulations (1984).

ground floor including arcade and not more than 2/3rd on the subsequent floors subject to the condition that the Floor Area Ratio does not exceed 1:3.

Carpet area standards for Government Departments in relation to Basic Pay Scales are given in Table 5.5. Private sector organisations may also use these as yardstick to calculate their requirements. Once carpet area has been calculated, Table 5.5 also gives the formula for estimating site area required.

TABLE 5.5 : OFFICE SPACE STANDARDS

Categories	Carpet Area per person (Sq.Metres)	Formula for Site Area
1) Secretarial staff without public dealing.	4 to 4.5	a) Divide total carpet area by 0.9, add 20% to get Floor Area.
2) Secretarial staff with public dealing	5.5 to 7.5	b) Check bye-laws for permissible F.A.R. c) Decide number of storeys for office building.
3) B.P.S.17-18	15	d) Derive Ground Floor Area
4) B.P.S.19-20	22.5	e) Use permissible plot ratio(LDA has 7/8th in central area, 3/4th other areas) to determine site area needed.
5) B.P.S.21-22	35	
6) Committee Room	1.5 to 2	

Source: Derived from ECNEC Standards for Carpet Areas and LDA building regulations.

5.3 INDUSTRY

5.3.1 Standards

The standards set out cover workshops, small scale, light and general industry. Heavy industry is not included. Heavy industry can be defined in different ways such as in terms of capital investment, labour requirements, etc. The most relevant criteria in planning context is however, an industry producing considerable noise, fumes, dust, smoke or other pollution. The decisions regarding such industry should be made on case to case basis.

5.3.1.1 Layouts

There is no golden rule for a good industrial layout. However, over the years experience has shown that certain forms are successful, but much depends on the size of the estate, the topography of the site and external factors, such as the relationship of the estate to adjacent developments.

The grid iron pattern is ideal for a rectangular site. Seldom however, will a site be a regular shape. The system can be adapted for almost any shape. Usually the only differences are that the main roads include a bend at some point in their length, and the plots bounding on a peripheral main or secondary road are of irregular type.

5.3.1.2 Space Standards

Generally 50 industrial workers per acre or 80 sq.m. per industrial worker are recommended as space standards.

5.3.1.3 Landuse Distribution

The recommended landuse distribution for medium sized estates is given in Table 5.6.

TABLE 5.6 : LANDUSE IND INDUSTRIAL ESTATES

Category	Percentage
Factory Plots	60-65
Roads	Upto 20
Open Spaces	Upto 20
Administration & other Buildings.	5-10

Source: UNIDO, 1978

5.3.1.4 Set-Backs

Location of industries along the roads should be consistent with the Highway Ordinance, according to which it would be unlawful without the consent of the Highway Authority:

a) to construct or layout any means of access to or from the highway; and

b) to erect any building upon land within two hundred and twenty feet (67 metres) from the middle of the highway.

Industrial agglomerations, generate / attract lot of traffic and to separate industrial traffic from the general traffic, it is necessary to provide service roads for industrial estates. It is also desirable that the setback from the existing road should be more than the minimum given in Highway Ordinance (67 metres).

It is proposed that :

i) Setback from any primary road be at least 200 metres from the road edge.

ii) The industrial estate should be separated from existing and proposed residential areas by at least 150 metres (medium sized units of light industry and warehouses) or at least 500 metres (large units of light and general industry)*

iii) Small scale and non-offending cottage industries may be allowed in low-income residential areas. They may operate within dwelling units or a separate Nursery Industrial Estate may be provided for them. These nursery estates may vary in size, from about 0.4 hectares to about 3 hectares.

5.3.1.5 **Access**

i) The industrial areas should have access to power and water supplies.

ii) The industrial areas should also have good access to primary and secondary roads, but no access to individual plots from primary roads.

5.3.1.6 **Plot Sizes**

In order to achieve the flexibility as an in-built character of an industrial area, it is proposed that a dominantly Modular Approach be adopted for physical planning. The Modular Approach permits the adoption of an optimum size of space unit, various numbers of which can be combined to generate plots of varying sizes. The dimensions of the basic module may be 25 m x 50 m. This versatile size with a length/breadth ratio of 2.0 permits its combination into a large number of industrial plots of varying sizes. Fig. 5.2 gives six basic combinations.

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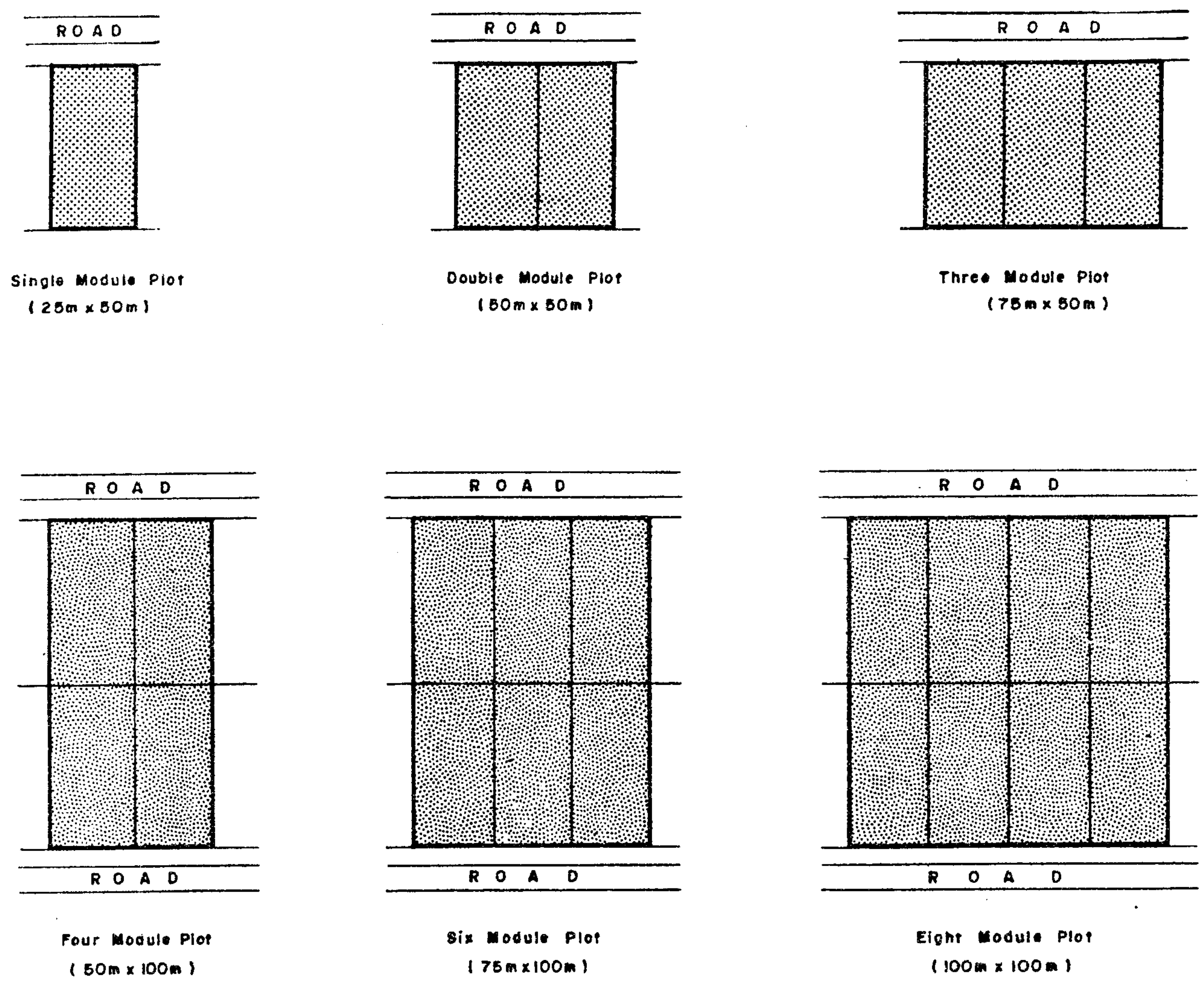
* Heavy Industry requires case by case decision. Generally it should be located well outside the urban fringe.

Fig. 5·2



NATIONAL REFERENCE MANUAL ON PLANNING AND INFRASTRUCTURE STANDARDS

INDUSTRIAL PLOTS THROUGH MODULAR COMBINATIONS

DEVELOPMENT PLANNING UNIT

The Modular Approach, however, may not be strictly followed. Corner plots and those at the peripheries may have non-modular dimensions.

5.3.2 Guidelines

5.3.2.1 Planning Principles

Industrial areas should be planned in accordance with following guidelines:

i) Plots of smaller size should be grouped as to separate small workshops from large scale industry.

ii) Larger plots should be positioned in the most visible locations.

iii) Where site conditions permit, a grid pattern road layout should be used, with staggered T-junctions on the local roads in the industrial area.

5.3.2.2. Location

The following are partial guidelines to be considered while selecting locations for industrial estates.

i) Areas of reasonably flat land to allow large plots and buildings with large spans.

ii) Areas which do not have substantial natural vegetation.

iii) On the downside of existing or proposed residential areas for the prevailing wind; and

iv) Separated from orchards and other valuable agricultural areas.

5.3.2.3. Industrial Waste

Industrial wastes should be treated prior to disposal. Processing is intended to reduce their volume and weight and to ensure their hygienic safety by reducing BOD toxicity and poisonous quality of the effluents/emission to the required standard placed at Appendix 5.2

After processing, the wastes may be discharged into receiving waters, more rarely onto receiving soils, or reclaimed for industrial water supply.

5.3.2.4 Zoning and Phasing

It is desirable that industrial estates be zoned according to a broad categorisation of industrial units. One useful categorisation is as follows:

i) Iron and Steel
ii) Electrical & light engineering
iii) Chemicals
iv) Less polluting processes and small industries.
v) Less mechanised processes.

Such categorisation allows rational zoning, reflecting the varied traffic generation and pollution caused by different types of industries. Heavy traffic generators should be placed near the main entrance/exit, while heavy pollutors leewards. Less mechanised processes can conveniently adjust to rolling topography.

However, zoning will almost inevitable clash with the objective of compact development at every phase of growth. Compact development at each phase minimizes the lengths of idle services.

The Planner should recognise this dilemma and attempt design solutions such that every phase of growth is relatively compact, while maintaining zoning to an acceptable degree.

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CHAPTER - 6 : COMMUNITY FACILITIES, INSTITUTIONAL AND AMENITY USES

6.0 GENERAL

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CHAPTER 6: COMMUNITY FACILITIES, INSTITUTIONAL AND AMENITY USES

6.0 GENERAL

Community facilities may be defined as basic services, other than purely fixed capital (i.e. infrastructure), provided to citizens collectively, at local scale. The individual beneficiary may be identifiable, (some community facilities can be run in the private sector virtually like commercial services), but usually the element of aggregate welfare is prominent. Participation is generally unrestricted and usually voluntary, though some communities may mandate use of educational or religious facilities.

Institutions may be defined as establishments or organisations for the promotion of some public objective, (O.E.D). The definition usually implies a building used for such purposes. There is a grey area of overlap with the concept of community facilities in so far as these are provided from specific buildings, but there is an obvious difference of scale. Community facilities are usually of local relevance while institutions tend to be established/patronized by higher levels of Government, can be involuntary and serve city-wide or regional catchments. Many important institutions tend to cluster in the city/town centre alongwith city-serving business establishments. (For the total area required by city centres, refer section 10.1.3).

Amenities are cinemas, theatres and hotels, etc., which though functionally commercial, in land use zoning are usually classed with institutional and community uses.

The planner is specifically interested in the sub-set of community, institutional, and amenity uses which are space consuming. Thus sub-set includes most forms of education and health-care delivery, other public services, facilities for performance of religious duties, recreational and incidental open spaces, and entertainments. Accordingly Table 6.0 lists the various facilities described in this chapter under the above section heads.

In the urban context, community facilities including open spaces should occupy between 12% to 20% of the areal extent of a neighbourhood or township. Additionally at city scale, around 3 to 5% of the built-up area is normally occupied by distinct zones for institutions and city parks.

In rural areas, the critical parameter is not the space but the locational requirements of community facilities. They need to be located in the centre of gravity or thickest cluster of rural population served. Many facilities cannot be provided to individual villages, but only become feasible for groups of villages. Being the focus of local life, they occupy prominent sites near the crossings of rural roads and tracks.

TABLE 6.0

LIST OF COMMUNITY FACILITIES, INSTITUTIONAL USES AND ALLIED COMMERCIAL SERVICES

No.	Sector	Community Facilities	Institutional Uses	Amenities
6.1	Education	Schools	Colleges/Technical and Professional Training Institutions, Universities.	Private Schools/Educational Institutions.
6.2	Health	Dispensaries, BHUs, RHCs	Hospitals	Private Hospitals/Clinic
6.3	Religion	Jumma/Mohalla Mosques Eid gahs,Mudrasas	Markazi Mosque, Large Mudrasas	
6.4	Open Spaces	Play Fields,Mohalla, Neighbourhood Community and City Parks.	Stadiums	
6.5	Public Services	Sub-Post Offices Public Call Offices, Local Libraries, Graveyards.	General/Head Post Offices Telephone Exchanges Fire Stations, Muncipal Secretariat, Town Hall, Courts, Libraries, Police Stations, Jails	Petrol Stations
6.6	Entertainments		Auditoriums	Hotels, Cinemas, Theatres.

6.1 EDUCATION

Education is the most vital investment for socio-economic advance. Its neglect can cost generations. No uneducated society has ever achieved the heights of economic and political power. No educated society has ever been left behind in the relentless march of history, (Sixth FYP).

6.1.1 Background

Nearly four decades after independence, Pakistan has a literacy rate around 26 per cent and just about half the primary school going age children are in schools. Literacy has increased at a distressingly low rate of around 0.5% per annum (1972-81). During the Fifth FYP, primary school enrolment increased only marginally, while the participation rate actually declined from 54% to 50%. By a massive effort, the Sixth FYP envisaged raising the primary school participation rate to 75%.

6.1.2 Hierarchies of Educational Facilities

Vertical and horizontal hierarchies are basic features in the delivery of formal education. In the vertical (aspatial) dimension, a pyramid may be visualised, its base comprising of many thousands of primary schools attended by millions of children of ages 5 to 9,while at the top are about 20 universities, providing specialized education to a few thousand post-graduates. The complement of this pyramid is a horizontal or spatial hierarchy. Primary schools are located in every mohalla/large village; secondary schools in neighbourhoods/clusters of villages/small towns; intermediate colleges in the larger tehsil towns; degree colleges in tehsil/district headquarters or sectors of major cities, while the specialised institutions are virtually limited to the metropolitan cities. A unit at each level is fed by a catchment comprising 3 - 7 facilities of the next lower level.

It is a rational evolution mediating between parameters of minimum **threshold** size for viable operations and acceptable **range** (distance) to each level of education facility. This hierarchical arrangement can be idealised using a model based on Central Place Theory. In actual practice, the "ideal" size-distance relationships are markedly affected by different participation rates, (between males/females, urban/rural populations, and regions), and very different population densities, (within and outside cities, between provinces). Lower participation rates mean fewer facilities are viable/needed for a given population, while low densities resulting in increased distance constraints may require compensation to some degree by opening smaller (below standard sized) facilities.* Finally in compact environment of large cities, to economise on valuable land, certain levels in the hierarchy are often merged, (e.g. intermediate and degree colleges). Relatively high participation rates and/or extensive catchments simultaneously result in large enrolments. In such situations, **minimum tolerable** space standards have to be determined on per student basis.

6.1.3 Implications of National Education Policy for Physical Planning

National Education Policy (NEP) is multi-faceted. Its components which have strong implications for allocational criteria and space standards are briefly summarised below:

i) A massive effort is envisaged to increase primary education. It is proposed to devolve the brunt of responsibility to local bodies, including transfer of control of existing Government primary schools.

ii) Government intends to gradually integrate education of classes XI and XII with

* Since low participation rates generally coincide with low densities (for example, Baluchistan), the dilemma can be quite acute. On the other hand, Azad Kashmir has quite successfully raised participation rates to overcome the threshold-range constraints.

secondary education and this process of restructuring will be completed by 1993. For this purpose, classes XI and XII will be added in high schools to meet additional demand, degree sections of over-crowded colleges shall be shifted to newly created facilities and the facilities of underutilized intermediate colleges will be used for classes IX and X.

It is therefore recommended that a detailed education facilities plan should be prepared for each city and town, (jointly by the concerned local body, PPH and Education Departments), in the framework of NEP, calibrated by existing facilities, population structure and its anticipated growth.

Similarly, District Councils should prepare, (in consultation with Education Departments), five-year plans for location and upgrading of rural schools, in the light of rationally delimited catchments, centrality measures, programmes in other sectors, (e.g. farm-to-market roads), and target participation rates.

The drawing up of such plans and associated capital investment programmes are complex tasks which can be expedited by the use of planning standards.

6.1.4 Scope and Limitations of Standards

Table 6.1 lists the allocational and distance criteria and space standards being provided for different categories of educational institutions. Standard sizes (range of enrolments) have been subsumed in the derivation of space requirements.

TABLE 6.1:LIST OF STANDARDS PROVIDED:

Sr. No.	Type of institution	Allocation	Distance	Space requirements
1.	Primary Schools	/	/	/
2.	Middle/High Schools	/	/	/
3.	Inter-Colleges/Classes XI-XII	/	/	/
4.	Degree Colleges	/	-	/
5.	Polytechnic Colleges	-	-	/
6.	Vocational Training Institutes	-	-	/

Distance criteria have not been provided for degree colleges, while neither distance nor allocational criteria have been laid down for polytechnics and vocational training institutes, because of variability and influence of other than general factors.

No common physical planning standards are prescribed for post-graduate colleges, medical and engineering colleges, universities, professional institutions, foundations, research academies as these are highly specialised facilities. Detailed feasibilities, specifying users, users requirements, streams of capital costs and social benefits are necessary in the planning of such facilities or their components.

6.1.5 Participation Rates

Table 6.2 gives the existing, planned and forecast school participation rates, (i.e. percentage of relevant cohort attending school), for the country as a whole, alongwith break-up by sex and urban/rural areas. It also gives the cohort size for the pertinent periods.

TABLE 6.2 : SCHOOL PARTICIPATION RATES (%)

Sr. No.	CLASS	Existing (1982-83) Males	Females	Total	Planned (1987-88)* Males	Females	Total	Forecast (2003) Males	Females	Total
1.	Primary Classes 1--V									
	COHORT SIZE	13.9 m (28% urban)			16.4*			21 m(43% urban) +		
	TOTAL	66	33	50	90	60	75	100	89	95
	URBAN	80	67	74	96	87.5	92	100	100	100
	RURAL	61	21	42	88	50	70	100	80	90
2.	Middle Classes VI–VIII									
	COHORT SIZE	6.5m			8.4m*			11.5+		
	TOTAL	35	14	26	44	19	33	71	34	53
	URBAN	64	39	52	71	45	59	90	60	76
	RURAL	24	4	15	34	8	22	56	14	36
3.	High Classes IX - X									
	COHORT SIZE	4.3m			5.6m*			7.7m+		
	TOTAL	21	8	15	26	12	20	45	24	35
	URBAN	49	27	39	52	36	45	61	48	55
	RURAL	10	1	6	16	2.5	10	33	6	20

* According to Sixth FYP.

\+ As per NHSPS forecast

Table 6.3 gives the existing participation rates for intermediate and degree colleges by province by sex. Urban/rural split of raw data is misleading because almost all colleges are located in urban areas, but most have substantial students from rural localities, either commuting daily or residing in hostels/privately arranged accommodation. Thus provincial participation rates are generally more appropriate, but may be doubled for colleges with an exclusive urban catchment and halved for those with almost entirely rural students. Again, during the currency of this Manual, college participation rates may double.

TABLE 6.3 COLLEGE PARTICIPATION RATES %(1984-85)*

PROVINCE	Intermediate (Classes XI-XII)		Degree College	
	Males	Females	Males	Females
Punjab**	9.8	4.7	2.8	1.8
Sind£	10.6	6.0	3.0	2.3
NWFP£	6.9	1.8	2.0	0.7
Baluchistan£	4.1	1.2	1.2	0.4

6.1.6 Physical Planning Standards for Educational Facilities

These comprise allocation criteria, (based on existing and forecast participation rates),

* Since other than 16-17 years olds and other than 18-19 years olds attend inter and degree colleges respectively, strictly speaking the participation rates are lower. However, their use for deriving allocation criteria on the basis of total populations is unbiased (i.e. the error is self-correcting).

** From actual enrolment data, Directorate of Public Instruction, (Colleges), Punjab, 1985.

£ Estimates.

standard plot size and variations thereto, (using standard and variable enrolments with respective covered/open area requirements), and distance-to-facility criteria, (based on population density and consideration of rural/urban traffic problems).

6.1.6.1 Allocation Criteria

Estimates of the total population number which allows feasible operation of a standard facility is a useful reference for preliminary planning. Logically, the estimate should be derived from data regarding the relevant cohort as % of total population and the existing ,and forecast participation rates of the cohort. Since both are variables, a range rather than single estimate emerges, when the scope is country-wide. These range of estimates can be further refined by using small, standard and large enrolment patterns apparent from raw data.

Table 6.4 gives the allocation criteria for facilities ranging from primary schools to degree colleges. The planner should use the figure most applicable to his local situation.

6.1.6.2 Standard Plot Sizes

Plot sizes for various educational facilities vary as a function of buildings and open areas required per unit group of students, the variable number of students,the variable number of student groups (enrolment) and the pressure on land, (land values, alternative uses etc.).

Appendix 6.1 provides calculations for covered and open area requirements at different levels of enrolment in educational institutions.The ranges so determined have been summarised in Table 6.5.

TABLE 6.4 : ALLOCATION CRITERIA

Sr. No.	Description of Facility	Variables	Total pop. of area served Present 1985–95	Total pop. of area served Future 1995–2005	Inferred Location Present 1985–95	Inferred Location Future 1995–2005
1.	2	3	4	5	6	7
1.	Two Section Primary School Standard Size.	Co-educational Boys Urban.	7,800	7,500	Mohalla	Mohalla
		Girls Urban	9,300	8,200	Mohalla	Mohalla
		Boys Rural	8,800	7,500	Large Village	Large Village
		Girls Rural	16,300	10,200	One per 2 large villages/Small Town	Large village
1.A	One Section Primary School in barani/low density rural areas.	Boys Rural	2,100	1,800	Nucleated village	Nucleated village
		Girls Rural	4,000	2,400	In larger of two nucleated villages	Nucleated village
2.	One Section Middle School (Classes I-VIII).	Boys Rural	6,400	3,900	Large village	Village
		Girls Rural	30,000	17,000	Town	Town
3.	Four/three Section Secondary School (Classes V-X)	Boys Urban	27,500	23,000	Neighbourhood	Neighbourhood
		Girls Urban	42,000	31,000	One per two neighbourhoods	Neighobourhood
3.A	One Section Secondary School (Classes I-X).	Boys Rural	25,600	12,400	Town	Cluster of large villages
		Girls Rural	1,77,000	74,000	Edge of city	Large town
4.	Intermediate College Classes XI-XII					
			* **	* **		
4.1	Primarily urban students over standard sized.	Males	300,000-900,000	170,000-440,000	Large City	Large City
		Females	425,000-2.2m	225,000-1.1m	Metropolitan City	Metropolitan City
4.2	Standard Size	Males	290,000-750,000	140,000-370,000	Large City	Intermediate City
		Females	350,000-1.8 m	170,000-900,000	Large City	Intermediate/Large City.
4.3	Primarily Rural Students Sub-Standard Size.	Males	260,000-500,000	130,000-260,000	Large Tehsil H.Q.	Tehsil Town
		Females	150,000-750,000	80,000-330,000	Large District H.Q.	Tehsil District H.Q.
4.4	Classes XI-XII in Schools	Males	61,000-160,000	30,000- 80,000	Centres of Excellence, Tehsil Towns,	Centres of Excellence, Tehsil Towns.
		Females	140,000-690,000	70,000-350,000	District H.Q.	District Town.
5.	Degree College					
			* **	* **		
5.1	Primarily Urban Students, Over-Standard Sized.	Males	0.75 – 2.0 m	0.4 – 1.0 m	Metropolitan City	Metropolitan City
		Females	1.25 – 7.0 m	0.75 – 3.5 m	Metropolitan City	Metropolitan City
5.2	Standard Sized	Males	0.55 – 1.3 m	0.27 – 0.65 m	Large City/Divisional H.Q.	Large City Divisional H.Q.
		Females	0.86 – 5 m	0.43 – 2.5 m	Large City/Divisional H.Q.	Large City Divisional H.Q.
5.3	Primarily rural students, Sub-Standard Sized	Males	0.4 – 0.95 m	0.2 – 0.5 m	Large City/District H.Q.	Intermediate City District H.Q.
		Females	0.5 – 1.4 m	0.25 – 0.7 m	Large City/Divisional H.Q.	Intermediate City District H.Q.

* Derived from participation rates of Sind

**Derived from participation rates of Baluchistan.

m = Millions

6.1

TABLE 6.5: RECOMMENDED PLOT SIZES FOR EDUCATIONAL INSTITUTIONS

Sr. No.	TYPE OF INSTITUTION	Site Area (hectares)	Minimum Tolerable Site Area/ Student in large cities (m^2)	
			Existing Built-up areas	New Schemes
1.	Two to Four-Section Primary School.	0.6 – 1.0	-	-
2.	Five plus-Section Primary School	-	7.5	10
3.	One-Section Primary School (Rural).	0.6	-	-
4.	One-Section Middle School (Rural).	0.8	-	-
5.	Secondary Schools:			
	5.1 Four/Three-Section (Urban).	1.5 – 2.1	-	-
	5.2 One-Section (Rural)	2.1	-	-
	5.3 Five/Six-Section (Large Urban).	-	10	15
6.	Intermediate College:			
	Males	3.5 - 4.0 – 4.5	7.5	19
	Females	2.3 – 3.0 – 3.5	6.0	13
7.	Degree College:			
	Males	4–7 – 8	7.5	19
	Females	3–3.5 – 5	6.0	13
8.	Polytechnic College	3–5	-	-
9.	Vocational Training Institutes.	3–5	-	-

Source . Appendix 6.1 & 6.2

In large cities, where the pressure on land is severe and enrolment may exceed normal limits, the minimum tolerable site area per student is required, both for planning new facilities and as a guide when to stop additional enrolment. Using the 75th percentile of existing highest student densities, the minimum tolerable site area per student in existing built-up areas has been determined. For new schemes in large cities, minimum area per student in facilities envisaged to get large enrolment, has been worked out envisaging a shift orientated system (Table 6.5).

The areas required by play/sports facilities have been duly considered in the framing of plot standards given in Table 6.5. As a further guide, (since the bulk of plot area is occupied by sports components), Appendix 6.2 gives typical configurations envisaged for congested and uncongested secondary schools and colleges, using different combinations of playfields, (e.g. hockey, football) of standard sizes given in Section 6.4 on recreational facilities.

6.1.6.3 Distance Criteria

An idea of maximum tolerable distance of each type to educational facilities is important for physical planning. Given threshold-size constraints, it has to be ensured that the facility is within reachable distance of the maximum proportion of population. However, population densities vary markedly between and outside cities and between provinces.

Low density urban areas contain 7000 persons per sq.km. In irrigated rural districts, density declines to around 300 p/sq. km. At the other extreme, densities may be less than 10 p/sq. km. in Baluchistan and other arid areas. Consequently, the distance criteria has to vary.

In urban areas because of huge traffic flows, the distances which a small child can walk are very limited. Consequently, a primary school should be available within a convenient walking distance,preferably within the mohalla. High densities and high participation rates usually allow siting of primary schools within each urban mohalla. Less traffic hazards in rural areas permit children to travel greater distances to obtain primary education. In extreme low density situations, it is necessary to reduce the sizes of educational facilities to allow viable operations within convenient distances to users.

Using these parameters, distance criteria for educational facilities have been given in Table 6.6. The recommended radii for girls facilities has to be larger than for boys owing to lower participation rates, whereas per social norms, it should be reverse. This suggests co-education institutions may be considered, at least at the primary school level.

TABLE 6.6: RECOMMENDED RADII FOR 90% CATCHMENT AND MAXIMUM TOLERABLE DISTANCE FOR FARTHEST STUDENTS (KMS):

Sr. No.	LEVEL	URBAN Recommen-ded Radii	URBAN Maximum Toler-able	RURAL Recommen-ded Radii*	RURAL Maximum Tolera-able.*
1.	Primary Class I-V	0.5	1.00	2.20	Present=6.00 Target =4.00
2.	Secondary School Class VI-X	1.25	2.45	5.00	15.00
3.	Inter College Class XI-XII	2.75(B) 3.25(G)	4.00(B) 5.00(G)	10.00 -	25.00 -

* Multiply by 2 for Cholistan, Sind Arid Zones. Baluchistan, Northern Areas and Chitral. Higher participation rates in Azad Kashmir allow use of distance criteria given in Table.

- Urban Standards based on standard sized facilities in low density residential neighbourhood for schools and in low gross densities sectors for colleges. Existing posh very low density communities e.g. E+F Sectors, Islamabad; Defence Officers Housing Society, Karachi; Gulberg, Lahore excluded, because of high private car ownership which allows commuting.

- Rural Standards based on population densities in less dense districts of Punjab excluding Cholistan, Sind excluding Arid Zones, and NWFP excluding Chitral.

6.1.7 Guidelines

Primary and secondary schools have common and widely replicable features, which allow framing of general guidelines. These encompass typical layouts, factors to be considered in siting, as well as conditions for satisfactory access and parking.

6.1.7.1 Typical Layouts

Square or rectangular sites are preferred. A typical arrangement of buildings and facilities is as follows:

i) Setback at front for parking.

ii) Administration block at the side of school buildings, accessible to but separate from classrooms.

iii) Classrooms - arranged around a small courtyard and orientated north/south to reduce solar gain.

iv) Playground - as large as possible and behind main buildings.

v) Other elements such as staff housing, etc., are usually located away from the main complex.

vi) Unless site is small, all the buildings may be single storey.

6.1.7.2 Siting

School facilities are usually space extensive, owing to the need for play fields. As such, it is important that sites chosen should be as flat as possible.

Detailed siting considerations are different in urban areas from rural areas and the two are described below separately.

6.1.7.2.1 Urban Areas

School sites should be located:

i) Close to the existing or planned housing areas they will be serving. The entrance to the primary schools in particular should be within easy walking distance of houses and generally located centrally within a residential mohalla, away from busy roads and noxious, or dangerous construction and work plant.

ii) Primary Schools should be served by pedestrian routes which do not involve crossing major roads.

iii) Secondary Schools should have good access by car and safe access by foot. They should not be located adjacent to:

a) Schools for opposite sex;

b) Major busy roads carrying fast traffic; and

c) Noxious or dangerous sites, such as industrial areas, machinery plant, contractor's work plant.

Schools which cannot provide adequate sports or play facilities because they have had to be sited on a plot considerably smaller than the recommended, should be located close to community sports and recreational facilities.

In addition and where possible, schools should be located:

i) close to community facilities such as clinics, mosques and public open space; and

ii) close to public transport routes.

6.1.7.2.2 Rural Areas

Schools in rural areas will be widely dispersed and have very extensive catchment areas. Locations within walking distance of housing areas are therefore, not a practical possibility. Many students will only be able to get to school by bus or cycle. Good road access is very important.

At the same time, the existing and proposed road networks will not constrain siting for safety reasons as much as in urban areas. Rural roads are not likely to carry very much traffic and only highways present a significant hazard.

As well as providing good access by road, a location bounded by a local road has the advantage of giving a clear definition to the road alignment and the edge of the road reservation in the form of the plot's boundary wall or fence.. This is particularly important where the road is still a poorly defined track or where a new road is being proposed.

Locating schools directly next to other community facilities may create difficulties. Because the plot sizes are likely to be larger, than in urban areas, a school sited centrally within a village may use up most of the surplus land available and prevent other community facilities from being sensibly located. Where schools can be sited near to existing or planned facilities (such as shop, mosque or football pitch) care must be taken to avoid the school becoming a major barrier to access for people wishing to get to these facilities.

Schools sites in rural areas should therefore be located:

i) away from dangerous/unpleasant sites;

ii) not adjacent to the schools for opposite sex;

iii) with good road links to their catchment area;

iv) not adjacent to a highway.

v) with a boundary along an important local road;

vi) where their facilities may benefit the local community without obstructing movement to shops, clinics, mosques or other community facilities.

6.1.7.3 Access:

6.1.7.3.1 Access to School Sites

All school sites must be accessible by vehicles from at least one side. There must be access to all buildings on the site for emergency services with minimum wayleaves of 6 m.

Where possible an alternate access point for vehicles should be provided apart from the main entrance, particularly as possible school extensions behind the main buildings will require contractor's plant and equipment to get onto the site safely and with minimum disturbance. Ideally the play area should be accessible to maintenance lorries. Schools occupying corner sites must not impair.visibility at junctions.

6.1.7.3.2 Access to Staff Housing:

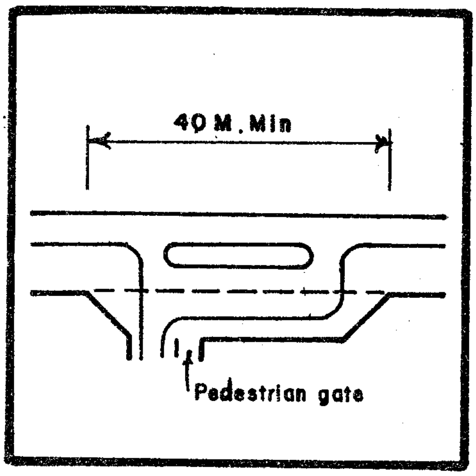
Any staff housing being provided for a school, but away from the main school buildings, should have a separate access. This can be achieved by siting the housing on a separate but adjacent plot with its own access, or by siting it within the plot along a back or side boundary from which separate access would be provided.

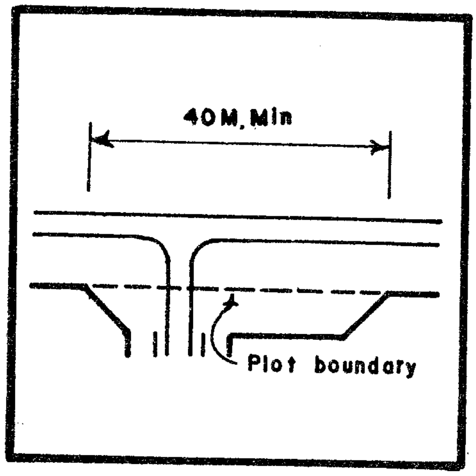
6.1.7.3.3 Design of Access Points

All access should be properly designed and at least the same standard as the road from which access is being gained.

The area outside the main entrance of a school will be used for setting down and collecting students by car or bus and as a meeting place for students and parents and it will attract other activities such as selling of food, soft drinks, ice creams, etc. It is important that these various activites do not occur within the road reservation where they would obstruct traffic and endanger people. The main entrance to a school and the wall or fence to either side must be set back sufficiently within the plot to enable these activities to take place away from the road side.

Fig. 6.1 Design of Main Entrance/
Collection Point:





6.1.7.4 Car Parking and Servicing

Car parking for teachers (inside school plot) and visitors (outside the plot) should be provided. A reasonable guideline for the number of parking spaces to be provided would be 1 car space per class room inside the plot (i.e. one car space per teacher).

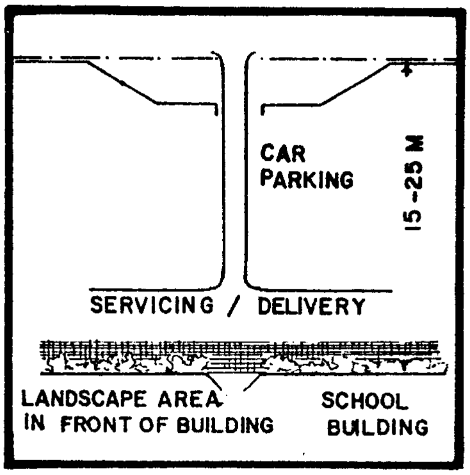
Visitor parking, being occasional and of shorter duration, may be provided @ one car space per 3 classrooms.

This level of provision may not be required immediately in urban areas and for the considerable future in rural areas. Nevertheless, sufficient space in front of the main buildings should be left in order to maintain flexibility.

In addition to car parking, space is required for vehicles to deliver and set down school supplies, etc., near the main doors to the school building. School buildings must therefore be setback sufficiently to accommodate car parking and servicing within the plot.

A setback from the plot boundary of 15m for primary school building (on 0.6 hectare plot) and 20-25 m for secondary school building (on 1.5 hectare plot), would provide adequate space for a car park, serving area, a footpath and landscaping area immediately in front of the school buildings.

Fig. 6.2 Setback from School plot line:



6.2 HEALTH

Rapid population growth has exerted severe pressure on health services and facilities. Available facilities are insufficient and improperly distributed. The country as a whole has 0.56 beds per thousand persons, as opposed to 7.14 and 10.48 beds/1000 in U.K. and U.S.A. in 1960, respectively. This is not merely a function of levels of development. Even as far back as 1909, the U.S.A. had 4.5 beds/1000 persons, i.e. 8 times the provision in Pakistan today.

Ignorance of personal hygiene, over-crowding, improper community sanitation, impure water supply, and deficient systems for refuse disposal have caused high morbidity and mortality rates in the country. Given the high unit cost of curative treatment,and the scarcity of resources, the emphasis of national health policies is on preventive medicine emphasizing community and personal hygiene.

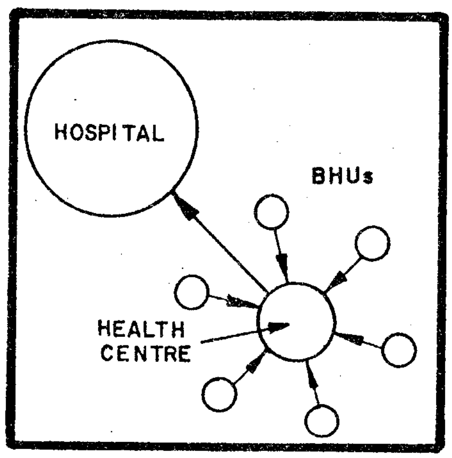
Concepts of scale and specialisation, related to the frequency and severity of diseases, dictate that health facilities of different orders be provided according to the distribution of population in the country.

6.2.1 Hierarchy of Facilities

There is a general hierarchy of health care facilities throughout the country at the moment. It is not comprehensive and most rural areas rely heavily on the big cities for general as well as specialist cover. However, national health policies envisage a change from this centralised system to one based upon regions.

The lowest level facility envisaged is the Basic Health Unit (BHU). Existing dispensaries and MCH Centres will be upgraded to BHUs. Depending on the terrain and communications, 5 to 10 BHUs will be linked to a rural health centre (RHC). The main activities of BHUs and RHCs will be to provide poly-immunization, diarrhoea control, traditional birth attendants training, malaria and tuberculosis control services. The Rural Health Centre is sometimes considered as a small hospital rather than field clinic. It refers difficult cases to the Tehsil or District Hospital. In large urban centres, it is usually by-passed in the steps of the hierarchy by Poly-Clinic or General Hospital..

Fig. 6.3 : Hierarchy of Health Institutions:



6.2.2 Standards

The long term national goal is 5 hospital beds per thousand population. Owing to scarcity of resources, the Sixth FYP target was only 0.63 beds/1000. Apart from a few well provided urban places, the medium term feasible target may be taken as 2 beds/1000 population. A general guide to the provision of facilities is in Table 6.7.

The standards relate the geographical distribution of facilities and plot sizes to population/administrative units. Higher incidence of certain diseases in specific regions/localities may indicate a different distribution and introduction of specialities at lower level. In

TABLE 6.7: STANDARDS FOR HEALTH FACILITIES

Sr. No.	TYPE	Function*	Facilities	ALLOCATION CRITERIA B.M. (1983)	Sixth FYP objective	Medium Term	Covered Area**	Site Area
1.	Dispensary (Urban)	First aid	Dispenser	-	One per large school/factory	-	2 rooms/ W.C. in Premises.	
2.	BHU	EPI/ORS TBA training, MC/TC	1 doctor 2-3 paramedics	12,943	10,000	5,000	$200m^2$ +doctors' residence	1250-2500 m^2
3.	RHC	– do –	3 doctors (1 female) 1 dentist	246,059	73,000	50,000		0.6 hectares
3-A	Rural/ Community Hospital/ Polyclinic	Laboratory X-Ray Minor Surgery	Upto 25 beds		(upgrading of S.No. 3)		$650m^2$ + 3 doctors residences	1 hectare
4.	Tehsil/Taluka Hospital	3 basic specialities/ dentistry.	60 beds	-	One per tehsil		$3600m^2$ + residences	2 hectares
5.	District HQ Hospital	All medical facilities/ 6-10 specialities	100-250 beds	-	One per district		8400-9700m^2 +residences	5-8 hectres
6.	General Hospital	All medical facilities/ 5-10 specialities	100-250 beds	-	In large cities in addition to DHQ Hospital (but not handling medico-legal cases)			3–7 hectares
7.	Teaching Hospitals	All specialities	500-1000 beds	-	On provincial/regional basis.		-	20-40 hectares
8.	Specialised Hospitals (e.g. Mental Hospitals, T.B. Sanitoriums).			-	In metropolitan cities/ hill stations.		-	55-75 m^2 /bed.

* From Sixth FYP.

** Adapted from Cento Seminar on Hospital Administration (1973). For details of covered area, refer Appendix 6.3.

sparsely populated areas, smaller facilities may be provided. Other areas with good climate are receipients of TB Sanitoriums, etc. In upper income communities in large urban centres, private clinics will take some load and reduce need for public provision.

The plot sizes include an allowance for housing 25% of medical staff in urban areas and 45% of staff in rural areas. In special cases extra land requirements may be discussed in detail with the Health Department, (Health Ministry in Federally controlled areas).

6.2.3 Guidelines

6.2.3.1 Location and Siting

There are three main criteria for assessing the quality of a potential site:

a) Convenience for users is essential since the primary aim of the Basic Health Unit is preventive health care. This requires easy access for local people to encourage and facilitate frequent use. To achieve this the following are required:

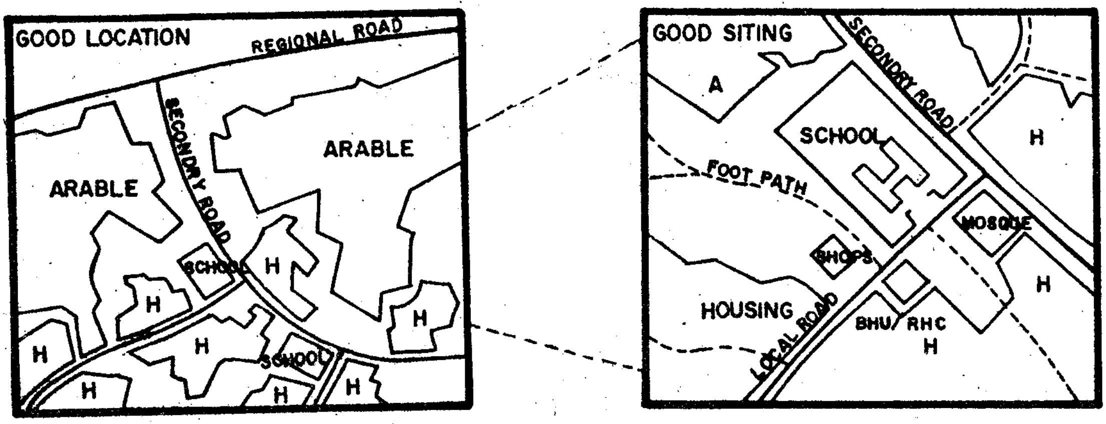
i) Short walking distance from houses being served.

ii) Preferably a location on route or adjacent to other facilities.

iii) The proximity of public transport.

iv) Reasonable car access and parking.

Fig. 6.4 One possible arrangement of Community facilities in a small town/large village.



b) Co-ordination with other emergency services is crucial for a comprehensive, efficient service. At the very least, a Hospital should be in telephonic communication with police, ambulance and fire services. (In rural areas this may well be difficult to achieve and these facilities may need to be located close together to make easy coordination possible).

c) There are a number of special site conditions required for health facility sites. These are:

i) Good cross ventilation by prevailing wind.

ii) No environmental pollution such as noise, dust or smells e.g. not next to heavily used road or a fish market.

iii) Pleasant surroundings e.g. trees, plants, etc., especially where recuperative patients are being cared for.

6.2.3.2. Ambulance Services

i) It is expected that these will be focussed on District/General Hospital upwards in the hierarchy.

ii) Adequate parking near emergency wards/cardiology units should be ensured. Access should be separate from the main public entrance.

6.3 RELIGION

6.3.1 Mosques

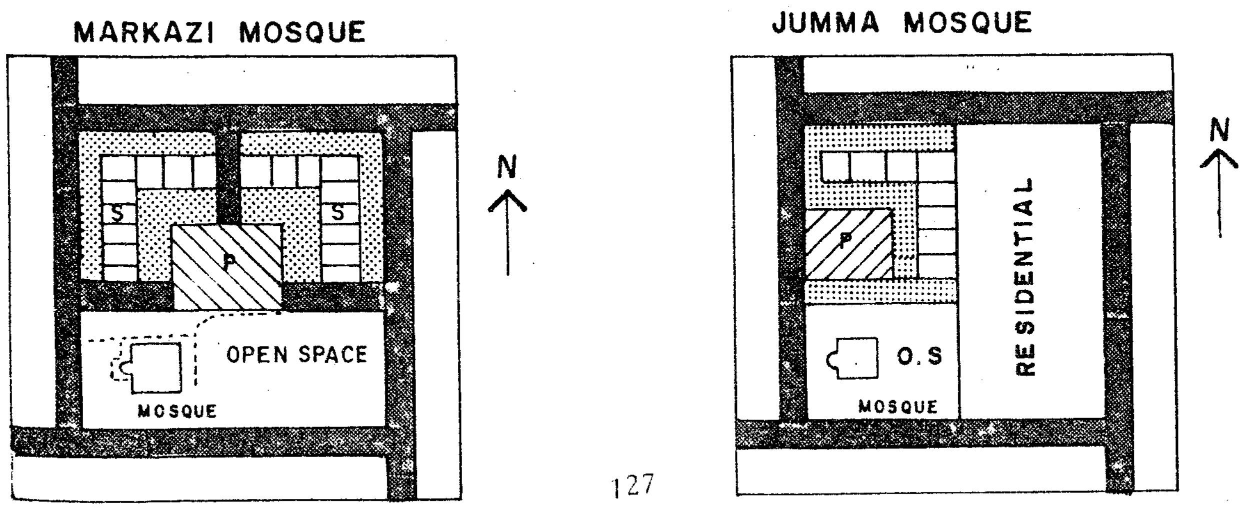
Mosques are a major component of the community facilities available at local neighbourhood level. Socially they perform wider function than simply accomodating religious services. They are a focal point for a community and as such their location and provision must be considered carefully in order to achieve a well-ordered and convenient arrangement.

Religious shrines and other endowed properties are administered by the Auqaf Department. The Auqaf Department, therefore, should be consulted at an early stage in the plan-making process for an area near a shrine. Other mosques may be sponsored by local governments/administrations, but in many cases private individual/institutions have the de facto responsibility.

6.3.1.1 Standards

i) A Markazi Mosque should be provided per 100,000 population with a plot area of 3500 sq metres to 3800 sq. metres, (calculations in Appendix 6.4). Such a mosque must be located adjacent to a park or public open space to cater for Eid overflow. Ideally, Markazi Mosque should be located in the centre of its catchment area.

Fig 6.5 : Typical Siting Arrangements for Mosques:



ii) One Jumma Mosque should be provided neighbourhood level for 25,000 persons on a plot measuring 1800 to 2000 square metres (Appendix 6.4). It should be located adjacent to an open area so that large Friday gatherings can be accommodated.

iii) A Mohallah Mosque for 5,000 to 6,000 persons on a plot measuring 600-700 sq. metres is recommended (Appendix 6.4) adjacent to open space.

6.3.1.2 **Guidelines**

i) The location of a Mohallah Mosque must always be within the local community it serves, since it provides that community with an essential social focus. Its position should be considered in relationship to other community facilities, especially schools and shops and the main circulation patterns within the area.

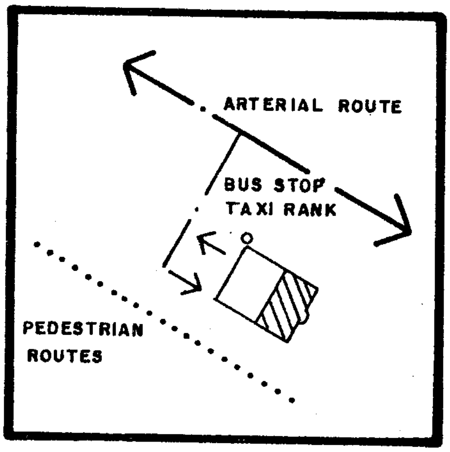
ii) In an urban area, the farthest distance, a resident has to travel to a Mohalla mosque should not exceed 500 m.

iii) Vehicular traffic because of Markazi/Jumma Mosque is greatly increased due to the extent of the catchment area and therefore it is important that good vehicular access and space for parking exist. A public transport lay-by and taxi rank should be incorporated into the site plan.

iv) No cinema/theatre is permitted within 200 m of a mosque.

v) The orientation of the plot for a mosque should be in consonance with Kibla (west-ward) to avoid waste of space viz-a-viz the mosque building.

Fig. 6.6: Relative Location of Markazi/ Jumma Mosque:



6.3.2 Eidgah

Eidgahs are levelled open spaces, provided at prominent locations at town scale or community scale in large city, to accommodate huge congregations which assemble twice a year for Eids. During the balance of the year, it is permissible to use the site as play ground or community open space, provided no permanent fixtures are installed, demarcations made or ground unlevelled.

Depending upon town/community size, a gross space provision ranging from 0.5 to 1 hectare may be considered. Alternatively, a levelled portion of a community park (Table 6.10) may serve the purpose.

6.3.3 Mudrasas

Mudrasas are required to impart religious education. Mudrasas have a 3-tier hierarchical system viz., small (Mohallah) mudrasa, average (community) mudrasa and large mudrasa. The gross space requirements for different categories of mudrasas are given in Table 6.8.

TABLE 6.8:SPACE REQUIREMENTS FOR MUDRASAS

Category of mudrasas	Space requirements (sq.m/ Student)	Total Area Required (sq.m)
Small (for 30 students)	21	637
Average (for 60 students)	131	7856
Large (for 200 students)	42	8401

The basis for the above space standards are given in Appendix 6.5.

Unlike the general educational institutions, no allocational criteria can be fixed, specially for large mudrasas. The catchment does not depend upon population or distance involved, but the fame of the teacher(s).

6.4 OPEN SPACES

6.4.1 Introduction

Open spaces in urban areas may be planned or incidental (i.e. reserved, unutilized or unutilizable land). Planned open spaces are generally associated with outdoor recreation. They may be sub-categorised into stadiums and playfields, designed for active recreation, (i.e. formal and informal games), while parks, zoos, etc., are meant for relaxation, sight-seeing etc., i.e. passive recreation.

Incidental open spaces have significance as land reserve to introduce relief from what might otherwise become uninterrupted development. They may also afford opportunity for recreation, such as hill-walking and tan-rides on canal paths.

In large urban centres, disappearance of incidental open spaces and non-provision of planned open spaces is seen as a major problem. Building densities in large cities are generally high and the fringe of built-up area is farther from the average resident, intensifying the need for within-city outdoor recreation. Simultaneously the pressure on land, (as reflected in land values), is greater. Thus urban planning agencies have to stress the need for reserving open spaces against many competing demands for land.

This Section deals with open spaces designated for recreational purposes while Chapter 9 provides guidelines for reserved, protected and unutilizable land. However, the linkage, (the lesser the incidental open space, the greater the demand for planned open spaces), should be kept in mind.

6.4.2 Parameters Controlling Recreational Space Standards

Recreational space standards vary from country to country depending on the type of habitat, and the overall demand and pattern of usage. The controlling factors are population size and density, climate and cultural habits. As such, internationally applicable standards cannot be fixed.

i) Population size and density:

These parameters cut both ways, i.e. determining the aggregate demand as well as the possible supply of open space. For rural areas, supply of recreational open space poses no problem. However, open spaces become increasingly difficult to provide as the city size increases,particularly in densely built-up areas. On the other hand, increasing size means the country-side is farther away. Higher densities imply that incidental open spaces are minimal. On both counts, the demand for recreational open spaces is most intensified precisely where it is most difficult to meet.

ii) Climate:

In sub-tropical countries, owing to hot weather, open spaces are intensively used for short periods of the day (early mornings and evenings) for organised sports. During the same hours, open spaces are used by the elderly for walking and resting. (Therefore, open spaces should be well shaded in general, with distinctly marked play fields).

iii) Cultural Habits:

Propensities for recreational walking, jogging and outdoor sightseeing can be assumed to be common over large groups. On the other hand, the demand for active recreational facilities is very much a function of social preferences. Among the space extensive games, hockey and cricket are the preferred ones in the urban areas of Punjab and Sind, while football is popular in Baluchistan.

6.4.3 Standards

Various standards have been advocated from time to time. One traditional rule was to reserve 10% of gross area for Parks and Playgrounds. This standard has been abandoned as it is not rational. As noted above, space for recreational facilities has to be linked to demand in a much more organic manner. Another traditional rule (inherited from British textbooks), was to allow 6 acres per 1000 persons. This is excessive. At a gross urban area densities around 30 persons/acre (which are common in the cities of the country), it implies 18% of land should be reserved for planned open spaces; at 20 p.p.a, it implies 12%. Furthermore,the simple linear relationship with density implies high-rise accommodation at moderate to high densities, foreclosing the option of mohalla-type residential communities more suited to our inland climatic conditions.

As such, there is no recourse but to build-up recreational space standards from the size elements of facilities in relation to their specific demand (popularity) and threshold populations for feasible operation.

6.4.3.1. Standards for Active Recreational Facilities

Active recreation comprises formal and informal, outdoor and indoor games. The physical planner is specifically interested in the sub-set of games which are space-extensive.

6.4.3.1.1 Standard Playfield Sizes

Standard playfield sizes of common outdoor games along with necessary run-ons are given in Table 6.9. These have been established by the international federations of these games. Sub-standard sizes may be considered for cricket and football where the games are limited to pre-teen and early-teen age groups.

TABLE 6.9: STANDARD PLAYFIELD SIZES(m)

Sr. No.	Game	Playing Area	Minimum Run-on
1.	Cricket		
	i) Pitch	20 x 5	-
	ii)Outfield	46 m from edge of pitch	
2.	Football	105 x 68	109 x 70
3.	Hockey	91 x 55	99 x 59
4.	Tennis	23.77 x10.97	36.5x18.29
5.	Volleyball	18 x 9	24 x 13
6.	Basketball	26 x 14	30 x 18
7.	Badminton	13.41 x 6.10	16 x 8

Source : John & Heard, Handbook of Sports and Recreational Building Design, Vol 4, London, 1981.

In addition, golf and polo are games patronised by the rich and influential. Both require substantial area, but space standards are not rigid. The guidelines in Table 6.10 may be used:

TABLE 6.10: GUIDELINES FOR GOLF COURSE & POLO FIELD SIZES.

Golf	Minimum area required	Area required for better golf course
9 holes	20 ha (50 acres)	32.5 ha (80 acres)
18 holes	45 ha (110 acres)	65 ha(160 acres)
Polo		
Plain Area	275x183(900'x600') =	5 ha (12.4 acres)
Mountainous Area	275x146m (900'x480') =	4 ha(10 acres)

Source: Adopted from Dechiara & Koppelman,1975

6.4.3.1.2 **Allocation Criteria and Plot Sizes**

The more capital intensive the facility, the larger the catchment required for its viable operations. Table 6.11 gives the range of stadiums and playgrounds alongwith their site sizes recommended to be provided at various levels of urban hierarchy.

Polo, golf and race courses catering to motorised clientele should be located outside the urban fringe.

6.4.3.2 **Passive Recreation Standards**

Surveys conducted for a number of master plans in the country reveal that in a reference week, the number of visitors to open spaces for passive recreation are typically 4 to 5 times the number participating in outdoor sports (e.g. Master Plan for Greater Lahore, 1973, page 48).

Furthermore, as residential plots become smaller and a larger share of urban population moves into apartments/flats, there will be much more need for tot-lots and mohalla open spaces than heretofore.

However, there are no fixed sizes for elements of passive recreation. Allocation and space criteria need to be flexible, leaving room for judgement based on local factors, (specifically the extent of pleasant incidental open spaces within easy accessibility).

Proto-type sizes may be built-up a starting from the smallest, most widely distributed facility and cross checked with percentage land utilized each level of urban space. A tot-lot containing swings, see saws and slide can be as small as 250 sq.m. but to function effectively in providing relief from oppressive weather, it should be part of mohalla open space. The desirable average size for mohalla open spaces is 4000 sq.m. (one acre). Furthermore, they should be located within convenient walking distance of small children (<200 m).This implies 3 mohalla open spaces in moderately dense residential zones (160 person/ha) increasing to 8 open spaces in low density zones (70 persons/ha.)

A neighbourhood park should allow brisk walking/jogging for periods extending upto two hours. Thus 3.25-4 hectares (8-10 acres) appears to be a reasonable size.

Allocation of the above spaces at mohalla and neighbourhood level, along with the active recreation spaces given on Table 6.11, result in utilizlation of 5% of gross neighbourhood area at moderate densities (upto 80 p/ha) and 7.5% at higher densities (upto 160 persons/ha).

In addition to facilities at mohalla and neighbourhood level, Community Parks should provide picnic facilities to cater for weekend visitors. Therefore while site area needs to be just somewhat larger than the neighbourhood park, it would be a much more capital intensive facility.

Standards for higher level, specialized facilities at city and metropolitan levels have been taken from actual examples in the country treated as prototypes.

The information is consolidated in the form of Table 6.12.

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TABLE 6.11 : ACTIVE RECREATION STANDARDS

Sr:No.		Stadiums and Playgrounds
1. Metropolitan City Stadiums	i)	For city above 2 million population, provide cricket (2.5 ha), multiple hockey (2.8 ha) and, if popular, football (1.5 ha) stadiums or a stadium complex encompassing above games plus other less extensive games (indoor & outdoor).
	ii)	Outside the stadiums, provide parking space to meet the full ultimate capacity (assuming 4 persons per car & 50 persons/bus) @ 24.89 sq.m/car and 98 sq.m/bus (Example, stadium capacity = 30,000 people,= 5000 cars + 200 buses = 14 hectares parking area.
2. City Stadiums	i)	For cities above 300,000 population provide cricket stadium of 2 ha. bounded area. Temporary stands will be converted to perament stands over the course of time.
	ii)	For cities above 200,000 population provide hockey stadium of 1.15 ha. bounded area.
	iii)	In cities, where football is popular provide football stadium of 1.4 ha. bounded area.
	iv)	Provide parking spaces outside stadiums @ 24.89 sq.m./car and 98 sq.m/bus, anticipating full ultimate stadium capacity. (Example,ultimate stadium capacity = 7000 persons = 500 cars + 100 buses = 2.22 ha. parking area).
3. Community Level Playgrounds	i)	For communities of around 100,000 persons provide a combined playfield of 2.14 ha. comprising standard hockey and football grounds, alternating as standard cricket ground.
	ii)	Provide simple washroom/water closet if a sports club will take responsibility for maintenance.
4. Neighbourhood Level Play-grounds.	i)	For neighbourhoods of around 25,000 persons, provide a combined playfield on 1.63 ha. comprising sub-standard sized cricket, hockey cum football ground basically for teenagers.
	ii)	The playfield should have temporary/multiple markings so that it can be used for different games, including Kabbadi.

Source: Space Standards from Appendix 6.2 plus parking standards.

TABLE 6.12 PASSIVE RECREATION STANDARDS

Sr. No.	TYPE	Description	Allocation Criteria (pop.)	Total Area (ha)	Hectares/1000 pop. served.
1.	Metropolitan City Park	A specialized facility containing zoo & botanical gardens	2 million	50 - 70	0.025 - 0.035
2.	City Park	Wide range of amusement facilities, fountains, lakes, landscaping, etc.	400,000	12 - 15	0.03 - 0.037
3.	Community Park	Selected amusement facilities, paved walks, tree plantation.	100,000	4 - 5	0.04 - 0.05
4.	Neighbourhood Park. *	Wide range of child play fixtures, walking & jogging paths.	25,000	3.25 - 4	0.13 - 0.16
5.	Mohalla Parks (3-8 per mohalla, av. size 0.45 ha. each)**	Tot-lots with slides, swings, seesaws; other spaces with some turfing.	6,250	1.6 - 3.6	0.26 - 0.58
			Total:		0.485 - 0.862

* Excessive in case of hill stations and other urban localities with pleasant incidental open spaces within convenient access.

** This provision would be excessive in existing posh residential colonies where plot sizes exceed 420 m^2 and children can play inside compound.

6.5 PUBLIC SERVICES

Public services, (other than education and health-care), may be defined as comprising postal, telecommunication, fire protection, administrative, municipal, judicial, policing, detention, and burial services.

Part of these functions are of community scale, while others are instituted by higher levels of government. Some of the institutions occupy prominent sites on the Town Centre, whereas others are logically located outside the urban fringe.

This section provides standards for postal, telecommunications and fire protection services. Administrative functions are performed out of secretariats and offices (Section 5.2). However municipal secretariat/town hall require additional area for ceremonial occasions and therefore specific standards are provided. (For municipal field services i.e. dry garbage collection - refer Section 8.4). Similarly, higher judicial courts are special facilities which occupy prominent space in the Town Centre, while lower courts are accommodated in the provision for secretariat complex made in Table 5.4 for Divisional, District and Tehsil Headquarters. On the other hand, police secretariat is part of the administrative headquarters complex, but allocation and space criteria are provided for field functions, such as police stations and posts, where required to be independently sited. Criteria for jails are also required because they are a space extensive facility to be located outside the urban fringe. Finally, provisions have to be made for graveyards.

A petrol station is an amenity whose location and siting require careful consideration.

6.5.1 Post Offices

There is a well established hierarchy for articulation of the postal system. With increase in literacy and use of postal facilities, the network will have to be upgraded. Table 6.13 gives existing type of facilities and their functions, alongwith proposed allocation criteria and associated covered and site area needs. The system of house-to-house delivery is likely to continue. Should this be replaced by P.O. Box System at some stage, more floor area will be required in all categories of post offices and their density would need to be increased, requiring reconsideration of the standards given in Table 6.13.

6.5.2 Telephone Exchange and Telegraph Offices

In 1984, there were 0.4 million working connections in the country, i.e., one telephone for 230 persons. Maximum density was achieved in Islmabad with one telephone for 18 persons, while Karachi and Lahore had one telephone for 50 persons. These densities may be taken as the model for future needs in urban areas.

Exchanges installed in the country range from 25-50 lines manually operated/CB type in tehsil towns, housed in one room, to automatic/electronic switching systems in airconditioned environment with 10,000 lines capacity, requiring minimum 0.2 hectare site. Furthermore for large Exchanges, the T&T Department has requirements for :

i) Clearance from grid stations and other sources of electromagnetic fields;

ii) For security parameter; and

iii) Space for future extension

iv) To minimise network length, location in the density centre of development.

Telegraph Offices should be located in the same/adjacent compound as Telephone Exchanges, with the proviso that Telegraph Offices and Public Call Offices may be additionally provided in lower income

TABLE 6.13 EXISTING AND PROPOSED HIERARCHY OF THE POSTAL SYSTEM

	Facility	Existing Criteria	Functions	Proposed Allocation Criteria.	Covered Area	Site Area
1.	General Post Office (GPO)	Metropolitan Cities/ Provincial Capitals.	Regional Sorting Foreign mail Customs, Postal Insurance, Licence Vending, Dead Letter Office, Philately, Stamp Vending.	Provincial Capitals/Cities above one million population.	Variable as per workload.	2 hectares
2.	Head Post Office:					
i)	Higher Selection Grade– A.	Important Cities/ Divisional HQs.	Regional Sorting Postal Insurance Licence Vending	Important Cities/ Divisional HQs.	– do –	0.5 hectares
ii)	Higher Selection Grade–B.	District HQs.	Dead Letter Office Stamp Vending	District HQs.	– do –	0.25 hectares
3.	Sub-Post Office:					
i)	Higher Selection Grade	Tehsil HQ/Important Cities of tehsil/Communities in cities	Local collection Local sorting Licence Vending Stamp Vending.	Tehsil HQ/Important Cities of Tehsil/ Communities in large cities.	150-200 m^2	1000 m^2
ii)	Lower Selection Grade	Smaller Tehsil HQ.	– do –	Small towns/1 in 2 urban neighbourhoods (i.e. 50,000 population).	100-150 m^2	568-663 m^2
iii)	Time Scale Post Office	Small towns/large villages/neighbourhoods in large cities.	– do –	Large village	One/two rooms	

Source: Discussion, Deputy Director Works and Engineering, PMG's Office, Lahore, 1986.

communities with lesser telephone facilities. Extra departmental public call offices and phone booths should be provided in commercial centres and other places of public gathering.

Thus the Department should be consulted prior to earmarking sites for Telephone Exchanges. For preliminary planning, the following parameters are recommended:

TABLE : 6.14 TELEPHONE STANDARDS

Category	Pop. or Admin. Status	No.of Exch-anges	Capacity	Type	Plot Size
Small Town	25,00-50,000 or Tehsil Head-quarters	1	250-500	CBS	One room/ Compound.
Intermediate Town	50,000-200,000 or Distt.Head-quarters	1	500-3000	Auto	500-1000 sq.m.
Large Cities: a) Central Business District.	50,000 (day time)	1	6500	Elec-tronic	2000 sq.m
b) High Income Communi-ties.	100,000 i.e.4 neighbour-hoods	1	6500	-do-	3000 sq.m
c) Middle-low income communities	150,000-250,000 i.e. 6-10 neigh-bourhoods.	1	5000	Auto	3000 sq.m

Source: Discussions, office of Director General, T&T, Deptt. Islamabad, 1984.

6.5.3 Fire Stations

One fire station for every 100,000 urban population with a site area of 2025 sq. metres is recommended. In addition, Local Government Acts require that every Municipal and Town Committee should maintain a fire brigade. Given economic limitations, the provisions in Table 6.15 may be considered:

TABLE 6.15:FIRE PROTECTION SERVICES IN SMALL SETTLEMENTS

Settlement Class	Equipment	Location	Water Source
Town Committee with 5000 - 25,000	One tanker with pump	Shed near Town Committee Office	Local Pond/ Tubewell
Municipal Committee with 25,000 - 75,000 population	One Fire Engine	Garage near Municipal Committee Office	Hydrant near Overhead Reservoir

6.5.4 Municipal Secretariat & Town Hall

Municipal Secretariat should be located in the town centre and planned in relation to other civic amenities and central business activity. In addition, zonal municipal offices should be centrally located with respect to their constituent wards.

The Town Hall is prestigious component of the municipal secretariat. Because of the public activity of Councillors, larger than normal public dealing of municipal secretariat as well as space needs for ceremonial occasions, standards for office sites cannot be applied, but more generous provision should be made. Site standards are presented in Table 6.16 (Details in Appendix 6.6).

TABLE 6.16: SITE AREA STANDARDS FOR MUNICIPAL SECRETARIAT/TOWN HALL

Status	Site Area (hectares)
Municipal Corporation	3.0 - 5.0
Municipal Committee	1.5 - 2.5
Town Committee	0.5 - 1.0

Source: Appendix 6.6.

Zonal municipal offices should follow office space standards (Section 5.2) for public dealing offices.

6.5.5 Libraries

A library should be centrally located with reference to its catchment of potential readers and information seekers.

In addition to central location, the site chosen should be visually prominent.

Covered area standards are suggested in Table 6.17.

TABLE 6.17 : COVERED AREA STANDARDS FOR LIBRARIES

1. Stacking space (with checking & catalogue space).	130-170 books/sq.m.
2. Reading & Reference space	1.80 sq.m./person for maximum number of persons at any one time.

Source : ECNEC

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The gross site standards for libraries cannot be pre-determined. It depends upon the number of books to be provided, population served, and general density of zone in which located. Surrounding buildings would suggest single or multi-storey design solutions.

6.5.6 Courts

The Supreme Court at the Federal Capital is the highest judicial institution of the country followed by Federal Shariat Bench and the High Courts in Provincial Capitals alongwith their branches in other metropolitan cities. These are specialised institutions, whose site requirements need specific and detailed analysis.

Replicable facilities are Sessions Courts, Civil Courts and Resident Magistrates' Courts. Sessions Courts and Civil Courts are provided at district level while Civil Courts and Magistrates' Courts are provided at Tehsil Headquarters. Sub-Tehsils are served by Resident Magistrates' Courts (RMO). Table 6.18 gives the suggested site standards.

TABLE 6.18 : SPACE STANDARDS FOR COURTS

Administrative Unit	Type of Court	Covered Area (sq.m.)	Site Area (sq.m.)**
District	Sessions Courts	1317	4047
	Civil Courts	1115	3035
Tehsil	Civil Court	2x140=280*	809
	Magistrate's Court	2x140=280	809
Sub-Tehsil	Resident Magistrate's Court	140	405

* The area required per court is 140 sq.m. Normally at tehsil level, two courts are provided in the same premises.

** Includes Lawyers bar room, munshis sheds/benches etc.

Source: Office of the Chief Architect, Govt. of Punjab, Lahore.

The standardised facilities above should be a discrete part of the area given for Secretariat Complex in Table 5.4.

6.5.7 Police Stations

One Police Thana with staff quarters/barracks and judicial lock-up for every 50,000 persons is recommended. The site area may range from 0.4 to 0.8 hectares depending upon the prevailing density in the locality.

In addition, police posts without judicial lock-up, may be provided where population is scattered or crime rate is high. Site area should not exceed 500 sq.m.

6.5.8 Jails

There are two main kinds of jails i.e. Central Jails and District Jails. Their important characteristics are presented in Table 6.19.

TABLE 6.19 :CHARACTERISTICS OF MAIN JAILS

Type of Jail	Allocation Criteria	Optimal No. of prisoners	Category of inmates
Central	Civil Division	1000	Long term convicts.
District	Civil District	500	Under-trials, short term convicts.

Source: Office of the Inspector-General of Prisons, Punjab, Lahore, 1986.

Central Jails should be located outside the urban fringe. District jails should be located close to courts. When site availability does not allow proximate court-jail relationship, a transportation system must be established for quick and secure access of inmates to the courts and back.

Space requirements differ from place to place. According to Pakistan Prison Rules (Rule No. 745), the space requirements for jail components are given in Table 6.20.

TABLE 6.20: JAIL COMPONENTS SPACE STANDARDS

Component	Area requirement per prisoner in Hilly Areas	Plain Areas
Confinement Area	18 sq.m	16 sq.m.
Hospital	31 sq.m	24 sq.m

Source: Ibid.

In addition to building components, sufficient land is also required for agriculture, to make the facility partially self-reliant in vegetatables.

The minimum gross area recommended is given in Table 6.21.

TABLE 6.21: GROSS SPACE REQUIREMENTS FOR JAILS

Type of Jail	Gross Area Requirement (hectares)
Central Jail	31
District Jail	14

Source: Ibid.

6.5.9 Graveyards

6.5.9.1 Standards

Standard sizes of graves are given in Table 6.22.

TABLE 6.22: GRAVE SIZES

i) Graves of adults	7'x4'	(2.13 x 1.22 m)
ii) Graves of children under 12 years.	6'x3'	(1.83 x 0.91 m)
iii) Graves of infants	4'x3'	(1.22 x 0.91 m)

Source: Nawabshah M.C. and Moro T.C, 1983.

2.1 % of the total built-up area of an urban settlement is recommended to be set aside for graveyards. Separate graveyards for each area development scheme are **not** recommended. Instead graveyards should be located on the periphery of urban developments, attaining threshold of 100,000 population. The rationale for the provision is given in Table 6.23.

TABLE 6.23:AREA CALCULATION FOR GRAVEYARDS

i)	Mortality rate	=	12/1000 persons
ii)	Rotation time for a graveyard	=	40 years
iii)	Number of graves required for one rotation	=	40 x 12 = 480 graves
iv)	Gross size of the grave (including circulation, plantation & premises for the Caretaker).	=	9 ft. x 6 ft = 54 sq.ft.
v)	Total area required	=	54 x 480 = 25920 sq.ft. or 0.595 acres/ 1000 persons.
vi)	At average urban density of 35 persons/acre the total area required for grave yards for say 1000 acres of urban area is	=	$\frac{0.595 \times 35 \times 1000}{1000}$ = 20.8 acres or 2.1% of the total urban area.

6.5.9.2 Guidelines

Each grave should be numbered with a marker and the grave register filled in and preserved in careful manner.

Graveyards should be properly landscaped, enclosed by a low boundary wall, and their future extension should be in conformity with duly laid out plans.

In large urban areas, only those graveyards should continue to be operational which cover an area above 5 hectares.

6.5.10 Petrol Stations

Petrol Stations are outlets for retail sale of petrol and ancillary products for motor vehicles, whether or not part of a multi-storey garage or an establishment for the repair/servicing of motor vehicles, (a "Service Station").

The annual quota of new petrol stations, allowed to be leased by the petroleum distribution companies, is approved by the Ministry of Fuel and Power, while Provincial Industries Departments and the Federal Chief Inspector of Explosives, grant no objection certificates for particular sites and layouts, respectively. Where they exist, local town planning regulations govern site approval.

Petrol Stations, other than multistorey garages, may be located only on a primary/secondary road having right-of-way of atleast 30 metres.

A petrol station should not be located within 1 to 2 kilometre of an existing petrol station, (or approved site), unless on the opposite side of a primary road with minimum 50 m right-of-way and dividing median strip. No petrol station may be located within 100 metres of a crossing of two primary roads or a roundabout. The minimum frontage of a petrol station should be 30 metres. A site standard of 1000 sq.m. is recommended for petrol filling and servicing activities.

Access ways may be constructed in accordance with the following:

i) No access roadway may cross the sidewalk at an angle of more than 45 degree.

ii) The width of each lane, (petrol filling bay), may be at least 6 m.

iii) The curving of the curb on the outer sidewalk should have a minimum radius of 25 m.

iv) Both "in" and "out" roadway may be provided, respectively leaving and entering the approach traffic lane at an angle of not more than 45 degree.

Adequate space may be provided for parking a supply tanker while discharging its load.

No less than 1 lavatory may be provided at each petrol station.

Purely Service Stations may be treated like other workshops/small industry. Multistory garages are complex facilities requiring detailed scrutiny of location/design.

6.6 ENTERTAINMENTS,

Certain facilities which may be commercially operated are nevertheless located in zones of civic amenities, e.g. cinemas and hotels. Other institutions of cultural importance and entertainment value are auditoriums, theatres and libraries.

6.6.1 Cinemas

Five (5) cinema seats for every 1000 persons is recommended. Existing LDA/PDA standard of 10 seats/1000 is now an over provision because of television and VCRs. Plot area standards for various types of cinema halls are given in Table 6.24.

TABLE 6.24 : CINEMA TYPES AND SITE STANDARDS

Sr. No.	Type	Capacity			Plinth Area (sq.m)	Parking Areas (sq.m)		Site* Area (ha).
		Seating	Cars	Motor-Cycle		Cars	Motor-Cycle	
1.	35 mm single floor	336-400	30	190	390	750	1140	0.25
2.	35 mm with balcony	436-550	41	256	415	1020	1540	0.30
3.	Cinemascope -70 mm with balcony	1000	100	400	980	2489	2400	0.60

* For independently sited cinema. For cinemas in office and commercial complexes, add parking requirement of cinema to other afternoon and evening parking, compare with morning parking and provide for larger demand.

Source: Derived from DeChiara and Callender, Time Saver Standards, 1973, p.p. 913-915 and parking standards.

Before siting permission is given for cinema halls, reference should be made to Cinematography Act, 1935 and local town planning regulations. Cinemas are required to be sited away from road junctions, located atleast 200m away from a mosque, and with setback of 6m (20 ft) from plot line on all sides, because of fire safety requirements.

6.6.2 Auditoriums and Theatres

An auditorium needs to be located in the central area of a town for easy accessibility by all. Auditoriums* may be classified into three types:

Type-A Auditorium with allied facilities such as committee rooms, booths, prayer hall, cafetarias, foyer, etc.

Type-B Auditorium (with performing stage), but without foyer, cafetarias, booths, etc.

Type-C Projection hall (without performing stage).

Type-A is recommended for a city of 0.5 million, with multiples thereof for metropolitan centres. Type-B is recommended for intermediate towns (100,000 - 250,000 population) and for every 10 neighbourhoods of large cities. Type-C is suitable for smaller towns of less than 100,000 population.

The gross site standards for the three types are given in Table 6.25.

TABLE 6.25:SITE STANDARDS FOR AUDITORIUMS

Type-A	7-9 sq.m/Seat
Type-B	6-7 sq.m/Seat
Type-C	6.0-6.5 sq.m/Seat

* Auditoriums suitable for international conferences are special cases and not considered here.

The basis for these standards is presented in Table 6.26.

TABLE 6.26: SITE REQUIREMENTS FOR AVERAGE SIZED AUDITORIUMS

Auditorium type	Average seating capacity	Covered area per seat as per ECNEC Standards	Total covered area	Parking/ circulation	Gross site area (a+b) sq.m.	Gross area per seat
			(a)	(b)		
A	500	2.35-2.80	1175-1400	2750	3925 to 4150	7.85 to 8.30
B	350	0.95-1.40	333-490	1822	2155 to 2312	6.16 to 6.61
C	200	0.65-0.75	228-263	978	1206 to 1241	6.03 to 6.21

Source: Derived from ECNEC and parking standards.

Auditoriums may double as theatres because seminars are occasional while other congregations mostly occur during the day, afternoon and early evening. On the other hand, plays can be staged later in the evening.

6.6.3 Hotels

The primary function of hotels is to offer "bed and board" as well as pleasant surroundings in which to enjoy both commodities.

The hotel industry in Pakistan is predoninently in private sector. In addition to compliance with building codes and regulations, it has to be conscious of the assessment system of the international and local hotel associations and tourist trade associations. The planner who is responsible for preliminary identification and approval of possible hotel sites should be aware of the gross site requirements of various categories of hotels.

Hotels of the same class prefer to cluster together; high class hotels in a posh part of the civic zone. No allocation criteria is desirable as hotels entail large investments requiring detailed feasibility studies.

Table 6.27 suggests site requirements based on details of ground floor area requirements given in Appendix 6.7.

TABLE 6.27:GROSS SITE AREA FOR HOTELS

(sq.m)

	Hotel Type					
	5-Star (100 beds)	4-Star (75 beds)	3-Star (50 beds)	2-Star (25 beds)	1-Star (15 beds)	Others
Total Site Area	54648 (5.46 ha)	2223	1963	1028	568	365

ROADS AND TRAFFIC - CONTENTS

CHAPTER 7 - ROADS AND TRAFFIC

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CHAPTER 7 : ROADS AND TRAFFIC

7.0 GENERAL

Planning of the transport system cannot be isolated from landuse planning. This is illustrated in the landuse/transport cycle:

(1-2) Whatever the land is used for, its activities generate trips (movements of people or goods) and some activities generate more trips than others.

(2-3) The trip characteristics determine the transport needs.

(3-4) The transport needs indicate the facilities which will be required.

(4-5) The extent to which the transport facilities satisfy the needs determine the degree of accessibility of the land.

(5-6) The accessibility of the land influence its value since the land has no value if people cannot get to it.

(6-1) The land value determines the use to which the land is put.

Landuse and transport facilities are therefore mutually dependant and are constraints on each other.

Transportation planning and road design are specialised disciplines based on sophisticated mathematical models and robust engineering practice. To give an overview to the physical planner, this chapter outlines selected aspects of transportation planning and design. The intention is to provide the conceptual basis as well as broad guidelines for transport related land reservation, because the physical planner is usually required to make decisions regarding land reservations in advance of the advent of specialists.

Land reservation is critical for urban roads which are accordingly dealt with in main text. In the case of highways and rural roads, the planner's role is limited to suggesting broad road types and linkage priorities in the context of a regional plan or a farm-to-market roads programmes. Route alignment and highway design are the domain of the engineer with standard land reservation under Highways Ordinance. Accordingly, only the relevant aspects of highway traffic growth and related pavement design considerations are provided at Appendix 7.1.

7.1 URBAN ROADS

7.1.1 Types of Urban Roads

There are many road classification systems, most are orientated to the culture of the country of origin. Classification* of urban roads previously used in Pakistan may be adopted, based on their function, volume of traffic, type of traffic and position in network. Urban roads in Pakistan may be categorised as :

- Primary roads
- Secondary roads
- Local Roads.

The local roads may be further subdivided into:

- Local distributor (feeder) roads.
- Local access roads.
- Streets and galis.

The key characteristics of these categories are summarised in Table 7.1.

7.1.2 Dimension, Reservations and Setbacks

Reservation or Right of Way width (R.O.W) is the total width of the road or street required to accommodate roads, utilities and other ancillary facilities. A setback is the minimum distance the centre line of the road to the building line of property.

Right of way of roads generally accommodate the following elements depending upon the function and type of road, (Fig. 7.1).

a) Carriage way
b) Hard Shoulders for emergency parking
c) Cycle tracks
d) Parking bays
e) Bus lay-bys

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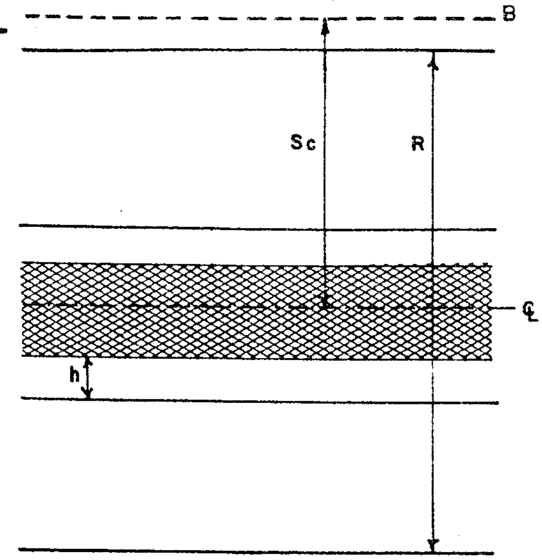
* Source: Lahore Traffic Manual, Halcrow Fox & Associates,1983.

TABLE 7.1: TYPES OF URBAN ROADS

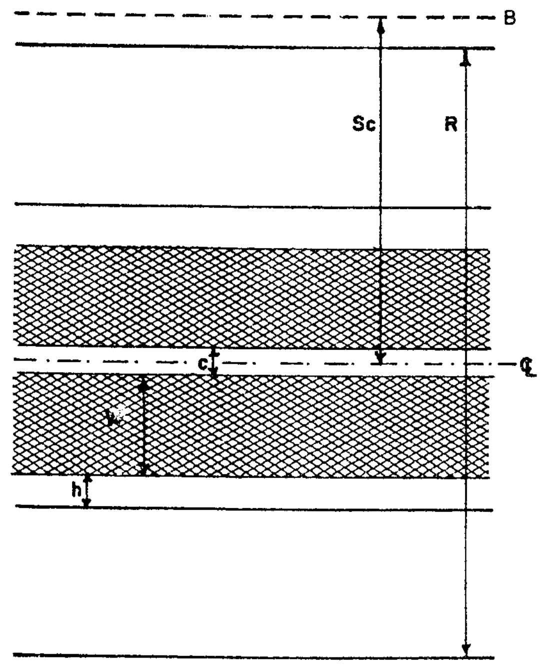
ROAD TYPES		PRINCIPAL CHARACTERISTICS
Primary		The most important roads of the city serving through traffic and providing communication between the main residential, industrial and commercial areas of the city. To maintain the function of providing free unimpeded flow of motorised traffic, the Planner should whenever possible, aim to restrict frontage access, number of junctions and on-street parking.
Secondary		These roads provide access to major geographical districts and may carry large traffic volumes. They form a "secondary" network drawing off from the primary network, traffic with destinations inside the district. They are however, not intended for local penetration nor should it be possible to use them as through routes.
Local	Distributor	These roads penetrate localities within districts and feed traffic down from the primary and secondary networks. They are the lowest category of road that can be readily penetrated by motorised vehicles, but they are not suitable for extraneous traffic without businees in the immediate vicinity.
	Access	They provide access to individual premises and blocks.
	Streets & Galis	These form the lowest category of public accessway and their use is limited to those wishing to reach premises served by them. Frequently such streets and galis are cul-de-sacs and their use and ownership is considered to be a communal extension to the adjoining properties.

FIG. 7·1

DIMENSIONS, RESERVATIONS AND SETBACKS OF ROADS.



SINGLE CARRIAGEWAY



DUAL CARRIAGEWAY

B = Building Line
R = road reservation
Sc = setback from centre line

w = width of carriageway
h = hard shoulder
℄ = centre line
c = central reservation

f) Footpaths

g) Utility services like water, sewerage, drainage, storm water, electricity, telephone and gas lines, etc.

h) Service lane

i) Median strip and other green verges

j) Streets signs and street furniture.

According to Section 8 of the Highway Ordinance, no building should be allowed to be erected within two hundred and twenty feet (67 metres) from the centre of the highway, without the consent of the Highway Authority. For setbacks on other roads, the bye-laws of the local agencies shsould be adhered to.

7.1.3 Geometry

Main components of road geometry are series of straight lines with curves at every change of direction, applicable both on horizontal as well as vertical planes. Good geometric design of a road enhances the efficiency and level of service of the road permitting adequate safety for road users. Proper geometry and design of good road allows sufficient stopping distance before hazards and adequate visibility on curves. Design standards vary with the design speed of a particular type of road. Design speeds for different types of roads are given in Table 7.2.

TABLE 7.2: DESIGN SPEEDS

Road Type	Location	Design Speed (KPH)
Primary	Outer urban	80
	Inner urban	60
Secondary	Outer urban	60
	Inner urban	50
Local Dis-tribution	Urban	50
Local access	Urban	20
Streets & Galis.	Predominantly residential use.	

Source: Adapted from Lahore Traffic Manual, Halcrow Fox and Associates, 1983.

7.1.3.1 Straights (bearings) and sight distances:

7.1.3.1.1 Straights (bearings)

Horizontal Straights should be of adequate length, neither too long nor too short. Longer straights tend to encourage overspeeding while shorter straights may cause congestion and reduce the level of service of a road. Vertical straights should not be too steep. Tolerable maximum gradients for different types of roads are given in Table 7.3.

TABLE 7.3:MAXIMUM TOLERABLE GRADIENTS

Road Types	Gradients	Critical Grade Length (metres)
Primary Roads	5% (1 in 20)	245
Secondary Roads	5% (1 in 20)	245
Local Roads	7% (1 in 14)	150

Source: Adapted from Planners Manual Vol.2, MOLAM, Sultanate of Oman, 1980.

It may however, be noted that it is difficult to specify a maximum gradient for local roads as these are more likely to be affected by restrictions of topography and development than primary roads. The adoption of steeper gradients for a short stretch of local road may occasionally be unavoidable.

7.1.3.1.2 Sight Distances:

On horizontal curves it is desirable that a driver should see a sufficient distance ahead for an overtaking manoeuvre to be carried out in safety.

The minimum safe stopping sight distance is the distance travelled by a vehicle in the period between the time when a driver can first see an obstacle or hazard, and the time when the vehicle is brought to rest. Minimum safe stopping and overtaking distances for various speeds are shown in Table 7.4.

TABLE 7.4: MINIMUM SAFE STOPPING & OVERTAKING SIGHT DISTANCES

Design speed (Km/h)	Minimum stopping Sight Distance (Metres)	Minimum overtaking Sight Distance (Metres)
80	140	360
60	90	270
50	70	225
30	30	135

Source: Lahore Traffic Manual, Halcrow Fox & Associates, 1983.

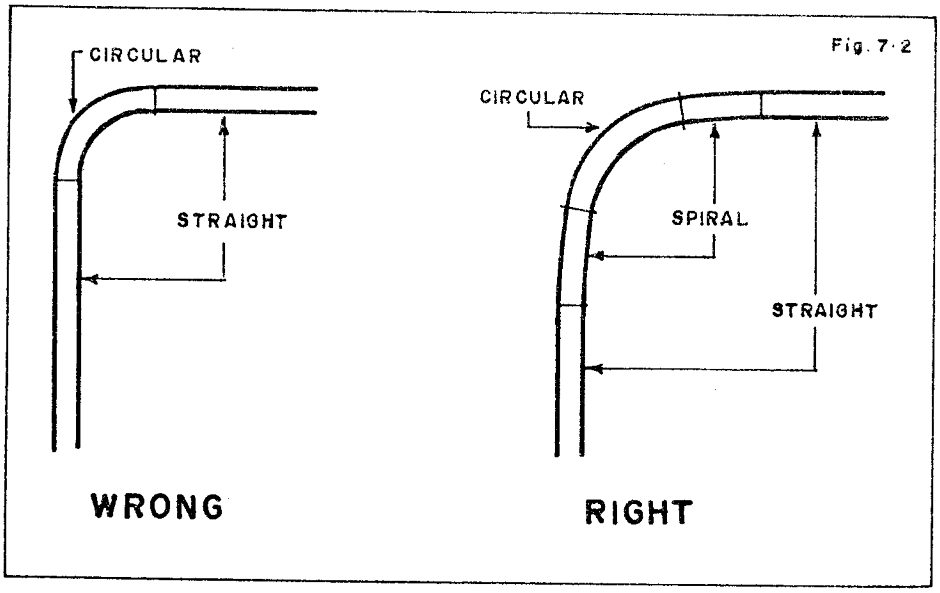
The stopping distances given in the above table are based on object and driver's eye height of 1.05 metres, in accordance with UK practice.

7.1.3.2 Curves

Horizontal and vertical curves are of fundamental importance in road design and geometry:

7.1.3.2.1. Horizontal Curves.

Horizontal curves should not be provided in the form of simple arcs but transition spirals must be placed between circular arc and the straights, to make vehicular movement easier and safe (Fig 7.2).



The radii for horizontal curves and their additional elements e.g. superelevation, extension of the width of carriage way and transition curves may be determined by applying appropriate techniques of traffic engineering practice in diverse traffic and terrain conditions.

For compound curves, the major radius should be two or three times that of minor radius, and the arc lengths of each segment should be equal.

The turning radii and transition lengths of horizontal curves are shown in Fig. 7.3, while Table 7.5 gives the minimum radii.

TABLE 7.5: MINIMUM RADII FOR HORIZONTAL CURVES

Design speed (Km/hr)	Minimum Radii (Metres)
80	350
60	300
50	200

Source: Adapted from Planners Manual Volume 2, MOLAM Sultanate of Oman,1980.

7.1.3.2.2 Vertical Curves

Breaks in the profile which occur where there is change of gradient, are smoothed out by introduction of connecting vertical curves. Vertical curves are of two types (i) Convex (summit or crest); and (ii) Concave (valley or sag). These are normally parabolic than circular.

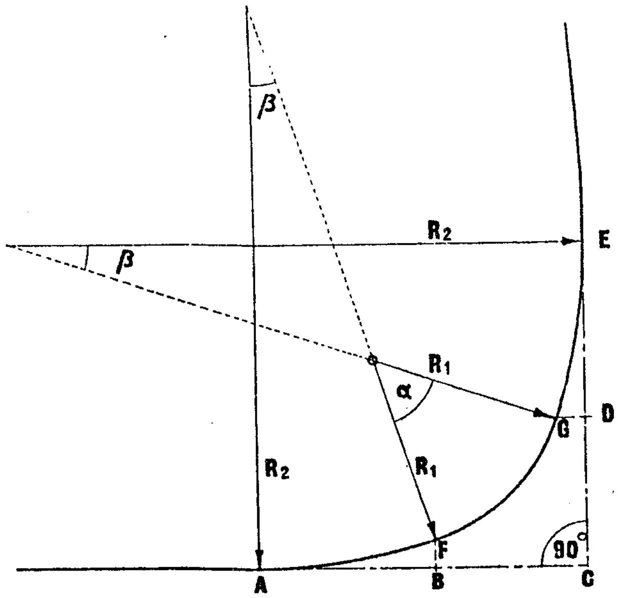
For convenience, visibility and safety, vertical curves should be made as large as possible with the minimum curve lengths as given in Table 7.6.

TABLE 7.6: MINIMUM VERTICAL CURVE LENGTHS

Road Type		Design Speed* (KPH)	Minimum length of vertical curve (metres)
Primary	i)	80	50
	ii)	60	40
Secondary	i)	60	40
	ii)	50	30
Local Distributor	i)	50	30

* Source : Ibid

Fig. 7.3 : Turning Radii & Transition Lengths:



R_1	R_2	β	α	AC.CE	AB,DE	BF,DG
35′	105′	18°	54°	60·5′	32·9′	5·1′
30′	90′	18°	54°	51·8′	28·2′	4·4′
20′	60′	18°	54°	34·5′	18·8′	2·9′

Source : Roads in Urban Areas,(HMSO,1973).

7.1.3.2.3 Visibility at Curves

Visibility Standards for horizontal and vertical curves are as under:

a) Horizontal Curves:

If the radii of different categories of roads are greater than those given in Table 7.5, reasonable visibility can be expected for the driver around the curve. A "graphical method" is used to ensure sufficient visibility standards along the curves. It is generally assumed that the driver is 1.5 m from the edge of the carriage way and at a height of around 1 metre. On a large scale plan of a curve, a series of points are marked each representing the position of the vehicle going along the inner lane of the curve. From these points straight lines of the length equal to normal sight distance are drawn. The curve inscribed along the inner parts of these lines is the limit for proper visibility. (Fig. 7.4).

b) Vertical Curves:

Sight distances should be measured between two points 1 metre above the carriageway on opposite sides of the crest. The curvature of summits (crests) should be sufficient to provide sight distances which allow safe stopping at design speed (Table 7.4). Where other design/cost considerations do not permit safe overtaking sight distances, the curve must be marked as a no overtaking zone.

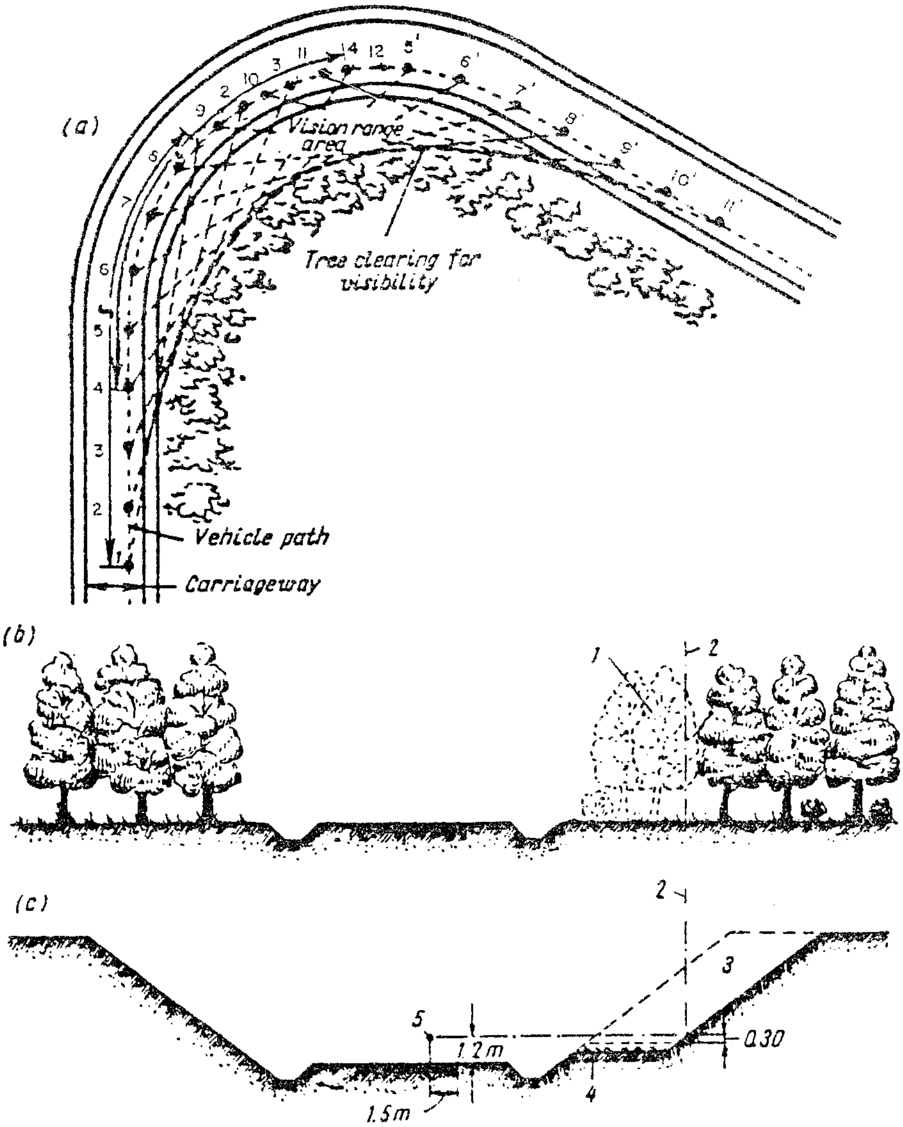


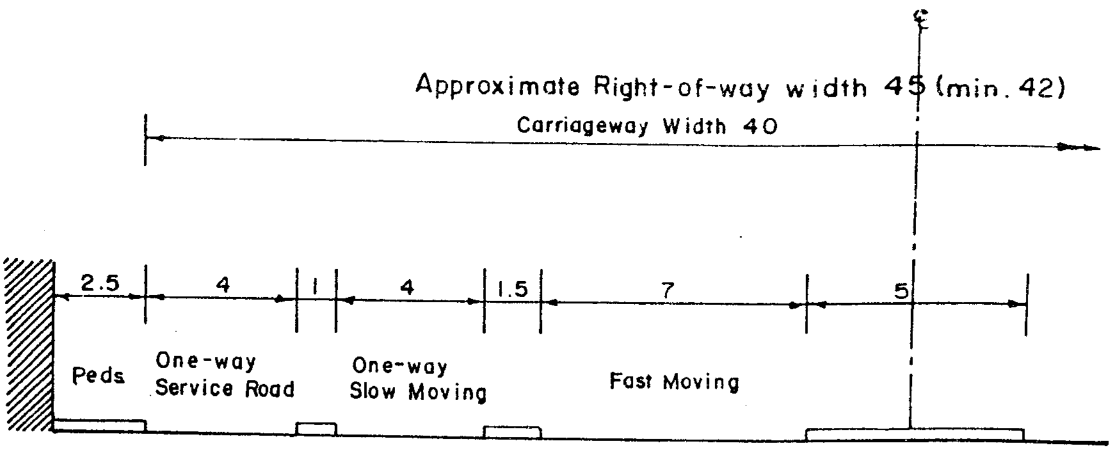
Fig. 7·4
VISIBILITY ALONG HORIZONTAL CURVES

SOURCE: Babkov and Zamakhayev, Highway Engineering, 1967.

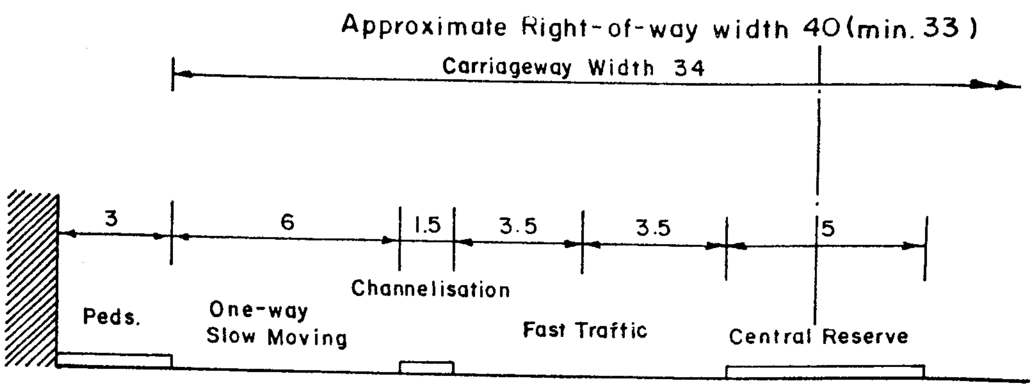
7.1.4. Road Width

Right of way width of a road or a street is determined in the light of present as well as future requirements of traffic. The width of a carriageway depends on the number of lanes it constitutes and the width of each lane. The width of a lane is calculable with the help of mathematical formula depending on the size of vehicles that pass on it, size of vehicles that will pass on it and the speed of the vehicles. As a rule of thumb, 3.5 m wide and 3.0 m wide traffic lanes are adopted for practical purposes. Types of carriageways, number of lanes and the minimum width for different categories of roads and streets are given in Table 7.7. Fig. 7.5 gives typical cross-sections for different roads and streets . Typical placement of services are considered in Section 8.6.

Fig. 7.5 **ROAD CROSS-SECTIONS**



1. Segregated slow-moving traffic
2. Provision of service road
3. Central Reserve with sufficient width for right-turn lane.
4. Recommended for primary urban road.

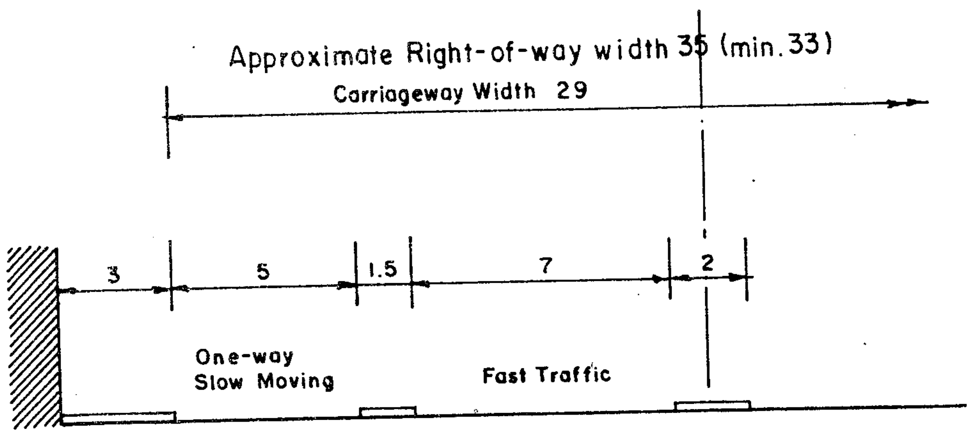


1. Segregated Slow Traffic
2. Central Reserve with sufficient width for right-turn lane

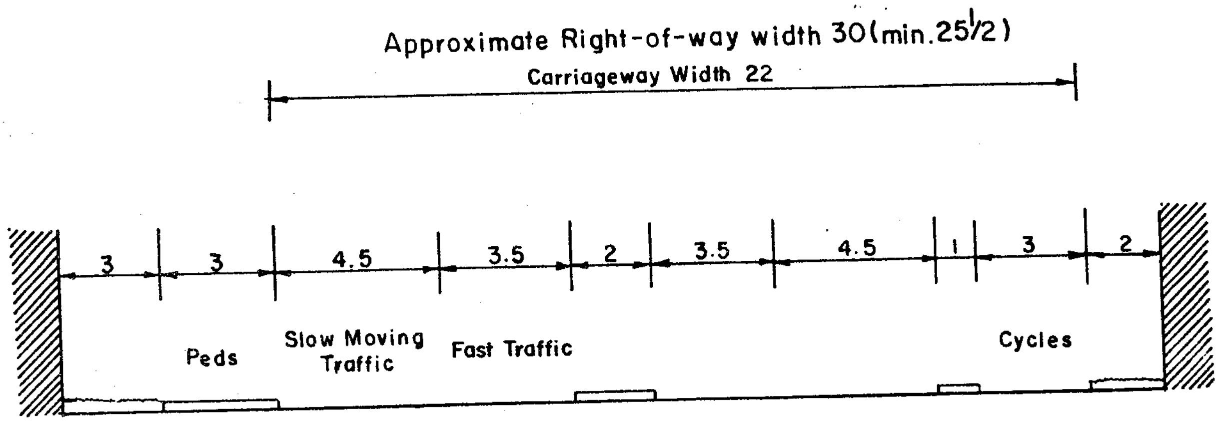
All dimensions are in metres

Scale: 1: 200

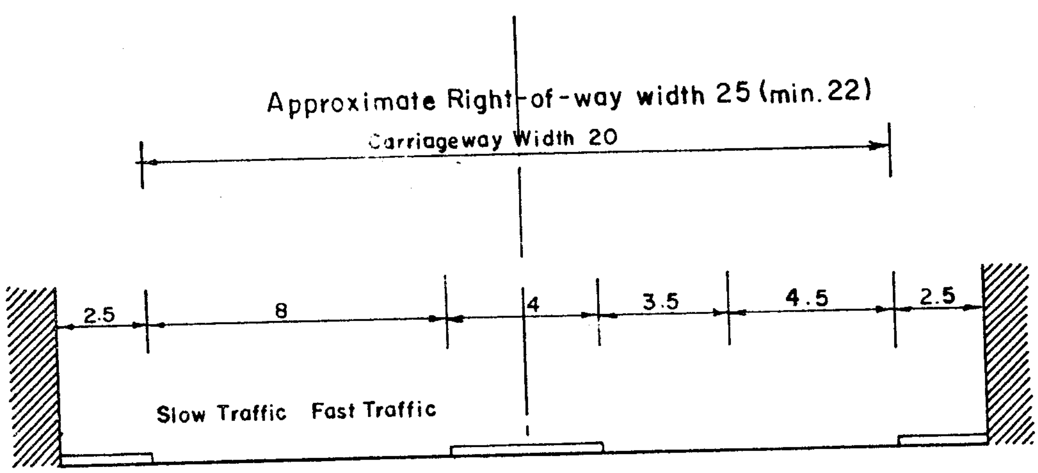
Fig. 7.5 (Contd)



1. Segregated Slow Traffic.
2. Recommended.

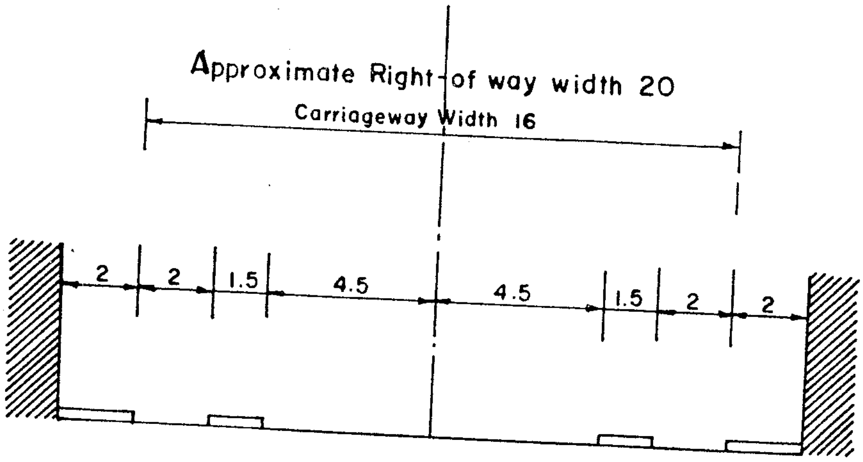


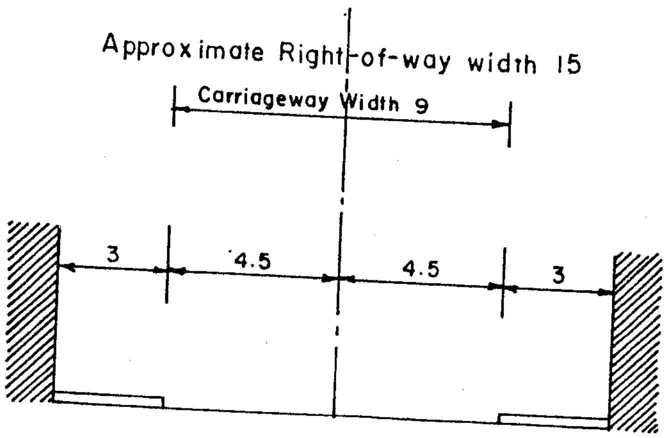
1. Segregated Cycle Track

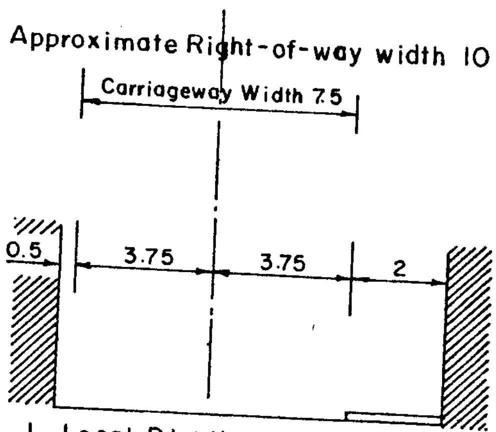


All dimensions are in metres
Scale:- 1:200

Fig. 7.5 .. Contd.





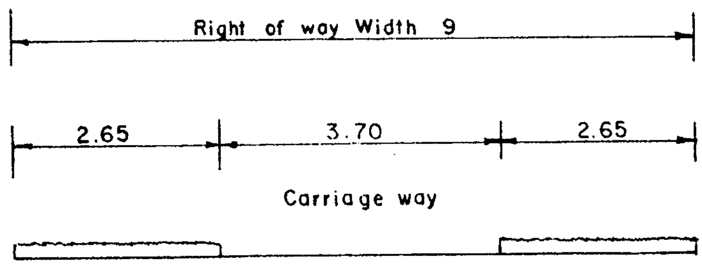


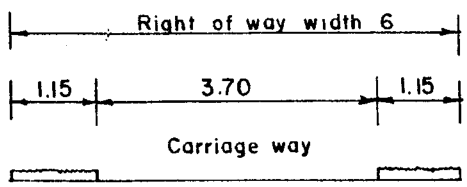
1. Local Distributor only
2. Sub-standard footway on left-hand side

All dimensions are in metres

Scale - 1 : 200

Fig. 7.5.. Contd.





All dimensions are in metres.

Scale:- 1:100

TABLE 7.7: RECOMMENDED LANES & CARRIAGEWAYS URBAN ROAD HIERARCHY

Road Type	Location	Carriageway widths (metres) Dual:2 lanes each direction	Carriageway widths (metres) Single:1 lane each direction	Other Considerations
Primary	Outer urban	7.0 to 8.0	-	Provide facilities for public transport, animal drawn vehicles and/or cycles. Restrict number of junctions, frontage access and on-street parking.
	Inner urban	7.0 to 8.0	-	
Secondary	Outer urban	7.0 to 8.0	-	Facilities similar to above less restrictions necessary.
	Inner urban	7.0 to 8.0	12.0(Min. 9.0)	
Local Distributors	Urban	-	9.0(7.5)	Service junctions take precedence over traffic flow.
Local access	Urban	-	*7.5 two-way flow 6.0 one-way flow.	Restrict vehicular movement to walking pace.
Streets	Urban	*	*7.0 two-way 6.0	Provide access for emergency vehicles one-way.
Galis	Urban	-	4.5	Pedestrian access path only.
			3.0	Loop Galis.

* Dimensions shown may be total right-of-way widths.
Source: Lahore Traffic Manual, Halcrow Fox & Associates, 1983.

TABLE 7.8: STANDARD RIGHTS OF WAY FOR URBAN ROADS

ROAD TYPE	RIGHT OF WAY (METRES)	
	With services at berms	With services under carriageway
Primary-1	55	45
Primary-2	50	40
Secondary-1	45	35
Secondary-2	35	30
Secondary-3	35	25
Local (Distributor) Road-I	25	20
Local(Distributor) Road-2.	20	15
Local (Access) Road-1	15	10
Streets & Galis-1	9	-
Streets & Galis-2	6	-
Streets & Galis-3	-	3-4

Source : Ibid

7.2 ROAD JUNCTIONS

7.2.1 Types of Road Junctions

A junction or intersection is a point at which two or more roads converge. Broadly road junctions are of two types:

i) Multigrade Junctions
ii) At grade Junctions.

7.2.1.1 Multigrade Junctions

These junctions help minimising the traffic conflict points and are very efficient as the traffic of one road flows without affecting that of the other. In Pakistan, such junctions are not common as they are expensive and require large land reservation. The design of such junctions is a specialised task, whose complexity depends on the converging road network.

7.2.1.2 At-grade Junctions

At these junctions the roads meet at the same level. Common types of single level junctions are tee, wye, cross, staggered, scissor and multiway.Junction types are associated with the layout plans. Tee, cross and staggered junctions are associated with grid iron layout, while wye, scissor multiway junctions emerge from ring and radial types of layouts.

Where two important roads converge, a cross junction is more appropriate than a staggered junction. Where, however, a lightly trafficked minor road meets a major road, a staggered layout is more appropriate. The design of a staggered junction will be similar to that of two T-junctions. The minimum tolerable distance between the vertical legs of two Tees is 36 metres (120 feet)*.

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* Road in Urban Areas, HMSO, 1973.

In the general context wye, scissor and multiway junctions are not recommended. However, where vistas are important, wye junctions are useful in focussing attention towards the monument / landscape.

7.2.2 Junction Controls

There are three types of at-grade junction controls:

i) Priority junctions
ii) Signalized crossing.
iii) Roundabouts.

7.2.2.1 Priority Junctions

Where a minor road meets a major road, priority junctions are provided, i.e. traffic on a major road has a priority over the traffic on the minor road. Traffic on minor road gives way at "gives way" or "stop lines" to major road traffic and waits for suitable gaps in the traffic before moving.

7.2.2.2 Signalized Crossings

Where two important roads cross, control by traffic signals is usual. As a general rule, traffic signals are provided where the number of vehicles entering a junction exceed 500 per hour.

7.2.2.3 Roundabouts

Roundabouts may be provided at a junction of two important roads, but are more appropriate for multi-leg or complex junctions.

Flow of traffic on roundabouts is in clockwise direction and therefore, traffic entering the roundabout "gives way" to traffic from the right i.e. traffic on the roundabout has priority over the traffic entering a round about (Fig. 7.6).

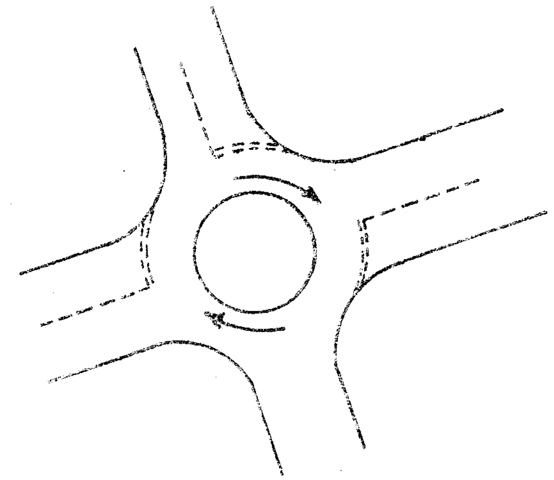


Fig 7·6

There are four main categories of roundabouts (Fig. 7.7):

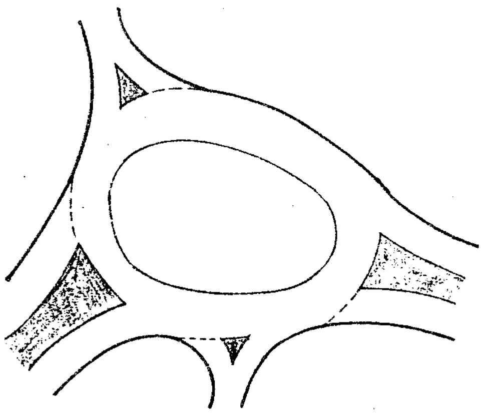
i) Conventional Roundabouts
ii) Improved conventional roundabouts
iii) Small roundabouts
iv) Mini roundabouts

Conventional roundabouts have a large central island and long weaving section. Improved conventional roundabout, on the other hand, is characterised by simple geometric shape, wider approaches and shorter and wider weaving sections.

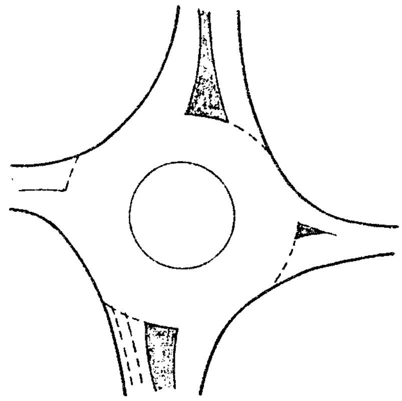
In case of small roundabout, the central island is reduced and the approaches extended into the junction.

Mini roundabout is provided in the urban areas where site conditions permit only limited land. Such a roundabout should be avoided in planned new development. In conditions of limited land,

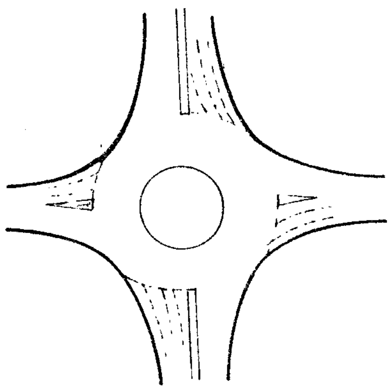
Fig.7.7 TYPES OF ROUNDABOUTS



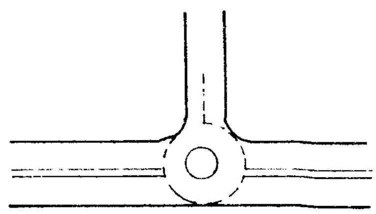
CONVENTIONAL
ROUNDABOUT



IMPROVED CONVENTIONAL
ROUNDABOUT



SMALL
ROUNDABOUT



MINI ROUNDABOUT

preference should be given to staggered (double T) junctions. Commonly used diameters of Central Island and the width of road around central island for different categories of roundabouts are given in Table 7.9.

TABLE 7.9: DIAMETERS OF CENTRAL ISLAND & WIDTH OF ROAD AROUND CENTRAL ISLANAD:

(Metres)

Category of Round-about.	Diameter of Central island	Width of road around Central island
Conventional round-about	25 - 50	8 - 15
Improved conventional roundabout	25+	8 - 15
Small roundabout	4 - 25	8 - 15
Mini roundabout	1 - 4	7 - 10

Source : Planners Manual, Vol.2, MOLAM, Sultanate of Oman

7.2.2.4 **Comparison of traffic signals & roundabouts**

Both traffic signals and roundabouts have merits and demerits as control mechanisms to channellise traffic in a busy junction. Table 7.10 gives a comparison in order to facilitate selection of the appropriate control type for a particular situation.

TABLE 7.10: COMPARISON OF TRAFFIC SIGNAL & ROUNDABOUT JUNCTIONS

Traffic Signals	Roundabouts
i) Land requirements for small and conventional roundabouts are greater than for signal control.	i) Roundabouts continue to function during power cuts.
ii) If traffic entering a roundabout from one arm is a lot greater than traffic leaving by that arm there will be a shortage of gaps in the circulating stream which will lead to excessive delays to minor-road vehicles. Signal assistance or full signal control is preferred.	ii) If right turning vehicles are greater than 30 per cent or 40 per cent of the total a roundabout is preferred.
iii) Traffic signals can incorporate facilities for pedestrians to have precedence over traffic for part of the signal cycle.	iii) 3-arm and 5-arm junctions operate better with roundabouts especiallly when flows are balanced. Mini-roundabouts are most successful at 3- arm urban junctions.
iv) "Area traffic control" can only be implemented with traffic signals.	iv) Roundabouts are to be preferred for safety reasons in rural areas, particularly on fast stretches of road. Roundabouts have been found to show lower accident rates than comparable signal-controlled junctions.

7.2.3 Spacing of junctions

For efficient traffic flow, the number of junctions on primary/secondary roads should be minimized by connecting local roads together before joining a primary/secondary road. Minimum tolerable distances between junctions are given in Table 7.11.

TABLE 7.11: MINIMUM TOLERABLE SPACING BETWEEN JUNCTIONS:

Road Category	Spacing of minor road junctions (minimum)
Primary	200
Secondary	100
Local Distributors	50
Access Streets	24

Source: Derived from layouts based on recommended residential plot dimensions.

7.2.4 Visibility Splays:

To improve the visibility at the road junctions, corner plots should be chamfered (Section 4.2.5). In addition no structure or obstruction higher than 1 m (e.g. parked vehicles, large road signs, advertisement boards, trees, shrubs, public utility structures, etc.), should be allowed in the areas as indicated below: (Fig. 7.8).

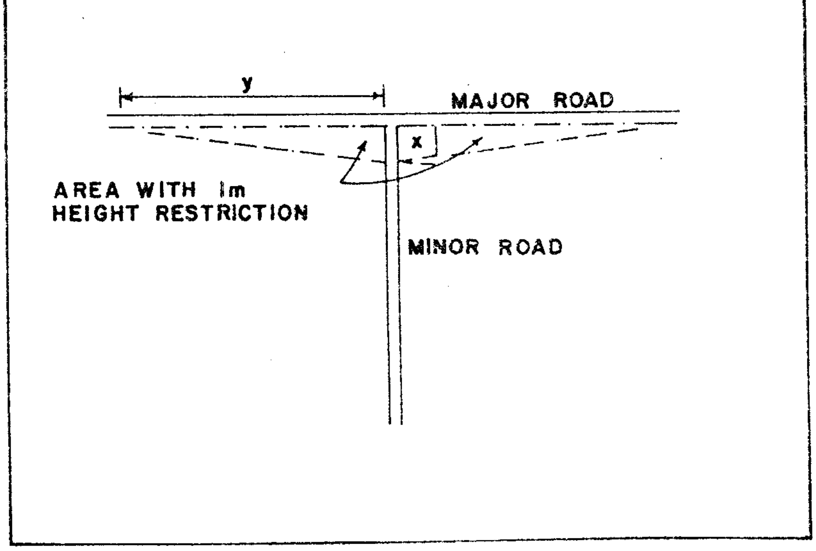


Fig 7·8

The X and Y values for different categories of roads are given be Table 7.12

TABLE 7.12: VISIBILITY SPLAYS

Categories of Road	X	Y
Primary Roads	10	230
Secondary Roads	10	150
Distributors	8	75
Access Roads	4	35

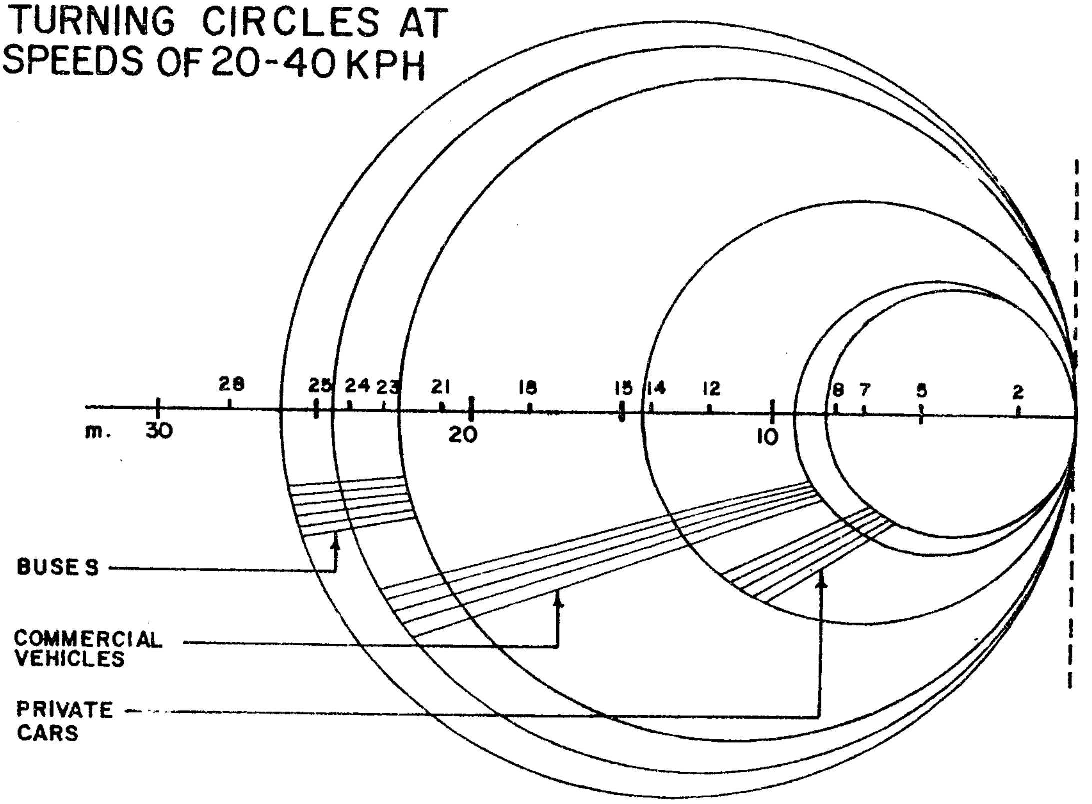
Source: Planners Manual, Vol.2, MOLAM, Sultanate of Oman (1980).

7.3 TURNING CIRCLES AND CUL-DE-SACS

There is a wide variety of turning circles for different types of vehicles as shown in the Fig. 7.9. These determine roundabout island size (reference 7.2.2.3) and cul-de-sac dimensions.

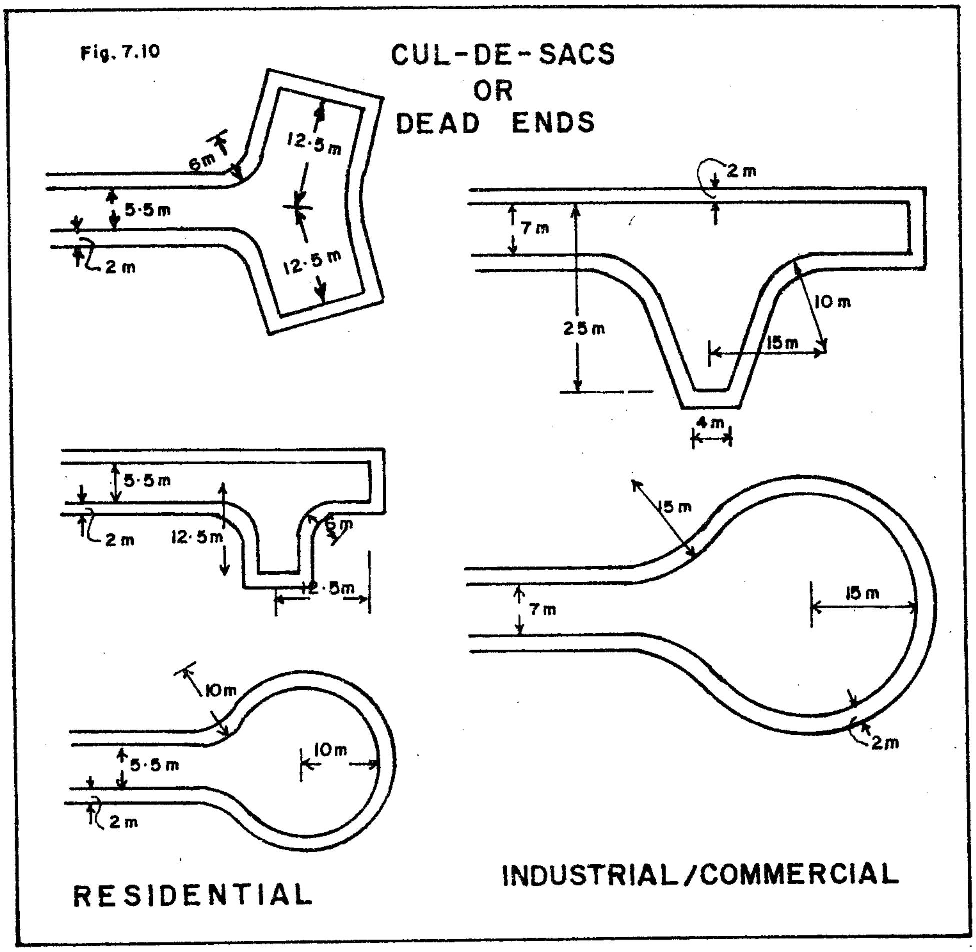
FIG. 7·9

TURNING CIRCLES AT SPEEDS OF 20-40 KPH



7.3 TURNING CIRCLES AND CUL-DE-SACS

Dimensions for Cul-de-sacs and Dead ends for residential and industrial/commercial vehicles are given in the Fig. 7.10.



7.4 TRAFFIC

7.4.1 Road Capacity

Vehicles/hour is the standard unit of measurement of the capacity of a lane under given pavement and terrain conditions.

The theoretical capacity of a traffic lane at traffic speeds between 20 and 40 km/hr, under ordinary road and traffic conditions is in the range of 1100 to 1600 vehicles/hr. The practical capacity of a lane is usually assessed at 1000 vehicles per hour in dry conditions and 500 vehicles per hour in case of slippery conditions.

Cumulative capacity of constituent traffic lanes is the theoretical capacity of the concerned carriageway/road. However, practical road capacity is a function of proportions of slow, fast and heavy traffic and pedestrians. Road capacity is also affected by the extent of street parking, the number of bus stops, number of junctions and roundabouts, and the terrain of the area. Because of above and sharp hourly variation, the standard measure for practical urban road capacity is Passenger Car Units Per Hour (PCUs/hour), while for highways, the most appropriate measure is PCUs/day, using the 16-hour day.

Table 7.13 gives the passenger car equivalents for different types of vehicles.

TABLE 7.13:PASSENGER CAR EQUIVALENTS

VEHICLES	PASSENGER CAR UNITS				
	Existing Highway	New 2-lane Highway	Urban Roads	At round-abouts	At traffic signals
Trucks	3.0	2.5	3.00	2.80	1.75
Buses	2.5	2.0	3.00	2.80	2.25
Motor Cycles	0.5	0.5	0.75	0.75	0.33
Animal Driven Vehicles	7.0	5.0	4.00	3.80	3.25
Cars	1.0	1.0	1.00	1.00	1.00
Bicycles	0.5	0.5	0.33	0.50	0.20

Sourc: Govt. of Pakistan, Advisor Highway Safety, 1986 and G.Terry Page, Traffic and Roads, 1975.

Maximum practical capacities under different road conditions for all purpose roads with or without standing vehicles and heavy cross traffic are given in Table 7.14.

TABLE 7.14: CATEGORIES OF ROADS & STREETS UNDER DIFFERENT ROAD CONDITIONS

Road type	No.of lanes (each direction)	Carriage width (metres)	Max. capacity (P.C.U/hour) for all purpose roads with no standing vehicle & no frontage access	Max. capacity (P.C.U/hour) for all purpose roads with waiting vehicles and heavy cross traffic
Primary	2	7-8	4500-6500	2500-3000
Secondary	2 1	7-8] 12]	4000-6000	2000-3000
Distributors	1	7.5-9	2000-3000	1000-1500
Local Access	1	7.5 two-way] flow 6.0 one-way] flow	1000-1500	500-750

Source: Roads in Urban Areas,(HMSO,1973).

Slow moving and heavy traffic have their impact in reducing the capacity of the road or street. If the percentage of commercial or heavy traffic is more than 15% of the total traffic, the capacity of the road of the street is significantly affected. Estimated deductions in the capacity of different categories of roads and streets, in case the proportion of commercial and heavy traffic is more than 15% of the total traffic is given in Table 7.15.

TABLE 7.15: DEDUCTION IN THE CAPACITY IN CASE COMMERCIAL & HEAVY TRAFFIC IS MORE THAN 15% OF THE TOTAL

Road Type	Primary	Selcondary	Local (Distribution, Access & Streets)
Deduction in Road/Street Capacity. (PCUs/hour)	-200	-200	-100

Source: Ibid.

Similarly, the slow moving traffic has a significant impact on the capacity of a road or street.

7.4.2 Capacity of Junctions

A junction attempts to control traffic movements which conflict with each other over a particular area of road space at the point where two or more roads intersect. Different junction types are intended to :

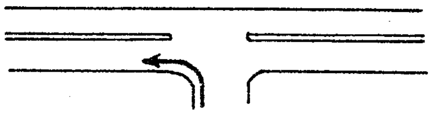
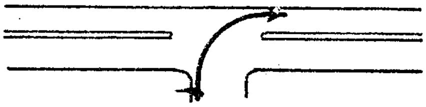
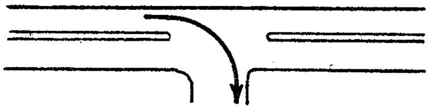
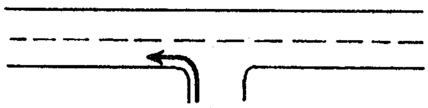
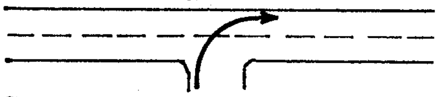
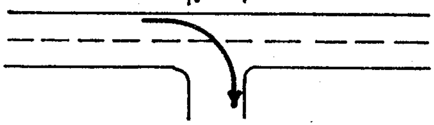
(i) maximise traffic flow through the junction
(ii) minimise delay to traffic
iii) minimise accidents

in particular sets of circumstances.

7.4.2.1 Priority Junctions

Fig. 7.11 shows the maximum flows available in good visibility conditions for the turning movements in a simple three way junction where traffic in the east-west direction, has priority over that on the minor road, in this case in the northerly direction for different major road flows:

Fig. 7.11: URBAN JUNCTIONS
(traffic speed 65 km/hr or less)

	Major Road Flows (PCU/hr.)				
	1000	1500	2000	2500	3000
Capacity of turning movements (PCU/hr.)					
Dual carriageways					
	1000	1000	1000	1000	1000
	440	260	140	75	30
	610	425	275	175	110
Single carriageways					
	1000	580	425	240	75
	140	35	–	–	–
	1000	580	425	240	75

SOURCE : Urban Traffic Engineering Techniques (HMSO, 1965).

7.4.2.2 Signal Controlled Junctions

Because of the large number of factors which determine capacity, it is difficult to provide a general standard for application to different types of signal controlled junctions. The important factors are as follows:

i) width of approaches
ii) number of arms at junction
iii) the signal setting
iv) parked vehicles
v) proportion of right turning vehicles for each arm
vi) proportion of heavy commercial vehicles and buses.

It is therefore normal to design each junction separately. Where a series of junctions have to be signal controlled in, for example, the city centre, "Area Traffic Control" is more appropriate. This technique maximises capacity and minimises delay by linking the phasing of the junctions through a central computer.

7.4.2.3 **Capacity of Roundabouts**

It is practically impossible to recommend one particular method to calculate roundabout capacity. It is worth noting that even within the United States considerable variation in results were found, a fact that resulted in the following statement in their Highway Capacity Manual:

> "because of wide possible variations in local conditions,... rigid service volumes and capacities cannot be presented".

Nevertheless, guidelines on capacity are desirable. Those given in Tables 402-13 and 402-14 of the Punjab Highway Design Manual relate to Rural Highways in USA and are very conservative. They are not applicable to urban conditions in Pakistan.

To give broad guidelines of capacity to be expected in urban areas, results derived from the UK method have been reproduced in Table 7.16.

TABLE 7.16: ROUNDABOUT CAPACITY

Type	Usage urban	PCU/hour (Total through junction)
Conventional	-3 arms	4,500
	-4 arms	3,000
	-5 arms	2,500
Improved Conventional	-3 arms	5,000
	-4 arms	3,500
	-5 arms	3,000
Small	-3 arms	5,500
	-4 arms	4,000
	-5 arms	3,500
Mini	-3 arms	2,500
	-4 arms	2,000
	-5 arms	1,500

Source: Ibid.

7.5 CYCLE TRACKS

Cycles are the only form of personal transport available to most people in Pakistan. It is important to segregate the cyclist from the motor vehicles as segregation minimises conflict between the two modes, decreases congestion and increases road safety. A kerbed median or green verge may be used to physically separate fast-moving and cycle traffic.

Consideration should be given to the provision of cycle tracks whenever practical and certainly where flows exceed 750 per hour, (two-way).

In populated areas, cycle tracks are designed for one-way traffic. They are located on both sides of the street, as a rule between carriageway and footpath. Standard cycle lane widths are given in Table 7.17.

TABLE 7.17: CYCLE LANE WIDTHS

Peak hour Cycle Count(one-way)	Type	Width (metres)
$>$ 800	Double:one way.	2.5
400-800	Single:one-way	1.5

Source: Babkov & Zamakhayev, High Engineering,Moscow.

Two-way paths, 3.75 metres wide, with a paint marked centre line, may be used only in parks.

7.6 PEDESTRIAN WAYS

In the interest of safety, the movement of pedestrians and vehicles should be segregated wherever possible Pedestrian-ways or footpaths should not however, be provided alongside primary or secondary dual carriageway roads.

The pedestrianways should be wide enough to minimise the tendency for pedestrians to walk in the carriageway. The following factors should be taken into account while calculating widths for pedestrianways:

- Minimum passing widths for pedestrians.
- The nature of landuses around the road.
- The magnitude of pedestrian traffic.
- The functions of the road.
- Utility lines under footpaths, if any.

Table 7.18 gives minimum recommended standards for pedestrian-ways adjacent to different road categories. Wider pavements, however, should be provided where there are intensive pedestrian-generating uses in the vicinity.

TABLE 7.18: MINIMUM RECOMMENDED FOOTPATH WIDTHS ADJACENT TO ROADS

ROAD TYPE	MINIMUM RECOMMENDED WIDTH FOR FOOTPATH
Primary:	
Dual-carriageway	i) A footpath should not normally be provided adjacent to the carriage-way.
Single-carriageway	ii)3.0m with a verge of at least 1.0m in width.
Secondary:	
Dual-carriageway	i)A footpath should not normally be provided adjacent to the carriage-way;
Single-carriageway	ii)2.5 m with or without verge; iii)2.0+clearance width + width of object if obstructions are present iv)3.5m - 5.0m if adjacent to shops, schools, etc.
Local Distributor:	i)2.0m with or without verge; ii)1.5m + clearance width + width of object if obstructions are present; iii)3.5m - 5.0m if adjacent to shops schools, etc; iv)2.0 m minimum width if public utilities are laid below the footpath.
Local Access:	i) 2.0 m with or without verge; ii) 1.5 m + clearance width + width of object if obstructions are present; iii) 2.0 m minimum width if public utilities are laid below the foot-path.

Source: Lahore Traffic Manual, Halcrow Fox & Associates (1983).

7.7 LANES FOR ANIMAL-DRAWN VEHICLES

Animal drawn vehicles such as tongas and rehras are a major and important element of the transport scene in Pakistan. Animal-drawn traffic does create congestion, but it also serves a valuable service that cannot readily be provided by other means. The animal drawn vehicles are desirable because neither their manufacture nor use place demands upon the country's foreign exchange. Furthermore, their use in the foreseeable future is unlikely to decrease, unless as a result of coercive measures. In general, the use of animal drawn vehicles should not be discouraged in small to medium sized towns, and low income sectors of large cities.

However, traffic mix of animal-drawn and motorised vehicles on primary and secondary roads causes problems. The alternatives are to ban animal drawn traffic on such roads or to provide special lanes for animal drawn vehicles.

In a situation of traffic mix on a primary or secondary road, where animal-drawn vehicles comprise more than 15% of total traffic, special lanes for animal-drawn traffic are desirable.

TABLE 7.19 RECOMMENDED LANES WIDTHS

One-way	- 3.5 metres minimum
Two-way	- 5.0 metres minimum

Source : Lahore Traffic Manual, 1983.

Where demand warrants the provision of specific lanes for animal-drawn vehicles, but the right-of-way width available does not permit the provision of "sole-use" lanes for each category, then consideration should be given to provision of a segregated lane designated for slow-moving traffic.

Typical layouts for slow-moving lanes are given in Section 7.1.4.

7.8 PARKING

Adequate on-street and off-street parking facilities are required to attain efficiency and higher convenience levels in the urban traffic network. In Pakistan, car ownership rates vary markedly between urban centres.

To establish the parking requirements and location of car parks, it is essential to carry out appropriate field studies such as concentrated parking demand, inventory of parking spaces, the regulations and cost of operating these spaces and derive unsatisfied parking needs.

There are different types of parking and each has different requirements as given in Table 7.20.

TABLE 7.20: TYPES OF PARKING & THEIR REQUIREMENTS

Type	Duration	Example	Requirements
Drop off/ Pick up	0-5 min	Drop off/pick up passengers in shopping area.May include taxis,pick-ups and buses.	Spaces on street or at property frontage.
Errand	0-15 min	Brief shopping, visiting bank,etc.	As above.
Convenience	0-30 min	Purchasing convenience goods, business visits, deliveries.	As above, and some off street parking.
Services	0-1 hour	Visiting doctor/ dentist.	Private off street parking, adjacent to destination,preferably within plot.
Basic	0-4 hour	Major shopping, entertainment,loading/unloading, multipurpose.	Off street, multiuse.
Employee	0-10 "	At offices & other places of employment	Private, within plot, may be in basement.
Overnight	0-15 "	Residential, hotels, Taxis.	Private or public. Some security may be required.

Source:Alexander;The downtown parking system, Traffic Quarterly,1969

7.8.1 Off-Street Parking

In the central areas, every prospective builder should be required to provide parking space within the premises at the rate given in Table 7.21.

TABLE 7.21: WITHIN PREMISE CENTRAL AREA PARKING

i)	One motor car space for every 1000 sq.ft. (93 sq.m) of floor area.
ii)	One motor cycle/scooter space for every 300 sq.ft. (27 sq.m) of floor area.
iii)	One cycle space for every 250 sq.ft. (23 sq.m.) of floor area.

Dimensions of within premises parking spaces shall conform to Table 7.22.

TABLE 7.22:PARKING BAY DIMENSIONS

	Motor Car	Motor Cycle	Bicycle
1. Bay width	8 ft (2.45 m)	2 ft 6 in(75 Cm)	2 ft (60 Cm)
2. Bay length	18 ft (5.50 m)	6 ft (1.82m)	6 ft (1.82 Cm)
* 3. Turning Circle	20 ft (6.1 m)	6 ft (1.82m)	6 ft (1.82 m)
4. Width of single driving lane.	9 ft (2.75 m)	3 ft (91 Cm)	3 ft (91 Cm)
5) Gradient group.	1:10	1:10	1:10

* At a speed of less than 10 kph.
Source: LDA Building Regulations 1984.

The ramp slope may be increased to maximum 1:5 provided that for slopes over 1:10, a transition at least 8 feet (2.45 m) long should be provided at each end of the ramp at one half the slope of the ramp itself.

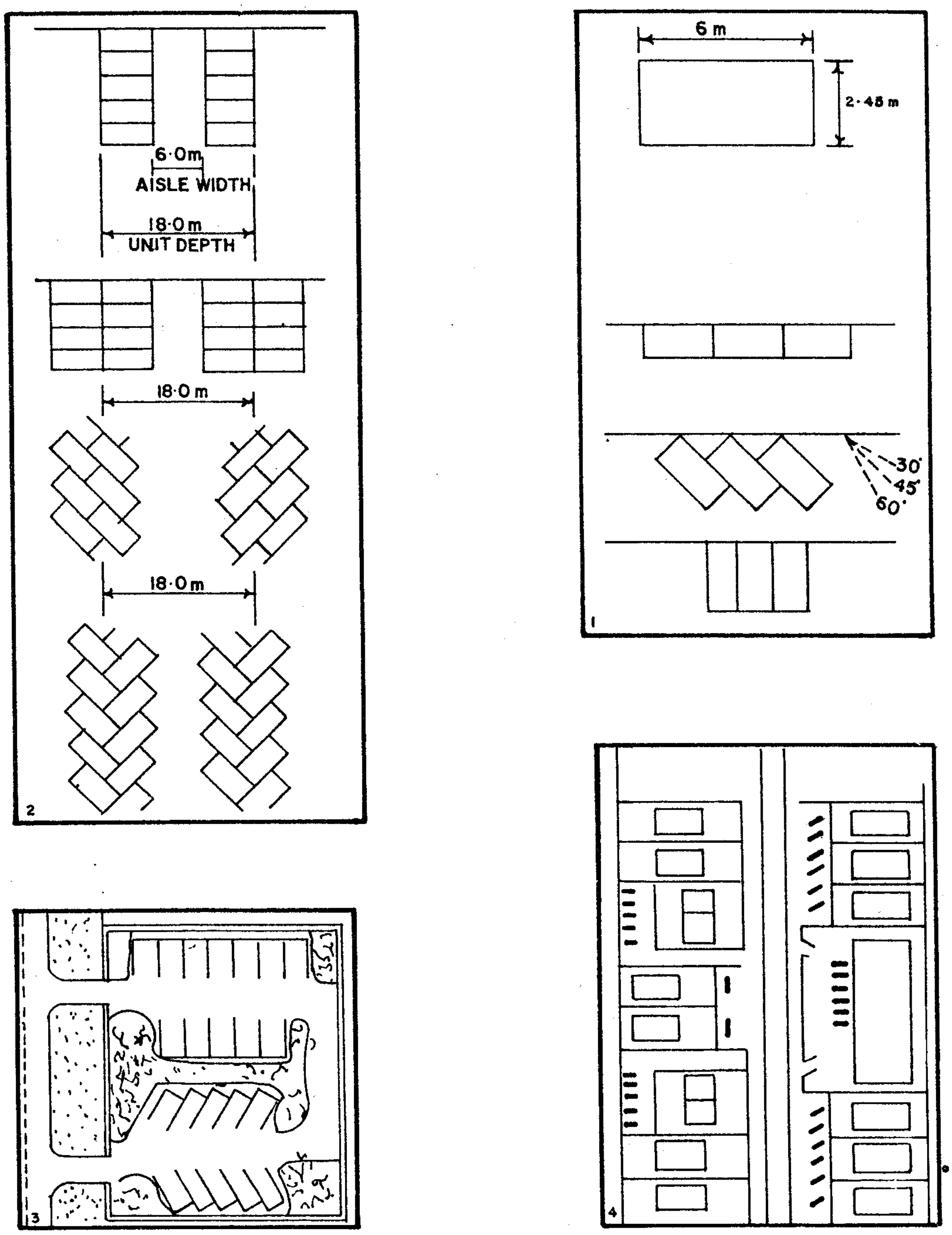
7.8.2 On-Street Parking

For on-street parking, following arrangements of spaces are possible:

i) Parallel parking
ii) Angular parking at 30 degree, 45 degree or 60 degree to the carriageway.
iii) 90 degree to the carriageway.

Combinations of above are also possible in off-street parking spaces. The width of lane or asile between parking rows is generally 6 metres. Lane space in addition to parking bay dimension results in the standard of 24.89 sq.m/car for off-street parking. In hot climate, a series of small car parks are desirable as shown in Fig. 7.12.

Fig: 7.12 **CAR PARKING ARRANGEMENTS**



7.9 PUBLIC TRANSPORT RELATED FACILITIES

7.9.1 Bus Stops

Dimensions for bus/minibus bays are given in Fig. 7.13. Bus stops should not be sited where their use might unreasonably interfere with the flow of traffic or restrict visibility on bends or at junctions.

A bus stop on the approach to an intersection should be far enough to ensure that:

i) A waiting bus does not obstruct visibility leftwards from the main road to the side road or to the right from the side road to the main road.

ii) Traffic wishing to turn left is not obstructed by the bus.

iii) A bus requiring on turn right after leaving the stop has ample room to cross safely to the lane for right turning traffic.

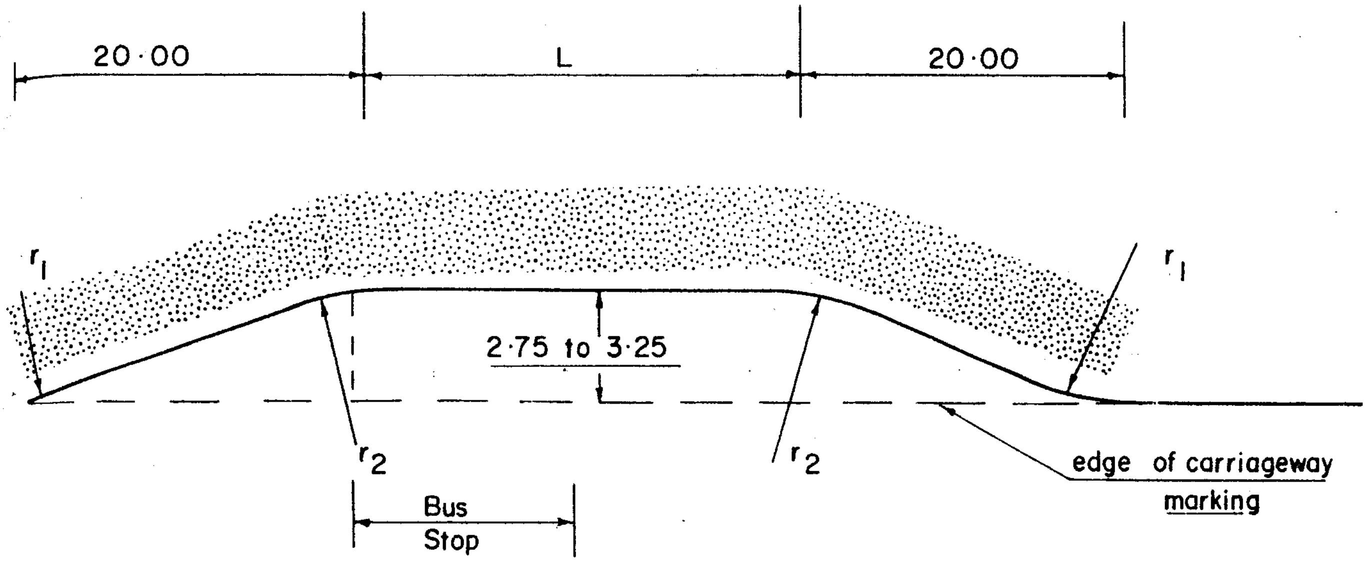
iv) Waiting buses do not interfere with the efficient working of traffic signals or the movement of traffic at a roundabout.

To maintain reasonable operating speeds and minimise interference to other traffic, it is recommended that the distance between bus stops should be as per information provided in Table 7.23. On primary and other important roads with a high degree of access restrictions, the spacing can be increased. Again, a lower spacing than normal may be warranted where the demand is heavy.

TABLE 7.23: DISTANCE BETWEEN BUS STOPS

Areas	Distance in kms.
Downtown	1 - 2
Urban	2
Suburban	2 - 3

Fig. 7·13 LAY OUT OF BAYS FOR BUS/MINI BUS



Notes:

1) All dimensions are in metres

2) r_1 = 18.00 and r_2 = 12.00

3) (i) For a mini bus only, L = 20.00 to 30.00 based on demand

(ii) For a bus only, L=12.00

(iii) For a mini bus/ bus, L=35.00 minimum; the 'bus stop' should be located just after the entry splay, drivers and passengers should be notified of this location by means of road markings and a 'bus stop' sign

4) It is desirable to erect a pedestrian safety fence 0.300 back from the road edge, for the length of the bay. Gaps should be provided:

(i) where bus passengers enter and alight; and

(ii) at one or two other locations for taxi passengers. Gaps should never be located on the splays.

7.9.2 Bus Stations and Terminals

Where many services radiate from the town centre, bus stations may be required to serve both local and long distance traffic. Bus stations should be located at a point where they have easy access to the distributor road system. If the railway station is not in too congested a locality, it may be convenient to locate the bus station nearby. Buses should be able to enter and leave the station without delaying or endangering the traffic - preferably without having to cross or turn right against opposing traffic streams. Unless bus stations and their access are carefully sited, the concentration of bus traffic may overload nearby streets and junctions.

Bus terminals are best located on the city/town fringe, adjacent to the most densely pop. area sector. They should be designed to avoid any need for reversing and with regard to turning circle requirements.

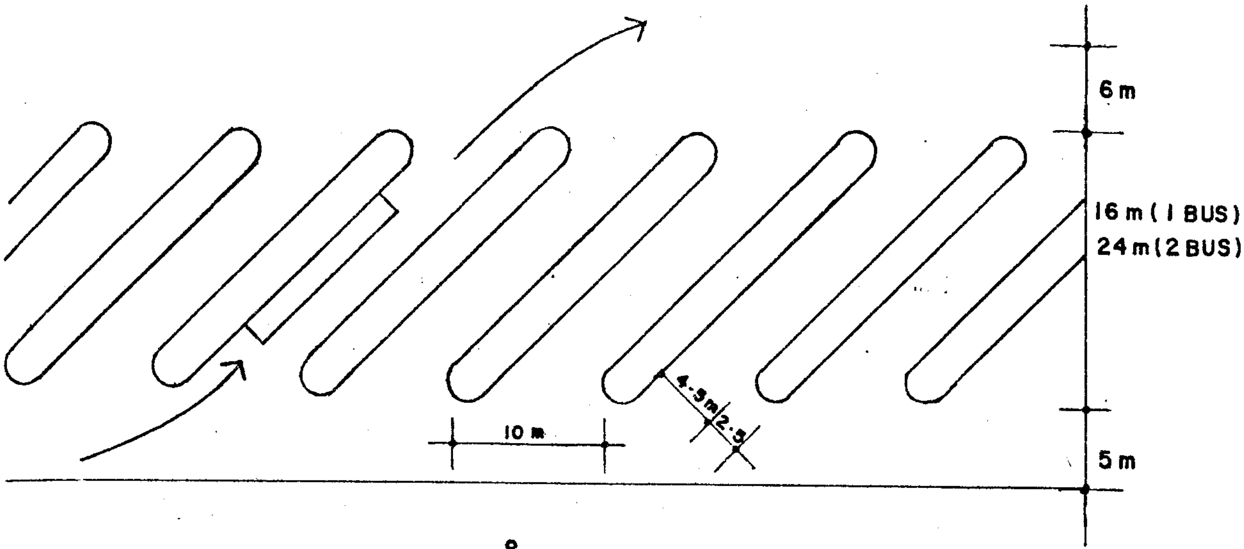
Large factories and offices with special bus services should have space for loading and unloading within their boundaries, with safe access to the highway.

Space requirements for buses depend upon the number and measurement of buses. The relevant measurements of a typical bus (Volvo B57) are:

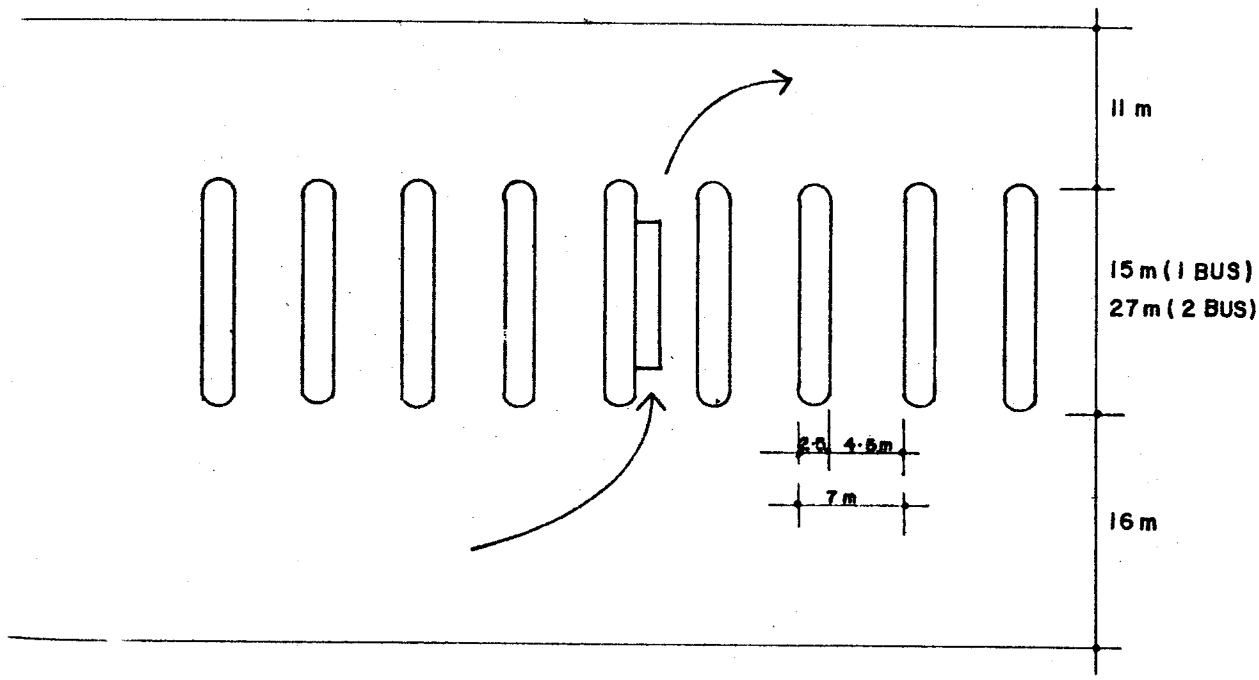
- Total length : 11 metres (max 12 m)
- Total width : 2.5 metres
- Front-rear axle: 8.0 metres (max. 8.6m)
- Turning radius: 7 metres (max 10-12 m)
- Turning width : 5.5 m
- Overhang width: 1.5 metres.

Fig. 7.14 gives a dimensioned terminal arrangement for buses. Depending upon the number of buses, the site areas required for terminals can be calculated. Consideration should also be given to the possible need for car parking facilities for picking up passengers at stations or terminals.

Fig: 7.14 BUS TERMINALS



TERMINAL WITH 45° ARRANGEMENTS



TERMINAL WITH 90° ARRANGEMENTS

7.9.3 Interchanges

At an interchange, the mode changes i.e. bus services providing collection and/or distribution facilities link with rail or bus line-haul* services. Such an interchange is called mode interchange.

There are also "park and ride" interchanges, where car parks are provided on the edges of a central urban area with bus services into the central area.

Interchanges do not yet exist in Pakistan. Planners, however, should know the basic essentials of inter-changes as their need will arise as motorised traffic increases. Some of the basic essentials are:

a) The interchange should be covered i.e. roofed, and preferably fully enclosed.

b) The interchange should provide adequate platform/bay space for the services using it.

c) The walking distances entailed in changing mode should be kept to minimum.

d) The interchange should be located conveniently near the town or city centre.

e) Adequate comfortable waiting space should be provided.

7.9.4 Depots, "Addas" and Stands

7.9.4.1 Bus Depots

The essential elements of bus depots are given in Appendix 7.2. Site standards range from 275 to 325 sq.m/bus.

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*A public transport service has three operational activities i.e. collection of people, line haul and distribution of people. Line haul is the movement between residential areas and work places and shopping areas (or from town to town).

7.9.4.2 **Truck Addas**

Truck Addas should be located on the fringe of the built-up area of the city/town, preferably adjacent to the road through which the bulk of the fruits and vegetables of the urban area are imported. The truck adda should have convenient approach to wholesale markets for foods and construction materials.

Space for truck adda may be provided at the rate of 205 sq.m per truck for the number of trucks anticipated at peak-hour in ten years' time.

Trucks are not allowed to ply in cities between 6 AM to 9 PM owing to traffic hazards. They should also not be allowed to ply in towns during school opening and closing hours.

7.9.4.3 **Rickshaw/Taxi Stands:**

Rickshaw/taxi stands should be provided near CBD, airports, and bus terminals. Otherwise congregation of vehicles for hire at such places causes congestion which delays other traffic. Parking space standard given in Section 7.8.2 alongwith peak anticipated demand may be used for determining stand site requirement.

Furthermore, passenger platforms and street furniture should be used to organise the queuing of rickshaws and taxis, to protect waiting passengers and to guide boarding and alighting passengers.

7.9.4.4. **Tonga/Rehra Stands**

Fig. 7.15 shows a tonga stand accommodating 10 tongas. The outer dimensions of an average tonga are 2.5 m x 4.5 m (including the animal). The cart to cart clearance of 1 metre is recommended between two standing tongas. Along with surrounding circulation path, fodder/water trough area, and rest area for tonga wallas, the total area of the stand works out to 551 sq.m or around 55 sq.m/tonga.

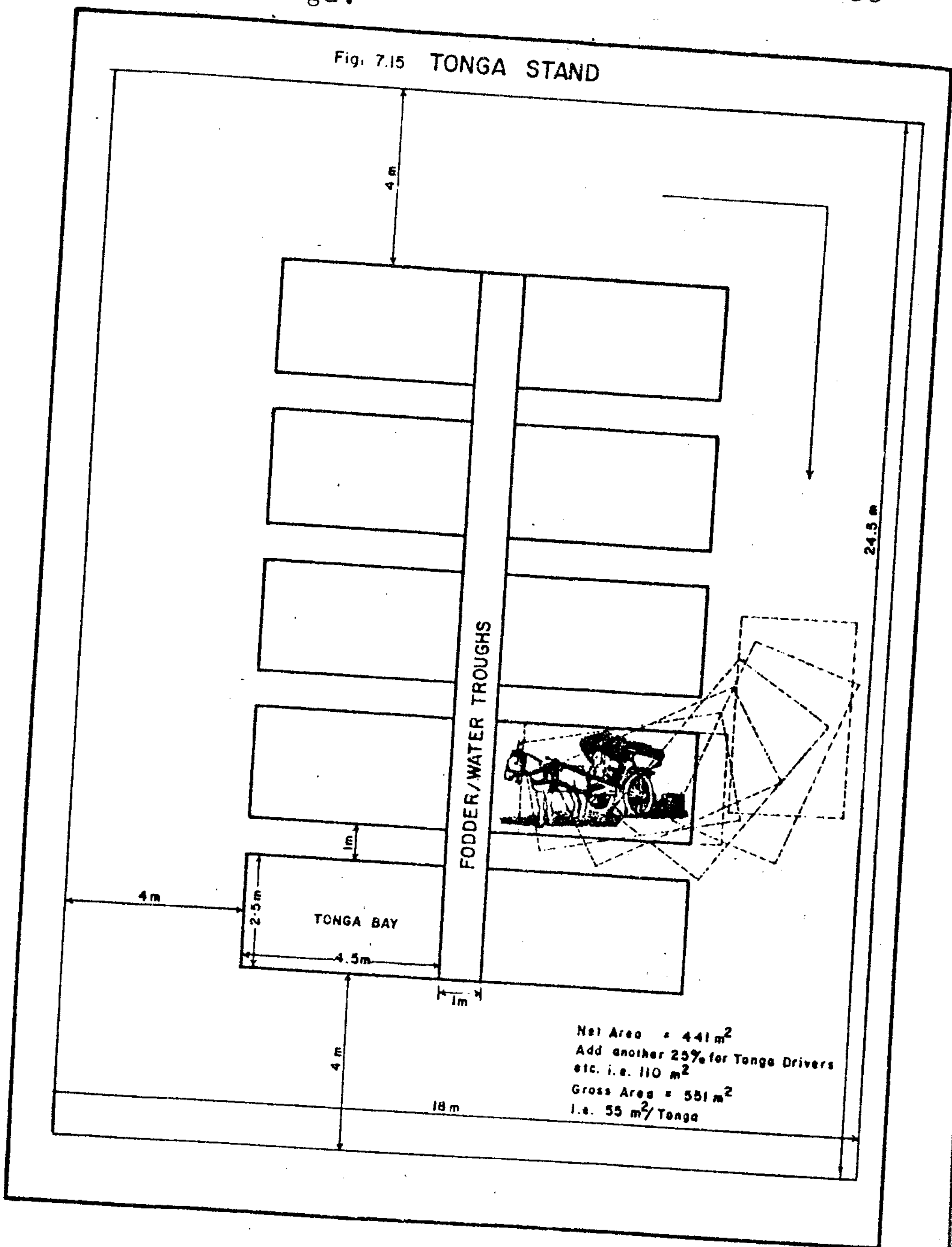

Fig. 7.15 TONGA STAND

CHAPTER -8 : INFRASTRUCTURE

8.0 INTRODUCTION

8.1 WATER

- 8.1.1 General Description
- 8.1.2 Design Requirements
- 8.1.3 Water Treatment
- 8.1.4 Storage

8.2 WASTEWATER MANAGEMENT

- 8.2.1 General Description
- 8.2.2 Wastewater Conveyance
- 8.2.3 Wastewater Treatment

8.3 STORM WATER DRAINAGE

- 8.3.1 General Description
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8.4 SOLID WASTES

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- 8.4.2 Quantities of Solid Waste.
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- 8.4.4 System of Solid Waste Management
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8.5 ELECTRICITY

- 8.5.1 General Description
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CHAPTER 8 - INSTRASTRUCTURE

8.0 INTRODUCTION

Physical infrastructure is defined as public utilities and services necessary for the efficient, comfortable and safe functioning of a community. It comprises of water supply pipes, sewers, storm water channels, power lines/cables, telecommunication and gas lines. The definition also includes water and sewage treatment plants, and refuse collection and disposal systems.

An evaluation of infrastructure reveals that a very large number of people in the country have not been provided these essential utilities and thus left out of the development process. For example, the urban population supplied with water supply and sanitation services in 1983 was 77% and 48% respectively, (Sixth Five Year Plan, 1983). The conditions in rural areas are still worse. However, technical options and other facilities do exist in the country and can be mobilised to rectify the present situation.

Engineering design in Pakistan generally follows standards derived from British and U.S. sources. For water supply and sanitation works, design standards have been mostly adopted from the guidelines laid down by Water Pollution Control Federation (WPCF), American Society of Civil Engineers (ASCE), American Water Works Association (AWWA) and World Health Organization (WHO). Similarly standards adopted for the supply of electricity have been mostly drawn from BSS and the International Electro Commission (IEC) Standards. However, solid waste management in urban areas is a complex area because of the quantity and diverse nature of the waste and funding limitations. Tentative standards have been given in this Manual, but there is need for extensive research before they are formally established. In the following sections, recommended standards for each element of infrastructure are presented.*

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* While the rest of the Manual is in Metric Unit, this chapter has been retained in English Units because of the much greater familiarity of engineers with the latter. Conversion units are given at the end of the chapter.

8.1 WATER

8.1.1 General Description

The source of water for domestic, commercial and industrial supplies, may be ground water or surface water. Surface water sources include rivers, canals, lakes, natural and artificial reservoirs, seas, etc. while ground water may be drawn through tubewells, open wells, infiltration galleries and natural springs.

Ground water for domestic supplies generally does not need extensive treatment except possibly disinfection, while surface waters are mostly treated for the removal of turbidity and pathogenic organisms. For special purposes such as commercial and industrial water supplies, the treatment of raw water may additionally involve removal of hardness, iron and manganese.

After treatment, water is pumped to the distribution network directly or through an overhead reservoir. Natural and artificial reservoirs lying at higher levels than service area may furnish minimum distribution pressures, through gravity flow without pumping.

8.1.2 Design Requirements

Recommended standards and requirements for a safe and sufficient supply of water to the communities are produced in the following sections:

8.1.2.1 Potable Water Quality Guidelines

The guideline values of quality for safe and acceptable water supply as established by WHO (1984) are adopted in most countries. The guideline values pertaining to important physio-chemical quality parameters are shown in Table 8.1.

8.1 WATER - QUALITY GUIDELINES

TABLE 8.1. : WHO DRINKING WATER GUIDELINES

Substance or Physical Property	Guideline value
1. Colour	15 Units
2. Taste and Odour	Unobjectionable
3. pH	6.5-8.5
4. Turbidity	5 Units
5. Total Solids	1000 mg/l
6. Chlorides	250 mg/l
7. Sulfates	400 mg/l
8. Copper	1 mg/l
9. Aluminum	0.2 mg/l
10. Total Hardness	500 mg/l as $CaCO_3$
11. Zinc	5.0 mg/l
12. Iron	0.3 mg/l
13. Manganese	0.1 mg/l

Source : WHO, 1984.

The guideline values,established by WHO (1984) for microbiological quality of drinking water are presented in Table 8.2.

8.1.2.2 Water Demands and Fluctuations

The water used in a community falls mainly in six categories:

a) Domestic Water Demands.
b) Industrial Water Demands.
c) Institutional Water Demands.
d) Water,Unaccounted for.
e) Arboricultural Demand.
f) Fire Fighting Demand.

a) Domestic Water Demands.

The quantities of domestic water consumption depend primarily upon water

TABLE 8.2. : MICROBIOLOGICAL QUALITY OF DRINKING WATER (SOURCE: WHO, 1984)

Category	Unit	Guideline value	Remarks
A Piped water supplies			
A 1 Treated Water entering the distribution system			
Faecal coliforms	number/100 ml	0	turbidity < 1 NTU: for disinfection with chlorine, pH preferably < 8.0; free chlorine residual 0.2–0.5 mg/litre following 30 minutes (minimum) contact
Coliform organisms	number/100 ml	0	
A 2 Untreated water entering the distribution system			
Faecal coliforms	number/100 ml	0	
coliform organisms	number/100 ml	0	in 98% of samples examined throughout the year—in the case of large supplies when sufficient samples are examined.
coliform organisms	number/100 ml	3	in an occasional sample, but not in consecutive samples.
A 3 Water in the distribution system			
Faecal coliforms	number/100 ml	0	
coliform organisms	number/100 ml	0	in 95% of samples examined throughout the year—in the case of large supplies when sufficient samples are examined.
coliform organisms	number/100 ml	3	in an occasional sample, but not in consecutive samples.
B Unpiped water supplies			
Faecal coliforms	number/100 ml	0	
coliform organisms	number/100 ml	10	should not occur repeatedly; if occurrence is frequent and if sanitary protection cannot be improved, an alternative source must be found if possible.

and sanitation service levels.The additional factors which influence the demand are climatic conditions,standard of living,cost and quality of water, etc. A range of demands for various water and sanitation service levels which may be adopted for Pakistan, are shown in Table 8.3. The domestic water demands include the water used for sprinkling lawns etc. The water demand varies on seasonal and hourly basis and the fluctuation depends upon factors like habits of people, size of community etc. for continuous water supply. The maximum day factor which accounts for the seasonal fluctuation and is ratio of maximum day demand to the average day demand, may be taken as 1.5. The peak hour factor which takes into account variation of demand during the day of maximum demand and is ratio of peak hourly demand to the maximum day demand, may be assumed to be 2.00.

TABLE 8.3: DOMESTIC WATER DEMANDS

No.	SERVICE LEVEL Water	Sanitation	Average Daily Demand (gpcd)
1.	House Connection; Full Plumbing	Water borne Sewerage.	40-60
2.	House Connection; Partial Plumbing (with pour flush toilet).	Sewers/covered drains	25-35
3.	Public Standposts	Pit latrines/night soil collection system.	15-20

b) Industrial Water Demand.

Water demands for industries primarily depend upon the type of industry and production process. Detailed analysis for each industry is required to reach at a reasonable figure for design. Table 8.4 provides typical average water demands which may be used for preliminary estimation. The maximum day factor and the peak hour factor may be taken as 1.5 and 2 respectively.

TABLE 8.4: INDUSTRIAL WATER DEMANDS

Type of Industry	Average Daily Demand gallon/100 sft of plot area
Steel (small to medium)	25-35
Chemcial	20-25
Less pollutir	35-40
Less mechani	15-20

c) Institutional Water Demands:

Table 8.5 summarizes average water demands for various institutions. The water demand for hospital include allowance for hospital staff, but the demands for resident staff shall be estimated separately. The water demand for educational institutions is based upon high level of service. For other levels of service the demands shall be decreased proportionally. The maximum day factor and peak hour factor may be taken as 1.25 and 1.5 respectively.

TABLE 8.5: INSTITUTIONAL WATER DEMANDS

Institution	Average Water Demand
Hospitals	100-150 gal/bed/day
Educational Institutions.	10 - 15 gpcd
Offices	10 - 20 gpcd

d) Water Unaccounted for.

The water wasted through leakages or consumed through illegal connections, ranges from 10-30% of average day demand depending upon distribution pressures, quality of construction and operational control. An average figure is 20%.

e) Arboricultural Water Demand.

Arboricultural demand covers the water requirements for parks, gardens, golf courses, play grounds etc. The average arboricultural demand may be taken as 5 gallon per day per 100 sq. ft. of area being irrigated with maximum day factor of 4.

f) Fire Fighting Demand:

This demand is not included in calculations of total water requirements of a community. During fire fighting, water for other uses shall be diverted. For water requirement during fire refer, Section 8.1.4 (e).

8.1.3 Water Treatment

The objective of treatment of water is to produce water that is safe and palatable for human consumption. A comprehensive definition of safe water is; it shall be free of pathogenic organisms, toxic substances, overdose of minerals and organic materials. A palatable water shall be free of color, turbidity, taste and odor and it shall have high enough oxygen contents and suitable temperature.

Two alternate systems alongwith their components which are most commonly employed for domestic water treatment are shown in Fig. 8.1. Both the systems furnish two essential purposes of domestic water treatment i.e. removal of turbidity and pathogenic organisms. The factors governing the selection of an appropriate treatment system include land availability, land value and raw water characteristics. For process description and design criteria of various treatment plant components, refer Appendices 8.1. and 8.2

Area requirements for the two types of treatment plants as function of treatment plant capacity and the detention period for emergency raw water storage (if needed) are presented in Table 8.6. The desirable ratio between the longer and shorter axis of the area reserved for plant ranges from 1.5:1 to 3:1.

TABLE 8.6:AREA REQUIREMENT FOR WATER TREATMENT PLANTS

Treatment System	Area Required (1000 sq.ft)	Minimum Area to be reserved (sq.ft.)
Rapid Sand Filter System	15.Q + 18 Q.T.	5,000
Slow Sand Filter System.	40.Q + 18 Q.T.	10,000

Q = Treatment Plant Capacity, mgd.
T = Detention period for Emergency Raw Water Storage (Equal to Canal Closure Period), days.

The capacity of treatment plant, Q required for the determination of plant area can be calculated as follows:

Let

q = Per capita average day domestic water demand, gpcd. [Sec.8.1.2.2(a)]

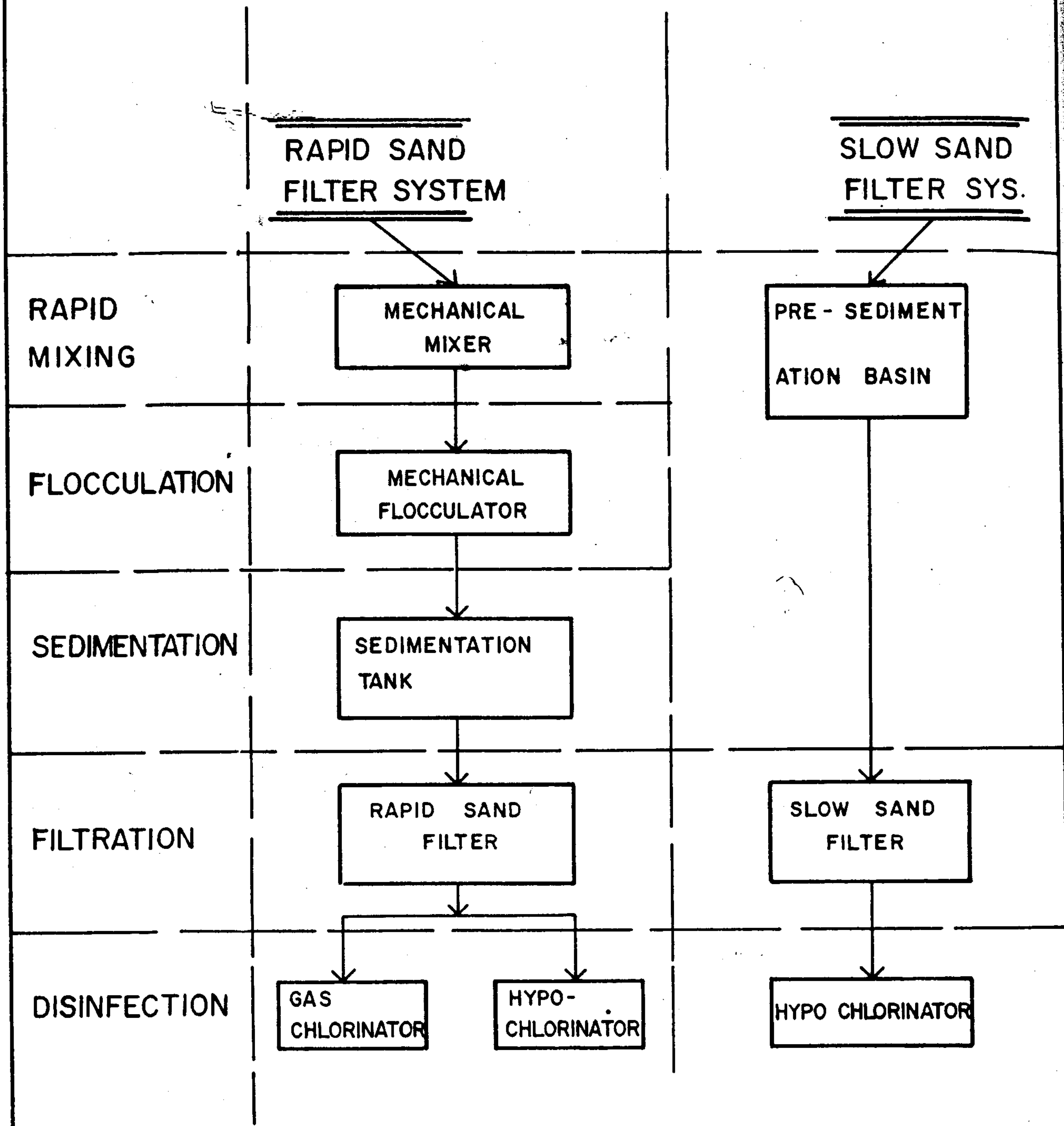


Figure: 8·1 WATER TREATMENT SYSTEMS AND THEIR COMPONENTS

P = Resident Population.

I = Average Industrial water demand, gpd. [Sec.8.1.2.2(b)]

N = Average Institutional water demand, gpd. [Sec.8.1.2.2(c)]

A = Average Arboricultural water demand, gpd. [Sec.8.1.2.2(d)]

Then

$$Q(mgd)=[1.8(qp+N)+1.5I+4.8A]\times 10^{-6}$$

8.1.4 Storage

A classification of various types of storages is illustrated.

- Storage
  - Raw water storage (Prior to Treatment)
  - Treated water storage
    - Overhead Storage
      - Operational Storage
      - Emergency Storage
      - Fire Storage
    - Ground storage (clear water well)

(a) Raw Water Storage.

Storage of raw water may be required to cater for regular supplies during the closure period of the canal. In such a case, this storage reservoir shall also act as a presedimentation basin.

(b) Ground Storage (Clear water well)

During the maintenance period of treatment plant, regular supplies can be maintained by clear water storage. Generally 18% of maximum day demand is provided as clear water storage.

(c) Operational Storage.

Operational storage is provided in overhead reservoirs for balancing the difference between supply and draft. For known water demand patterns and pumping rates, it can be estimated by drawing mass diagrams. In absence of such datas Table 8.7 can be used to find operational storage for ground water supplies (without extensive treatment). For supplies requiring extensive treatment, minimum operational storage shall be taken as 2% of Max. day demand.

TABLE 8.7:OPERATIONAL STORAGE

Operational Storage, % of Max. Day Demand	Pumping Rate,% of Max. Day Demand.
2	150
3	140
5	130
7	120

Source: GAS Manual, 1970

(d) Emergency Storage.

The extent of emergency storage is dependent upon parameters as likelihood of interruption by failure of power or pumping machinery. Recommended value is 2% of max. day demand, which is approximately equivalent to one-half hour of Max. day demand.

(e) Fire Storage.

The minimum fire storage (overhead) shall be provided for duration of 4 hours at the rate of fire flow as presented in Table 8.8.

TABLE 8.8: FIRE FLOW REQUIREMENTS

No.	Type of Area	Fire Flow (gpm)	Remarks
1.	Population less than 100,000	800	Interior urban areas only.
2.	Population more than 100,000	1200	Interior urban areas only
3.	All urban areas.	400	Fringes of urban areas only

Source: GAS Manual, 1970

Overhead storage is generally required both for surface water and ground water supplies. While raw water and clear water storage are generally not needed for ground water supplies. The suitable locations for all these storages are illustrated in Fig. 8.2.

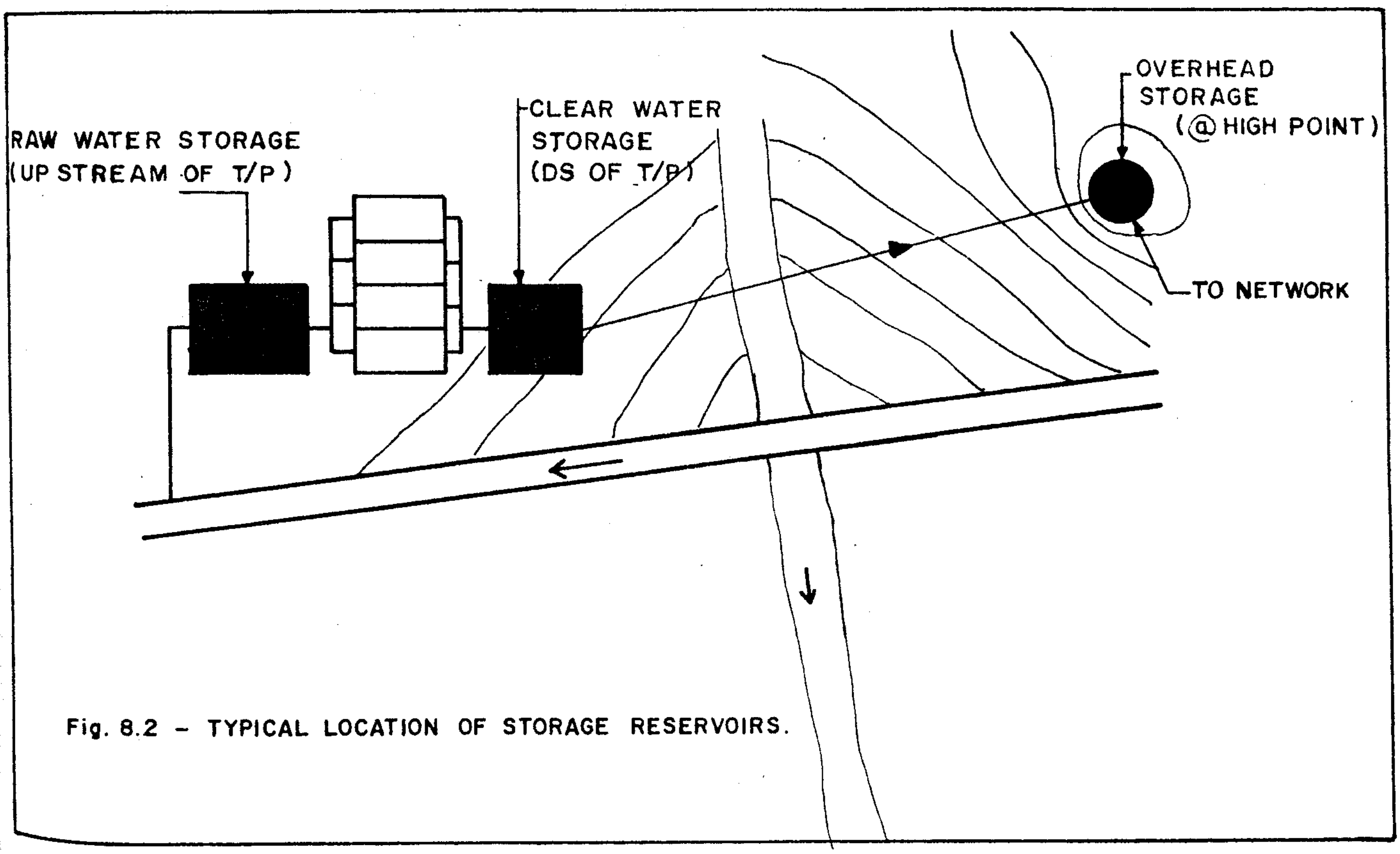


Fig. 8.2 - TYPICAL LOCATION OF STORAGE RESERVOIRS.

8.1.5 Water Distribution

The distribution networks for supplying water to the consumers are mainly classified as branched or tree-like networks and looped networks. Figure 8.3 illustrates typical example of the two types of networks.

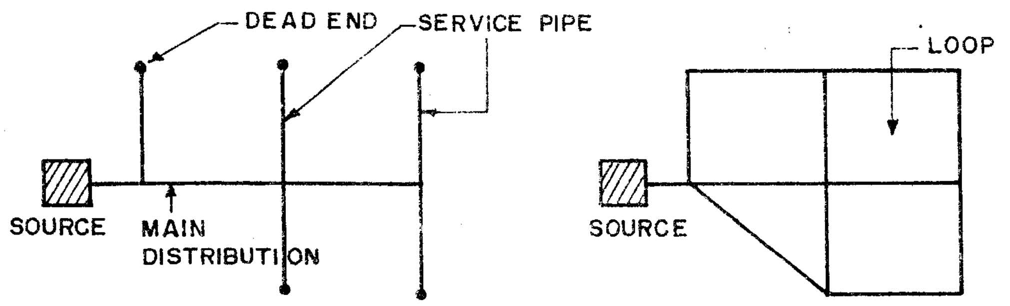


Fig. 8·3

The main disadvantage of branched network is that a defect at any point on pipelines will disconnect the supply of water to all downstream users. While in looped network,each consumer is connected to the source by two alternate paths. Looped networks incur higher capital costs but with less system head loss than the branched one.

The selection of an appropriate water distribution system shall be governed by the water service level which is in turn related to the general living standards. For urban communities where most of the houses are furnished with full or partial plumbing, looped networks is preferred. For small towns and rural communities with low population densities, it is normally economical to serve the consumers with public standposts connected to a branched network.

In addition to pipes, the distribution networks are provided with air relief valves at summits in a pipeline to allow air out, wash out valves at low points to drain the network and sluice valves at appropriate locations to control flow of water.

8.1.5.1 Design Guidelines

(a) Looped Network with Full Plumbing.

1. Minimum Pressure head for single storeyed buildings 35'

   For double storeyed buildings & above dd 12'/storey.

2. Minimum size of service main 3"

3. Cover Over Pipes = Average 3 ft.

4. Area Reservation for supply mains

   i) Along the shoulder of roads

Pipe Dia	Width of Strip
3" to 4"	3'-6"
6" to 8"	4'-0"
10" to 12"	4'-6"
16" to 18"	5'-6"

   (ii) In open fields

   For transmission mains 50'

(b) Branch Network with Public Standposts.

1. Max. population served per tap. 100 persons

2. Max. spacing 600 ft.

3. Min. pressure head 20 ft.

8.2 WASTEWATER MANAGEMENT

8.2.1 General Description

A complete wastewater management system comprises of collection, transport, treatment and disposal of wastewaters received from domestic, commercial and industrial sources. Wastewater management systems which involve the construction of infrastructure facilities can be broadly calssified into two categories:

(a) Centralized Treatment System
(b) Local Treatment System.

(a) Centralized Treatment System.

In this system, wastewater is collected and transported under gravity, by an underground sewerage network to one or more treatment plants. After treatment the effluents can either be disposed of to surface water bodies or can be reused for irrigation, arboriculture and others. It must be of appreciated, however, that reuse of effluents demands a higher effluent quality, which might need some additional treatment than what is required for disposal. The system is illustrated in Fig. 8.4.

The system is mostly employed in cities and urban communities where it may not be possible to accommodate local treatment units (e.g. septic tank) within the household premises. In addition to avoid any direct human contact with the raw sewage, provision of underground sewers fulfills the desired health standards. Stream or Marine water quality standards, (whichever be the disposal sink), can be satisfactorily maintained due to the higher efficiencies (80%-90%) provided by central treatment plants.

Economically, the cost of centralised treatment plant is less than the cumulative costs of local treatment units, due to the economies of scale. However, since all the facilities (treatment, transport and disposal) are part of the infrastructure, this system exerts more financial burden upon public funds, than local treatment system.

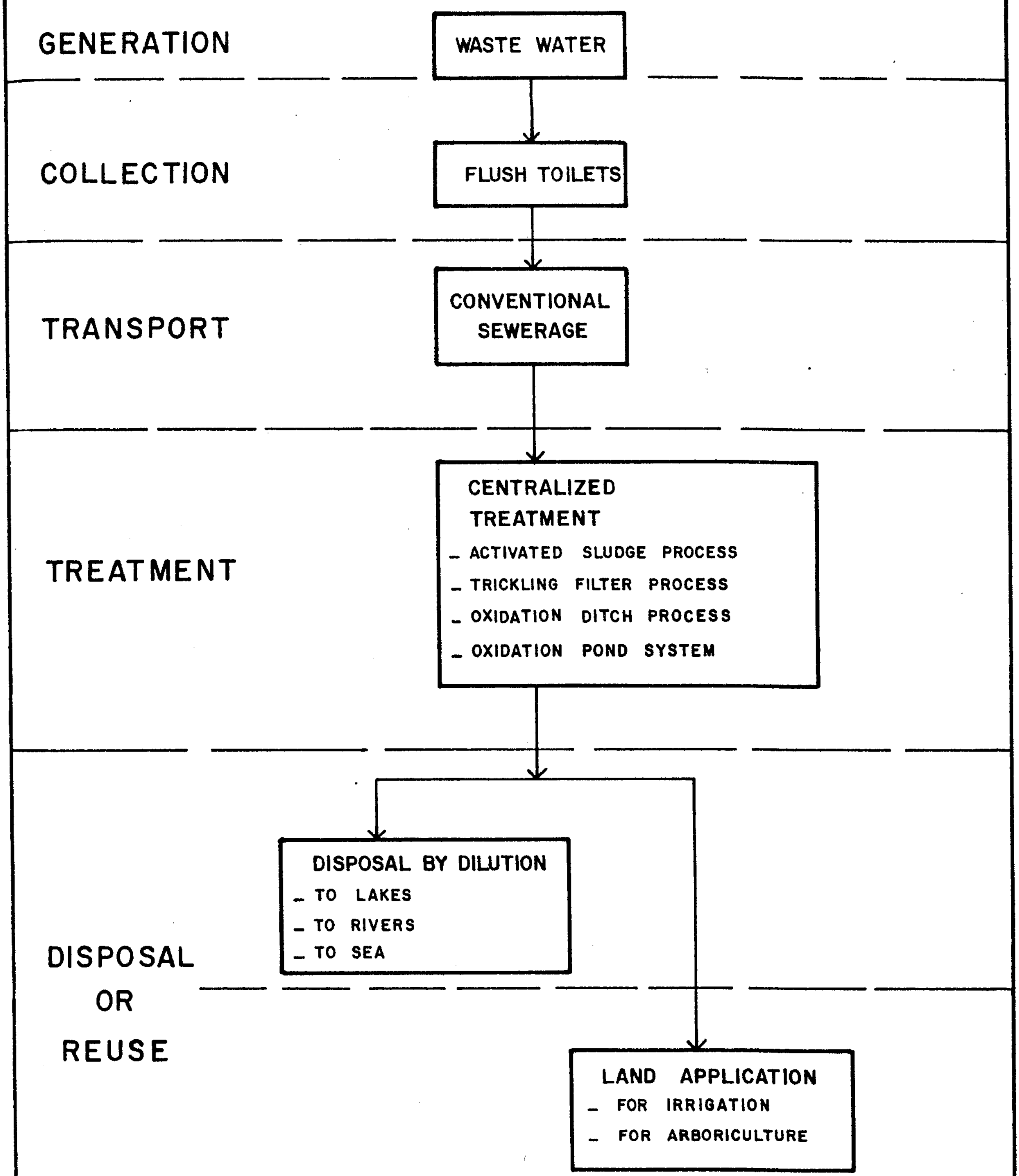


Figure: 8.4 CENTRALIZED TREATMENT SYSTEM

(b) Local Treatment System.

This system precisely,differs from the centralized treatment system in three ways. (Flow diagram is shown in Figure 8.5.)

i) In contrast to the centralized treatment, local treatment is partial (efficiency range from 50% to 60%) , and therefore pollution disposed to the receiving water bodies (streams, rivers etc.) is more.

ii) The treatment (partial) is carried out before the transportation.Since treated effluents are to be conveyed instead of raw sewage to the disposal site, covered drains may be provided instead of conventional sewers, without any health hazard.

iii) Local treatment with covered drains, is essentially a low-finance option for wastewater management because the treatment part is excluded from infrastructure facilities. The system may additionally prove to be a low-cost option (especially for rural areas and communities with low population densities), if the cost differential between the alternatives of underground sewer and covered drains is more than the cost difference between centralized treatment plant and cumulative local treatment units.

The system is bettar suited to rural areas and small towns, where the funds allocated for infrastructure facilities are relatively less, population densities are low and space for setting local treatment units within premises is not so a problem.

8.2.2 Wastewater Conveyance.

As discussed earlier, the raw wastewater shall always be carried to the central treatment site by conventional sewerage but

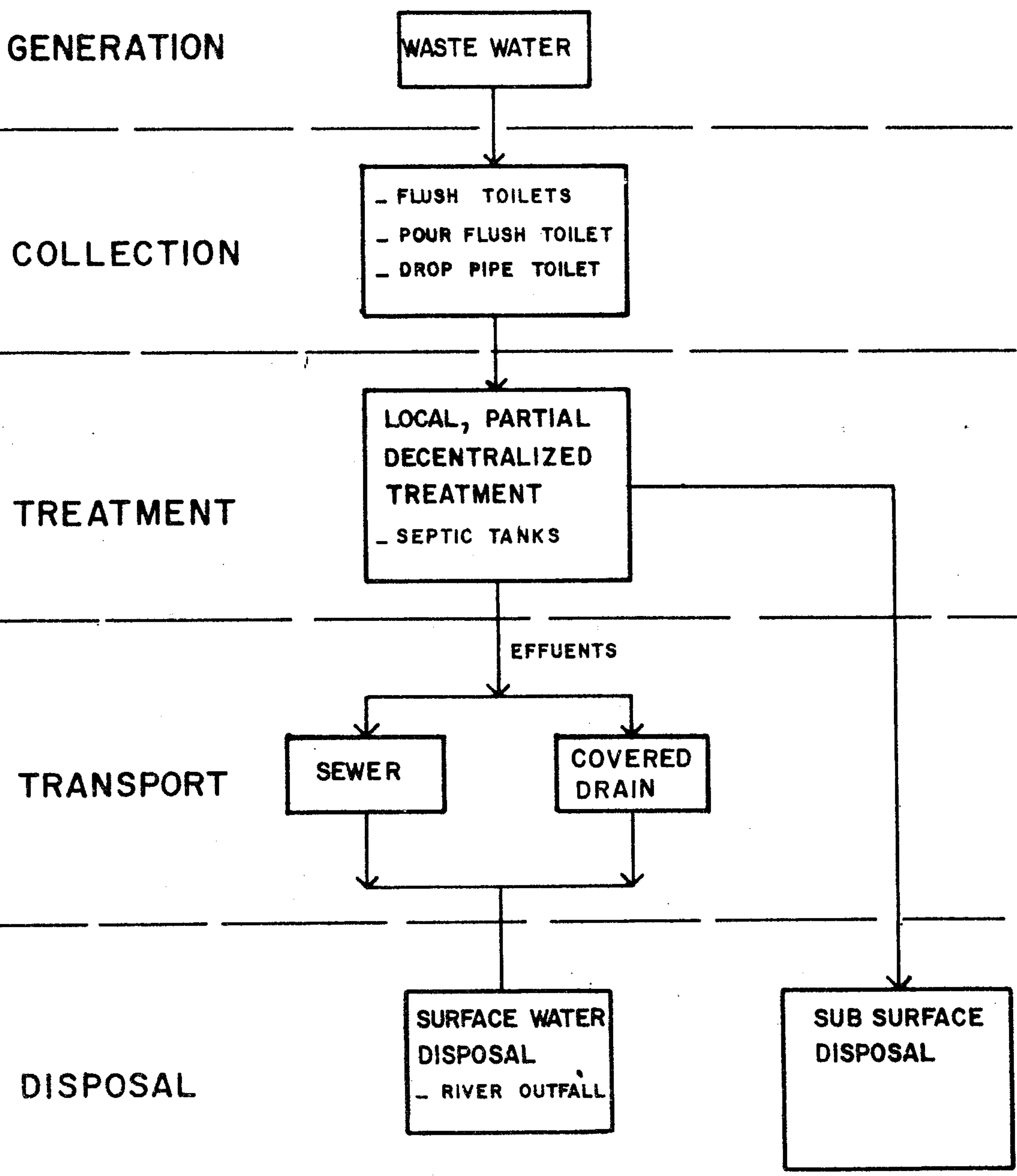


Figure. 8·5 LOCAL TREATMENT SYSTEM

effluents from septic tanks may be conveyed to the disposal site by covered drains.

8.2.2.1 General Description of Conventional Sewerage Institutions.

Wastewater from houses, institutions and industries, is carried by a service connection to the public sewer, sometimes called lateral sewer. The branch sewer receives sewage or domestic wastewater from laterals and feeds it to the trunk sewer which conveys it to the wastewater treatment plant.

Manholes are to be provided at every intersection and at every change in grade, level, diameter or direction. Additionally, in developed areas, manholes shall be spaced so that each plot can discharge its sewage in a manhole. Figure 8.6 shows a typical layout plan for sewerage.

8.2.2.2 Design Guideline for Conventional Sewerage.

- Minimum dia of pipe = 9 inch
- Minimum depth of cover = 2.5 ft.
- Manhole spacing:

Pipe Dia (in.)	Max.spacing (ft.)
9	150
12	200
15-24	250
27-39	300
42-60	400
above 60	500

- Area Reservation along street shoulder.

Pipe Dia (in.)	Width of Reserved Strip (ft.)
9-27	6

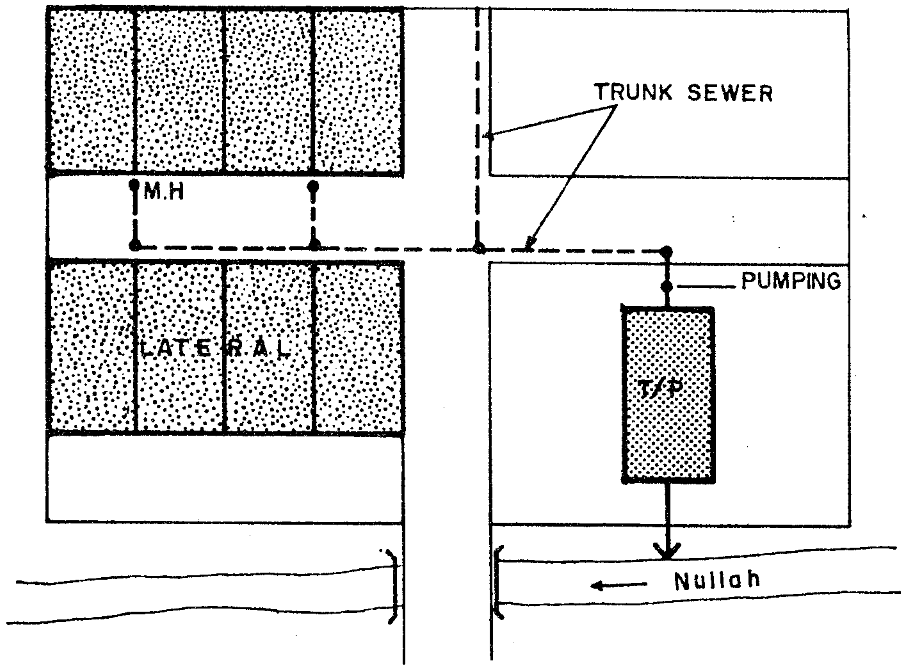


Fig. 8·6 – TYPICAL LAYOUT PLAN FOR SEWERAGE

8.2.2.3 Effluent Drains.

Drains for septic tank effluent may be rectangular or trapazoidal in cross-section, depending upon the space available for the purpose. Trapazoidal drains are more economical and efficient while rectangular drains need less space. Only the soil waste (wastewater coming from flush toilet) need to be treated in septic tank while the sullage (washwater, water used in kitchen), may be discharged directly to the drain after passing through traps. The drains may be constructed with brick masonry or concrete whichever is economical and more desirable in a particular situation.

The typical network of effluent drains consist of lateral, collection and transmission drains. The lateral drains collect effluents from the houses. The collection drains receive effluents from several lateral drains. The transmission drain conveys effluents to the point of ultimate disposal.

Area reservation for drains, along the shoulder of road is as follows:

Lateral drain	2' on both side of street
Collection drain	2-3 ft.
Transmission drain.	3-4 ft.

8.2.3 Wastewater Treatment

The objectives of wastewater treatment are as follows:

(a) Health criteria: To protect public health by reducing pathogenic organisms and toxic substances in wastewater before disposal.

(b) Ecological criteria: To prevent pollution of natural waters, by reducing BOD of wastewater.

(c) Recreational criteria: To avoid nuisance and septicity in natural waters.

The quality control requirements for treatment facility are governed either by receiving water standards or by effluent standards. Receiving-water standards are difficult to monitor and more difficult task is to allocate the responsibility of pollution when several pollutors are discharging their waste to the same receiving water. Effluent standards are easy to monitor whereby the limiting value of parameters defining the effluent quality are set. Secondary effluent standards as promulgated by U.S. EPA are produced in Table 8.9.

TABLE 8.9: SECONDARY EFFLUENT CRITERIA FOR PUBLICLY OWNED TREATMENT FACILITIES

Parameter	Monthly Average	Weekly Average
BOD, mg/1	30	45
SS, mg/1	30	45
Fecal coliform bacteria, number/100 ml	200	400
pH	Within range of 6.0 to 9.0	

Source: ASCE & WPCF, 1977.

The degree of treatment required depends upon the characteristics and flowrates of waste water, receiving-water standards to be met and assimilative capacity of the receiving-water.

8.2.3.1 Wastewater Treatment System (Centralized)

Wastewater treatment processes are generally classified as primary, secondary and tertiary. A combination of these processes forms what we call a treatment system.

(a) The primary or physical treatment processes include screening, comminution, grit removal, floatation and primary sedimentation. Most commonly employed processes are coarse screening, grit removal and primary sedimentation for the removal of coarse solids, grit and organic suspended solids from the wastewater respectively.

(b) The objective of secondary or biological treatment which constitute by far the most important treatment process, is to remove dissolved organic matter from the wastewater. Various alternate processes are available. Most commonly used are conventional activated sludge process, trickling filter process, oxidation ditch process and waste stabilization pond system.

(c) The purpose of tertiary treatment is to improve the quality of effluents received after biological treatment. Some of the processes employed are microstraining, biofiltration, maturation pond and disinfection. A tertiary treatment may be required when strict water quality standards are to be maintained in receiving waters. Generally, tertiary treatment is not necessary so it is not discussed in detail hereafter.

Suspended solids which settle in primary and secondary clarifiers are called sludge. A part of secondary sludge is recycled in activated sludge and oxidation ditch process. The remaining part of secondary sludge is generally mixed with the primary sludge and is disposed of for land application after proper treatment. The most common methods employed for sludge treatment are thickening, anaerobic digestion and drying.

Figure 8.7 shows the flow diagram for four most commonly used treatment systems for centralized treatment plants. A brief description of each follows:

1) Activated Sludge Process (Conventional).

After the physical or primary treatment, the settled sewage is fed to aeration tank where oxygen is supplied either by mechanical agitation or by diffused aeration. The aerobic bacteria present in the tank removes dissolved organic matter from wastewater, by converting it to new bacterial cells and mineralized gases such as CO_2, NO_3, SO_3 etc. The new bacterial cells are removed in the secondary clarifier, in the form of "activated sludge" by settling. In order to maintain high cell concentration, most of the sludge is recycled from clarifier to the aeration tank inlet. The remaining secondary sludge is mixed with the primary sludge and is disposed of after treatment.

2) Tricking Filter Process.

The trickling filter is a circular bed of coarse aggregates. The settled sewage is distributed over the bed and trickles down over the surface of aggregates. On these surfaces, a microbial film is developed and the bacteria which constitute most of this film, absorb organic matter from the wastewaterand convert it to new bacterial cells and mineralized gases. With the production of new

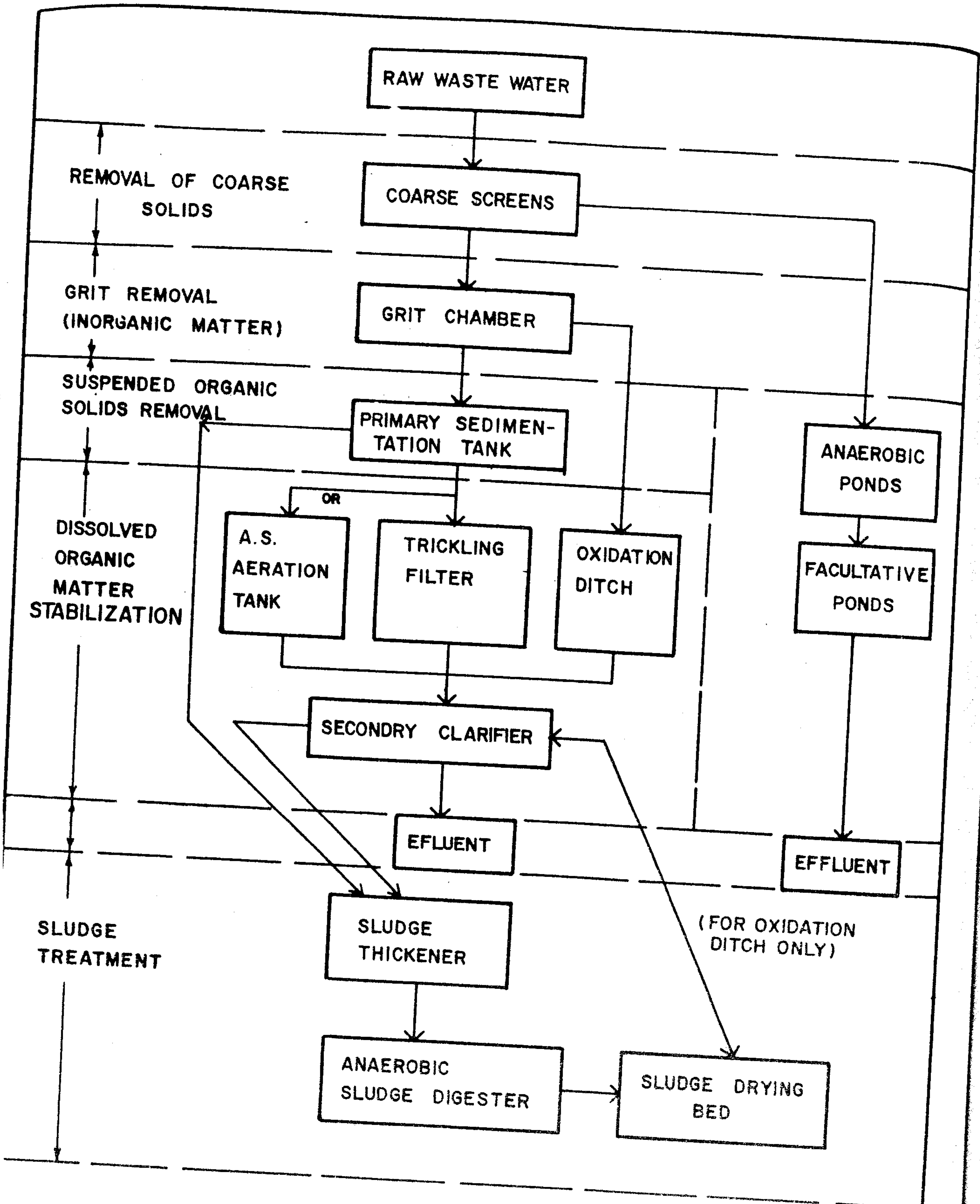


Figure : 8·7 DOMESTIC WASTE WATER TREATMENT SYSTEMS cells, the microbial film grows. Some of the new cells are washed away from the film by hydraulic action of trickling wastewater. These cells are separted from the wastewater stream in secondary clarifier, by settling in form of humus sludge. The clarified effluent is discharged to the receiving water body and humus sludge is pumped to the sludge treatment unit.

3) Oxidation Ditch System.

It is a modification of conventional activated sludge process. Its essential features are long retention times, continuously recirculating flow and that it receives screened and grit removed sewage. Primary sedimentation is generally not necessary. The oxidation ditch is a long channel usually oval in plan and ditch liquor is aerated by one or more cage rotors. The sludge production is less as compared to conventional activated sludge process.

4) Stabilization Pond System.

Waste stabilization ponds are large shallow basins in which raw sewage is treated entirely by natural process, involving both algae and bacteria. They are the most important method of sewage treatment in hot climates. However, since the rate of oxidation is slow so large areas are required for their construction. Their specific advantages are low construction and maintenance cost, simple operation and no sludge management problem.

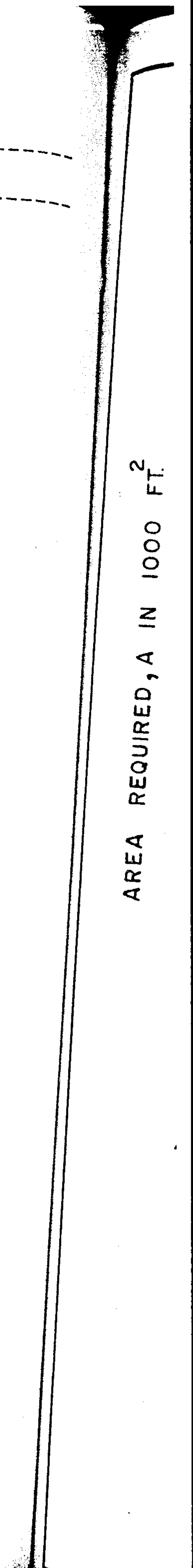
The choice of a treatment system is affected by the evaluation of numerous factors including the area available, proximity to build-up areas, topography versus hydraulic requirement and availability of qualified operating personnel. Figure 8.8 presents the area requirement for various treatment systems, as function of the population. For institution and industrial settlements the equivalent population may be found on the basis of pollutional load. For process description and design criteria of various component of waste water treatment plants, refer Appendices 8.3 and 8.4.

8.2.3.2 Local Treatment Unit

Most commonly used unit for local treatment is septic tank. Although, local treatment units are not a part of infrastructure but design guidelines for septic tank are provided here so that the planner may consider them for sizing the residential or commercial plots.

Setback requirements:

Distance from	Distance ft.
Building	5
Property boundary	5
Wells	100
Water pipe	9
Area required for 7-persons (only soil waste).	25 sq.ft.



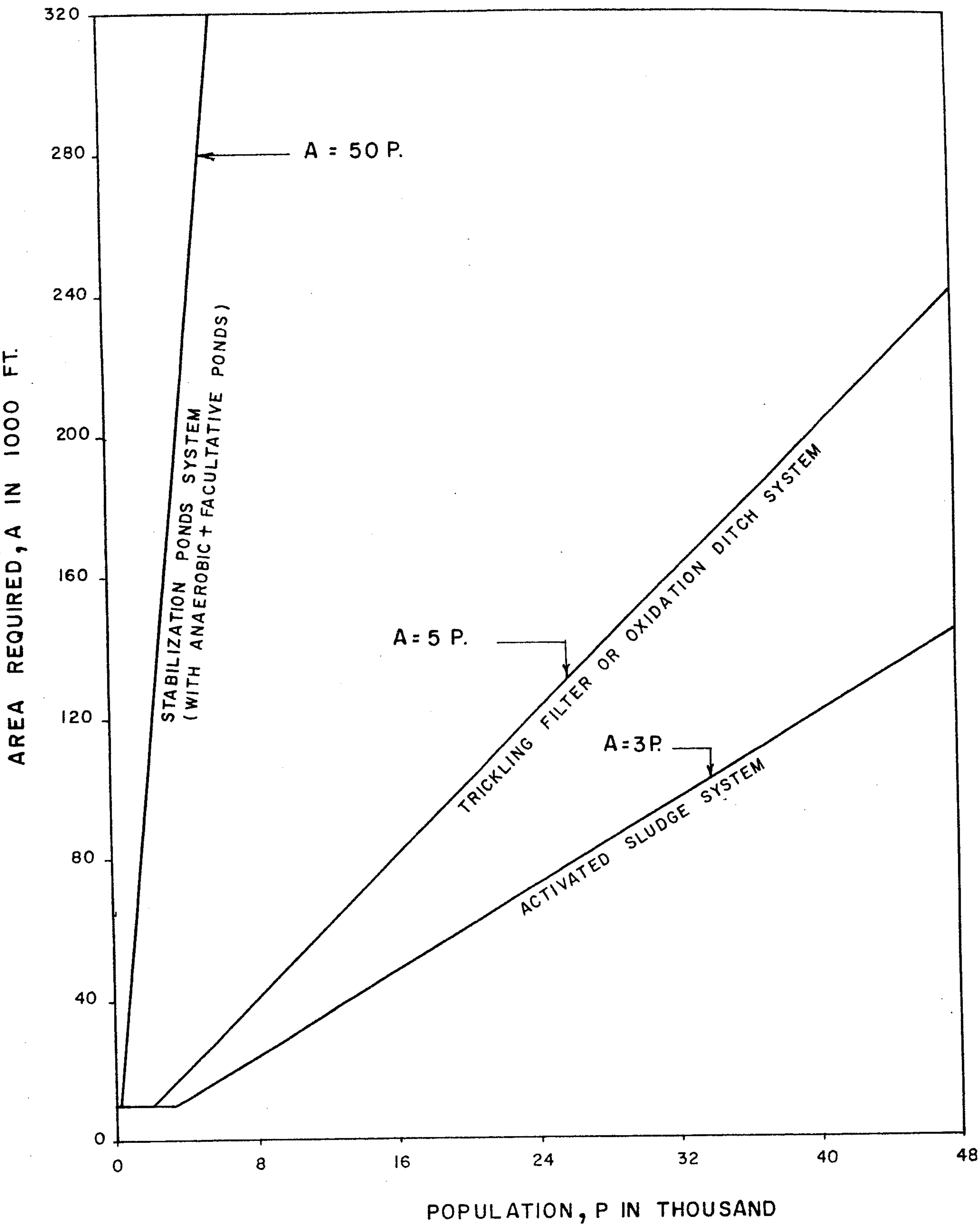


FIG. 8·8 AREA REQUIREMENT FOR VARIOUS WASTE WATER TREATMENT SYSTEMS

8.3. STORMWATER DRAINAGE

8.3.1 General Description

The function of storm water drainage is to intercept the surface run-off from roofs, yards, roads etc., carry it safely to the down stream of the area and discharge it to the natural water 'odies. The design of drainage system, therefore, depends upon rainfall intensity, storm duratio and frequency, extent and characteristic of area to be drained. Generally, open drains are provided for surface water drainage. Small interception drains may be rectangular in cross section but bigger transmission drains shall preferably be trapazoidal. Additionally, where an open drain crosses the road, culverts are provided. For road drainage, some times catchpits are provided along the curb of road, which are connected to the drain running along roadside or in medium divider.

8.3.2 Design Criteria

(a) Rainfall.

Rainfall intensity-duration curves for different return periods,are available only ror Karachi, Lahore and Islamabad. These curves may be used to find design rainfall intensity, for areas lying near these regions.

Return period:

For smaller urban Sectors	= 1/2-1-2 years.
For major urban Sectors	= 1-2-3 years.
ror high value districts/ urban Sectors.	= 3-5-10 years

(b) Design Storm.

1. Quantity of stormwater.

Two general methods available for the

determination of peak storm runoffs i.e. Rational Method and Hydrograph method may be employed depending upon the extent and nature of data available.

2. Runoff Coefficients.

Type of Surface	Coefficient
Roofs	0.70 - 0.95
Pavements	0.85 - 0.90
Parks, Gardens	0.05 - 0.25
Residential Area with detached houses.	0.25 - 0.50
Densely built-up area.	0.70 - 0.90

(Source: Stephenson, 1981.)

Appendix 8.5 gives the hydraulic design criteria for storm water channels.

8.4 SOLID WASTES

8.4.1 General

Solid wastes are generally taken to include all non-gasseous, non-liquid wastes resulting from the wide range of community, industrial, commercial and agricultural activities. Effective solution to the problems of solid wastes collection, treatment, conversion, re-use and disposal is a basic health requirement, otherwise indiscriminate dumping of these wastes in a populated community will cause many serious health hazard problems.

8.4.2 Quantities of solid waste

The amounts of solid waste generated by a community depend upon the socio-economic level of that community and such amounts by each person each day are increasing as a result of social, economic and technological changes. Careful sampling and actual weighing in the U.S.A. have indicated a figure of 1.5 kg. to 2.5 kg per capita-calendar day, with the annual increase between 1% to 2% per year. Similar trends have also been observed in Western Europe although the quantities are roughly one half to two third of those in the U.S.A.

Considering the local socio-economic levels of our urban communities such amounts are likely to be much less than those indicated above. Some studies carried out for Karachi, Hyderabad and Lahore have indicated a generation rate of 0.62 to 1.00 kg person per calendar day, and such figures for other urban areas are likely to be less. A figure in the range of 0.5 to 0.8 kg per capita per day may be adopted, depending upon the socio-economic level of the urban centre.

8.4.3 Characteristics of Solid Wastes

The most significant characteristics of solid waste are density, moisture, combustible and compostible contents and thermal values and each of these characteristics varies widely. The characteristics are mainly affected by seasonally and locally variable type of collection system, standard of living, extent and type of commerce and industry involved, prevailing climate and other considerations. The density of solid waste is an important criterion in the context of planning for collection system. Its range reported in the USA is 89 kg per cubic meter to 267 kg per cubic meter with an average of 128 kg per cubic meter.

Average figure for Europe is about 230 kg per cubic meter. No such estimates are available for the local conditions. The density can be reasonably estimated as 250 kg per cubic meter and is likely to decrease with increase in the standard of living.

8.4.4 System of Solid Waste Management

The system of solid waste management can be divided in the following operations:

a) Storage
b) Collection
c) Disposal

8.4.4.1 Storage

The refuse (solid waste) is temporarily stored on the premises and this requires adequate number of suitable containers to store the refuse accumulation between collections. The weight and size of this container is to be kept within the limits that can be easily and functionally handled by the collection crew. Weight should preferably not exceed 30 kgs. Where mechanical lifting and dumping is involved this weight can be increased manifolds. Light weight plastic containers are fast growing in the developed countries and can be adopted under the local circumstances. Such type of container should receive attention because it is low cost, coupled with its good appearance, cleanliness, noiselessness and reasonable resistence to chemicals and fire.

For multi-storeyed housing units, and large blocks of flats,noiseless, water proof, fire proof and rodent proof,chutes discharging by gravity into large containers in the basements or ground are to be preferred.

8.4.4.2 **Collection**

The frequency of collection will depend on the quantity of refuse, time of the year and others. In business districts, refuse should be collected daily except on Fridays while in residential areas twice a week, may be the norm during warm months of the year, whereas once a week should be the maximum permissible interval. Collection by tied-body open truck with a convenience or metal cover is to be gradually replaced by automatic load truck with packer to compact refuse dumped in the truck during collection. Compaction-type bodies have twice the capacity of open trucks. Low level closed-body trailors to eliminate the strain of lifting cans are also available now. Such type of collection trucks have capacities of about 20 to 25 cubic meter, although high in capital cost, have much lower maintenance and amortization cost.

8.4.4.3 **Disposal Systems**

Refuse disposal methods include open dumping incineration, grinding and discharge into natural stream, sanitary fill, dumping at sea, reduction and fermentation or biological digestion. Among these methods, three generally accepted methods of treatment and disposal of solid wastes are; sanitary land filling, composting and incineration.

a) **Sanitary Land Fill**

The sanitary land filling system of refuse disposal is simple, effective, inexpensive and most desirable under the local circumstances. A properly engineered, managed and controlled sanitary land filling operation can be successful and economical besides meeting public acceptance and health hazards and in addition is capable of reclaiming non-useable land for recreational and other development.

While selecting the site for sanitary land fill, following main points should be carefully considered:

- o Area to be as near as possible to the populated fringe.
- o Purchase price of land is to be within reasonable limits.
- o Type of top soil and special surface condition should be investigated.
- o The water table is to be at least 3' to 4' lower than the bottom of land fill.
- o All weather access road leading to the disposal area is desirable.

The land area required for a landfill is estimated at half acre to one acre a year per 10,000 population with the depth of compacted refuse at 6 feet.

A typical method for sanitary land full operations by light tractor is shown in Fig. 8.9.

b) **Composting**

Composting is the aerobic thermophilic decomposition of solid wastes to produce a relatively humus like material with principle bye-product as carbondioxide, water and heat. The end product is a good soil builder or conditioner containing small amounts of major plants nutrients. The system is relatively costly and is generally not adopted in developing countries. Such plants are normally not able to cover its capital service cost and expenses through income from sale of compost and salvage.

c) **Incineration**

Incinerators are designed to burn refuse under control, nuisance free conditions at relatively high temperatures which result in an inert organic-free residue that can be readily disposed of in a landfill. The capital as well as operating costs are relatively higher and are increasing as environmental standards rise and equipment becomes more complex and expensive to purchase and operate.

8.4.5 Existing Practices in the Country

The prevalent system of solid wastes management in our urban areas consists of bins and filth depots for communal storage. Trucks, tractor trolleys and bullock carts are used to transport waste to transfer stations from where the waste is dumped without cover in low lying areas/swamps in and around the cities. The system is, therefore, totally unhygienic and is quite inadequate in almost all the urban centres. Keeping in view the local circumstances, in terms of technological and economic constraints, the deficiences are to be identified and suitable alternative adopted. Some studies although with limited scope have been carried out for Karachi and Lahore. Recommended standards have been based on these studies.

8.4.6 Recommended Standards

Recommended standards for solid wastes management are given in Table 8.10.

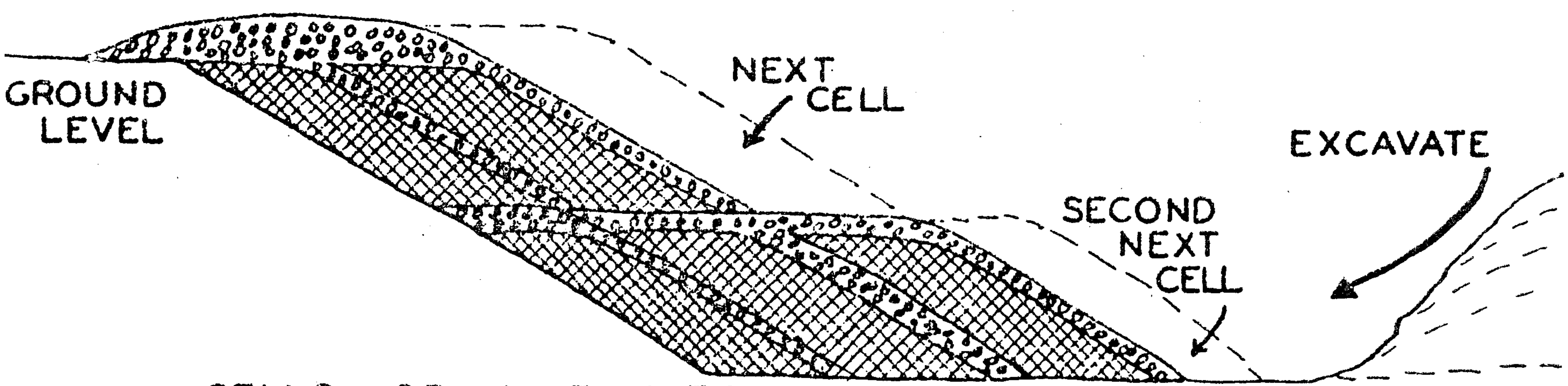
TABLE 8.10: SOLID WASTE MANAGEMENT STANDARDS

Sr.No.	Description	Standard
1.	Generation Rate	0.5-0.75-1 kg/capita-day
2.	Density	200-250-300 kg/cu.m.
3.	Storage Bin(Container)	25-30-40 kg.
4.	Pick-ups	Business Centres- Daily except on Fridays. Residential - Twice a week
5.	Sanitary Landfill	0.5-0.75-1 acre per year per 10,000 population.
6.	Total area requirement	For minimum 1 year period preferably 5 to 10 years.

Fig: 8·9

OPTIONAL SANITARY LANDFILL METHODS IN SMALL COMMUNITIES

LONGITUDINAL CROSS SECTION



CELLS OF HALF LIFT HEIGHT PROVIDING OPERATIONAL CONSERVATION

8.5 ELECTRICITY

8.5.1 General

Electricity plays a vital role in the life of modern man. The technological leap in this century,its speed, sophistication and miniaturization of components would not have been possible without this clean form of energy. Per capita consumption of electricity is in fact considered a reliable indicator of economic development. At 190 KWH/annum per capita, (1984), consumption of electricity in Pakistan is 1/10th the world average and is low even by developing country standards, barring the least developed group of countries. The demand for electricity is increasing at a fast rate, between 8-11% per annum (WAPDA, 1979). Forecasts for 2000 AD range from a high (unrestrained) peak load of 20,250 MW to restrained peak demand of 13,300 MW (NESPAK-HARZINT,1983). Generation and transmission to meet the higher peak system load is estimated to cost Rs.584 billion in 1982 prices (WAPDA,1983). As this expenditure exceeds 68% of a generous estimate of the total public sector resource pool (1983-2000), for all development purposes (PEPAC,1983), a severe shortfall is inevitable. Thus load-shedding and delayed availability of electricity to new area development schemes will be a persistent feature during the currency of this Manual. From this angle, area development schemes should be preferably located within convenient distance of existing/planned grid stations with excess capacity. Tentative locations of planned grid stations can be obtained from Planning Department, Power Wing, WAPDA, Lahore.

The system of electricity supply constitutes three distinct elements:

i) Generation
ii) Transformation and Transmission.
iii) Distribution.

8.5.2 Generation

Electricity is generated by three main processes:

8.5 POWER SUPPLY

Mode		Average full life cost/kwh(1984)
a)	Hydel	< Rs.0.10(Rs.0.02-0.03 at Tarbela/Mangla)
b)	Thermal	Rs.0.36-0.40
c)	Nuclear	Rs.1.25 at Kanupp;likely Rs.0.25 at Chashma.

Despite huge initial investment, hydel generation is the cheapest mode of electricity production. As of January,1984, WAPDA System (including KESC) comprised of a mix of Hydel (64%), and Thermal (36%) stations with a total installed capacity of 4800 MW. Firm hydel capacity varies seasonally with river regimes, and necessitates spare installed capacity of thermal stations to meet the November- December and March-May deficits. All generating stations are interconnected through a network of transmission lines and grid stations, called the National Grid.

In remote areas not connected to National Grid, local generation is through:

d) Diesel Sets Rs.1.5 - 2/kwh

Because of the rising cost of fuel, while there have been technological break throughs, the following can also be considered for local generation in remote areas:

e) Photovoltaic array Rs.9-19/kwh;likely to come down

f) Wind rotors with battery storage Rs.1-14/kwh,depending on system.

g) Micro-hydel Rs.1-5/kwh

The choice will depend on local conditions. Wind farms are feasible only in Maritime climatic zone, while micro-hydel would be limited to small perennial streams in Northern Areas, and mountainous tracts of NWFP.

In view of the inevitable shortfall in generation, the Planner may consider alternative sources of energy for lighting purposes,such as Bio-gas Plant.

8.5.3 Transmission and Transformation

Electricity cannot be stored. After generation, the electricity is despatched to various load centres (cities), by means of transmission lines called feeders. Greater potential (voltage) is required to transmit the load to distant centres, within acceptable line losses. Voltage is stepped up in the generating station yard and then stepped down in load centres (called grid stations) for further distribution. This stepping up and stepping down of voltage is called transformation.

The voltage (pressures) at which the electricity is transmitted have been standardised into the following categories:

TABLE 8.11 : STANDARDISED VOLTAGE CATEGORIES

Category	Voltage
Extra High Voltage (EHV)	66KV,132KV,220KV, 500KV
High Voltage (HV)	11KV, 33KV
Medium Voltage (MV)	440 V
Low Voltage (LV)	220 V

Extra high voltages are suitable only for transmission and not for distribution of power. Grid (transformation) stations are generally located in the outskirts of cities (load centres).

8.5.4 Distribution

All outgoing feeders, mostly at 11 KV (and also at 0.4 KV), which take off from any Grid Station are called Distribution Lines. These distribution lines feed various type of consumers or a group of consumers in urban and rural areas. As a rough rule of thumb, 11 KV Line can be extended to a maximum distance of 11 miles.

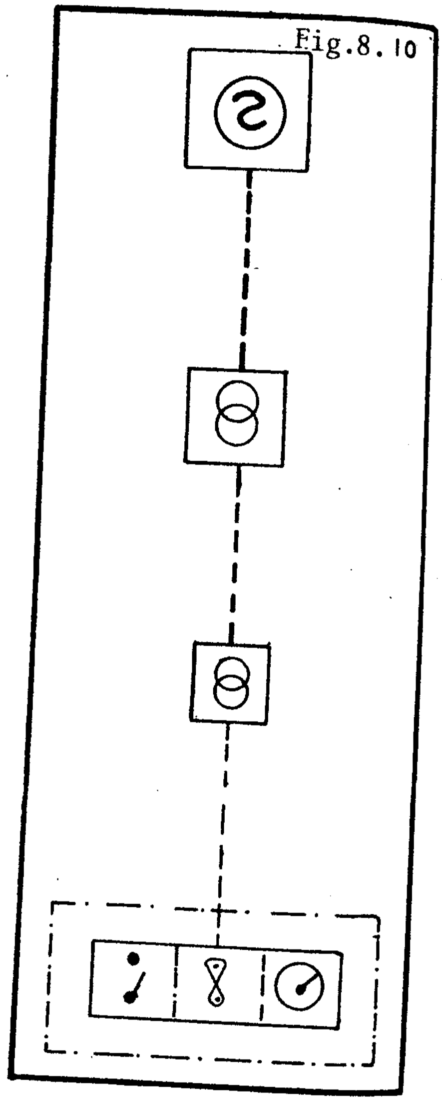
The distribution system may be overhead (O/H) pole strung or underground (U/G) cables. The U/G system is 3-5 times expensive. O/H system of distribution is widely used in Pakistan, though Islamabad has U/G system. In certain congested parts of big urban centres, the U/G may be preferable inspite of its high installation cost.

8.5.5 Illustrated Description of System.

A general description of transmission, transformation and distribution is presented for easy comprehension:

- ELECTRICITY is generated at POWER STATION
- TRANSMITTED at EHV ay 132 KV
- STEPPED DOWN by TRANSFORMER at PRIMARY GRID STATION for PRIMARY DISTRIBUTION at HV say 11 KV.
- TRANSMITTED BY H.V. LINES.
- Further STEPPED DOWN by a TRANSFORMER at a SUB-STATION for SECONDARY DISTRIBUTION say 240 Volts.
- TERMINATES within the PREMISES containing MAIN SWITCH, FUSES and METER through which the internal electric system of the building is supplied.

Fig.8.10



8.5 POWER CONNECTIONS

An average of about 46 and 90 consumers of all categories have been connected to each kilometer of 11 KV and 0.4 KV lines in Pakistan respectively.

8.5.6 Consumers and Service Connections

There were about 3 million electricity consumers, of all categories in Pakistan by 1984. Electricity consumers may be divided into the following broad categories:

a) Domestic (General supply)

b) Commercial (General supply)

c) Industrial

d) Agricultural

e) Bulk Supply

f) Street Lighting (public)

g) Others.

WAPDA, a licensee under the terms of Electricity Act, provides connections to each category of consumers. The service connections may be categorised on the basis of Schedule of Tarrifs or load of each consumer. The service connection may vary from an ordinary main switch to an 11/0.4 KV substation or substations and/or 132 KV grid station depending upon the load of the consumer premises.

Special conditions for different types of consumers are given in Table 8.12.

TABLE 8.12:SPECIAL CONDITIONS FOR DIFFERENT TYPES OF CONSUMERS

Sr. No.	Type of Consumer	Tarrif Category	Special Conditions
1.	Domestic & commercial for general supply, places of worship, approved religious, educational and charitable institutions, hospitals & dispensaries etc.	A-1	i) For load upto 4 KW, single phase supply will be made available and for load above 4KW, 3 phase supply will be made available. ii) Three phase pumps, motors A/C plants shall be charged as per appropriate Industrial Tariff.
2.	For general supply to all Govt,semi-govt.offices & institutions commercial offices/Establishments, e.g. shops, hotels,restaurants, private hospitals, clinics/dispensaries places of entertainment like cinemas/theatres/ clubs/rest houses & Govt. Lodges.	A-2	i) Same as for Tarrif Category A-1. ii) Fuel adjustment surcharge is applicable to this category.
3.	For general supply for connected load upto & including 70 KW (3 phase, 400 Volts.etc.)	B-1	i) Lamps and fans consumption in excess of 5% shall be charged under Tarrif A-2. ii) Provide separate circuit for metering lights & fans consumption. Otherwise 10% of total consumption shall be charged under Tarrif Category A-2. iii) Fuel adjustment charge shall be applicable to this consumer on monthly basis.

(Contd...)

		iv) The general & domestic consumption in residences to be charged at Tarrif A-I.
4. Same as B-I, but for sanctioned load exceeding 70 KW & upto 500 KW (@ 3 phase, 400 Volt,AC).	B-2	i) Conditions as in case of B-1.
5. Same as B-2, but sanctioned load above 500 KW & upto 5000 KW (@ 11/33 KV).	B-3 (Dual Tarrif)	i) All conditions in B-1. ii) Consumer will supply its own sub-station including sub-station equipment to the satisfaction & approval of WAPDA including the cost of circuit breaker at grid station for an independent feeder.
6. For sanctioned load above 5000 KW (@ 66 KV/ 132 KV).	B-4	i) Same as for B-1 ii) Consumer will supply its own 132/11 KV or 66/11 KV grid station including land, building and grid station equipment to the satisfaction and approval of WAPDA.

For other categories of consumers, WAPDA Tarrif booklet available with Commercial Department of WAPDA may be referred.

8.5.7 Design Guidelines

For planning and development of areas, the following points need be considered regarding electricity network and its various components.

i) Suitable minimum clearances and spaces for Right of Way, along roads and buildings for various categories of Transmission and Distribution Lines and Street Lights, as per WAPDA S.D.I. No.21, may be provided. Minimum clearance required from Buildings and Roads/Streets regarding different categories of Transmission and Distribution Lines are given in Table 8.13 and Table 8.14 respectively.

TABLE 8.13: MINIMUM CLEARANCE REQUIRED FROM BUILDINGS FOR DIFFERENT CATEGORIES OF TRANSMISSION AND DISTRIBUTION LINES

Category of Transmission/Distribution Line (Voltage)	Minimum clearance from Buildings		Minimum Clearance from ground
	Vertical	Horizontal	
500 KV	*	*	*
220 KV	20'	25'	23'
132 KV	17'	20'	22'
66 KV	15'	15'	20'
33 KV	12'	6'	20'
11 KV	12'	6'	15'
0.4 KV	8'	4'	15'

TABLE 8.14:MINIMUM CLEARANCE REQUIRED FROM ROADS AND STREETS FOR DIFFERENT CATEGORIES OF TRANSMISSION AND DISTRIBUTION LINES

Category of Transmission/Distribibuiton Line (Voltage)	Way Leave	Minimum Vertical Clearance	
		City/District Roads	Access Street
500 KV	*	*	*
220 KV	50'	26'	26'
132 KV	40'	26'	26'
66 KV	30'	26'	20'
33 KV	12'	20'	20'
11 KV	12'	20'	20'
0.4 KV	8'	17'	19'

*WAPDA's EHV Division may be consulted.

ii) The heights of non-illumination bearing towers and their spacing vary as a function of terrain in open areas and with morphology of built-up areas. The usual heights and spans of transmission towers and distribution poles are given in Table 8.15.

TABLE 8.15: USUAL HEIGHTS & SPANS OF NON-ILLUMINATION BEARING TRANSMISSION/DISTRIBUTION TOWERS/ POLES

Category of Line (Voltage)	Heights (Metres)	Spans + (Metres)
500/220 KV D.C.**	52	300 - 400
500/220 KV S.C.*	38	300 - 400
132 KV D.C.	38	250 - 400
132 KV S.C.	33	200 - 300
66 KV S.C.	25	150 - 200
33 KV S.C.	12	100 - 120
11 KV SC/Composite	10.66(35')	30 - 50
0.4 KV SC	9.44(31')	30 - 50

\+ Span varies with nature of terrain, the transmission line has to traverse. For spacing of distribution poles, road way-leaves and distance between road junctions are important.

**DC =double circuit.
* SC = single circuit

iii) Compensation charges are to be paid to the owners, for acquisition of land, trees and structures for provision of way leaves for Transmission and Distribution Lines.

iv) Adequate allowance for area requirement of grid stations and substations including the building to house the equipment should be made.

Typical area requirements are given in Table 8.16.

TABLE 8.16: SITES FOR GRID STATIONS (ACRES)

Locality	Grid Station Types 132KV	66KV	32KV
Inner Urban without residences	3.5	3.25	2.5
Outer Urban, small town and rural, with residences.	7.5	5.00	4.0

Source: Derived from WAPDA Grid Stations drawings Nos. PDW/TS-2597,2724, 2799 and 2864.

Upto 300 KVA, pole-mounted substations would be generally required for distribution. Area requirement in built-up areas may vary, depending on the capacity of transformer installed. For a substation of above 300 KVA, built up requirement may be from 600 sft to 1200 sft. In congested parts of the city where U/G distribution is employed, kiosk type substation may be preferred which require lesser area, say 100 sft approximately.

v) The buildings of the grid station, control house and of substations should conform to the architectural and aesthetic characteristics of the surrounding area.

vi) Adequate allowances for the crossing of roads, railway tracks, transmission / distribution lines and T&T lines may be made.

8.5.8 Public Street Lighting

Street lighting permits high volume traffic on major urban roads at night while increasing the safety of both vehicular and pedestrian movement on access roads. The other purposes of street lighting are to enhance public security from violence and burglary and to provide a more congenial social environment.

A common supply system may activate traffic signals and flood or spot lighting to illuminate special feature such as advertisements,road signs, etc.

8.5.8.1 General Description of Street Lighting System

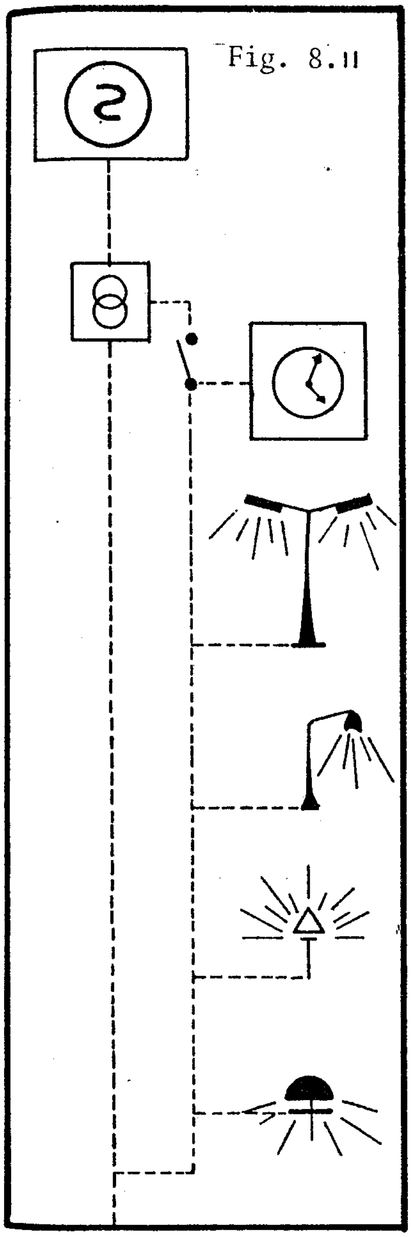


Fig. 8.11

General description of the street lighting system is presented. as under:

- Power for street lighting is taken from WAPDA/KESC.

- It may be controlled by manual switching or preset Time Switches.

- It is carried by overhead or underground cables to street furniture ranging from High Mast Lighting on City Roads/District Roads to street lamps on access roads, etc.

8.5.8.2 General Principles of Visual Guidance

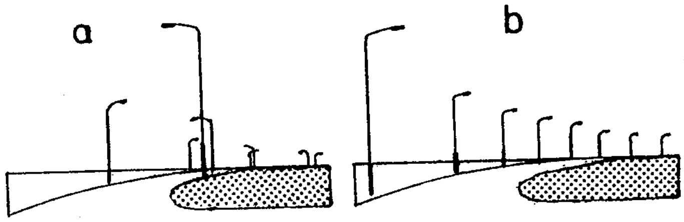
The quality of road lighting is guided by complex criteria that the Lighting Engineer will prescribe. The Planner needs to be informed about the broad principles of visual guidance. The following points are important:

i) On open roads with separate traffic lanes and central reservations, good visual guidance and economy is obtained by siting lighting columns on the reservation. However, if the central reservation is wider than 8 metres each carriageway should be treated as a separate road.

ii) A clear indication of the road and curve is achieved by siting the columns along the out-side of the curve, (Fig: 8.12).

Fig. 8.12: Visual Guidance on Curves:

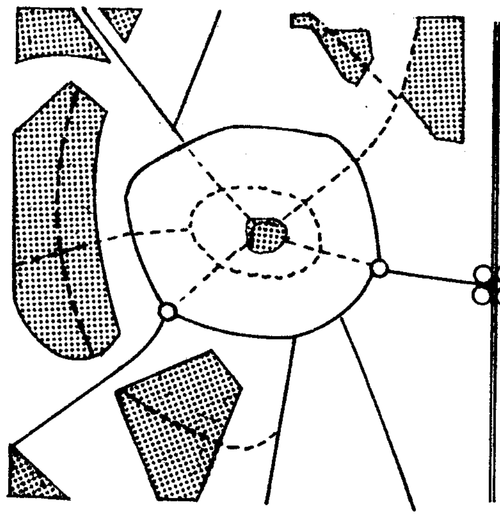
The irregular arrangement of the lanterns on a curve (a)gives the road user no information about the run of the road. Mounting the lanterns along the outside of the curve (b) gives a clear indication of the run of the road.



iii) Traffic can be piloted along certain roads by providing light sources of different colours. (Fig. 8.13). Road junctions should be illuminated in different colours to improve visual guidance to each entry / exit point.

ROAD GUIDANCE

(Fig.8.13) Plan of a town with routes marked by means of lights differing in colour appearance. Through traffic, which does not need to enter the town centre, follows the low-pressure sodium lighting on the approach roads and the ring road (full lines). Traffic making for the town centre leaves the ring road along roads lighted by high-pressure mercury lamps (broken lines).



8.5.8.3 Types of Lamps and Lanterns

Commonly used lamps for road lighting are:

1. Incandescent Lamps
2. Fluorscent Lamps
3. Gas Discharge Lamps

    3.1) High Pressure Mercury Vapour Lamps (HPMVL)
    3.2) High Pressure Sodium Vapour Lamps (HPSVL)
    3.2) Low Pressure Sodium Vapour Lamps (LPSVL)

For major urban roads, because of low cost per lux (i.e. efficiency) LPSVL used to be popular in U.K., while HPMVL is widely used in other countries because of light quality. HPSVL are becoming more common owing to better quality of light combined with high efficiency. Fluorscent lamps are tolerable only on minor/pedestrian streets while incandescent bulbs should be phased out, (except the high wattage variety for flood lights).

The purpose of lanterns is to provide weather protection to lamps and to control glare by focussing the beam of light. Two types are broadly recognised. Cut-Off (C/O) type focusses a 65 degree beam along the road while Semi-Cut-Off (S/CO) type permits a 75 degree beam up and down the road. Semi-Cut-Off type allows wider spacing of lanterns and is more economical though with somewhat increased glare.

8.5.8.4 Spacing & Height Standards

The most comprehensive standards for lighting engineering are provided by Commission International Eclairage (CIE). However, the system can be implemented only with automatic photometric equipment. The alternative is British Code of Practice CP1004, (together with BSS 1788/1963), which relates lanterns to installation layouts. It is highly practical for common applications. Spacing and height standards according to BSS 5489, para 2 are given in Table 8.17.

TABLE: 8.17 HEIGHT AND SPACING STANDARDS

Design lantern spacings for cut-off and semi-cut-off systems (From BS 5489 Part 2)

Arrangement	Type	Height	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	22	24	26	28
			Effective width (m) of Roads — Design spacing (m)																		
Staggered*	C.O.†	10		30	30	28	25	22	20	18	17	16	14								
		12				36	35	32	29	26	24	22	21	20	19	18					
	S.C.O.	10				40	40	36	33	30	28	26									
		12						48	47	43	40	37	35	32	30						
Opposite*	C.O.	10							33	33	33	31	29	27	26	24	22				
		12									40	40	40	40	37	35	32	29	26		
	S.C.O.	10											44	44	42	40	36				
		12													53	53	52	47	43		
Single side	C.O.	10	33	32	27	(24)															
				40	39	34	(32)														
	S.C.O.#	10	44	42	(36)																
		12		53	52	(45)															
Central on Single Carriageway	C.O.	10				33	33	33	33	32	29	27	(25)	(24)							
		12							40	40	40	39	36	34	32	(32)					
	S.C.O #	10						44	44	42	(39)	(36)									
		12							53	53	53	51	(48)	(45)							
Opposite plus central	C.O.	10										30	29	28	26	24	22	20	18	17	16
		12												36	36	35	32	29	26	24	22
	S.C.O.	10													40	40	36	33	30	28	26
		12															48	47	43	40	37
Twin central on dual carriageway. §	C.O.	10				33	31	(28)													
		12						40	37	(34)											
	S.C.O.	10				44	(41)														
		12						53	(49)												

* For a dual carriageway in which the central reserve is too wide for this installation, the carriageway should be treated as two single carriageways.

† Where a very short spacing is indicated, consideration should be given to the opposite arrangement which will involve approximately the same number of lanterns per mile.

\# Though these spacings are maximum design spacings, smaller spacings tend to produce an undersirable bright centre to the road, particularly if the surface is smooth.

§ It is desirable that lanterns on the central reserve should be mounted in pairs on a single column. Where the width of the central reserve exceeds 8m the installation on the two carriageways should be considered as independent and lighted as for two single side arrangements.

NOTE: Figures in parentheses to be used only for lanterns with a wide lateral spread.

8.5.8.5 Lantern Arrangements

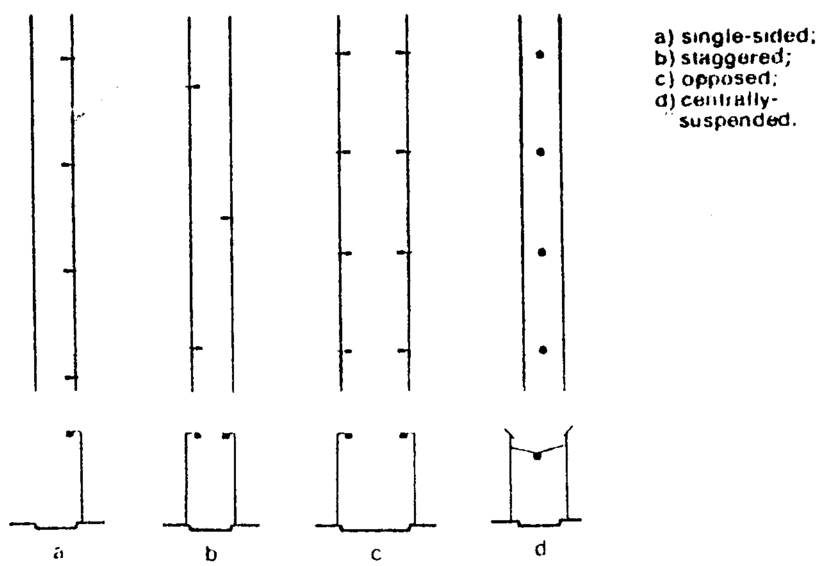
Table 8.18 gives the common lantern arrangements alongwith selection criteria.

TABLE: 8.18: LANTERN ARRANGEMENTS

Movement Path Types	Lantern Arrangements	Selection Criteria
1- Two Way Traffic Roads	i-Single Sided Lanterns are located on one side of the road.	Suitable where road width is $\leqslant$ height of the lantern.
	ii-Staggered Lanterns are located on both sides of road in a zig zag arrangement.	Suitable where road width is between 1-1.5 times the lantern height.
	iii-Opposed Lanterns are located on both sides of the road opposite one another.	Suitable where road width ÷ 1.5 times lantern height.
	iv- Centrally Suspended Lanterns are suspended along the axis of the road.	This arrangement is desirable for narrow roads having buildings on both sides.

Fig.8.14

Lighting arrangements for two-way traffic roads:



2- Motorways & Dual Carriageways	i-Central Twin Bracket Lanterns are located above the central reservation only.	This can be considered as a single sided arrangement for each carriageway. Selection criteria for 1.i. applies.
	ii-Combined Twin Brackets & Opposed Twin Brackets located on the central reserve are combined with opposed arrangement	This can be considered as a staggered arrangement for each carriageway. Selection criteria 1.ii applies
	iii-Caternary Lanterns are suspended axially from longitudinal cables over the central reservation. Supporting columns are widely spaced (60 to 90 m).	This system offers an excellent visual guidance & longitudinal uniformity, less glare, greater visibility in bad weather.

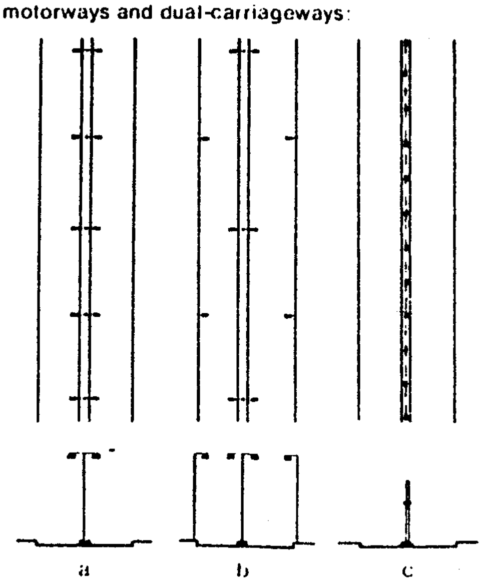


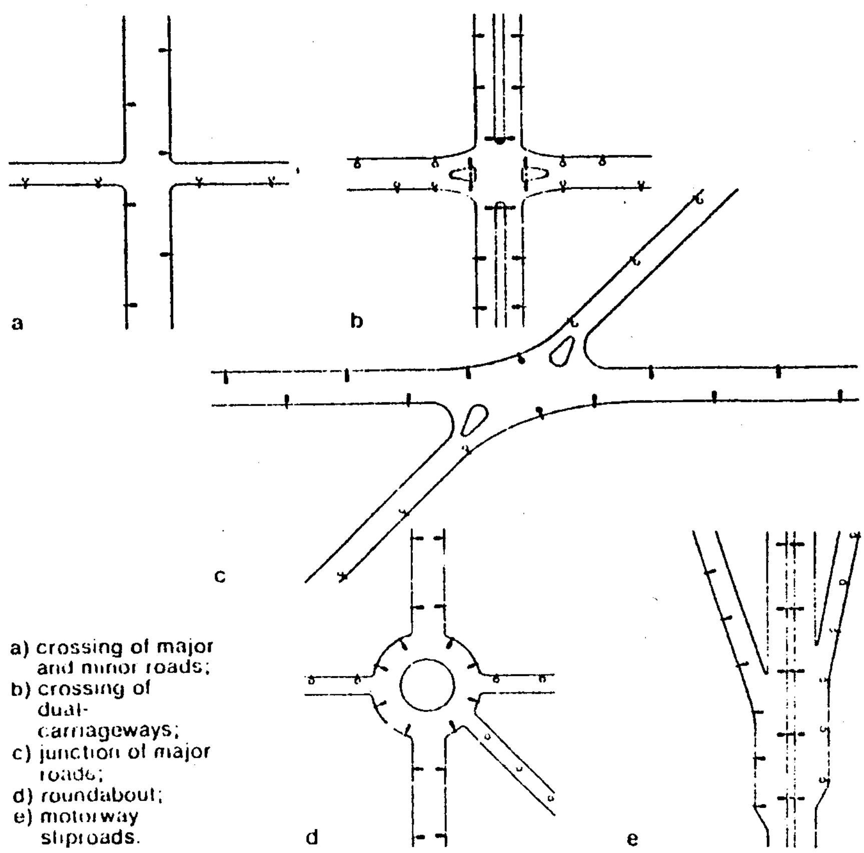
Fig. 8.15

Lighting arrangements for motorways and dual-carriageways:

a) central, twin bracket;
b) combined twin-bracket and opposed,
c) catenary.

3- Road Junctions	i- Conventional Lanterns Arrangement should be such that the junction is visible clearly from a distance.	Higher luminance using different colours, lanterns of different types and in different arrangements for the main & secondary roads, desirable.
	ii-High Mast Lighting Columns over 20 M height are used for Complex Junctions on main roads and for motorway interchanges.	Powerful flood lights mounted at a high level to help simulate the uniformity of natural lighting, are desirable at traffic junctions exceeding 5000 PCU/ hr at any night-hour.

Fig. 8·16



Lighting arrangements for traffic junctions in which lanterns of different types and in different arrangements are used to give visual guidance:

4-Curves

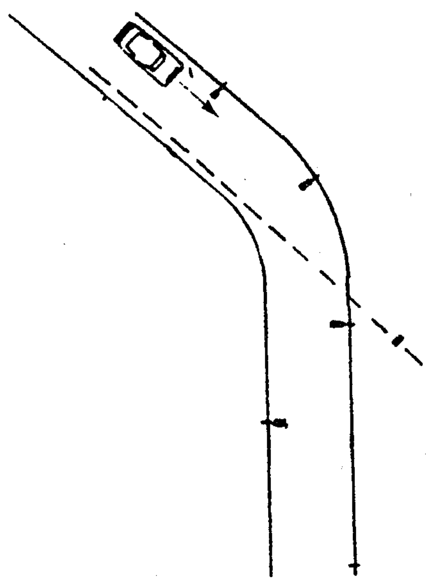
Curves having radius of 300 metres can be treated as straight.

The smaller the radius the closer the spacing. The usual spacing between the lanterns will be 0.5 to 0.75 times that for a similar stretch of straight road.

Where road width are less than 1.5 times lantern height, columns should be sited on outside of the curve in a single sided arrangement. For wider roads, an opposed arrangement should be used. Staggered arrangement should be avoided.

Fig. 8.17

Lanterns placed above the outside of a curve to aid visual guidance



8.6 PLACEMENT OF SERVICES IN ROAD CROSS-SECTIONS

Road standards proposed in Chapter 7 are based on traffic requirements, and not on the special requirements of other services. The need for space for these services may result in a need to modify the right-of-way width requirements.

In built-up areas, it may not be possible to leave space for the services. In such cases, the services will have to be provided under the carriageways.

The guidelines for appropriate locations of the service and utility lines for both cases are discussed below.

8.6.1 Placement of services at berms

It is preferable to place the service lines at berms so as to avoid frequent road digging for maintenance and repairs (Fig. 8.18). Guidelines;

i) Generally, sewer is located adjacent to roads. The recommended strip width for sewer is given in Section 8.2.2.2. Here the same is rounded up to 1.5 m for illustration.

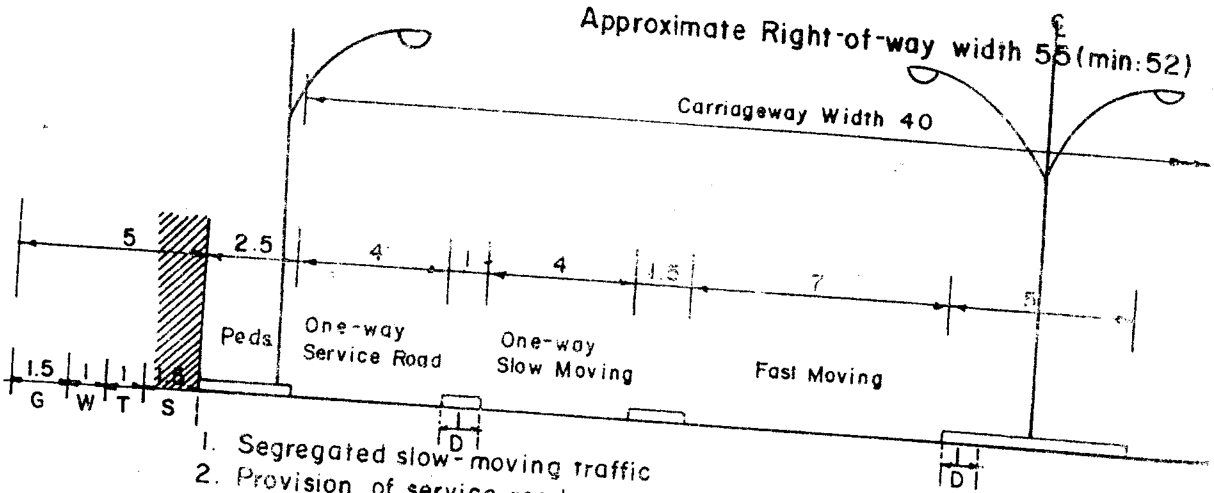
ii) Next to sewer may be the telephone lines. A strip width of 1 m is sufficient for this purpose.

iii) Water supply lines may be located next to telephone lines. These should not be placed adjacent to the sewerage lines so as to avoid contamination. As a further measure, water supply lines should be located at a depth less than the sewer. Strip widths for various diameters of water supply lines are given in Section 8.1.5.1. Here 1 m has been taken for illustrative purposes.

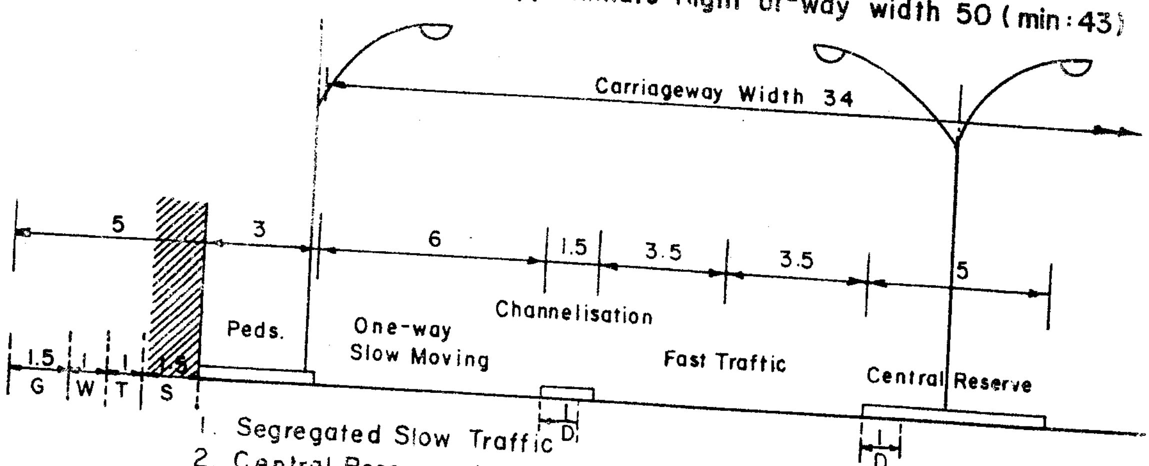
iv) In urban areas, a reservation of 1.5 metres is sufficient for gas distribution lines. A wider space has to be left for gas mains and trunk lines, for which standards of the concerned agency (e.g. SNGPL, SGC) should be adhered to.

Fig. 8·18 **TYPICAL PLACEMENT OF SERVICES IN ROAD CROSS SECTIONS (At Berms).**

PRIMARY ROADS



1. Segregated slow-moving traffic
2. Provision of service road
3. Central Reserve with sufficient width for right-turn lane.
4. Recommended for primary urban road.



1. Segregated Slow Traffic
2. Central Reserve with sufficient width for right-turn lane

SEWERAGE	S
WATER SUPPLY	W
DRAIN	D
GAS	G
TELEPHONE	T

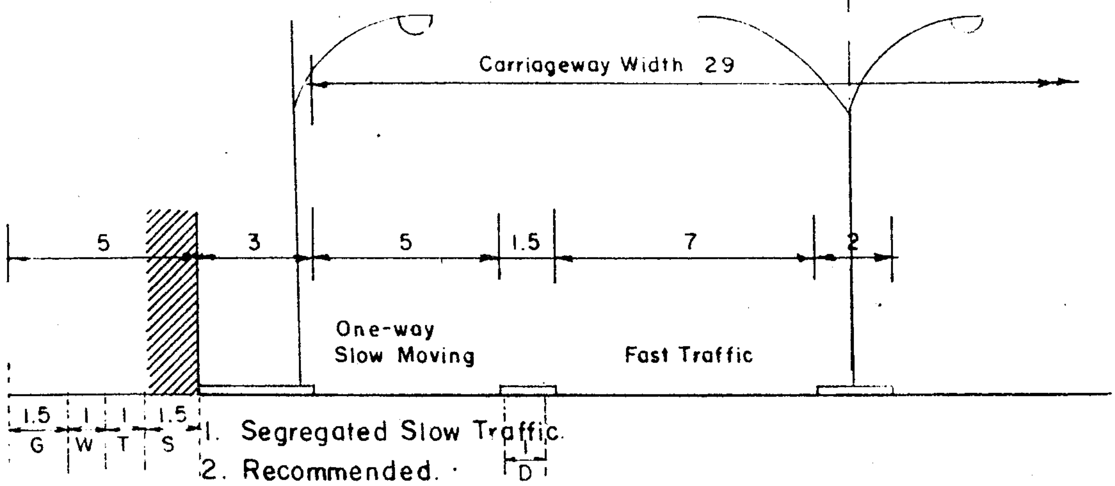
All dimensions are in metres

Scale: 1: 200

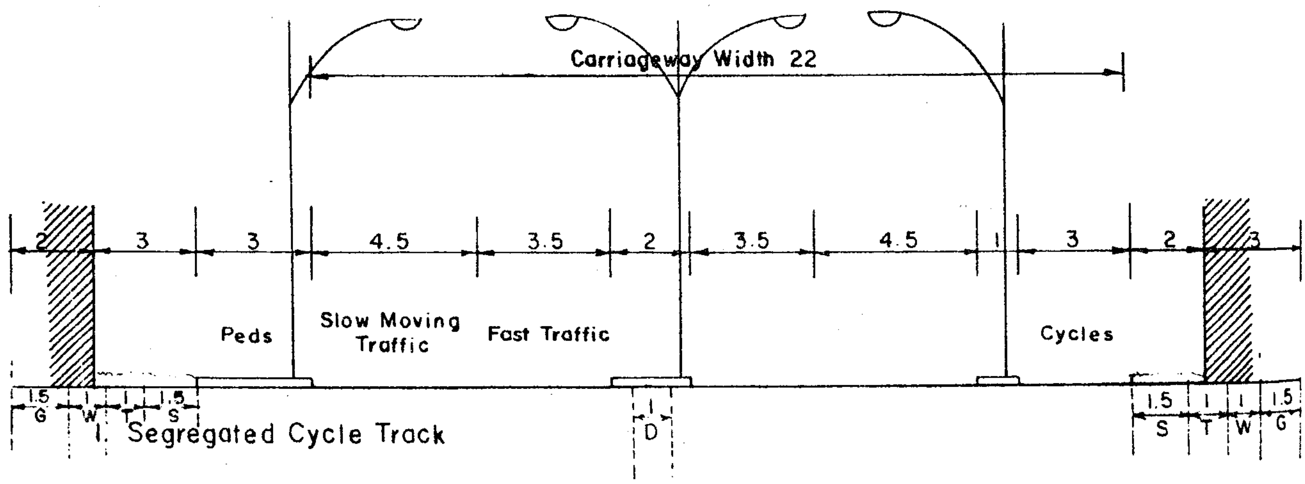
TYPICAL PLACEMENT OF SERVICES IN ROAD CROSS SECTIONS SECONDARY ROADS

Fig. 8.18 (Contd.)

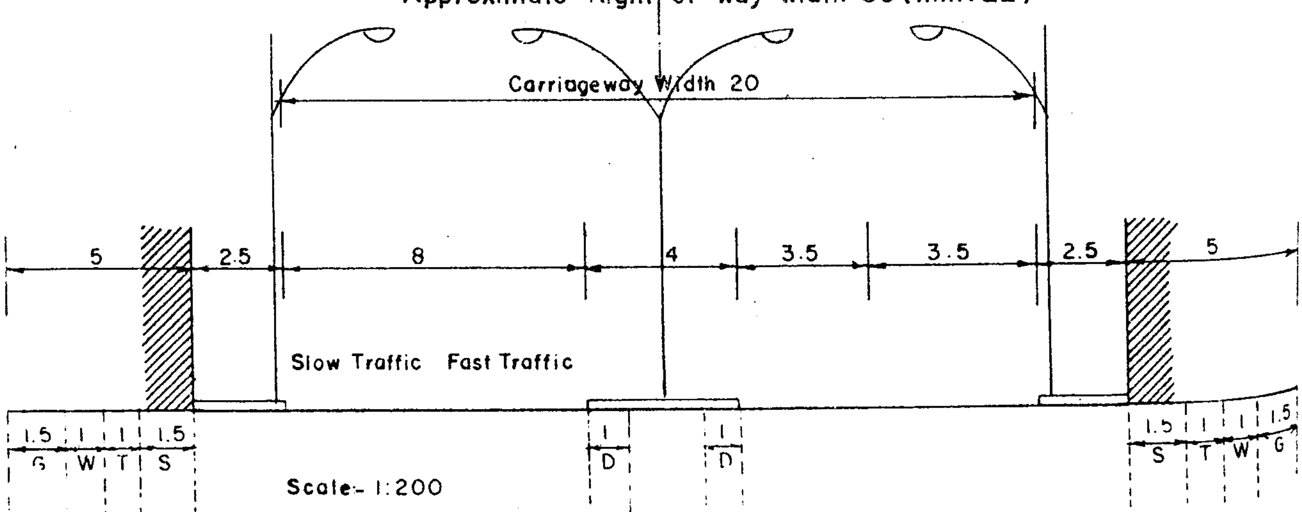
Approximate Right-of-way width 45 (min: 43)



Approximate Right of way width 35 (min: 25)



Approximate Right-of-way width 35 (min: 22)

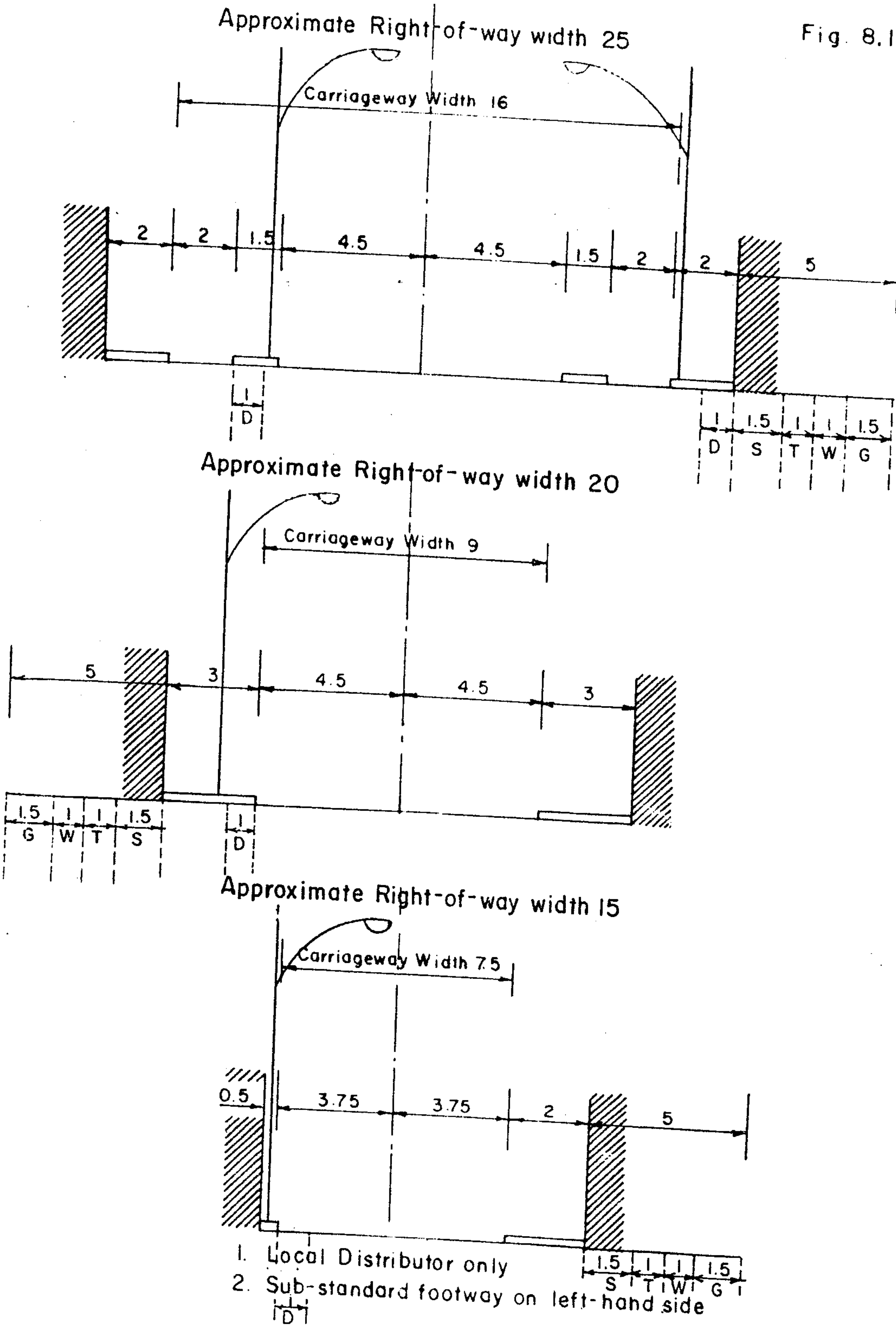


Scale:- 1:200

All dimensions are in metres

TYPICAL PLACEMENT OF SERVICES IN ROAD CROSS SECTIONS
LOCAL ROADS

Fig. 8.18 Contd

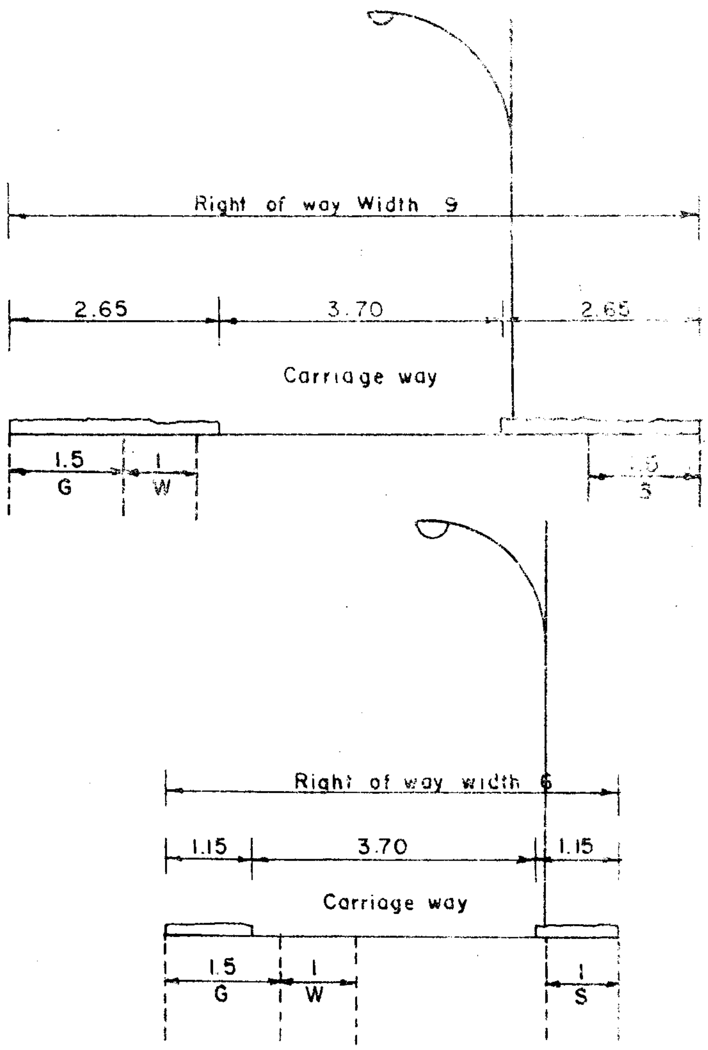


All dimensions are in metres

Scale - 1 : 200

TYPICAL PLACEMENT OF SERVICES IN ROAD CROSS SECTIONS LOCAL ROADS

Fig. 8.12 Contd



All dimensions ar in metres

Scale:- 1:100

The gas lines have thus been proposed to be placed at the extreme end to allow for the increased space requirements. The right-of-way widths of roads may accordingly increase. (This order of placement is not necessary when services are placed under carriageways).

v) Drains may be provided under footpaths, as in most cases, their top width requirement, (Section 8.2.2.3) is less than the footpath width (Table 7.18). Where footpath is not being provided or drain cannot be covered (owing to large size or capital cost), it should be provided in median, if primarily meant for road drainage or if there is no green verge. If primarily provided for plot drainage, such drain may be located within the shoulders. The cross-slope of carriage ways shall be towards the drain.

vi) The electric poles should be located at some distance from the drain to avoid contact with water.

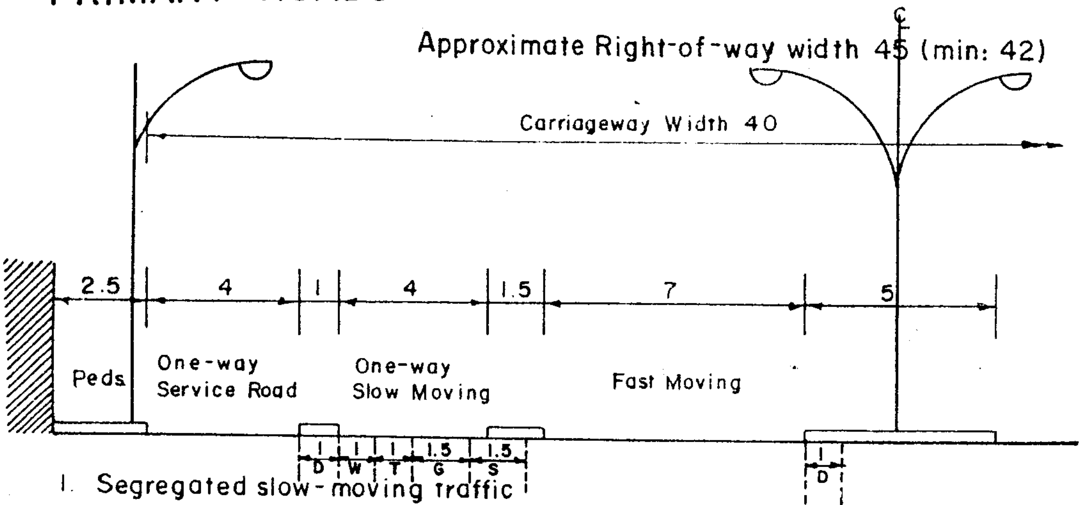
8.6.2 Placement under carriageways

The placement of services under carriageways is not recommended, except where road space is limited and space for berms is not available. The guidelines for placement of services are the same as those in Section 8.6.1.

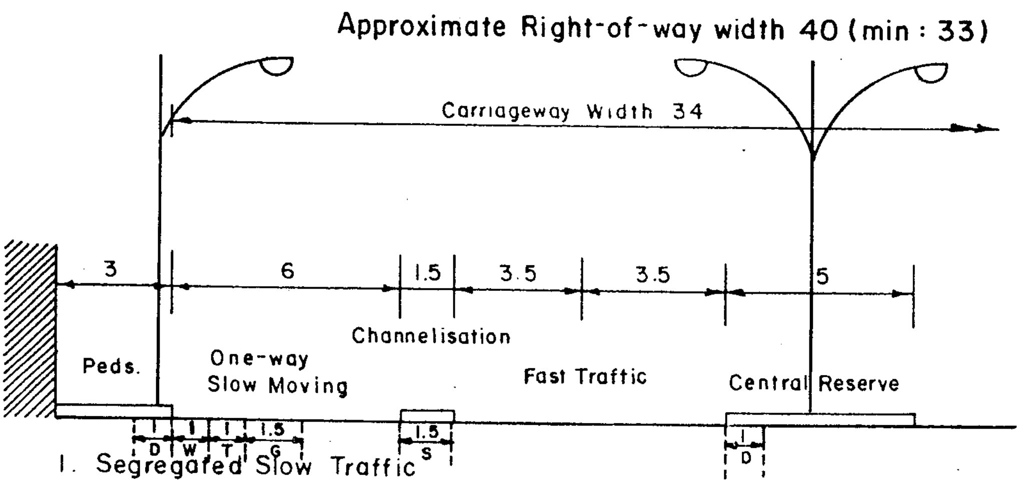
It is recommended that the services be placed under slow-moving lanes and cycle tracks. The use of fast moving lanes for this purpose should be avoided unless there is no other option (Fig 8.19).

FIG. 8·19

TYPICAL PLACEMENT OF SERVICES IN ROAD CROSS SECTIONS (Under Carriageways) PRIMARY ROADS



1. Segregated slow-moving traffic
2. Provision of service road
3. Central Reserve with sufficient width for right-turn lane.
4. Recommended for primary urban road.



1. Segregated Slow Traffic
2. Central Reserve with sufficient width for right-turn lane

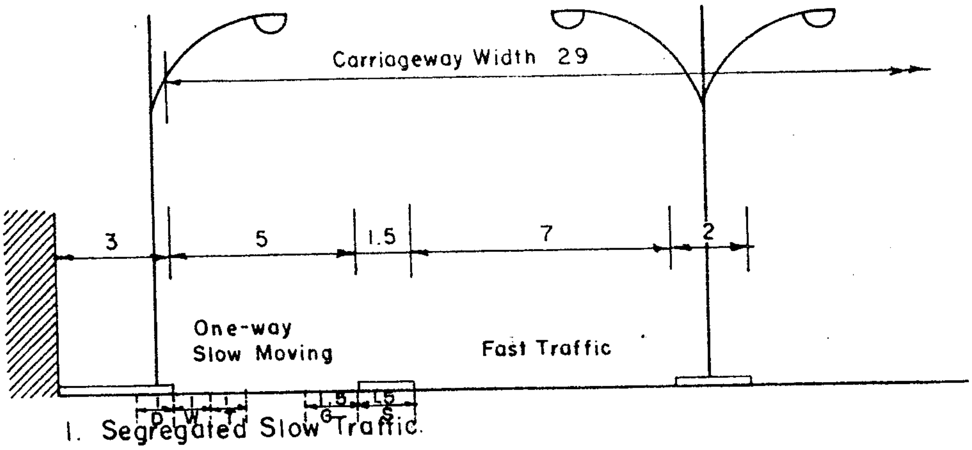
All dimensions are in metres

Scale: 1: 200

TYPICAL PLACEMENT OF SERVICES IN ROAD CROSS SECTIONS
SECONDARY ROADS

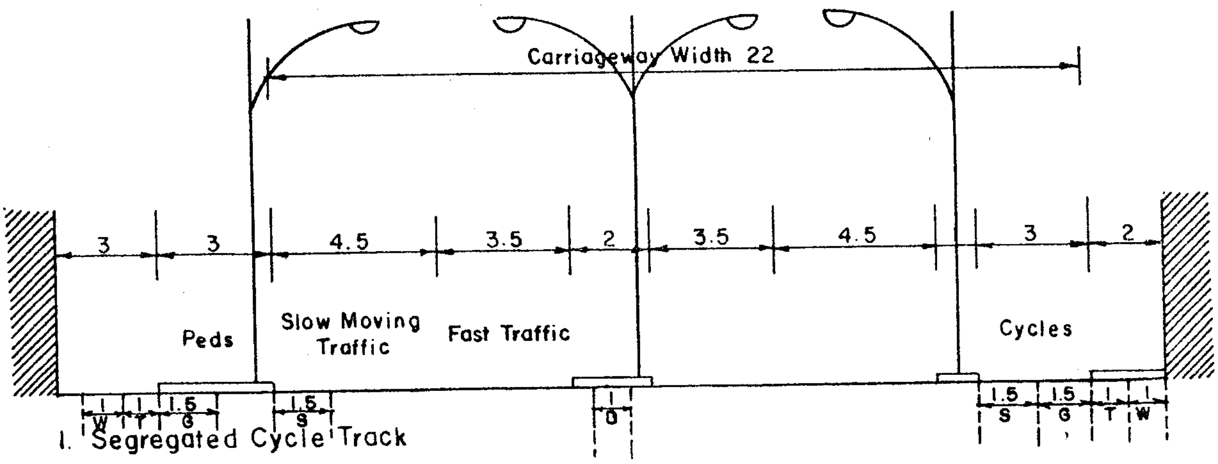
Fig. 8.19 (Contd)

Approximate Right-of-way width 35 (min: 33)



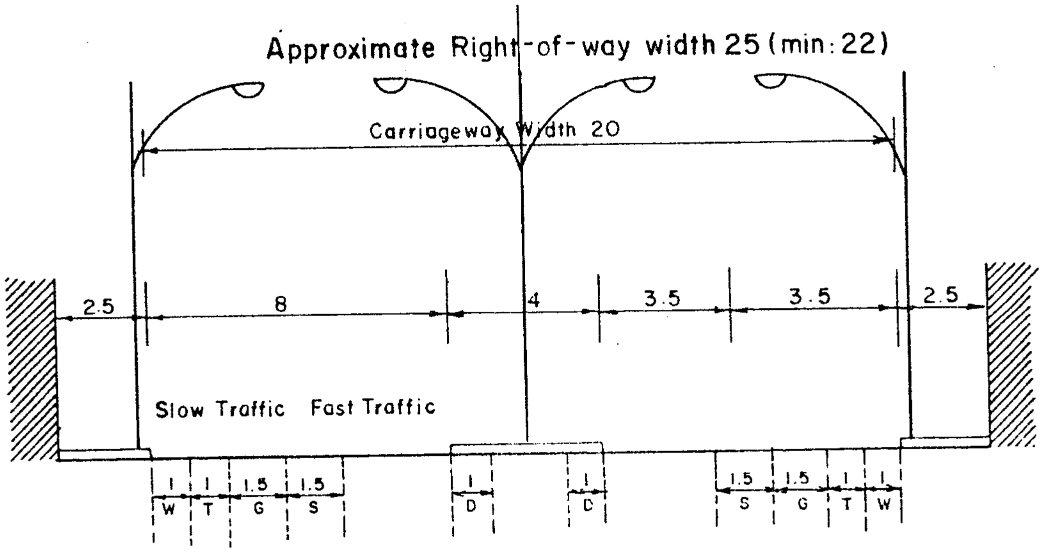
1. Segregated Slow Traffic.
2. Recommended.

Approximate Right-of-way width 30 (min: 25)



1. Segregated Cycle Track

Approximate Right-of-way width 25 (min: 22)



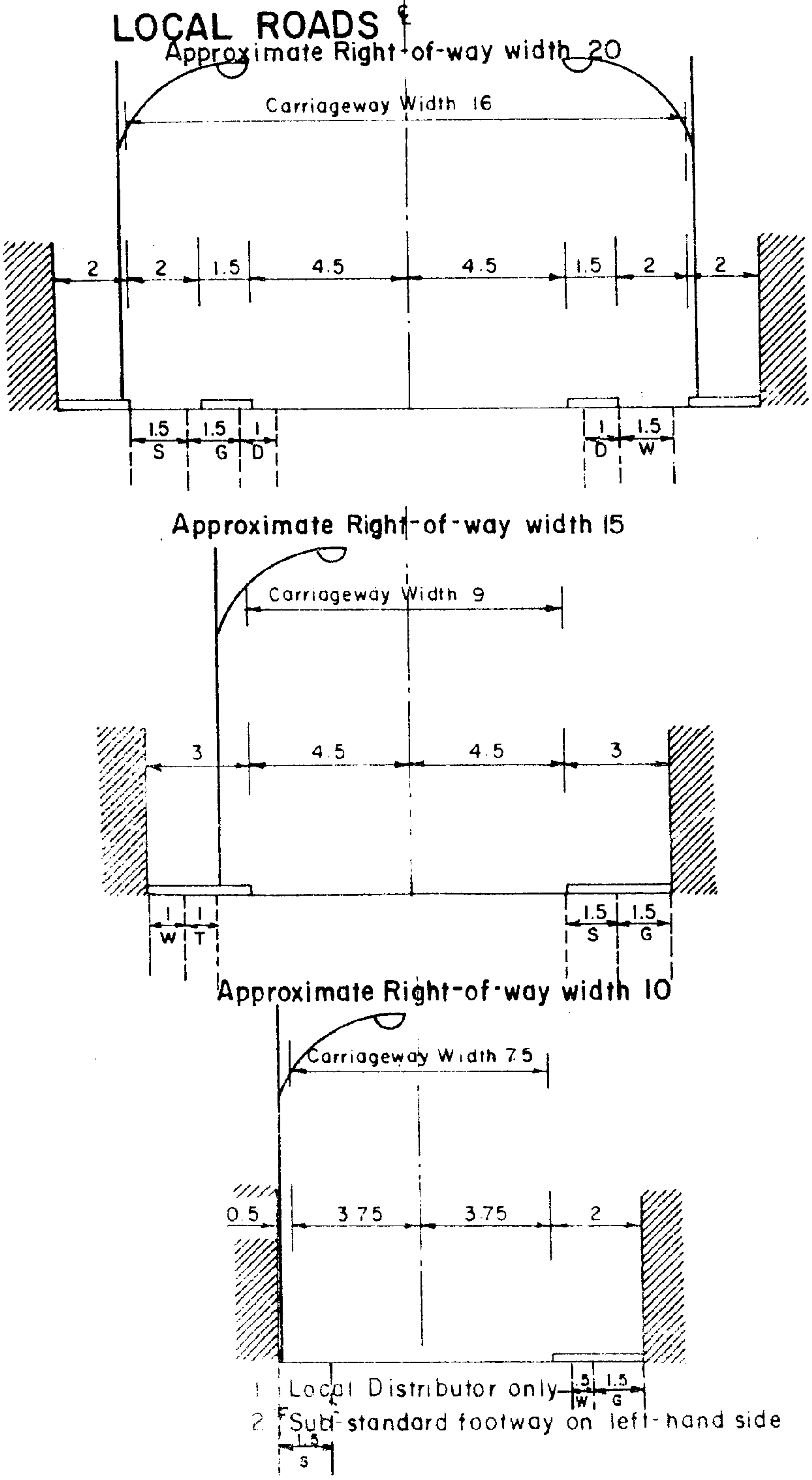
All dimensions are in metres

Scale - 1:200

TYPICAL PLACEMENT OF SERVICES IN ROAD CROSS SECTIONS

Fig. 8.19 Contd.

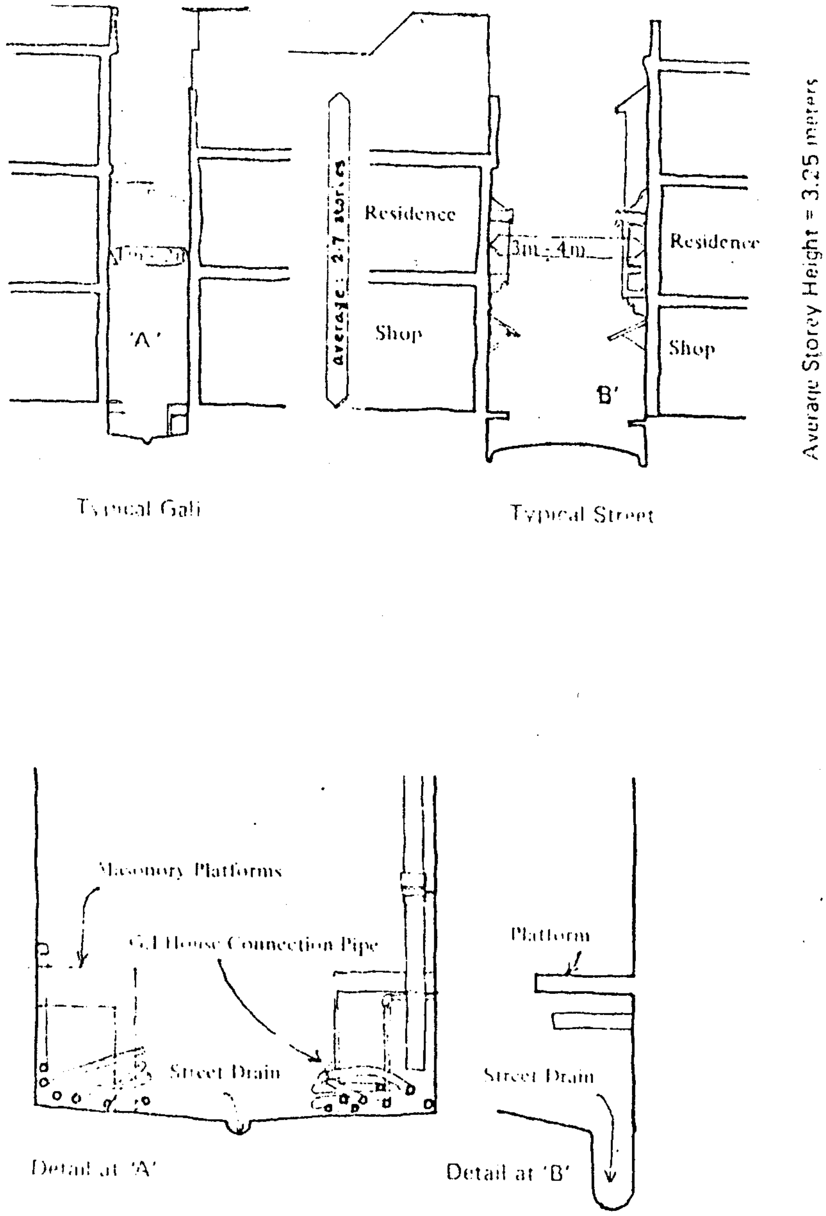
LOCAL ROADS



All dimensions are in metres

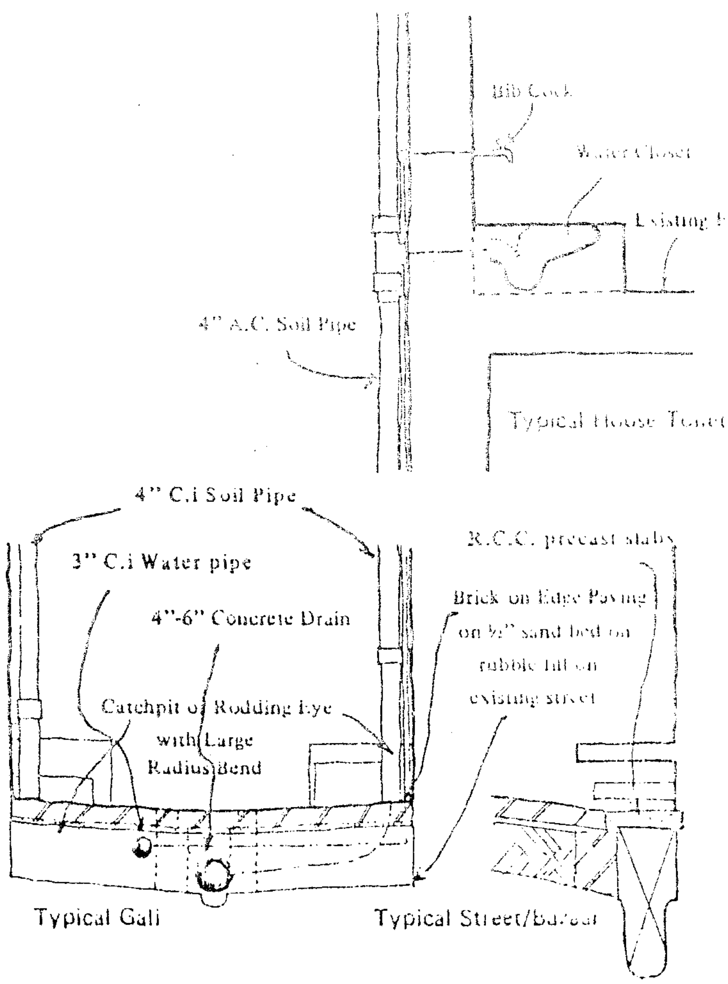
Scale - 1 : 200

FIG 8·19
(Contd)



Typical Existing Gali and Street Section

FIG 9·19
(Contd)



Proposed Street Drainage and Plumbing

LIST OF ABBREVIATIONS

ft	Foot
gpcd	U.S. gallon per capita per day
gpm	U.S. gallon per minute
h	Hour
HP	Horse Power
JTU	Jackson turbidity unit
l	Liter
mg	Milligram
mgd	Million gallons per day
s	Second
WHO	World Health Organisation
EPA	Environmental Protection Agency
BOD	Biochemical Oxygen Demand
fps	Foot per second
F:M	Food-Microorganisms
MLSS	Mixed Liquor Suspended Solids
SVI	Sludge Volume Index
Cft.	Cubic feet
SRT	Solid retention time
C	Centigrade

USEFUL METRIC CONVERSION

Multiply	BY	TO OBTAIN
Length		
feet	30.48	centimeters
feet	12	inches
feet	0.3048	meters
inches	2.540	centimeters
kilometers	0.6214	miles
meters	100	centimeters
meters	39.37	inches
microns	0.001	millimeters
Area		
acres	43,560	square feet
acres	0.41	hectare
square centimeters	0.1550	square inches
square meters	10.76	square feet
Capacity		
gallons (US)	0.8327	gallons (UK)
gallons	0.1337	cubic feet
gallons	231	cubic inches
gallons	3.785	liters
gallons of water	8.345	pounds of water
liters	1000	cubic centi-meters
liters	0.0353	cubic feet
liters	0.2642	gallons
Volume		
acre-feet	43,560	cubic feet
cubic centimeters	0.061	cubic inches
cubic feet	1728	cubic inches
cubic feet	7.481	gallons
cubic feet	28.32	liters
cubic meters	35.31	cubic feet
cubic meters	264.2	galllons
cubic meters	1000	liters

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CHAPTER - 9 : OTHER USES

9.0 GENERAL

9.1 PROTECTED AREAS

9.1.1 Prohibited Areas
9.1.2 Natural Conservation Areas
9.1.3 Man-made Environmental Areas

9.2 RESERVED AREAS

9.3 HELIPADS AND AIRSTRIPS

9.3.1 Restrictions near Helipads
9.3.2 Restrictions around Air Strips.

9.4 RAILWAY STATIONS AND TRACKS.

CHAPTER 9 : OTHER USES

9.0 GENERAL

Designation of protected areas, reserved areas and control of development near airstrips, helipads, railway stations and tracks is of vital importance for conservation of physical environment and economic resources. Huge capital investments are involved in airports and railway systems which are required to be saved from encroachments by strict enforcement of standards framed with a view to long term needs. On the other hand, while equally important, only broad guidelines have been evolved so far for designation of protected and reserved areas. Till legislative cover is available, the Planner is required to advocate the designation of such areas, on the basis of his professional training and experience.

9.1 PROTECTED AREAS

Generally, no physical development is permitted in the designated protected areas. The time scale for various protected areas may however vary depending upon the local situation. Protected areas may be categorised into three types:

1. Prohibited Areas.

   No development is permitted in prohibited areas.

2. Natural Conservation Areas.

   Areas where natural environment is to be conserved and enhanced.

3. Man-made Environmental Areas.

   Conservation and protection of features of built environment having historic and cultural significance.

Salient features of each category in the context of Pakistan, is discussed:

9.1.1 Prohibited Areas

Certain tracts are designated as prohibited areas in city plans for the following reasons:

(i) To create buffer zones between non-conforming uses, such as between residences and obnoxious industry, (e.g. glue & fish meal factories, tanneries, etc).

(ii) To check physical expansion of the city or to terminate process of growth in a particular direction.

(iii) To reduce density areas by providing open spaces in certain parts of the city.

(iv) Sometimes prohibited areas are designated in the form of green belts or green strips. Besides, other functions noted above, green belts also supply local fresh vegetables to the urban area.

9.1.2 Natural Conservation Areas

These areas are protected owing to their distinct natural characteristics. Natural conservation areas are categorised into four types:

a) Nature conservancies.
b) Storm water channels and water resource protection areas.
c) Hilly areas
d) Coastal areas.

(a) Natural Conservancies:

Areas, within the city scape, having thick ground cover of grasses, reeds, shrubs, trees or other vegetation of significant landscape value may be designated as nature conservancies with the following planning rationale:

i) To reduce urban density as in Fig. 9.1.

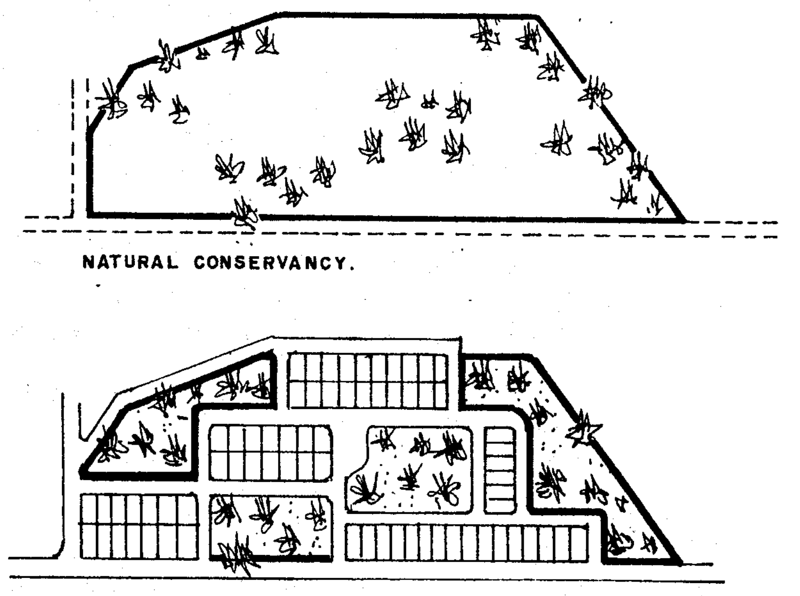
ii) To provide active and/or passive recreational facilities.

iii) To dilute air pollution in highly pollution prone areas.

iv) To bring micro climatic changes in the area.

v) To complement and enhance the aesthetic quality of overall settlement or part thereof.

Fig. 9.1 Development in Natural Conservancy



vi) To act as bio-sphere reserve for the **insitu** conservation of genetic resources, notably wild crop relatives, forest species and ancestors and close relatives of domesticated animal species, in order to safeguard the genetic diversity of species on which their continuing evolution depends.

Nature conservancies are a boon to any city and play a vital role in its healthy functioning.

(b) Storm Water Channels and Water Resources Protection Areas:

Storm water channels and water resources protection areas may be designated as protected areas owing to the following considerations:

(i) Storm water channels with established regimes should be protected and incorporated in the plans for efficient drainage of the area and to avoid any flood hazards.

(ii) No development should be permitted in such areas to avoid loss of life and investment during floods.

(iii) The water resource areas of significant importance should be protected from such development which may lead to overabstraction of ground water.

(iv) Groundwater particularly in aquifiers beneath the valley beds should be protected from pollution by domestic sewage or industrial effluents.

(v) Sewage or industrial effluents should not be disposed in those channels or water resource areas where it may prove hazardous for human health or plant life.

(c) Hilly Areas:

The following planning considerations may be kept in view for designation of certain hilly tracts as protected areas:

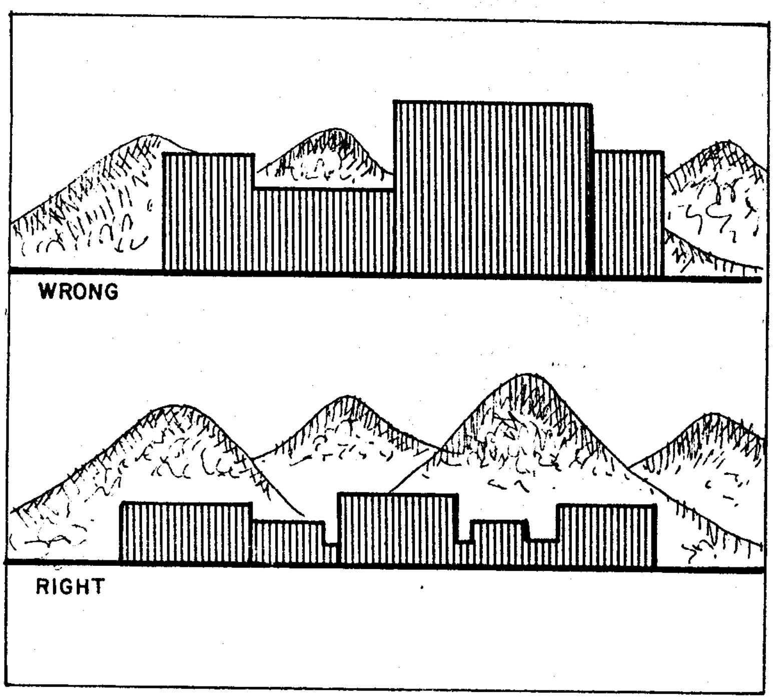
(i) To conserve natural beauty of hilly areas, development should not be allowed in areas where it may block views or vistas of outstanding quality.

(ii) Services provision on hill slopes is generally difficult and uneconomical. Such areas should be discouraged for large scale development.

(iii) Development on hill slopes should also be discouraged for reasons of safety in areas where large scale cutting or terracing could alter the flood water runoff patterns causing damage to adjacent development, natural vegetation or agriculture.

(iv) If the beauty and character of the hill is largely due to its silhouette on the skyline, the hilly area may be designated as protected area. Development in such areas may be permitted in compliance with the precise guidelines drawn by the planner. (Fig. 9.2).

Fig 9.2: HILL SIDE DEVELOPMENT



(v) Development on north facing slopes should be discouraged.

(vi) No development should be permitted in areas where there may be risk of land slides.

(d) Coastal Areas:

Coastal areas need to be protected for tourism, recreation or expansion of existing harbour facilities. Since only a few towns are located along the sea side in Pakistan, protection of coastal areas becomes even more significant from national point of view. Following guidelines may be useful for coastal area protection:

i) To retain the coastal areas under government ownership so that greater benefits could be extended to general public.

ii) To prevention of coastal erosion (e.g. caused by extracting sand from stabilized sand dunes).

iii) To prevent marine pollution particularly from industrial effluence or other chemical wastes.

The Coastal Protection Area should, generally, extend to about 200 m inland from the high water line. Within 20 m of high water line, no development should be permitted in any case. Behind this foreshore, for further 180 m, no development should be permitted in general. However, certain low intensity uses like fishermen's huts, beach and sailing clubs, jetties and boat-yards, etc. which do not affect the natural beauty of the coastal area, may be permitted.

9.1.3 Man-made Environmental Areas

Historic buildings, ruins and archaeological sites (i.e. the man-made or built environment) represent the cultural legacy of man. They depict the life styles and values of past civilizations. Preservation and upkeep of the man-made environment exhibits our pride in our heritage and hopes for cultural continuity. Pakistan is endowed with rich cultural heritage. Unfortunately, some elements are in a state of neglect and at other places, under pressure from reconstruction activity, fuelled by housing shortage. In old walled cities, it may not be possible to preserve every element. Great care needs to be exercised in designation of the best representative elements for conservation. These may be termed Special Premises.

Development in the vicinity* of historically, architecturally and culturally significant buildings/areas should be regulated to enhance their prominance in a given setting. The shape, bulk height, grain and texture of adjoining buildings should bear some logical relationship with such buildings. In renewal or redevelopment of urban scape, views or vistas should be planned to focus on historically significant structures. The Department of Archaeology must be consulted when considering redevelopment in or near any object of historical, social, cultural and archaeological interest.

* Defined as within 200 ft. of the special premise, in the Punjab Special Premises (Preservation) Ordinance, 1985.

9.2 RESERVED AREAS

Reserved areas are meant for future utilisation. Undeveloped or temporarily utilized land is set aside. Reservation allows greater flexibility in evolving multiple patterns of landuse . Following are the main purposes behind designation of reserved areas:

i) To facilitate economical and efficient use of land.

ii) To earmark government land for future expansion of various land uses or to cater for unforeseen requirements of certain landuses in future.

iii) To allow development agencies greater control over utilisation of land and more freedom for manipulation of the landuse configuration for public cause.

iv) To rationalise land value structure of the city and check land speculation.

v) To retain a land reserve for meeting compensation and land-exchange needs of the future.

Areas can be reserved for multiple uses, i.e. accommodate unexpected/unforeseen needs of the community, future needs of various government departments, future public utilities, future residential, commercial, industrial and recreational needs of the area.

In general, the planner should consider designating a reserved area, whenever a central zone catering to uses with the need for high accessibility is being planned alongwith surrounding land uses (i.e. a commercial centre with surrounding residences).

9.3 HELIPADS AND AIRSTRIPS

Development in the vicinity of air-strips and helipads is restricted mainly for two reasons:

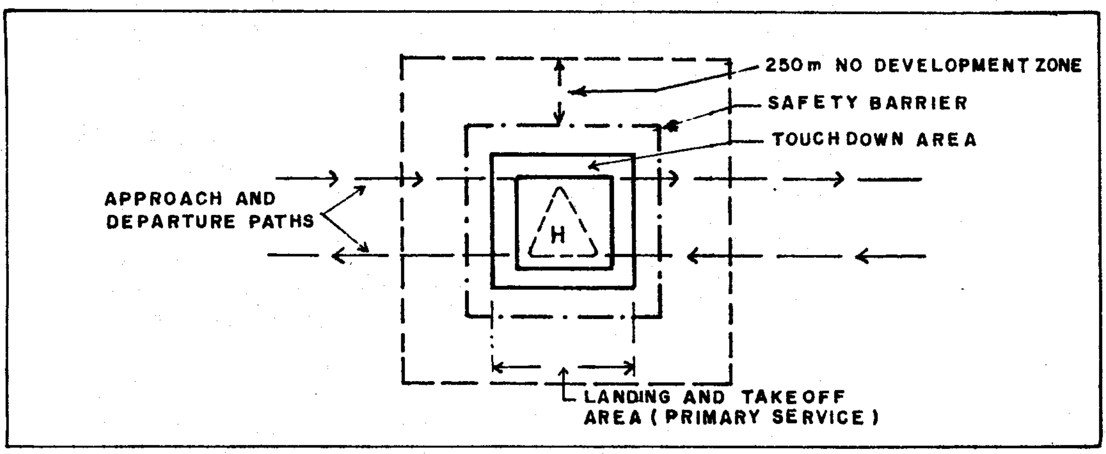
i) To avoid any hazard to air traffic; and

ii) To protect people from noise, vibration, pollution, or disturbance resulting from air traffic.

9.3.1 Restrictions near Helipads

Development within 250 metres from the helipad should be carefully scrutinised in consultation with Civil Aviation Authority.

Fig:9.3:Helipad Zone



9.3.2 Restrictions around Air Strips

Detailed parameters for air strips are governed by the National Clearance Policy. There are two standards, one followed in case of air bases of

Pakistan Air Force, while Civil Aviation Authority (CAA) follows ICAO Standards for civilian aircrafts. Planners entrusted with airport planning and designing should refer to Ministry of Defence, Aviation Division and CAA. Appendix 9.1 gives essential outlines.

Salient features of the National Clearance Policy pertaining to restrictions on surrounding developments and height control are provided. Fig. 9.4 illustrates the layout of a standard runway. Large Airports, are multiples of this basic design but are considerably more complex. Fig. 9.5 provides the clearance criteria for the flying gap. No development is permitted in the funnel area extending 3658 m (12000 feet) from edge of the over-run. For another 4572 m (15000 feet) there is a height restriction for buildings and towers not to exceed a maximum of 55.5 m (182 feet). Away from the funnel area there are height restriction transition zones of 1:7 and 1:20. These may be seen in Fig. 9.6 giving the Airfield Clearance Plan.

As guidelines, two additional points may be noted:

i) Landfill sites, butcheries and fruit gardens should not be located near airfields to reduce instances of birds hitting aircrafts. Brick kilns should be discouraged in the vicinity to reduce haze/smoke hazard.

ii) There is considerable noise impact on residential areas under aircraft flight paths. The planner should avoid extensive residential developments under flight paths with heavy traffic.

FIG 9·4

LAYOUT STANDARD RUNWAY

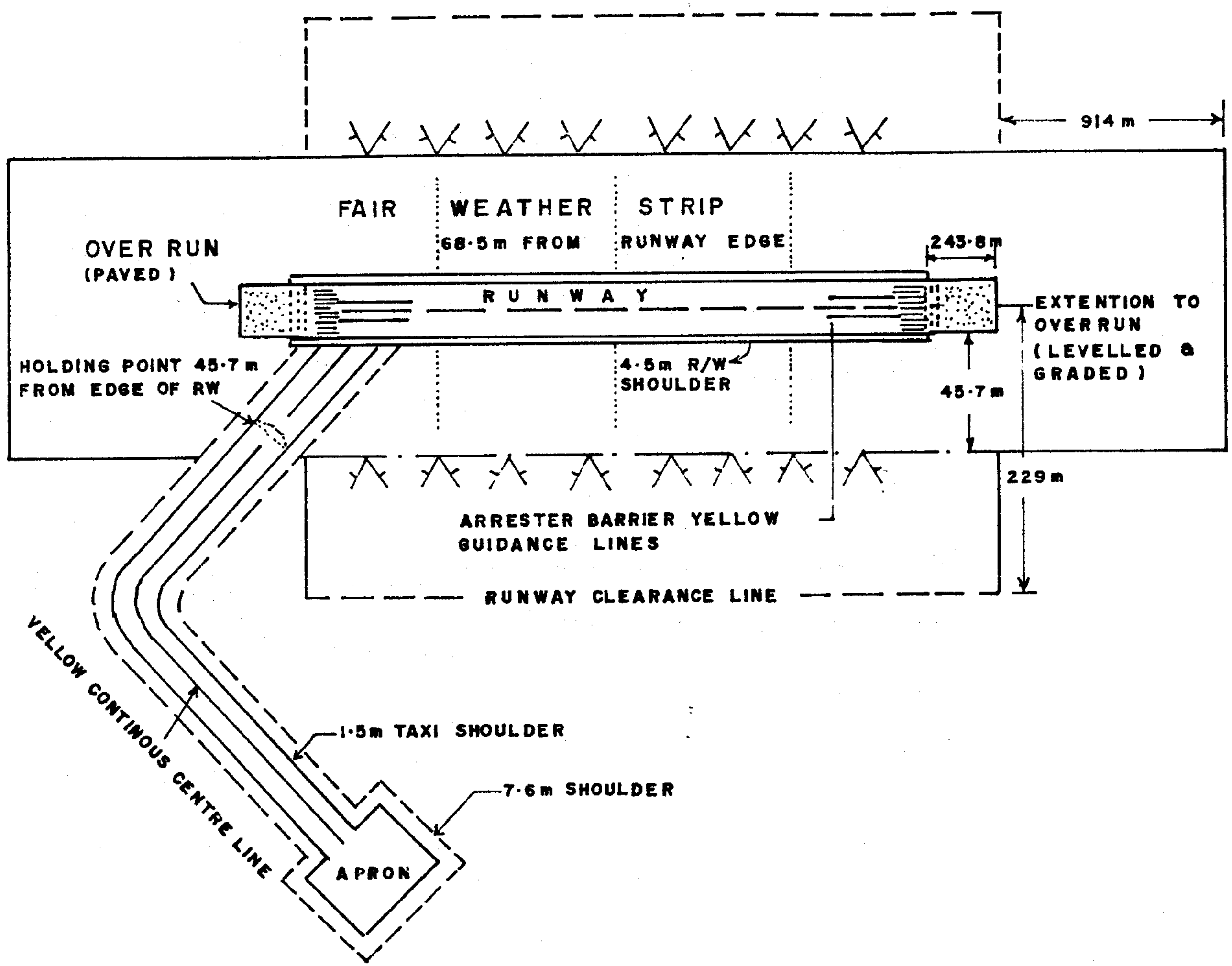
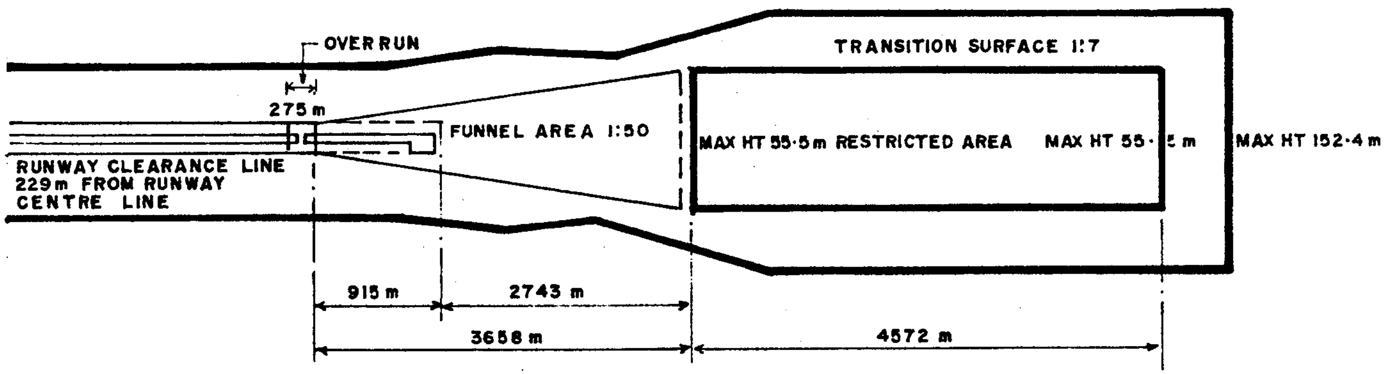
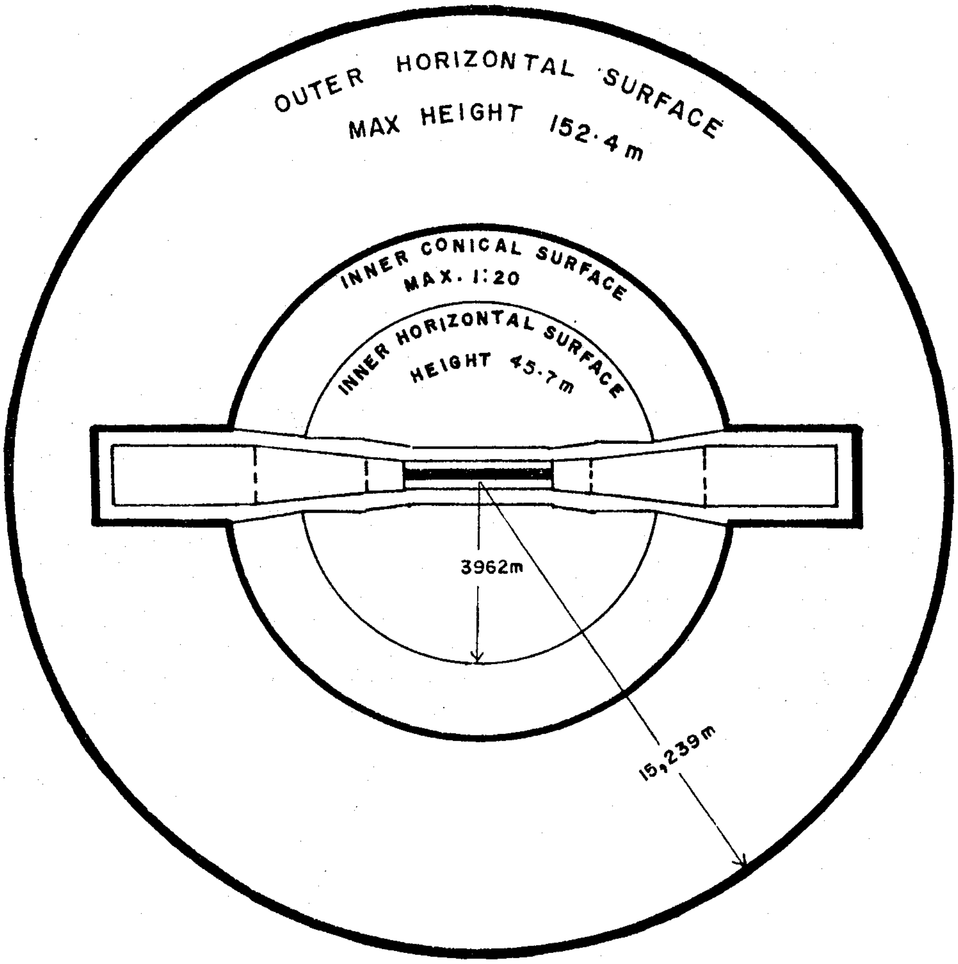


FIG. 9·5



CLEARANCE CRITERIA FLYING GAP

FIG. 9·6



AIR FIELD CLEARANCE PLAN

9.4. RAILWAY STATIONS AND TRACKS

Design of station yards and ancillaries for the various classes of railway stations have been standardised by Pakistan Railways. Site dimensions (boundaries) for typical stations are given in Table 9.1.

TABLE 9.1: SITE DIMENSIONS OF RAILWAY STATIONS

Sr. No.	Type	Description	Length (m)	Width (m)	Area (ha)
1.	B-Class Station	Station Yard for 72 wagons on Double-Line Section.	3014	152	45.8
2.	C-Class Station	3 wagon platform Single-Line.	914	152	13.9

Source:PR HQE Plan No. 32628 and NWR HQE Plan No. 3792.

Width of wayleave required for railway track is a function of height of embankment or depth of cutting. Tables 9.2 & 9.3 give total wayleave width for various heights and depths, while Fig.9.7 illustrates the typical components of the way leave for single and double-line sections.

Table 9.2 : RAILWAY TRACK WAYLEAVES ON EMBANKMENT

Schedule of land widths to be taken up for a single line in bank 5 feet 6 inches gauge
(All dimensions in feet)

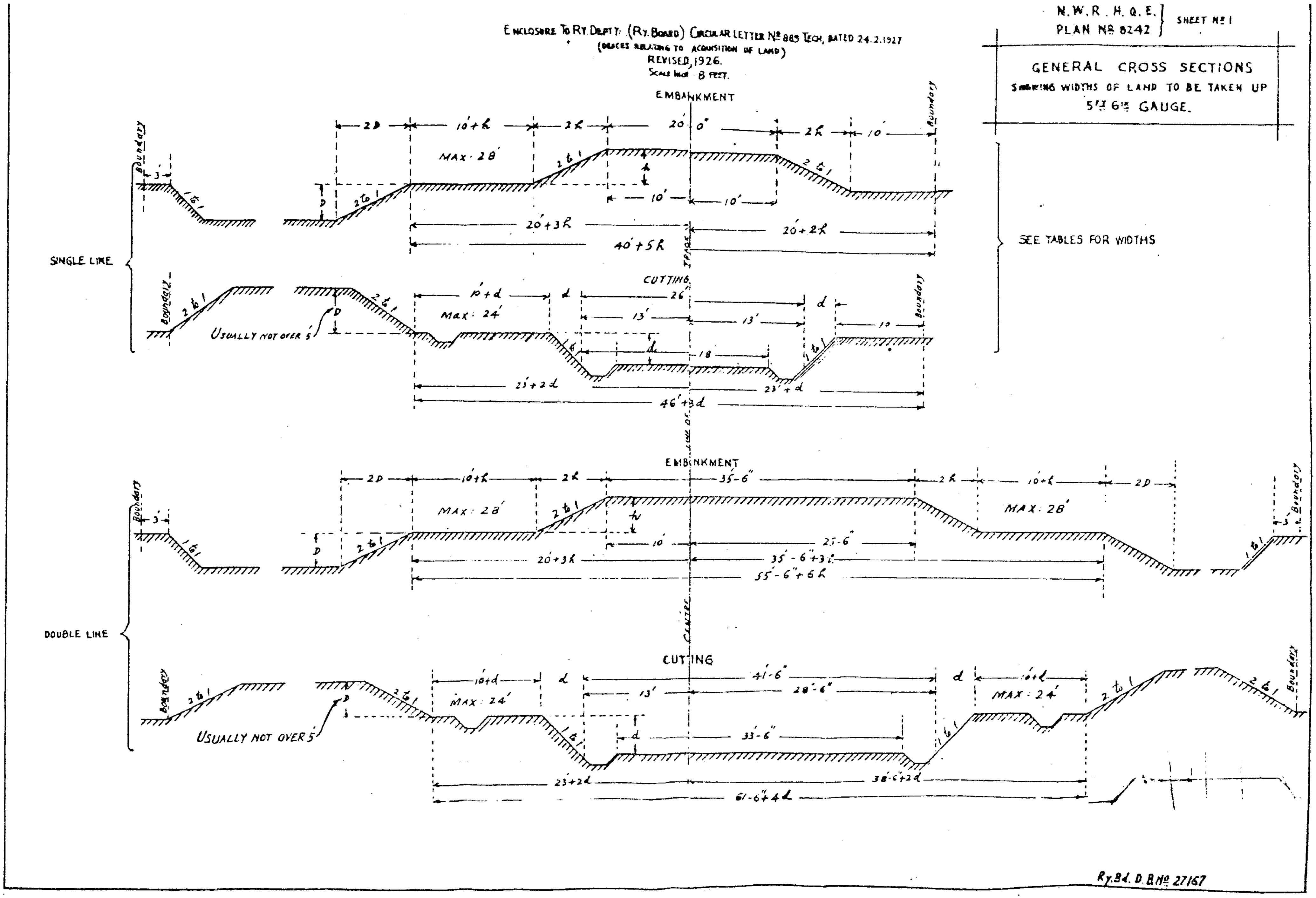
height of bank	Centre line to toe of slope	Berm		Width at top of borrow pit	Add outside pits to allow erection of fence	Width from centre line to boundary		total width of land	Remarks	Depth of pits
		One side	Other side			One side	Other side			
1	2	3	4	5	6	7	8	9	10	11
0	10	10	10	—	—	20	20	40	Pits on. one side.	—
1	12	11	10	14	3	40	22	62	Do.	2
2	14	12	10	30	3	59	24	83	Do.	2
3	16	13	10	34	3	66	26	92	Do.	3
4	18	14	10	47	3	82	28	110	Do.	3
5	20	15	10	61	3	99	30	129	Do.	3
6	22	16	10	61	3	102	32	134	Do.	4
7	24	17	10	74	3	118	34	152	Do.	4
8	26	18	10	88	3	135	36	171	Do.	4
9	28	19	19	47	3	97	97	194	pits on.both sides	5
10	30	20	20	53	3	106	106	212	Do.	5
11	32	21	21	60	3	116	116	232	Do.	5
12	34	22	22	68	3	127	127	254	Do.	5
13	36	23	23	76	3	138	138	276	Do.	5
14	38	24	24	84	3	149	149	298	Do.	5
15	40	25	25	93	3	161	161	322	Do.	5
16	42	26	26	103	3	174	174	348	Do.	5
17	44	27	27	113	3	187	187	374	Do.	5
18	46	28	28	123	3	200	200	400	Do.	5
19	48	28	28	133	3	212	212	424	Do.	5
20	50	28	28	145	3	226	226	452	Do.	5
21	52	28	28	134	3	217	217	434	Do.	6
22	54	28	28	144	3	229	229	458	Do.	6
23	56	28	28	154	3	241	241	432	Do.	6
24	58	28	28	165	3	254	254	508	Do.	6
25	60	28	28	177	3	268	268	536	Do.	6
26	62	28	28	188	3	281	281	562	Do.	6
27	64	28	28	200	3	295	295	590	Do.	6
28	66	28	28	213	3	310	310	620	Do.	6
29	68	28	28	226	3	325	325	650	Do.	6
30	70	28	28	239	3	340	340	680	Do.	6

Table 9.3: RAILWAY TRACK WAYLEAVES IN CUTTING

Schedule of land widths to be taken up for a single line in cutting 5 feet 6 inches gauge

(All dimensions in feet)

Depth of cut-ting	Half width at top of cutting	Berm		Width at bottom of spoil-bank	Width from centre line to boundary		Total width of land	Remarks	Depth of spoil-bank
		One side	Other side		One side	other side			
1	2	3	4	5	6	7	8	9	10
0	13	10	10	0	23	23	46	Spoil-banks on one side	5 feet.
1	14	11	10	15	40	24	64	Do.	Do.
2	15	12	10	21	48	25	73	Do.	Do.
3	16	13	10	27	56	26	82	Do.	Do.
4	17	14	10	34	65	27	92	Do.	Do.
5	18	15	10	41	74	28	102	Do.	Do.
6	19	16	10	48	83	29	112	Do.	Do.
7	20	17	10	56	93	30	123	Do.	Do.
8	21	18	10	64	103	31	134	Do.	Do.
9	22	19	19	42	83	83	166 on	Spoil-banks both sides.	Do.
10	23	20	20	46	89	89	178	Do.	Do.
11	24	21	21	51	96	96	192	Do.	Do.
12	25	22	22	56	103	103	206	Do.	Do.
13	26	23	23	61	110	110	220	Do.	Do.
14	27	24	24	66	117	117	234	Do.	Do.
15	28	24	24	72	124	124	248	Do.	Do.
16	29	24	24	77	131	131	262	Do.	Do.
17	30	24	24	83	138	138	276	Do.	Do.
18	31	24	24	89	145	145	290	Do.	Do.
19	32	24	24	96	152	152	304	Do.	Do.
20	33	24	24	102	159	159	318	Do.	Do.
21	34	24	24	109	167	167	334	Do.	Do.
22	35	24	24	116	175	175	350	Do.	Do.
23	36	24	24	123	183	183	366	Do.	Do.
24	37	24	24	130	191	191	382	Do.	Do.
25	38	24	24	138	200	200	400	Do.	Do.
26	39	24	24	145	208	208	416	Do.	Do.
27	40	24	24	153	217	217	434	Do.	Do.
28	41	24	24	161	226	226	452	Do.	Do.
29	42	24	24	170	236	236	472	Do.	Do.
30	43	24	24	178	245	245	490	Do.	Do.


N.W.R. H.Q.E. PLAN No 8242
SHEET No 1
ENCLOSURE TO RY. DEPTT: (RY. BOARD) CIRCULAR LETTER No 885 TECH, DATED 24.2.1927
(ORDERS RELATING TO ACQUISITION OF LAND)
REVISED, 1926.
Scale 1inch 8 FEET.
GENERAL CROSS SECTIONS
SHOWING WIDTHS OF LAND TO BE TAKEN UP
5FT 6IN GAUGE.
SINGLE LINE
EMBANKMENT
CUTTING
SEE TABLES FOR WIDTHS
DOUBLE LINE
EMBANKMENT
CUTTING
USUALLY NOT OVER 5'
MAX: 28'
MAX: 24'
Boundary
20'+3h
20'+2h
40'+5h
23'+2d
23'+d
46'+3d
35'-6"+3h
55'-6"+6h
38'-6"+2d
61'-6"+4d
Ry. Bd. D.B No 27167

CHAPTER - 10 : LAND USE

10.0 GENERAL

10.1 PROPORTIONS OF LANDUSES

10.1.1 Small/Medium Housing Schemes.
10.1.2 Towns and Cities
10.1.3 Size of City/Town Centre

10.2 RELATIVE LOCATIONS AND PLANNING FOR CHANGE.

10.2.1 Locational Themes
10.2.2 Related Planning Considerations

10.3 ZONING AND LAND SUBDIVISION

10.3.1 Zoning
10.3.2 Floor Area Ratios
10.3.3 Land Subdivision
10.3.4 Town Planning Regulations.

CHAPTER 10 : LAND USE

10.0 GENERAL

This chapter is concerned with the distribution of land uses in an urban setting in the broadest sense.* Its purpose is to state guidelines which have emerged as a result of long experience in the planning profession, regarding proportions of various land uses at different scales and the usual relative locations of commerce, industry, housing, etc. There is no "normative" land use allocation at the city scale nor ideal pattern of distribution of activities. The proportions and form of the city scape are the resultants of past and present socio-economic forces.

In a given society, at each historical stage, market/institutional forces throw up common and widely recognised patterns of urban land distribution in human settlements of similar size**. The improving technology of transportation and communication acts upon the historical from and provides new opportunities for development. Where the inherited form does not meet the changing goals and objectives of society or is slow to respond to opportunities created by new technology, the Planner is called upon to intervene. However, the Planner must be aware of the pervasive power of market processes, so that limitations to the scope of planned intervention are understood. In this context, the basic tools of land use control i.e. zoning and subdivision regulations are described.

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* Standard Land Use Classification for urban jurisdictions in Pakistan is provided at Appendix 10.1

** Urban land use patterns are the subject of many theories. At a minimum, the Planner should be familiar with the theories of the historical school (Sjoberg), the human ecology school (Park and Burgess), geographers (Hoyt, Ullman), and the urban economists (Alonso, Wingo), and also the relevance of these theories to South Asia (Brush, Johnson, Smailes). A basic reading list is provided at Appendix 10.3.

10.1 PROPORTIONS OF LAND USES

The proportions of land under various uses vary according to the scale under consideration. Obviously, a small residential scheme will be predominantly occupied by dwelling units and an industrial estate by various types of factories, whereas at the urban scale, both will be reflected in a certain mix.

10.1.1 Small/Medium Housing Schemes

To be economical, efficient and convenient, the planning of small to medium area development schemes for low rise housing should conform to the following range of land use distribution:

TABLE 10.1 : LAND USE DISTRIBUTION IN AREA DEVELOPMENT SCHEMES

Use	Percentage
i) Residential	45-52
ii) Commercial	2-3
iii) Education, Health & other Community Facilities.	7.5-10
iv) Roads/Streets	25-30
v) Open Spaces	5-7.5
vi) Others, including graveyards equivalent reserve*	2-5

*Reference 6.5.8.

The saleable area of an area development scheme may be upto 65 percent.

High rise housing with a different pattern of land use should be controlled by F.A.R. guidelines given in section 10.3.2.

10.1.2 Towns and Cities

At the scale of towns and cities, one is concerned with broad land use zones rather than specific uses e.g. a residential zone also encompasses area falling under the network of local roads and services in that tract. It also includes mohallah and sub-mohallah shopping, and small scale/household manufacturing.

Collation of data from 25 master plans and outline development plans (out of the 45 odd prepared in the country since 1960), reveals wide variation in the proportions of land uses at city/town scale, (Table 10.2), even after adjustments by excluding agricultural and defence land within urban jurisdictions.

The variations are partly a result of the crude and non-standardised methodology of land use data collection, generally based on plot boundaries rather than actual use extent, (which, for example, exaggerates the area under institutional and industrial uses in some towns). However, the Table essentially brings out the diversity of function (specialisation), and areal organisation between the urban centres.

The following generalisations may be deduced from the variations in land use proportions.:-

i) There is no simple relationship between population size and share of land under different uses.

ii) In large cities owing to competition and complexity, there is less variation in land use proportions and a minimum area of 12-13% is required for arterial circulation and terminals.

iii) In large cities, in an expansion phase, there may be huge amounts of vacant land left lying between old and recent localities and between development corridors.

iv) Owing to specialisation and less intense competition for land, small and medium towns vary markedly in the shares occupied by the main land uses.

v) Some small and intermediate towns, not located on railway network or national highways, have very little area under trunk infrastructure, having grown organically around a system of local roads and streets, (definitionally included in residential zone).

vi) Other small and medium towns having grown around a railway station, crossing on national highway, or airport have large shares under arterial terminals.

vii) In some small towns, large shares of land under institutional use may occur owing to regional functions, (such as cadet college, teaching hospital, etc.).

The following principles may be kept in mind by a Planner when land use analysis reveals shares close to extreme values reported in Table 10.2.

i) In large cities, control on vacant land is extremely important. Leap-frog development leads to uneconomical length of services and should be avoided unless the vacant land is unutilizable owing to terrain or reserved for central commercial expansion.

ii) In small towns, prevention of unnecessary extensive acquisitions for regional functions is important, as otherwise they may blockade the growth of other uses.

iii) In a small town with a low share under arterial circulation/terminals, planned intervention to create a hierarchy in the road network, clearly defining trunk roads and providing adequate bus/truck/wagons terminals, is strongly indicated.

The above are only partial and preliminary guidelines and need to be supported by economic base studies for more clearly determining the surpluses and deficiencies of existing towns.

The broad percentages given in Table 10.3 may be used as preliminary guidelines in the initial design of new towns.

10.1.3 Size of City/Town Centre

The concept of Town Centre has great appeal to the Planner as it maximizes the aggregate convenience of inhabitants and provides a social focus,yet allows latitude in civic design.Most of the region/city-serving institutional and commercial facilities of an urban settlement are concentrated in its Town Centre.The uses located in a Town Centre vary from settlement to settlement depending upon its population,economic and social character.The following uses are generally found in a Town Centre:

i) Important Public Buildings,(including prestigious government offices,specifically Town Hall).

ii) Main Commercial/Business Establishments*.

iii) Markazi Mosque**.

iv) (General/Head) Post Office.

v) (Central) Telephone Exchange.

vi) Fire Station

vii) Polyclinic.

viii) Other Institutional Buildings.

ix) Transport Interchanges and Public Toilets.

---

* In cities and the larger towns,these evolve into a Central Business District (CBD).

** In most cities/towns of Pakistan, the Jamia Mosque is located outside the Town Centre. Either it precedes the city centre (e.g. Lahore) or is located elsewhere because of huge space requirement and aesthetic reasons (e.g. Islamabad).

TABLE 10.2 : OBSERVED RANGE OF LAND USE PROPORTIONS AT CITY/TOWN SCALE (%)

City/Town Population Size Class	Residential[1]	Industrial[1]	Commercial[2]	Institutional	Arterial Circulation/ Terminals	Recreational open spaces	Grave-yards.	Vacant
All size Classes	24-50	2–20	0.5–5	2–21	2–29	0.5–7	0.5–6	3–45
500,000 +	24-32	2-15	1–2	3–8	13–20	2–5	0.5–3.5	9–45
100,000 – 499,000	26–48	3–8	0.5–2	2–10	12–29	1–7	0.5–4	3–17
50,000 – 99,000	27–43	2–20	1–5	3–11	3–27	1–6	0.5–6	8–26
25,000 – 49,000	26-50	3-11	0.5–3	2–21	2–18	0.5–2	1–4	7–31

1. Includes local networks and services.
2. Includes local networks and residential use not on ground floor.

Source: H&PP Dept., Lahore.

TABLE 10.3 : GUIDELINES FOR LAND ALLOCATION TO ZONES IN THE PRELIMINARY DESIGN OF A NEW TOWN (%).

Design Size (ultimate Population)	Residential Zones*	Industrial Zones	Commercial Zones	Institutional	Arterial Circulation + Terminals	Community Open Spaces	Grave yards	Protected Reserved.
100,000 +	40-45	2-10	2–3	3-5	15–20	4–6	2–3	15–25
50 - 99,000	45-50	2-15	2–3	3–5	10–15	3–5	2–3	15–25

* Including local networks, services, and neighbourhood open spaces.

Lively town centres also have cottage industry and flats located just behind or on top of the commercial/business establishments. Site standards for individual functions have been given in Chapter 6. However, being a central zone surrounded by other uses, adequate scope for expansion of the entire town centre is essential. Thus the ideal size of City/Town Centre has agitated planners and there is considerable international research on the subject. Worldwide study by M/s Doxiadis shows that town centres vary from 47 sft per inhabitant in small and medium settlements down to 10 sft per inhabitant in great and congested cities. Frank Gibberd reports that though initially designed at higher standards, most British new town centres were actually implemented at a standard of around one acre per thousand persons.

M/s Doxiadis used ultimate design population and the basis of 47 sft per person (or 1.1 acres per thousand persons), for demarcating the Red and Blue Areas of Islamabad.

In most cities of Pakistan,owing to organic growth,this standard is presently not practical and perhaps unnecessary owing to the current low ownership of private automobiles.

For the present,0.5 acres per thousand persons is recommended as a guideline for delimitation of Town Centre.

If there are vacant patches on the periphery of the Town Centre,these tracts may be reserved for high order civic and commercial uses to allow future attainment of the standard of one acre per thousand projected inhabitants.

In the absence of adjacent vacant land,commercial invasion of surrounding residential zones may be allowed to the extent that the Town Centre expands to a size of one acre per thousand projected inhabitants (Table 10.4).

TABLE 10.4: GUIDELINES FOR SIZE OF NEW TOWN CENTRE & DELIMITATION OF CBD OF EXISTING SETTLEMENT

Town Centre of New Settlement		0.4 hectare/1000 persons
Delimitation of CBD of Existing Settlement	Present:	0.2 hectare/1000 inhabitants
	Future :	0.2 hectare/1000 inhabitants plus 0.2 hectare/1000 reserved/allowed conversion.

Circular to rectangular shapes may be preferred in the design of the town centre of a new settlement unless:

i) Express routes are envisaged within the centre making a linear shape more economical;

ii) the town has potential to grow into a full-fledged city, making the possibility of town centre expansion the most important criterion. (A linear centre is better adapted to expansion than a circular or hexagonal one).

The town centre of an organic settlement is most likely to be star-shaped with bands of central uses extending along the arterial roads emerging from the nucleus.

10.2 RELATIVE LOCATIONS & PLANNING FOR CHANGE

10.2.1 Locational Themes

Relative locations are determined by space and accessibility needs. Fixed investments in housing, etc., formed by space and accessibility needs of the past, slowly adapt by the process of invasion and succession to the current needs for space and accessibility. Table 10.5 gives some generally recognised location themes.

TABLE 10.5 LOCATIONAL THEMES

Sr. No.	Landuse	Location/Description
A :	Housing:	
	i) High income housing.	1.5 kms* from town/city centre specially in sectors leading to pleasant amenities.
	ii) Middle income housing	As above, but in sectors leading to industrial/low amenity uses.
	iii) Low income housing	On land available free of cost or at cheap rates.
	iv) Old residential areas	Close to town/city centre with high percentage of dilapidated dwellings in process of conversion to commercial use along main roads.
B :	Commerce:	
	i) Central Business District (CBD)	Geographical centre of city
	ii) Specialised Commercial Areas.	Along major roads and junctions.

(Contd...)

iii)	Local commercial areas(i.e. neighbourhood, mohallah & sub-mohallah shopping centres).	Centre of residential communities.

C : Offices:

i)	Commercial Offices	Close to CBD.
ii)	Govt.Offices	Various landuse zones, including town/city centre.

D : Industry:

i)	Small Sale Industry	Close to low income communities along major transport facilities.
ii)	Heavy Industry	On the outskirts of the cities, though warehouses may be close to CBD and transport terminals.

* Depending on size of the settlement.

10.2.2 Related Planning Considerations

Planning intervention to radically change the evolving but distinct landuse pattern mentioned in Section 10.2.1 is likely to be high risk and cost ineffective.

Working within severe resource constraints, it is fruitful to concentrate on certain key issues, as given in Table 10.6.

TABLE 10.6 : KEY ISSUES AND POSSIBLE SOLUTIONS

	Use	Location	Key Issue	Some possible solutions
1.	High density low income housing.	Central	Service/ Amenity deficiencies.	a) Create minimum necessary green/open spaces, (e.g. by relocating gowalas). b) Control encroachments. c) Provide sewage collection system. d) Try to provide parking spaces.
2.	Low income housing	Outskirts of town	Services deficiency	a) Rationalize layout so that services networks can be laid. b) Provide feasible level of services, specially water supply and public transport. c) Provide employment opportunities.
3.	Commercial	Town Centre	Pre-empting bottlenecks and atrophy	a) Provide vehicular access and parking spaces. b) Pedestrianize congested commercial roads. c) Control hawkers. d) Ensure adequate parking spaces inside high rise commercial buildings. e) Develop alternative locations for business generating bulky/slow moving transport, (vegetable, grain markets).
4.	Commercial	Highways/ Principal Urban Roads	Pre-empting Bottlenecks.	a) Discourage ribbon development. b) Encourage commercial development along loop/tranverse streets.
5.	Commercial	Residential Zones	Conversions	a) Delimit Town/City Centre. Allow conversions within it. b) Do not allow conversions outside town/ city centre.
6.	Arterial Road Network	Enclosing/ connecting major land uses.	Maintaining/ enlarging right-of-way.	a) Identify major roads. b) Enlarge their right-of-way early before road-side developments increase to make widening impossible. c) Where arterial road widening impossible, provide by-pass. d) Rigidly maintain wayleave of by-pass, do not permit direct access, but provide controlled access points to local residential/ commercial uses.

10.3 ZONING AND LAND SUBDIVISION

Zoning, Land Subdivision and Building Control comprise a hierarchy of regulatory techniques for landuse control, at different degrees of detail:

i) Zoning regulates the overall structure of a settlement.

ii) Land Subdivision is concerned with the immediate relationship between contiguous plots, access and services.

iii) Building Control regulates the proportion of built-up area, setbacks, height and bulk on each plot.

The three devices are normally used in conjunction and indeed have overlapping elements. Their operations are governed by town planning regulations and building regulations. The following sections briefly outline guidelines for zoning and land subdivision. Building control guidelines have been incidentally touched upon in various sections of previous chapters. For comprehensive information, the planner should refer to National Building Code and building regulations of various authorities acting under provincial legislation.

10.3.1 Zoning

Zoning involves statutory limitations to the use of urban space in order to improve efficiency, derive agglomeration economies, ensure minimum standards for health and safety, and provide land for public goods and services. Operational tools for zoning are generally a set of permissive rules about the use of land and plot ratios (controlling bulk, height and coverage of structures), within each zone. Scope and extent of these rules are generally influenced by the character of the area, perceptions for its development, and societal values.

10.3 ZONING

Traditionally, in an attempt to allocate sufficient space for present and future activities and to avoid incompatibility, zoning designates areas for residential, commercial, civic, industrial, institutional, recreational and miscellaneous purposes. Salient features of each zone are as under:

i) Residential Zone:

Consists of dwelling structures and other selected amenities and services. It is usually divided into sub-zones based on the predominant type of dwelling such as detached, semi-detached housing, and apartment buildings/flats based on densities. The following other uses should be located in a residential zone:

a) Schools
b) Dispensary/Clinic
c) Mosque
d) Open Spaces
e) Convenience Shops
f) Post Office, Bank, etc.
g) Community Halls, Local Clubs, and Indoor Sports Facilities.

Residentiary manufacturing may also occur in some residential zones.

ii) Commercial Zone:

The various uses grouped in commercial zone are:

a) Markets (Demand and Impulse Shops, etc).
b) Godowns and warehouses
c) Business offices.

Besides, the commercial zone may also have some residential structures.

iii) Civic Zone:

Generally located in the central part of the city, it consists of:

a) Administrative Offices
b) Town Hall
c) Courts
d) Showrooms
e) Public and Private Offices
f) Higher order community facilities such as General Post Office, Banks, etc.
g) Parks
h) Entertainment uses such as cinemas, theatres and other buildings of cultural significance.
i) Marriage Halls.

iv) Industrial Zone:

Mainly consists of factories, workshops and warehouses etc. It is generally an intense activity area generating considerable traffic, noise, air pollutants, industrial effluent, etc. Intensity of toxic and harmful elements however, may depend upon the nature and the scale of industries in the district. From public health point of view, the industrial zone is generally considered incompatible with residential use. However, if certain residences are required in the industrial zone, they should adequately be protected from possible health hazards. Buffer belts of thick plantation may be provided for the purpose.

v) Institutional Zones:

Institutions other than in the Civic Zone are sometimes separately zoned where prominent. Educational, health care and religious facilities are the important institutional uses found outside the civic centre. (For definition and list of institutional uses, refer Chapter 6).

Educational uses defined as institutional include polytechics, colleges, universities, other research and training facilities, and occasionally secondary schools which are exceptionally large or operate as centres of excellence.

Health institutions include community hospitals, general hospitals and specialised hospitals.

Religious institutions include mosques, churches, temples, gurdwaras, shrines, dargahs, tombs and attached green and open spaces owned by a religious body.

vi) Recreational Zones:

Meant for outdoor recreation, may consist of city parks, recreational stadiums and grounds, large open spaces, lake areas, zoological and botanical gardens, etc. Also clubs, indoor-sports facilities, where prominent.

vii) Miscellaneous Zone:

Includes graveyards of all religions/denominations, cremetoria, towers of silence, etc. Also includes land reserved/protected for any purpose.

Each zone may have further subdivisions and accordingly related sets of rules. However most cities, owing to diversity and different intensity of landuses do not conform to the above format of single use zoning. To allow effective and meaningful control of landuse, in diverse situations, a brief review of important zoning techniques is presented below. This should help the Planner in selecting the most relevant technique for each specific situation.

i) Zoning Based on Scale of Intensity: it involves designation of distinct areas for control and regulation based on intensity of activities generated by uses. For example, heavy industrial use, the most intense, may be designated as one zone and single family residential area, the least intense, the other. This is a rigid form of zoning, outlining detailed guidelines for shape, volume, height, setbacks, open spaces, etc. It is a less practical form of zoning and may lead to higher cost to the community.

ii) Zoning Based on "Bulk Control": Applicable to both residential and commercial buildings, this type of zoning ordinance is comparatively more flexible. It controls use volume or floor area ratios, ensuring sufficient day light and air for different buildings. It has three purposes:

a) To control population density and volume of traffic;
b) To ensure adequate daylight and air; and
c) To provide sufficient privacy and open space.

iii) Mixed Use Zoning: It may be applied, at a larger scale, to integrate mutually supporting projects or to achieve physical and functional complementarily among compatible uses at a smaller scale. Mixed use development enables greater accessibility. It may allow higher densities at certain points e.g. around a public transport station etc.

Planned unit development zoning is one form of mixed use zoning. It is applicable to projects/schemes to make them balanced and partially self sufficient. For example, a zone of housing may have appropriate level of commercial and institutional facilities for the convenience of the residents.

iv) Floating and Conditional Zoning: Generally a vacant area, may be defined as a zone for which no specific use has been designated so far. A floating district is generally not located on the zoning map but is mentioned in the zoning ordinance. The ordinance gives guidelines regarding possible uses for the floating zone. It is least rigid form of zoning and is meant to be more responsive to the new/future demands. However, for location of new uses, other than prescribed, the proposals for the floating district are evaluated in the light of performance standards before granting permission.

v) Interim/Phased Zoning: During the course of plan preparation or modification, certain short term controls regarding historical buildings, land marks, conversion of one landuse into the other etc.,are imposed. For development in interim or phased zone, a special development permit is required. It is an effective instrument to control new development and channellize growth of cities or towns. Under this type, the new development is phased in accordance with the city's capacity to provide infrastructural facilities or other essential services.

Zoning, as a legal instrument, represents a restrictive force. It poses difficulties for modifications and alterations. Zoning has been most practical for settlements with stagnant/low rates of population growth and single use patterns of land development. Single use zoning is not suited to the rich and inter-woven fabric of Pakistani cities and towns. Where human settlements exhibit significant rates of growth, even sophisticated zoning techniques may have only marginal utility. Zoning functions best when it is used to effectuate an approved urban plan. Unfortunately very few cities of the country have functioning urban plans and there is not enough expertise to prepare structure plans/detailed plans or even outline development plans for the vast majority of the 400 odd cities and towns of the country, let alone the 400 new urbanisms expected in the next 20 years. Besides, plans take many years to prepare.

Despite these serious limitations, some form of zoning is badly needed as evidenced by the plethora of land use regulations/schemes recently issued/submitted for higher approval by various Development Authorities, on an entirely adhoc basis, with little sense of balance, at one extreme naming specific roads and streets and at the other covering the entire urban jurisdiction.

10.3.2. Floor Area Ratios

The maximum permissible coverage (ground and total) for single unit dwellings already been covered in Chapter-4. For measuring and controlling the intensity of high rise residential and non-residential uses, application of the Floor Area Ratio is a widely accepted method. It is based upon the total area of permitted floor space expressed as a proportion of the site. Fig. 10.1 illustrates the concepts of Land-Use Intensity (LUI) and Floor Area Ratio (FAR). It is a system which caters for all services/facilities implicit in development, such as roads, parking, access and footpaths. The recommended floor area ratios for high rise residential and non-residential uses are given in Table 10.7.

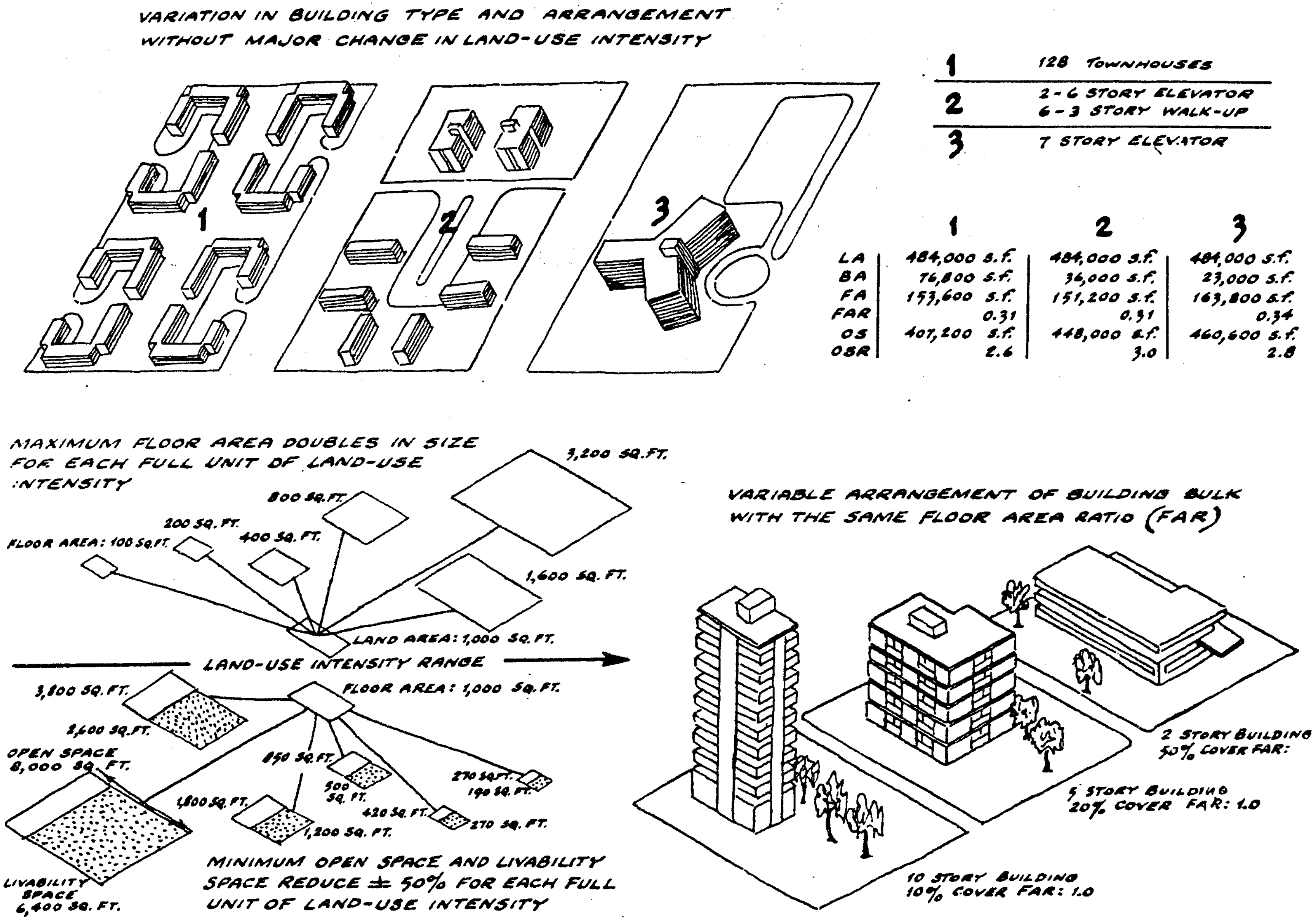
Development of the town/city centre is more intensive and hence higher FARs are suggested for such area. The intensity also varies a function of city size as reflected in Table 10.7.

TABLE 10.7 : **F.A.R. GUIDELINES**

USES		Recommended F.A.R. Limits
Commercial-cum-Residential		2 - 2.5
Commercial		2.5 - 3
Central Area	City Size upto 100,000	3
	City Size 100,000 to 1,000,000	4
	City Size beyond 1,000,000	Depending on local bye-laws

Fig: 10.1

LAND-USE INTENSITY



	1	2	3
LA	484,000 s.f.	484,000 s.f.	484,000 s.f.
BA	76,800 s.f.	36,000 s.f.	23,000 s.f.
FA	153,600 s.f.	151,200 s.f.	163,800 s.f.
FAR	0.31	0.31	0.34
OS	407,200 s.f.	448,000 s.f.	460,600 s.f.
OSR	2.6	3.0	2.8

Source: De Chiara and Koppelman, 1975.

Since the FAR methodology is relatively new to Pakistan (except Karachi), planners, uncertain about its long term ramifications, may use it is conjunction with regulations for absolute height control.

10.3.3 Land Subdivisions

Land subdivision is a technique to develop virgin land, or redevelop less intensely used parcels, by fractionating into smaller units, for residential or other purposes. The process involves mapping of the site and dividing it into blocks and individual lots. Land subdivision is one of the most important determinant of different urban patterns e.g. grid iron, radial, circular, linear, star or mixed etc., etc. Land subdivision also indicates land ownership, precisely by mapping, for construction, taxation and public rights. It is far more detailed than the zoning plan.

Land subdivision regulations govern the process of sub-dividing. They set standards for lot sizes, their dimensions, street widths, street improvements and other related requirements.

The purposes of land subdivision are:

a) To achieve orderly urban development.,

b) To promote and development the utilisation of land to assure the best possible community environment in accordance with the master plan of the city/town.

c) To secure sufficient land for public services.

d) To provide for adequate municipal services and safe streets.

e) To protect against negative locational spillover effects of one property on the other.

f) To protect and promote public health, safety and general welfare.

10.3.4. Town Planning Regulations

Town Planning Regulations are the legal framework through which the planning authority informs the community of its general planning intent as well as zoning and sub-division regulations. The need for such a presentation is obvious. At a minimum, it shows how the regulations have been derived from parent law. Hopefully, the codification reduces individual discretion, and by imposing a set process of approvals, facilities clearer and strategic thinking in the planning authority.

It is futile and perhaps dangerous to attempt to impose the substantive contents of "model" town planning regulations because individual urban settlements vary so markedly in size, form and nature of problems. We believe it is necessary for planners in planning authorities to read widely, (including this Manual), and evolve their own regulations.

However,it is noted that except in the largest cities, there appears to be no concept of how to organise and present the town planning regulations.Some of the present formats are very restrictive, not only in the sense that they simply focus on prohibition and restrictions, but that they are not readily adaptable to changing circumstances and confuse specific situations with general issues. To help avoid repeated cumbersome legislative changes, an annotated format of town planning regulations is presented at Appendix 10.2. This format allows flexibility for easy incorporation of changes over time. It is recommended for use in the creation of the initial skeleton of town planning regulations, whose details can be filled up as planning practice and awareness grows.

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APPENDIX 1.1 : GLOSSARY

Affordability:	The maximum outlay a potential purchaser can make either at a point in time or in instalments. In the context of housing, it is the sum of downpayment plus instalments capitalised over a period of time.
Arcade	An arched or vaulted passage or walk, specifically shopping arcade fronting a row of shops or between two rows of shops.
Arid	Deficient in annual rainfall.
At Grade Junction:	Where roads meet at the same level. Common types of at-grade junctions are Tee, Wye, Cross, and Staggered.
Backwash Rate	The flow rate per unit area at which the filter bed is washed in reverse direction, to remove the suspended impurities entrained during preceding filter run.
Backwash Time	The time for which the filter bed is backwashed, for removal of impurities entrained in the filter bed.
Bench Marks	In surveying, a mark, either cut in stone or embedded RCC pillar, taking the form of an arrow with a horizontal bar across its apex and used as a reference mark for determination of altitudes and locations relative to (national) grid.
Blue Area	Area designated for main commercial activity.
Biochemical Oxygen Demand(BOD)	The amount of dissolved oxygen consumed by the micro organisms in the biochemical oxidation of organic matter per unit volume of waste water.

Building Line	A line beyond which the outer face of any building except compound wall, may not project in the direction of any street, existing or proposed.
Cul-de-Sac	A street closed at one end. Other expressions are "blind alley" and "dead end", but these are not terms used in a purposeful planning sense.
Density	The ratio of persons, households, or volume of building or development to some unit of land area.
Design Speeds	The maximum speed maintainable throughout a journey with safety and comfort when weather and traffic conditions are favourable and the geometric features of the road are the controlling factors.
Filtration	A physio-chemical process for separating suspended and colloidal impurities from water by passage through a porous medium.
Floor Area Ratio	The aggregate covered area of a building or buildings on a plot divided by total area of the plot. Thus if the site is 20,000 sq.ft. and the total area of all floors is 50,000 sq.ft. then the F.A.R. is 2.5.
Floor Space Index	Similar to Floor Area Ratio, except that in FSI, 20' width of major roads and half the widths of minor roads are included in the site area calculations, whereas in FAR these are excluded.

Grade Separated Junction	Junctions where roads are segregated by levels. These are very efficient junctions with minimum conflict points, but not popular in Pakistan because of high costs and large area requirements.
Gradient	The rate of rise or fall of ground surface. It is usually expressed as a ratio of 1 vertical in n horizontal (i.e. 1 in n).
Grid Iron	An urban plan divided into approximately square building blocks formed by the street pattern.
Habitable Room	Normally a bed room, dining room, living room, or a room for servant. Attics, kitchens and other separate covered spaces which can be used for sleeping purposes are also habitable rooms.
Household	A collection of persons living and eating in one mess with their dependents, relatives, servants and lodgers who normally reside together. The principal criteria, it will be noticed, is the one of common cooking and messing facilities.
Lateral Sewer	(Also known as service connection), it carries waste water from houses, institutions and industries, to the public sewer.
Leeward	The side or direction which is sheltered from the wind, e.g. by a range of mountains. Also with reference to the dominant wind direction, describes a location in a set which receives a particular gust after the others in the set.

Local Plan	Any plan, subject to an approved Structure Plan, adopted by a local planning authority for part or all of an area.
Maritime Climate	A climate which is mainly influenced by the proximity of the sea, giving a comparatively cool summer and a comparatively warm winter.
Meridian	A line of longitude, or half of one of the great circles which pass through the poles and cut the equator at right angles.
Metropolitan	Pertaining to the greater urbanised area developed around a city.
Modal Split	The proportions of trips using various modes of travel.
Mortality Rate	Number of deaths per 1000 persons in one year.
Neighbourhood	An integrated, planned urban area related to the large community of which it is a part and consisting of residential districts, a school or schools, shopping facilities, religious buildings, open spaces and perhaps a degree of service industry.
Oxidation Pond	An artificial pond of sewage which provides a water surface at which oxygen is dissolved from the atmosphere to be used by aerobic bacteria for meeting B.O.D.
Passenger Car Units	Vehicles of different types require different amount of road space because of variations in size and performance. In order to allow for this in capacity measurements for roads and junctions, traffic volumes

	are standardized in passenger car units (PCUs), which have been empirically determined and codified. Values usually range from 7 per bullock cart to 0.5 per cycle.
Pathogenic Organisms	The disease causing micro-organisms such as E.Coli, salmomella, shigella, etc.
Physical Planning	A distinctive form of planning essentially concerned with changes within the physical environment. The physical environment is taken to mean the land on which activities of living are based, the buildings which house these activities and the artifacts which are necessary for society to function.
Piedmont Plain	In arid and semi-arid regions, the gently sloping plain strewn with boulders that borders the mountains.
Plot Ratio	Same as floor area ratio, but generally reserved for application to low rise residential development
Potable Water	The water which is safe to drink, pleasant to the taste, and useable for domestic purposes.
Presedimentation	The sedimentation of raw water prior to all other treatment operations, for removal of readily settleable suspended particles.
Rate of Filtration	The flow rate per unit area at which the raw water passes through filter bed.
Residential Density	Number of Dwelling Units per unit area.
Ribbon Development	Urban spread along the main roads, especially those leading to a city.

Road Capacity	The maximum number of vehicles etc., that can pass a given point on a lane or a carriageway during one hour under the prevailing road way and traffic conditions, without unreasonable delay or restrictions to the drivers freedom to manoeuvre.
Setpic Tank	A tank in which sewage is collected and decomposed before its discharge into public sewer or soakage pit.
Sludge	The solid and semi solid residual obtained from settling of waste water.
Structure Plan	A plan for a country or large or important urban area comprising policy and general proposals. It relates to the social, economic and physical systems of an area insofar as these are subject to planning control or influence.
Superelevation	The raised outer edge of the carriageway provided on curves as a safety measure.
Terminal Head Loss	The loss of pressure through filter at the end of a filter run.
Turbidity	A water is turbid when it contains visible material in suspension. While turbidity may result from living or dead algae or other organisms, it is generally caused by silt or clay.

Zoning

The division of a community into zones according to present and potential use of properties for the prupose of controlling and directing the use and development of those properties. It is concerned primarily with the use of land and buildings, the height and bulk of buildings, the proportion of a lot which buildings may cover and the density of population for a given area.

APPENDIX 2.1 : HOUSING DATA CHECK LIST

CHECK-LIST OF BASIC DATA REQUIRED FOR PROJECT APPRAISAL: GENERAL HOUSING*

I. Project Justification and Scope

i) Existing housing situation-information on:

a) housing backlog on the basis of structural conditions and overcrowding.

b) Annual supply of plots by the public and private sectors.

c) Number of housing units being constructed per year.

d) Estimated supply of plots during next five years, through on-going public and private schemes.

ii) Housing demand: information on:

a) Present population.

b) Population projections: short term and long term, (mention growth rate applied for population projection).

c) Socio-economic grouping to ascertain demand composition.

d) Average annual demand of housing units during next five years.

e) Capacity of proposed project to meet the housing demand.

f) Relationship with current Five Year Plan objectives and targets.

*Government of Pakistan, Planning & Development Division (PP & H Section).

II. **Technical Aspects:**

i) Site selection criteria-information on:

a) Map showing location of various tentative sites for the project.

b) Topographical data of each site.

c) Status of the scheme in respect to Master Plan of the city/town, if any.

d) In the absence of Master Plan, then consider the local conditions and regulations of the city/town.

e) Availability of following primary services:

- Roads/transportation links.
- Water supply
- Sewerage/drainage.
- Electricity.
- Gas
- Telephone

f) If these services are not available to the project, then what are the other alternatives.

ii) Layout plan and designing of services-information on:

a) Town planning concepts applied in the preparation of master plan of the scheme.

b) Plans showing land utilization, roads/paths, community buildings, etc.

c) Proposed housing densities.

d) Plot sizes and their percentage with respect of socio-economic groups. How do they conform to the local policies.

iii) Planning standards and design criteria-information on:

a) Type of access to the houses i.e. motorable or pedestrian.

b) Road network of access, collectors and major roads.

c) In case of pedestrian access, vehicular road should be available at suitable distance for fire fighting and ambulence services.

d) Is water supply continuous or intermittent?

e) Water supply standard i.e. lpcd.

f) Drainage and sanitary systems i.e. combined or separated.

g) Underground or overhead electrification.

h) Underground or overhead telephone system.

III. **Cost Estimates:**

i) What Schedule of Rates is used for cost estimates.

ii) Broad quantification of following services:

a) Lengths, widths and surface areas of all typesof roads/paths.

b) Number, lengths and widths of bridges and culverts.

c) Lengths of water supply pipes of various diameter.

d) Lengths of sewers for stormwater drainage and sanitary sewage of various diameter.

iii) Itemized costs:

a) Overall costs and unit costs (including cost of manholes and specials) for each size of water pipes. Also indicate what kind of pipes are proposed for different diameters

b) Overall costs and unit costs (including cost of manholes) for each size of drainage pipes, sewers and open drains, if any.

c) Overall unit costs of each type of roads/paths. Also indicate typical specifications and drawings showing cross-section of each type of roads/paths.

d) Broad quantification and rough estimates of electrification/street lighting prepared by WAPDA/KESC.

e) Cost estimates of landscaping and horticulture works.

f) Cost estimates of water source development i.e. pumping and storage.

g) Cost of trunk sewers and sewage disposal/treatment system.

h) Proportionate cost of indirect services on per sq.metre basis chargeable to the project.

iv) Per sq.m unit cost of each service and comparison with the similar type of schemes.

v) Sale policy for residential, commercial, industrial, and institutional plots.

a) If bigger size plots i.e. 420 to 500 sq. metre are to be auctioned, then what will be percentage of the plots and what will be the reserve prices.

b) Reserve price of each category of commercial and industrial plots.

c) Sale/reserve prices of flat sites, if provided in the scheme.

d) Sale prices of plots for educational and community services.

e) Whether cross-subsidy is being provided to small plots over big plots or not?

PLAN PREPARATION EXAMPLE

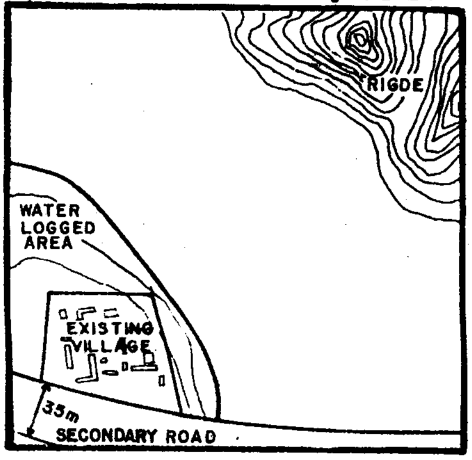
The broad steps of the plan preparation process can be illustrated in the following example:

i) Environment

Identify the following

- natural features (ridges, trees, nullahs).
- historical sites (locate, outline, mark for preservation).
- difficult building conditions (poor load bearing capacity, etc).

Fig. A-2·2·1

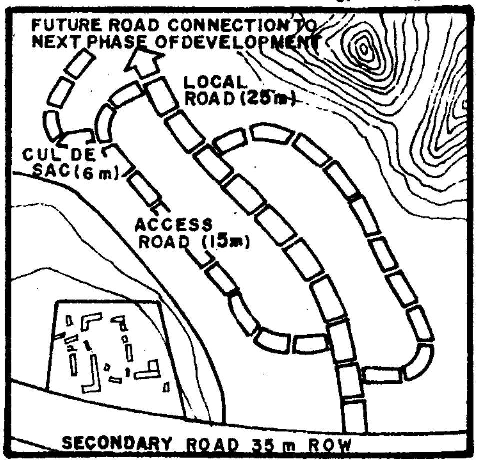


ii) Roads

Define the overall road pattern:

- future road connection to next phase of development.
- local roads (use most obvious local route through site with proper right of way and curves, and then subdivide remaining areas with access roads and cul-de-sacs, the exact location of access roads and cul-de-sacs will be determined by land uses at a later stage).

Fig.A-2·2·2

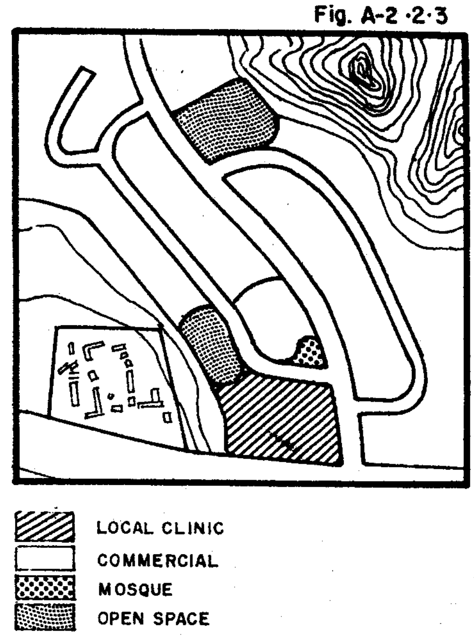


iii) Community Facilities

Locate the main facilities

- Local Clinic: is an area-wise facility, therefore location must be on the main road.
- Commercial neighbourhood shopping: to be located fairly centrally in the site, on one of the more important interior roads and adjacent to other public facilities.
- Mosques: to be easily accessible from the road with parking provided, especially for Friday prayers - in this respect the parking area of the adjacent commercial development may be used.
- Utilities and services
- Open spaces: all neighbourhoods should have a large enough open space to provide for sports like hockey or other field sports and play grounds, as well as smaller buffer areas.

Fig. A-2.2.3

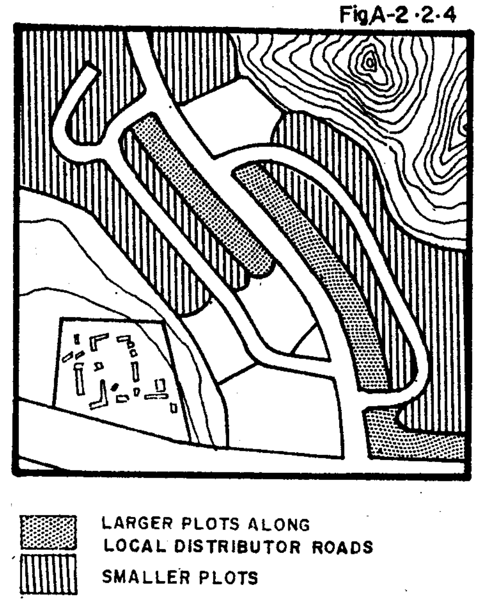


iv) Residential Plots

Define residential areas:

- by large plots with on-site parking.
- smaller plots with parking areas in close proximity, if required.

FigA-2.2.4

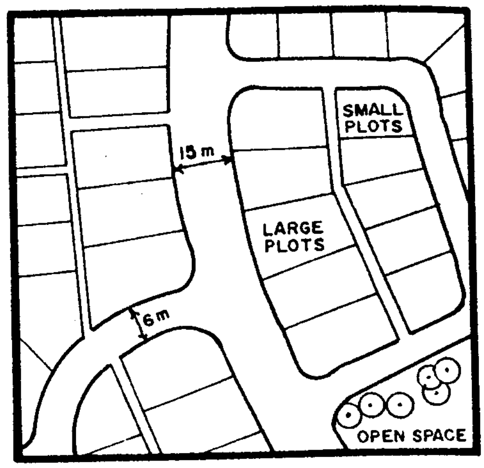


v) Details

Work up the Scheme in detail:

- enlarge areas to 1:2000 scale to show arrangement of residential plots, streets, pedestrian ways, buffers, open space and also to show the non-residential areas of the site, including local clinic, commercial area, mosque and open space.

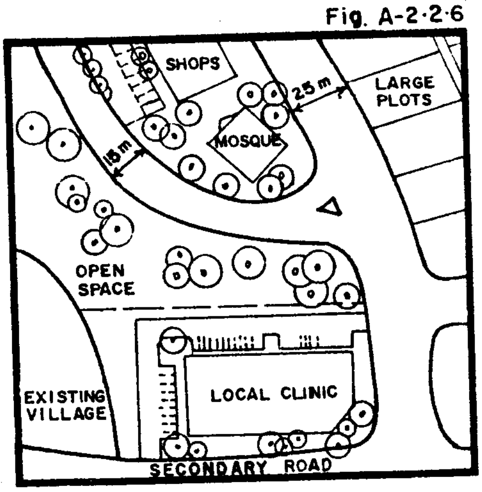
Fig. A-2·2·5



vi) Costs

- Calculate lengths of roads of various types, cost on standard basis.
- Assess covered areas of public buildings, cost on sq.m. basis.
- Hand over scheme to Public Health Engineer for preliminary design of water supply, sewerage and drainage networks, water and sewage treatment plants,alongwith their cost estimates.
- Add above costs alongwith lumpsum deposits to be paid for electrification and gas networks.

Fig. A-2·2·6



APPENDIX 3.1 : SURVEY CHECK LIST

CHECK LIST FOR PRELIMINARY PHYSICAL AND GEOTECHNICAL SURVEY

The purpose of geotechnical investigations is to ensure structural stability of proposed construction and adequate and economical availability of potable water.

The following stagewise procedure is recommended:

STAGE 1 : Preliminary Survey:

The Planner should reconnoitre the area and answer the following questions:

1) Is the area hilly, plain or rolling?

2) Is the site a valley in a hill range?

3) Is the land part of the piedmont plains which come next to the foot-hills of mountains?

4) Is the area subjected to seasonal floods regularly? Or, does it get flooded every 3 or 4 years? What is the extent of flood and what is the cause of flooding? Study flood marks and interview local elders.

5) Is the land waterlogged/saline?

6) If waterlogged, what is the depth of subsoil water level? May be checked from dug-wells.

7) Is the area covered by gardens, crops, natural forest, bush or wild shrubs?

8) What is the source of water for:

    a) agriculture; and
    b) drinking.

9) If there are any villages in or around the area, what is the condition of structures built on the ground?

    a) standing well;
    b) showing minor cracks; and
    c) showing signs of subsidence.

If the area is not on steep hillside, bottom of narrow valley or on alluvial fan, is not subjected to flooding, water depth exceeds 5 m most of the year, the vegetation includes some trees, the ground water is not saline or brackish, structures in nearby villages are standing well, then the Planner may tentatively proceed with planning work.

In case any of the above signs are not favourable, then proceed to Stage 2.

STAGE 2: Preliminary Laboratory Analysis:

10) Is there a tubewell in the area? If yes, get its bore-log which will vividly describe the soil lithology from surface to the depth of well.

11) Samples of soil taken at every one metre or at change of strata from a pit 2 to 4 metre deep should be sent to well established testing laboratory, for preliminary analysis, with the Planner's visual observations whether the soil is sandy, clayey, gravelly or rocky and from angle of moisture content whether it is dry, moist, wet or slushy.

Preliminary analysis will alow provisional go ahead or indicate further investigations.

STAGE 3: Geotechnical Investigations:

In case the Soil Specialist specifies further tests, the following will be the broad requirements:

12) Pits should be dug at the rate of a minimum of 2 pits for 100 acres or at a greater rate if the site reconnaissance exhibits marked variations in ground surface. Undisturbed samples collected with the help of standard sized augers and sealed with wax should be sent to the laboratory for following tests:

a) Soil classification test:

The laboratory may use sieve analysis and determine plasticity indices for soil classification and prepare particle-size distribution monographs.

b) Sulphate content tests:

This test does not require collection of undisturbed samples. Representative samples from various depths of all pits should be sent for determination of sulphate content in the soil.

c) California Bearing Ratio (CBR) Test:

The laboratory should be asked to submit detailed reports supported by pit-logs, monographs and CBR distribution maps.

Further tests may be prescribed by the Specialist after looking at laboratory test reports for detailed investigations.

STAGE 4 : Special Geotechnical Investigations:

In any case, the Planner should consult Geotechnical Engineer, where the following conditions obtain:

13) High rise buildings, bridges or heavy industrial structures are intended. Special geotechnical investigation should be conducted for specific sites by a specialist contractor under the instructions of a qualified Geotechnical Engineer.

14) The Planner should consult hydrologists and geotechnical engineers in case of :

a) flood-prone areas;
b) waterlogged land; and
c) area underlain with Karezes.

METHOD OF DETERMINING LOTS PER GROSS ACRE

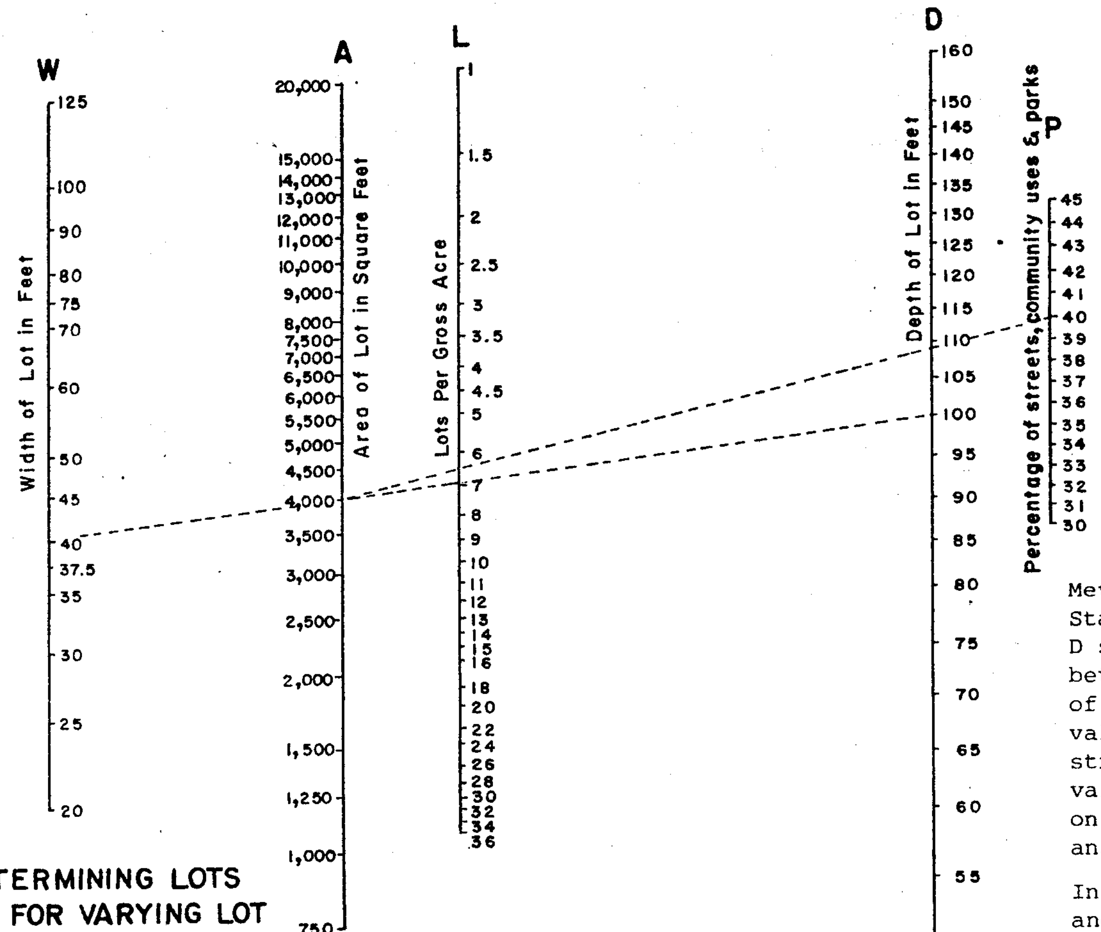


DIAGRAM FOR DETERMINING LOTS PER GROSS ACRE FOR VARYING LOT SIZES AND PERCENTAGES OF STREETS, COMMUNITY USES AND PARKS

W – Width of lot in feet.
D – Depth of lot in feet.
A – Area of lot is square feet.
L – Lots per Gross acre.
P – Percentage of streets, community uses and parks.

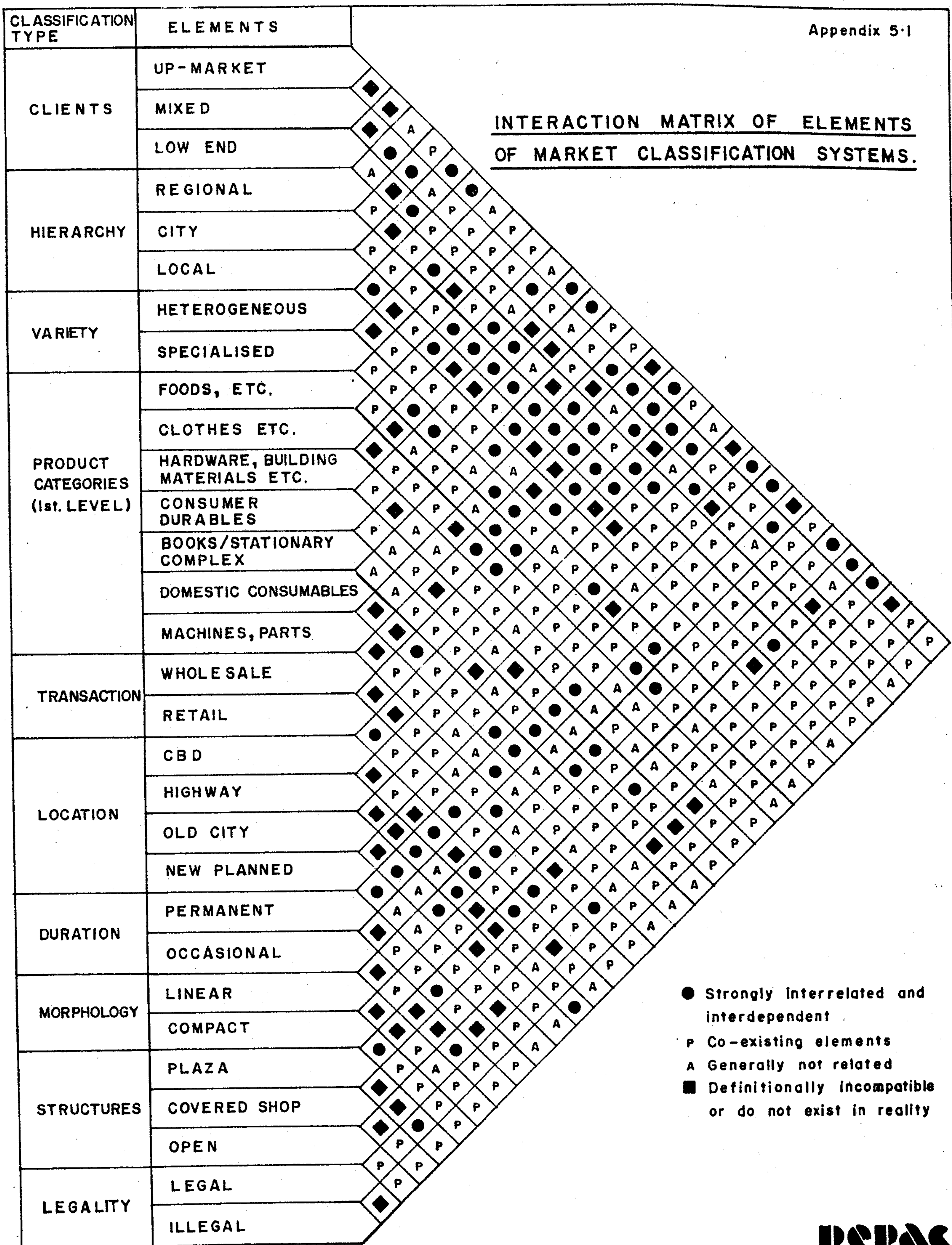
Method of using diagram: Start with values on W and D scales; lay straight-edge between them and read area of lot on A scale; choose value on P scale; lay straight-edge between this value and determined value on A scale; read required answer on L scale.

In example shown, W=40 feet and D=100 feet; hence A=4,000 square feet. With P=40 per cent, L=6.5 lots per gross acre.

Source: N.Y. Regional Survey of New York and Its Environs - 1929.

Appendix 5·1

INTERACTION MATRIX OF ELEMENTS OF MARKET CLASSIFICATION SYSTEMS.



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A.5.1: DERIVATION OF MAJOR MARKET TYPES

Classification	Elements	Cross-explantion ranking*	Significant Overlaps	Derived Market Types
Clients	Up-Market	3		1. Up-Market
	Mixed	12		
	Low End	9		
Hierarchy	Regional	13		
	City	11	Specialized Regional Markets	2. Specialized Regional Market
	Local	4		
Variety	Heterogeneous	24		
	Specialized	16		
Product Categories (Ist level)	Foods, etc.	26		
	Clothes etc.	25		
	Hardware, Building Materials, etc.	17		
	Consumer Durables	10	Local Retail Markets	3. Local Retail Market
	Books/Stationery Complex.	23		
	Domestic Consumables	20		
	Machines, parts	18		4. Wholesale Market
Transaction	Wholesale	1		
	Retail	5		
Location	CBD	6		5. Market in CBD
	Highway	8		
	Old City	21		
	New Planned	22	Highway Ribbons	6. Highway Ribbons.
Duration	Permanent	7		
	Occasional	14		
Morphology	Linear	19		
	Compact	27		
Structures	Plaza	2		7. Plaza
	Covered Shop	28	Jumma Bazars	8. Jumma Bazaar
	Open	15		
Legality	Legal	29		
	Illegal	30		9. Bara Market**

* Derived from inter-relationship/incompatibility scores of interaction matrix.

** Significant because not explained by other elements.

PERFORMANCE STANDARDS FOR INDUSTRY

All undertakings in an Industrial Estate shall conform to the following performance standards:

1) NOISE - Any sound of intermittent nature will be so controlled as not to become a nuisance to adjacent areas.

2) VIBRATIONS - Any use creating intense earth shaking vibration such as created by heavy dropping forges or heavy hydraulic surges shall be set back at least 500 feet from the plot line, but in no case shall any such vibration be allowed to create nuisance or hazard beyond the plot line.

3) SMOKE & PARTICULATE MATTER - Any use established in the industrial zone shall be so operated as to comply with the following:

   a) Emission of smoke or particulate matter should be regulated so as not to be detrimental to the public health and safety.

   b) Dust and other types of air pollution borne by the wind from such sources as storage area, yards, roads and so forth within the boundaries shall be kept to a minimum by appropriate landscaping, paving, ceiling or other acceptable means.

4) FIRE AND EXPLOSIVE HAZARDS - The storage, utilization or manufacture of materials, goods or products ranging frcm moderate to free/intense burning is permitted provided that such material goods or products shall be stored utilized or produced within completely enclosed buildings or structures, having incombustible exterior walls and being set back at least 50 feet from the plot lines or being lieu thereof protected throughout by approved automatic sprinkler system. (Reference to Inspector of Explosives, Ministry of Industries is required).

5) GLARE OR HEAT - Any use producing intense glare or heat shall be performed within a completely

enclosed building in such a manner as not to creat public nuisance or hazard, along the building line

6) EFFLUENT CONTROLL REGULATIONS:

i) **Substances Prohibited:**

Any liquid matter substance likely to injure or be injurious to the construction, use, repair, inspection or efficiency, or to be detrimental to sewers or treatment works or to interfere with the free flow of the contents of the said sewers or to cause silting up, corrosion, decay, or accident thereto, or make specially difficult or expensive the treatment or disposal of the contents of the said sewers or to interfere with the processes of purification. Among these prohibitions would be :

a) Any liquid at a temperature higher than 120 degree F.

b) Any substance (such as from the manufacture of rubber products, adhesives, plastics, paints, etc. or other products) which would be liable to form viscous or solid coatings or deposits in any part of sewerage system.

c) Any petroleum spirit mixtures or other inflammable solvents.

ii) **Substances whose concentration is limited:**

Quantitative emission control standards are under preparation by Government of Pakistan, Environment and Urban Affairs Division and will be available by 1987.

APPENDIX 6.1 AREA REQUIREMENTS OF EDUCATIONAL FACILITIES
TABLE A.6.1.1 Primary Schools:

1. No. of classes 5
2. Sections in each class 1–3–5
3. Total No. of classrooms 5–15–25
4. Students per class 25–40–50
5. Total strength of students 125–600–1250
6. Building components of Primary Schools:

		No.	Dimensions (m)	Carpet Area (m^2)				
6.1	Classrooms	5–15–25	6 x 9	270	–	810	–	1350
6.2	Headmaster room	1	3.5 x 5			17.5		
6.3	Staff Room	1		14	–	28	–	37
6.4	Store	1	3.5 x 5			17.5		
6.5	Science Room	0–1		0	–	55	–	55
6.6	Bath Rooms	2–8–10		10	–	42	–	53
6.7	Admin. Section	1	3.5 x 4			14		
6.8	Chowkidar Room	0–2		0	–	12	–	23
		Sub-Total Carpet Area (A)		343	–	996	–	1567
6.9	Internal Circulation (B) (@ 30% of A)			103	–	299	–	470
6.10	Internal Walls (C) (@ 10% of A+B).			45	–	130	–	204
	Total Covered Area (D) of Rural, Urban and Large Urban Schools, (A+B+C)			491	–	1425	–	2241

7. Play and Parking Areas/ Agricultural Plots.

		Rural School (m^2)	Urban Schools (m^2)		
7.1	Play Area (D x 3)	1473	4275	–	6723
7.2	Parking (@ one car space per class).	–	373	–	622
7.3	Agricultural Demonstration Plot.	4047		–	
	Sub-Total (E)	5520	4648	–	7345
	GRAND TOTAL D + E	6011	6073	–	9586

TABLE A.6.1.2 : SECONDARY SCHOOLS

1	Cohort of 10–15 age as % of national population	15%	
2.	In 4 large villages/one neighbourhood, (25,000 population), the 10–15 age cohort	3750	
		Rural	Urban
3.	Participation rates in 1983 (%)	3–7.5	26–69
4.	Participation rates in 2003 (%)	7.5–25	50–100
5.	Range of students in 1983	113–281	975–2588
6.	Range of students in 2003	281–938	1875–3750
7.	Sections of each class	1–3	4–6
8.	Class Rooms	5–18 – 25	
9.	Students/Section	56–53–62.5	
10.	Building components of secondary school:		

	Elements	No.	Dimensions (m)	Carpet Area (m²)		
10.1	Class Rooms	5–18–25	7 x 8	280	1008	1400
10.2	Laboratory	1	9 x 15		135	
10.3	Headmaster's room	1	4.5 x 6		27	
10.4	Staff Room	1	–	14	27	36
10.5	Admin. Section	1	4.5 x 6		27	
10.6	Multipurpose Hall	0–1	–	0	72	135
10.7	Workshop	0–1	–	0	27	72
10.8	Dispensary	1	–	14	20	27
10.9	Canteen	0–1	–	0	14	20
10.10	Library-cum-Reading Room	1	–	14	20	29
10.11	Sports Room	1	–	0	20	27
10.12	Bathrooms	4–10–16	2 x 2	16	40	64
10.13	Room for Chowkidar	0–1–2	3 x 4	0	12	24
			Total A:	527	1449	2023
10.14	Internal Circulation (B) (30% of carpet area)			158	435	607
10.15	Internal Walls (C) (10% of A + B).			69	188	263
	Built-up Area D = (A+B+C)			754	2072.5	2893

		Rural Schools (m²)	Urban Schools (m²)	
11.	Play and Parking Areas/ Agricultural Plots.			
11.1	Play Fields (D x 3)	8360	12039	16386
11.2	Parking @ 1 car space per class	–	448	622
11.3	Agricultural Demonstration Plot.	12140	–	
	Sub-Total (E)	20500	12487	17008
	GRAND TOTAL (D + E)	21254	14559	19901

TABLE A.6.1.3 : INTERMEDIATE COLLEGES (MALES):

1. Observed range of enrolment 1984 — 218 – 624 – 1463
2. Expected range of enrolment 2003 — 624 – 1463 – 2000
3. Students per Section — 50 – 60 – 70
4. No. of Class Rooms — 12 – 24 – 28

5. Necessary Components of Inter Colleges

	Elements	No.	Dimension (m)	Carpet Area (m²)				
5.1	Classrooms	12–24–28	6 x 14	1008	–	2016	–	2352
5.2	Biology Lab.	0–1 –1	10 x 15	0	–	150	–	150
5.3	Chemistry Lab.	1	10 x 15			150		
5.4	Physics Lab.	1	10 x 15			150		
5.5	Library+Reading Room	1	–	84	–	150	–	186
5.6	Principal's Office	1	4 x 7			28		
5.7	Staff Rooms	1–3–4	6 x 7.5	46	–	135	–	180
5.8	N.C.C. Office	1	4 x 7			28		
5.9	N.C.C. Store	1	4 x 7			28		
5.10	Union Office	1	4 x 7			28		
5.11	D.P.E. Office	1	4 x 7			28		
5.12	Canteen	1	6 x 7.5			45		
5.13	Shops	1–2–2	3 x 6	18	–	36	–	36
5.14	Lecture Theatre	1–2–3	7.5 x 15	113	–	225	–	338
5.15	Auditorium	0–1–1	–	0	–	150	–	186
5.16	Bathrooms	10–16–20	2 x 2.5	50	–	80	–	100
5.17	Rooms for Chowkidar	2	3 x 6			36		
5.18	Dispensary	1	4 x 7			28		
5.19	Admn. Section	1	6 x 6			36		
			Total (A)	1904	–	3527	–	4113
5.20	Internal Circulation (30% of the carpet area)			571	–	1058	–	1234
			Total (B)	2475	–	4585	–	5347
5.21	Internal Walls (10% of the built-up area).			248	–	459	–	535
			Total (C)	2723	–	5044	–	5882
6.	Lawns and Buffers					4046 m²		
7.	Water Works					1012 m²		
8.	Cycle Shed					607 m²		
9.	Car Parking					486 m²		
10.	Staff Accommodation					3035 m²		
11.	Hostel for 100–200–300 students			2428	–	4856	–	7284
			Total (D)	11614	–	14042	–	16470
12.	Grounds (E)			21446	–	21446	–	21446
	Total Site Area = (C + D + E)			35783	–	40532	–	437970
			Hectares =	3.58	–	4.05	–	4.38

TABLE A.6.1.4: INTER COLLEGES FOR FEMALES:

1.	Observed range of enrolment 1984	79 – 170 – 400
2.	Expected range of enrolment 2003.	170 – 400 – 600
3.	Student/Section	30 – 35 – 40
4.	No. of classrooms	7 – 11 – 15

5. Necessary Elements of Female Inter Colleges :

	Elements	No.	Dimension (m)	Total Area (m²)
5.1	Class rooms	7 – 11 – 16	6 x 12.5	525 – 825 – 1125
5.2	Labs.	1 – 2 – 3	8.5 x 15	127 – 255 – 383
5.3	Library + Reading Room	1	10 x 15	150
5.4	Principals Office	1	4 x 7	28
5.5	Staff Rooms	1 – 2 – 2	4 x 7	28 – 56 – 56
5.6	N.C.C. Office	1	4 x 7	28
5.7	N.C.C. Store	1	4 x 7	28
5.8	Union Office	1	4 x 7	28
5.9	DPE Office	1	4 x 7	28
5.10	Canteen	1	4 x 7	28
5.11	Shop	1	3 x 6	18
5.12	Lecture Theatre	0 – 1 – 1	6 x 14	0 – 84 – 84
5.13	Auditorium	0 – 1 – 1	6 x 14	0 – 84 – 84
5.14	Bathrooms	6 – 8 – 10	2 x 2.5	30 – 40 – 50
5.15	Rooms for Chowkidar	1 – 2 – 2	3 x 6	18 – 36 – 36
5.16	Dispensary	1	4 x 7	28
5.17	Admn. Section	1	4 x 7	28
			Total (A)	1120 –1772 – 2210

5.18	Internal Circulation (30 % of Carpet Area)	336	– 532	– 663
	Total Built-up Area =	1456	– 2304	– 2873
5.19	Internal Walls (10% of Total Built-up Area)	146	– 230	– 287
	Total (C) =	1602	– 2534	– 3160 m²
	or	0.16	– 0.25	– 0.32 ha.
6.	Lawns and Buffers (ha.)	0.40	– 0.51	– 0.61
7.	Water Works (ha.)		0.01	
8.	Car Parking (ha.)		0.05	
9.	Staff Accommodation (ha.)		0.30	
10.	Hostel for students (50 - 100 – 150) hectares	0.24	– 0.40	
	Total (D)	1.00	– 1.27	– 1.37
11.	Grounds (E)	1.13	– 1.42	– 1.68
	Total Site Area (C + D + E) (hectares)	2.3	– 2.94	– 3.37

TABLE: A.6.1.5 : DEGREE COLLEGES FOR MALES

1.	Observed range of students at Degree Level, 1984			116	– 325	– 910
2.	Observed range of students in Degree Colleges in Intermediate Classes.			436	– 879	– 2123
3.	Observed range of enrolment in Degree Colleges			552	– 1204	– 3033
4.	Forecast range of enrolment (2003)			1204	– 3033	– 4200
5.	Students per section			45	– 55	– 65
6.	No. of Classes (4 ÷ 5)			27	– 55	– 65
7.	No. of Classrooms*			16	– 25	– 30
8.	Building Elements of Degree Colleges (Males)					
	Elements	No.	Dimension (m)	Carpet Area (m^2)		
8.1	Classrooms	16 – 25 – 30	6 x 14	1344	– 2100	– 2520
8.2	Biology Labs.	1 – 2 – 2	10 x 15	150	– 300	– 300
8.3	Chemistry Labs.	1 – 2 – 2	10 x 15	150	– 300	– 300
8.4	Physics Labs.	1 – 2 – 2	10 x 15	150	– 300	– 300
8.5	Library + Reading Room	1	10x15- 12x15.5- 14x20	150	– 186	– 280
8.6	Principal's Office	1	4 x 7		28	
8.7	Staff Rooms	2 – 4 – 4	6 x 7.5	90	– 180	– 180
8.8	N.C.C. Office	1	4 x 7		28	
8.9	N.C.C. Store	1	4 x 7		28	
8.10	DPE Office	1	6 x 6		36	
8.11	Canteen	1	6 x 7.5		45	
8.12	Shops	1 – 2 – 4	3 x 6	18	– 36	– 72
8.13	Lecture Theatre	1 – 2 – 3	7.5 x 15	112.5	– 225	– 337.5
8.14	Auditorium	1	–	150	– 186	– 186
8.15	Bathrooms	10 – 16 – 20	2 x 2.5	50	– 80	– 100
8.16	Rooms for Chowkidar	2 – 3 – 3	3 x 6	36	– 54	– 54
8.17	Dispensary	1	4 x 7		28	
8.18	Admn. Section	1	36–45–56	36	– 45	– 56
			Total (A)	2629.5	– 4185	– 4878.5
8.19	Internal Circulation (30 % of Carpet Area)			788.85	–1255.5	– 1463.55
8.20	Internal Walls (10% of A + B)			341.84	–544.05	– 634.21
	Total covered area (C)			3760.19	– 5984.55	– 6976.26
			or	0.38	– 0.60	– 0.70 ha-
9.	Lawns and Buffers (hectares)			0.40	– 0.61	– 0.81
10.	Water Works (hectares).				0.10	
11.	Cycle Shed (hectares).				0.10	
12.	Car Parking (hectares).				0.05	
13.	Staff Accommodation (hectares).			0.40	– 0.61	– 0.81
14.	Hostel for 150 - 300 - 400 residents (hectares).			0.40	– 0.81	– 1.05
			Total (D)	1.45	– 2.28	– 2.92
15.	Grounds (E)			2.14	– 4.29	– 4.29
	Total Site Area C + D + E			3.97	– 7.17	– 7.91

*By making adjustments in timetable.

TABLE : A.6.1.6 DEGREE COLLEGES FOR FEMALES :

1.	Observed range of students at Degree Level,	103	–	375	– 1069
2.	Observed range of students in Degree Colleges at inter level, 1984	326	–	696	– 1744
3.	Observed range of enrolment in Degree Colleges, 1984	429	–	1071	– 2813
4.	Forecast range of students 2003	1071	–	2813	– 3500
5.	Students per section	40	–	50	– 60
6.	No. of Classes	27	–	56	– 58
7.	No. of Classrooms*	12	–	18	– 22
8.	Building Elements of Degree Colleges (Females):				

	Elements	No.	Dimension (m)	Carpet Area (m²)			
8.1	Classrooms	12–18–22	6 x 12.5	900	–	1350	– 1650
8.2	Biology Labs.	1–1–2	8.5 x 15	127.5	–	127.5	– 255
8.3	Chemistry Labs.	1–1–2	8.5 x 15	127.5	–	127.5	– 255
8.4	Physics Labs.	1–1–2	8.5 x 15	127.5	–	127.5	– 255
8.5	Library+Reading Room	1	8.5x15-10x15-12x15.5	127.5	–	150	– 186
8.6	Principal's Office	1	4 x 7			28	
8.7	Staff Rooms	2–3–4	4 x 7	56	–	84	– 112
8.8	N.C.C. Office	1	4 x 7			28	
8.9	N.C.C. Store	1	4 x 7			28	
8.10	DPE Office	1	4 x 7			28	
8.11	Canteen	1	4 x 7			28	
8.12	Shops	1–2–3	3 x 6	18	–	36	– 54
8.13	Lecture Theatre	1–2–2	6 x 14	84	–	168	– 168
8.14	Auditorium	1	6 x 14			84	
8.15	Bathrooms	8–10–12	2 x 2.5	40	–	50	– 60
8.16	Rooms for Chowkidar	1–2–3	3 x 6	18	–	36	– 54
8.17	Dispensary	1	4 x 7			28	
8.18	Admn. Section	1	4 x 7			28	
			Total (A)	1906	–	2536.5	– 3329
8.19	Internal Circulation (30% of Carpet Area)			571.8	–	760.95	– 998.7
	Built-up Area = Total (B)			2477.8	–	3297.45	– 4327.7
8.20	Internal Walls (10% of Built-up Area)			247.78	–	329.75	– 432.77
	Total covered area (C)			2725.58	–	3627.20	– 4760.47 m².
			or	0.27	–	0.36	– 0.48 ha
9.	Lawns and Buffers (ha.)			0.40	–	0.61	– 0.71
10.	Water Works (ha).					0.10	
11.	Car Parking (ha).					0.05	
12.	Staff Accommodation (ha)					0.40	
13.	Hostel for student 100–200–300 (ha.)			0.24	–	0.49	– 0.73
			Total (D)	1.19	–	1.65	– 1.99
14.	Grounds (E)			1.68	–	1.92	– 2.14
	Total Site Area (C + D + E)			3.14	–	3.93	– 4.61

*By making adjustments in timetable.

TABLE A.6.1.7 : POLYTECHNIC COLLEGE

	Elements	No.	Dimension (m)	Carpet Area (m^2)
A.	General			
1.	Chemistry Lab.	1	10 x 15	150
2.	Physics Lab.	1	10 x 15	150
3.	Library + Reading Room	1	12 x 18	216
4.	Principal's Office	1	4 x 7	28
5.	Staff Room	3	6 x 7 .5	135
6.	N.C.C. Store	1	4 x 7	28
7.	N.C.C. Office	1	4 x 7	28
8.	Union Office	1	4 x 7	28
9.	Stores	2	4 x 7	56
10.	D.P.E. Office	1	4 x 7	28
11.	Canteen	1	6 x 7 .5	45
12.	Shops	2	3 x 6	36
13.	Lecture Theatre	1	7.5 x 15	112.5
14.	Auditorium	1	18 x 24	432
15.	Bathrooms	-	-	-
16.	Quarters for Chowkidar	2	3 x 6	36
17.	Dispensary	1	4 x 7	28
			Total:	1537.5
	Internal Circulation (40% of the net covered area).			615
		Total Covered area		2152.5
B.	Electrical Technology			
1.	Comprehensive workshop	1	30 x 12	360
2.	Electrical Lab.	1	15 x 5	75
3.	Classroom	2	6 x 5	60
4.	Sub Store	1	4 x 5	20
5.	Junk Room	1	2 x 4 .5	9
	Offices			
6.	Head of Department Room	1	33 x 3	99
7.	Sr. Instructor & Instructor Room.	1	4 x 5	20
8.	Lavatory	1	2 x 4.5	9
			Sub-Total:	652
C.	Mechanical Technology			
1.	Comprehensive workshop (Wood-shop, Welding, Metal & basic Machine Shop).	1	36.5 x 12	438
2.	Multipurpose room	1	6 x 5	30
3.	A.C. Repair Shop	1	6 x 5	30
4.	Class Room	1	6 x 5	30
5.	Class Room	1	6 x 5	30
6.	Junk Room	1	2 x 4 .5	9
7.	Sub Store	1	3 x 5	15
	Offices			
8.	Head of Department Room	1	3 x 3	9
9.	Sr. Instructor & Instructor Room	1	3 x 5	15
10.	Lavatory	1	2 x 4.5	9
			Sub-Total:	615

D.	Refrigeration & Airconditioning Technology:			
1.	Comprehensive Wrokshop	1	36.5 x 12	438
2.	Classroom	1	6 x 5	[illegible]
3.	A.C. Repair Shop	1	6 x 5	30
4.	Sub Store	1	5 x 3	15
5.	Multipurpose room	1	6 x 5	30
6.	Junk Room	1	2 x 4.5	9
	Offices			
7.	Head of Department Room	1	3 x 3	9
8.	Sr. Instructor & Instructor Room.	1	3 x 3	9
9.	Lavatory	1	2 x 4.5	9
			Sub-Total	579
E.	Radio-Electronics Technology:			
1.	Comprehensive workshop	1	30 x 12	360
2.	T.V. Laboratory	1	15 x 5	75
3.	Classroom	1	6 x 5	30
4.	Sub Store	1	4 x 5	20
5.	Junk Room	1	2 x 4.5	9
6.	Lavatory	1	2 x 4.5	9
	Offices			
7.	Head of Department Room	1	3 x 3	9
8.	Sr. Instructor & Instructor Room.	1	4 x 5	20
9.	Lavatory	1	2 x 4.5	9
			Sub-Total	541
	Net covered area of departments			2387
	Internal Circulation			955
	Total Covered Area of Departments			3342
	Total Covered Area of College (A)			5494.5
			=	0.55 hectares
10.	Other Uses			m^2
	Lawns + Buffers			4046
	Water Works			1012
	Cycle Shed			1012
	Car Parking			486
	Staff accommodation			3035
	Hostel for 100 students			2428
	Total other uses (B)			12019 = 1.20 hectares
	Grounds (C)			2.43 hectares
	Total Area = A+B+C			0.55 + 1.20 + 2.43 4.18 hectares Say 4 hectares

TABLE A.6.1.8 : VOCATIONAL TRAINING INSTITUTES:

	Elements	Area (m²)	
1.	Bench Fitter	374.5	
2.	Machinist	129	
3.	Turner	110	
4.	Electrician	122	
5.	Welder and Sheet Metal	156	
6.	Automechanics	377.5	
7.	Radio & T.V.	104	
8.	Refrigeration & Airconditioning	187	
9.	Plumbing & Pipe Fitting	187	
10.	Classrooms	100	
11.	Library	216	
12.	Workshop Office & Store	251	
13.	Central Store	45	
14.	Admn. Section	93	
15.	Toilet	74	
16.	Canteen	45	
17.	Quarters for Chowkidar	36	
	Total (A)	2608	
	Ancillary spaces (40% of the net covered area) (B)	1043	
	Total covered area	3650 =	0.36 hectares
	Lawns and Buffers		0.40 "
	Water Works		0.10 "
	Cycle Shed		0.06 "
	Car Parking		0.05 "
	Staff accommodation		0.30 "
	Hostel for 100 students		0.24 "
	Total (D)		1.15 "
	Ground (E)		2.43 "
	Total Area = C + D + E		3.94 "

Area for the staff facilities varies from city to city. Therefore, it is preferable that these areas should be added in the total area of Vocational Institutes according to the requirements.

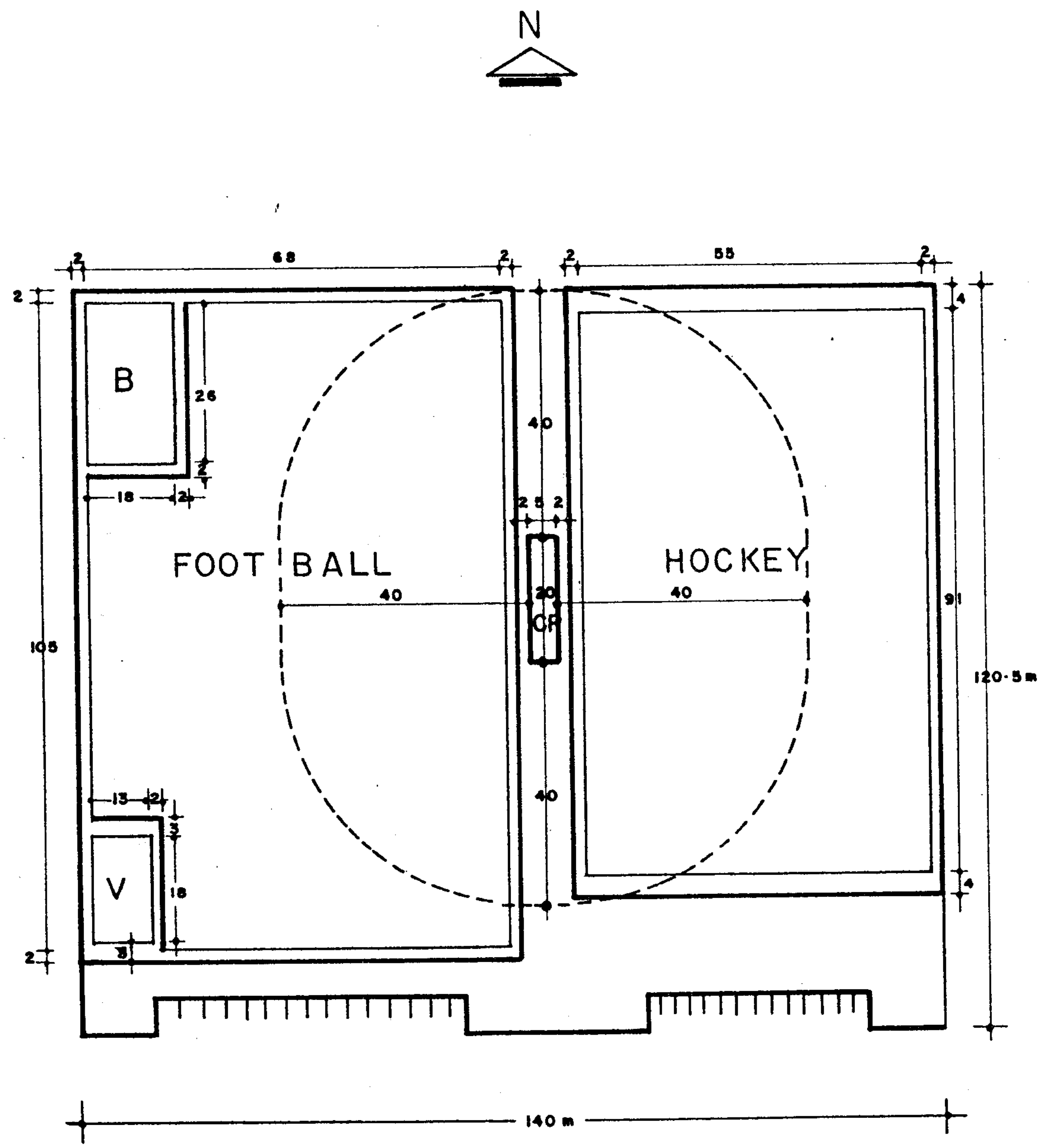


FIG A-6·2·1 **TYPICAL CONFIGURATION OF PLAYFIELDS IN STANDARD SIZED SECONDARY SCHOOL (Boys).**

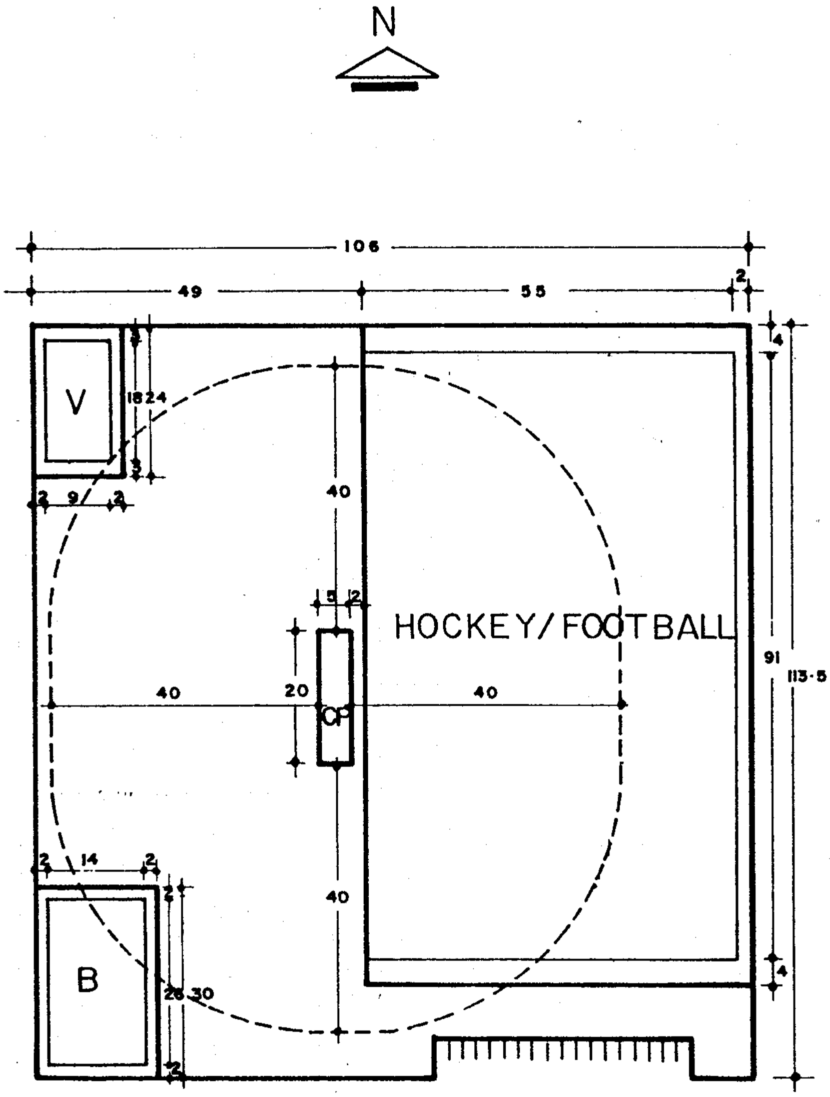


FIG. A-6·2·2 **TYPICAL CONFIGURATION OF PLAY FIELD IN CONGESTED SECONDARY SCHOOL (Boys).**

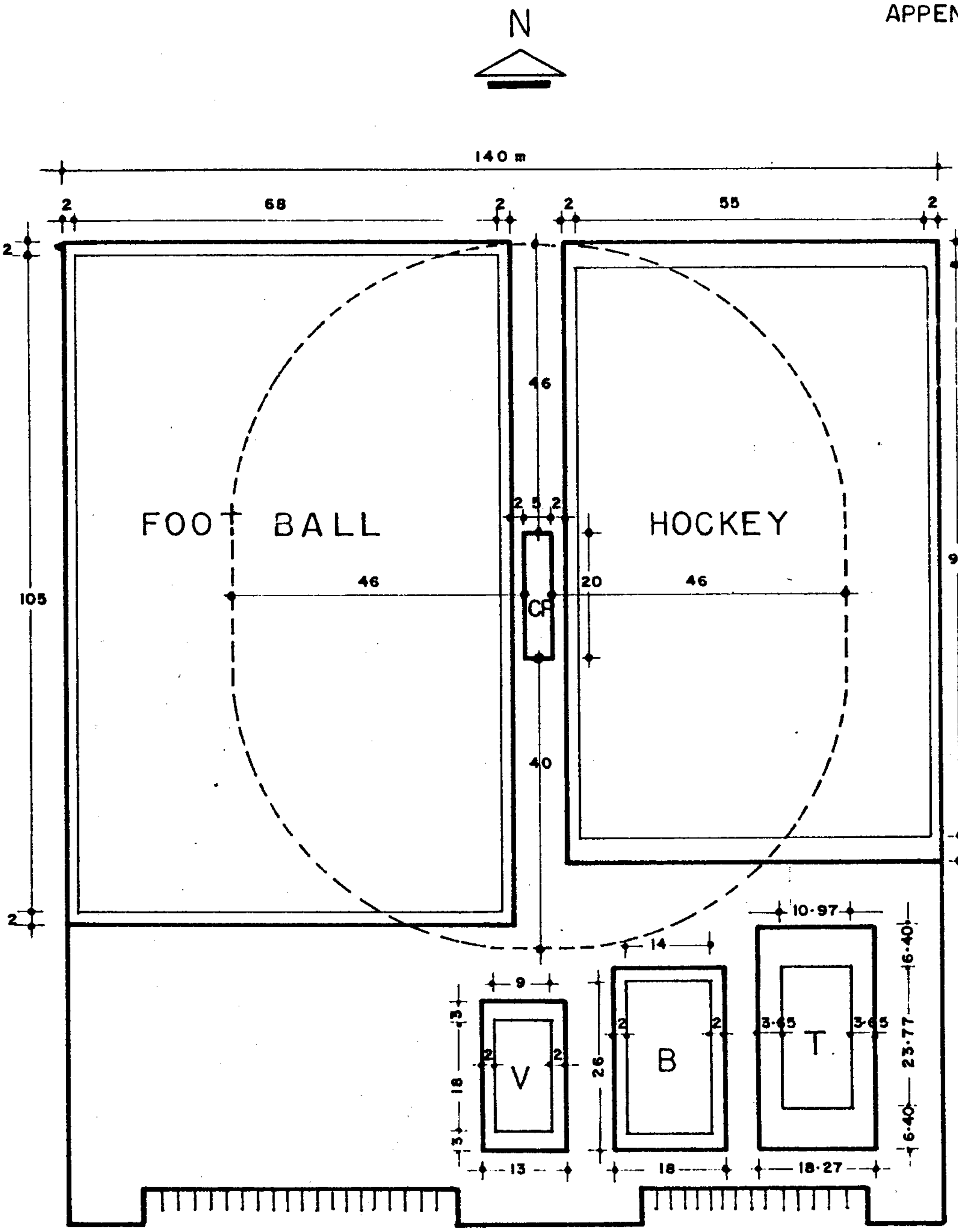


FIG. A-6·2·3 **TYPICAL CONFIGURATION OF PLAY FIELDS IN STANDARD SIZED INTERMEDIATE COLLEGE (Males).**

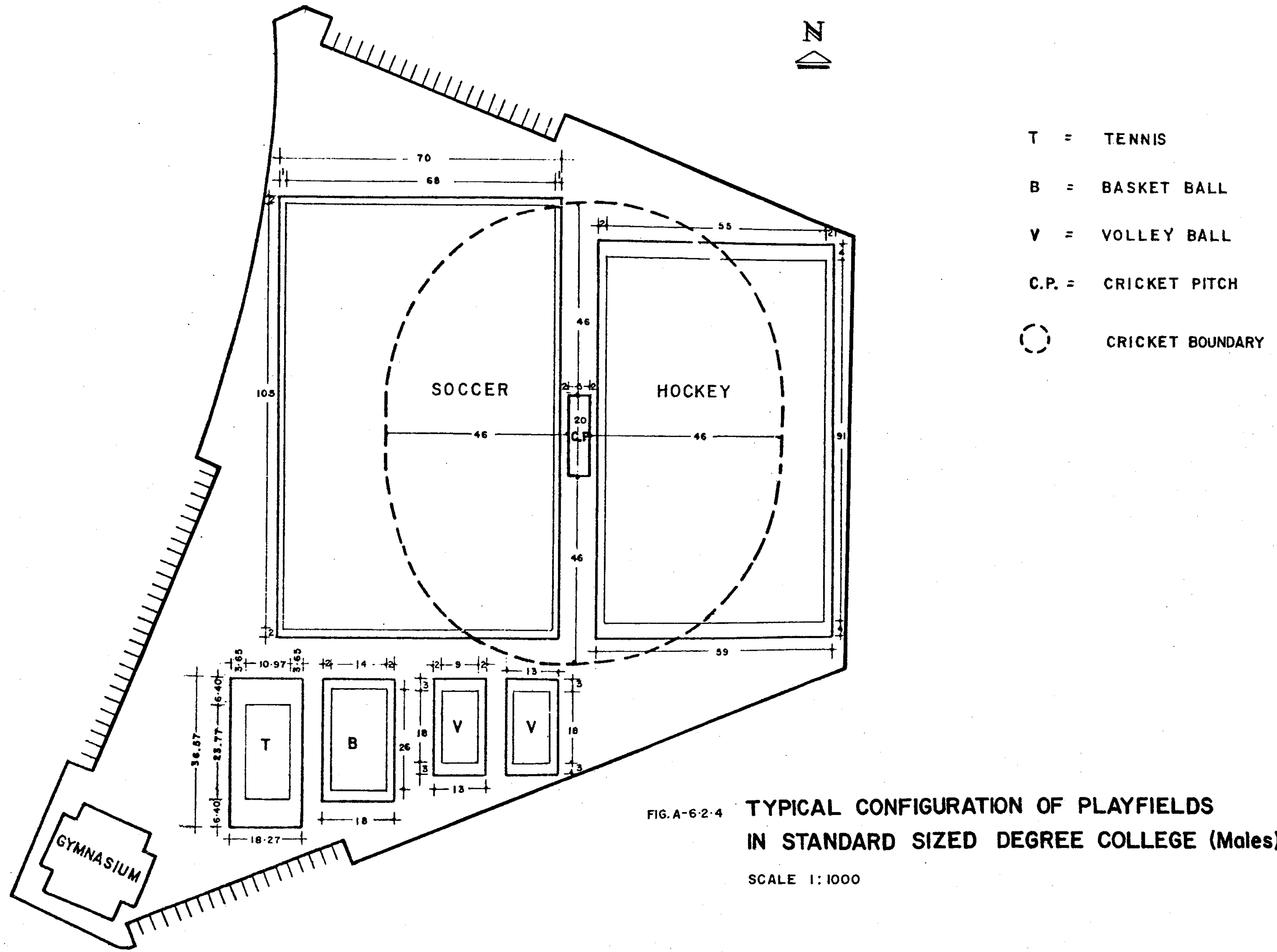


FIG. A-6·2·4 **TYPICAL CONFIGURATION OF PLAYFIELDS IN STANDARD SIZED DEGREE COLLEGE (Males).**

SCALE 1: 1000

APPENDIX 6.3 : ELEMENTS AND COVERED AREAS OF HEALTH FACILITIES.

1. BASIC HEALTH UNIT/MEDICAL AID

(Only Outpatient facilities)

Staff :

Doctor	1
Hakim	1
Lady Health Visitor	1
Midwife	1
Health technicians	2
Sanitarian	1
Family planning staff	2
Other staff	2
Total	11

Space Requirements:

Doctor's room	17	m^2
Hakim's room	17	"
Lady health visitor	9	"
Midwife	9	"
Sanitarian	9	"
Family planning staff	17	"
Waiting areas	37	"
Dispensary	19	"
Injection/dressing room	19	"
Stores	19	"
Cleaner's room	6	"
Male staff toilet	7	"
Female staff toilet	8	"
Male patient's toilet	11	"
Female patient's toilet	11	"
Total net area required	214	m^2
Circulation space/communications and walls 35% of net area	74	m^2
Total	288	m^2

2. RURAL HEALTH CENTRE/TOWN HEALTH CENTRE/SUBCLINIC

(Beds - 10)

Staff:

Doctors	2
Hakims	2
Lady health visitors	2
Family planning officer	1
Midwives/maids	4
Sanitary inspectors	2
Technicians	3
Dispenser	1
Other staff	10
Total	27

Space requirements:

Doctor's rooms	2 x 16.5	Sq. meters		=	33 m^2
Hakims	2 x 16.5	"	"	=	33 "
Lady health visitors	2 x 9.5	"	"	=	19 "
Family planning officer	1 x 14.0	"	"	=	14 "
Midwives/maids	4 x 3.75	"	"	=	15 "
Sanitary inspectors	2 x 7.0	"	"	=	14 "
Technicians	3 x 4.5	"	"	=	14 "
Waiting areas	2 x 28.0	"	"	=	56 "
Dispensary					28 "
Injection/dressing rooms	2 x 9.5	"	"	=	19 "
Stores – Medical/General	2 x 14.0	"	"	=	28 "
Cleaners' rooms					11 "
Male staff toilets					11 "
Female staff toilets					11 "
Male patients' toilets					17 "
Female patient's toilets					17 "
Ward 10 beds	10 x 7.5	"	"	=	75 "
Nurses' station					9 "
Nurses room					9 "
Doctors' room					9 "
Treatment/ dressing room					9 "
Linen store room					9 "
Stretcher bay					7 "
Cleaners' room					6 "
Ward toilets male/female					11 "
Net area required					484 m^2
Circulation space 35% of the net area					169 "
Total					653 m^2
	say				650 m^2

3. TEHSIL HOSPITAL

(Beds – 60)

Staff :

Specialists	5
Doctors	10
Dental surgeon	1
Nurses	12
Midwives/maids	15
Sanitary inspectors	4
Lady health visitors	3
Radiographers	2
Pharmacist	1
Dispensers	3
Technicians	16
Administrative staff	8
Other staff	60
Total	140

Distribution of 60 beds :

Medical	15
Surgical	15
Paediatrics	12
Obstetrics and gynaecology	12
Isolation	6
Total	60

Space requirements :

Medical superintendent	1 x 22	Sq. meter	=	22 m^2
Specialists	5 x 17	" "	=	85 "
Doctors	10 x 17	" "	=	170 "
Dental surgeon	1 x 17	" "	=	17 "
Sanitary inspectors	4 x 7	" "	=	28 "
Lady health visitors	3 x 7	" "	=	21 "
Radiographers	2 x 4.5	" "	=	9 "
Administrative staff	8 x 5.5	" "	=	44 "
Toilet facilities for 140 staff members 60 sq. ft – 7 persons	60 x 1.85	" "	=	111 "
Toilet facilities for outpatients				56 "
Outpatients' waiting areas	7 x 14	" "	=	98 "
Reception/issuance of slips/record room				56 "
Injection rooms/dressing rooms	4 x 9	" "	=	36 "
Dispensary with store				37 "
Casualty:				
Reception at trolley bay				19 "
Doctors' duty room				9 "
Treatment room				17 "
Observation room 4 beds				37 "
Stores, etc.				9 "
Nurses' duty room				9 "
X-ray				46 "
Laboratory/blood bank				74 "
E.C.G. room				11 "
Physiotherapy				33 "
Labour suite				232 "
Twin operation theatre suite (Anaesthetic, growing scrub, set up sterilization theatres, disposal of)				279 "
Medical stores				139 "
General stores				139 "
Kitchen			=	46 "
Laundry			=	28 "
Mortuary			=	19 "
Net area				1934 m^2
Circulation space 35% of net area				677 "
Subtotal				2611 m^2
Wards: Two 30-bed wards with 20% of beds in single rooms (including circulation space and facilities of the ward)	180 x 5.6	Sq. meter	=	1008 m^2
Total				3617 m^2

4. DISTRICT HOSPITAL

(Beds – 250)

Distribution of beds:	
Internal medicine	50
General Surgery	50
Paediatrics	40
Eye and E.N.T.	40
Obstetrics and gynaecology	30
Dental	10
Psychiatry	20
Isolation	10
Total:	250

Staff :	
Specialists	15
Doctors	30
Dental surgeons	4
Nurses	50
Lady health visitors	6
Midwives/maids	86
Physiotherapist	1
Dispensers	6
Radiographers	6
Pharmacists	4
Technicians	39
Total	247

A District Hospital will consist of the following departments:

Service	Department
1) Administration services	a) General administration b) Main entrance accomodation c) Medical records
2) Inpatient service	a) General acute wards b) Children's wards c) Maternity department i) antenatal clinic ii) reception and admission iii) operating theatre suite iv) special baby care unit. d) Isolation beds
3) Main operating facilities	a) Operating suites and related rooms b) Theatre sterile supply unit (for department with no nearby central sterile supply dept.)
4) Diagnostic and treatment facilities	a) X–ray department b) Pathology department c) Mortuary and post mortem room d) Department of Physical medicine i) Physiotherapy dept. ii) Occupational therapy dept. e) Medical photography
5) Outpatient service	a) OPD (consulting suite) b) OPD (operating theatre suite) c) OPD (day ward) d) OPD (dental suite) e) Accident and emergency department i) minor operating theatre suites ii) recovery and short-stay unit iii) orthopaedic and fracture clinic. iv) departmental accomodation
6) Service facilities	a) Pharmacy department b) Central sterile supply department c) Central kitchen d) Laundry
7) Staff facilities	a) Dining rooms
8) Hospital engineering and work services	a) Boiler house b) Works department
9) Psychiatric patients' service	a) Short-stay psychiatric unit b) Treatment centre c) Psychiatric ward for patients d) Rehabilitation centre for psychiatric patients

Space requirements:

1) Administrative service:

a) General administration:

i)	Hospital Administrator's office	17 Sq. meters
ii)	Assistant Hospital Administrator's office	9 " "
iii)	Matron's office	11 " "
iv)	Assistant Matron's office	9 " "
v)	Secretarial Staff typists/clerks	65 " "
vi)	Waiting space	14 " "
vii)	Additional office	14 " "
viii)	Committee room	46 " "
ix)	Sanitary facilities	
	Male	14 " "
	Female	19 " "
x)	Stores	11 " "
xi)	Cleaners' room	6 " "

b) Rooms related to the main entrance:

i)	Central inquiry counter	6 " "
ii)	Telephone exchange	11 " "
iii)	Wheel chair and trolley store	9 " "
iv)	Gift shop	9 " "
v)	Sanitary facilities for visitors	
	Male	5 " "
	Female	5 " "

c) Medical records:

i)	Reception counter	11 " "
ii)	Medical record officer's office	11 " "
iii)	Record clerks	11 " "
iv)	Stores	232 " "
v)	Sub-waiting space/typist	15 " "
vi)	Duplicating and microfilming space	14 " "
vii)	Toilets	
	Male	5 " "
	Female	5 " "
	Net area required	584 Sq. meters
	Circulation space 30%	175 Sq. meters
	Total:	759 Sq. meters

2) Inpatient service

a) General acute wards 150 beds:

i)	Internal medicine	50	
ii)	General surgery	50	
iii)	Eye/ENT	40	
iv)	Dental	10	
with 10% of beds in single rooms for intensive care, etc. Space requirement per bed 16.5 Sq. meters.		16.5 x 150	2475 Sq. meters

b) Children's ward - 40 beds space requirement is more, putting it @ 18.5 Sq. meters. per bed -	40 x 18.5	740 Sq. meters

c) Maternity department		
i) Antenatal clinic including waiting space	186 Sq. meters	
ii) Reception and admission	37 Sq. meters	
ward unit 30 beds @ 18.5 Sq. meters	557 Sq. meters	
iii) Labour suite	232 Sq. meters	
iv) Special baby care unit	46 Sq. meters	
d) Isolation beds 18.5 Sq. meters per bed	232 Sq. meters	
Total inpatients minus psychiatry, i.e., 230 beds and maternity block	4505 Sq. meters	
3) Main operating facilities:		
Four operation theatre and sterilization units	975 Sq. meters	
4) Diagnostic and treatment facilities:		
a) X–Ray department office reception and filing rooms	19 Sq. meters	
Patients' waiting room	9 Sq. meters	
Patients' lavatories	9 Sq. meters	
Changing and preparation	6 Sq. meters	
Kitchen and sluice	11 Sq. meters	
X–ray diagnostic rooms (2 rooms) 32.5 x 2	65 Sq. meters	
Film pressing	19 Sq. meters	
Staff room	11 Sq. meters	
Cleaners' room	6 Sq. meters	
Mobile X-ray	9 Sq. meters	
Film and chemicals stores	37 Sq. meters	
Circulation space 30%	60 Sq. meters	261 Sq. meters
b) Pathology department		557 Sq. meters
c) Mortuary and post mortem room		46 Sq. meters
d) Department of Physical medicine		
i) Physiotherapy	93 Sq. meters	
ii) Occupational therapy	93 Sq. meters	
e) Medical photography	19 Sq. meters	
Total:	1069 Sq. meters	
5) Outpatient services:		
OPD consulting suites	650 Sq. meters	
Dental suite	63 Sq. meters	1177 Sq meters
Accident emergency department	464 Sq. meters	
6) Service facilities:		
i) Pharmacy department	279 Sq. meters	
ii) Central sterile supply department	279 Sq. meters	1023 Sq.m.
iii) Central Kitchen	186 Sq. meters	
iv) Laundry	279 Sq. meters	
7) Staff facilities:	279 Sq. meters	
8) Psychiatric unit:		
i) Treatment centre	650 Sq. meters	
ii) Psychiatric ward		
9) Boiler room, etc.	139 Sq. meters	
Total:	10576 Sq. meters	

APPENDIX 6.4: PLOT SIZES FOR MOSQUES

Sr. No.	Type of Mosque	Catchment Population	Prayees in Catchment*	Prayee's to be served	Saf & Misc. Area/Prayee (m^2)	Plot Area (m^2)	Minimum Adjoining Open Space Towards East
1.	Markazi Mosque	100,000	33,250	16,625**	0.425	3500-3800	One hectare
2.	Jumma Mosque	25,000	8,312	4,156***	0.43	1800-2000	–
3.	Mohalla Mosque	5000-6000	1,996	1,376@	0.44	600-700	–

* Derived by excluding women, children less than 7 years, religious minorities and disabled from total population.

** Half the prayees will be served by Jumma & local mosques, except on Eids, for which overspill necessary.

*** Half the prayees will be served by Markazi and local mosques.

@ 620 prayees will prefer going to Markazi and Jumma mosques for daily prayers.

APPENDIX 6.5 MUDRASAS

TABLE A. 6.5.1

SPACE REQUIREMENTS FOR SMALL AND AVERAGE LEVEL MUDRASAS

Category	Mohtamim's Room	Sheikh's Room	Teacher's area @ $9m^2$/ teacher	Student area @ $1.75m^2$ per student	Mosque m^2	Play area m^2	Other anc. uses m^2	Total m^2	Area per student
Small Mudrasa	14 m^2	—	(a) 18 m^2	(b) 52.50 m^2	—	460	92	636.50	21.22 (Say 21)
Average Mudrasa	14 m^2	(c) 11 m^2	(d) 36 m^2	(e) 105 m^2	460	(f) 7000	230	7856	130.93 (Say 131)

a) For a minimum of 2 teachers.
b) For a minimum of 30 students.
c) For a minimum of 1 Sheikh.
d) For a minimum of 4 teachers.
e) For a minimum of 60 students.
f) Usually a football ground.

TABLE A.6.5.2
SPACE REQUIREMENTS FOR LARGE MUDRASAS

Uses	No.	Dimensions (mxm)	Area (m^2)	Total Area (m^2)
Mohtamim's Office	1	4 x 5	20	20.00
Sheikh-ul-Hadith's Room	1	3.65 x 4.25	15.51	15.51
Sheikh-ul-Quran's Room	1	3.65 x 4.25	15.51	15.51
Scholars' study cabins	8	2.44 x 2.44	5.95	47.60
Class room/study area per student.	200	1.25 x 1.50	1.88	376.00
Mosque	1	–	551.00	551.00
Play area (football ground).	1	–	7006.00	7006.00
External Circulation, etc.	–	–	68.87	68.87
Ancilliary Uses.	–	–	300.00	300.00
		Total area	8400.49	
		No. of students	200	
		Gross area per student	42 m^2	

APPENDIX 6.6: MUNICIPAL SECRETARIAT/TOWN HALL SITE STANDARDS

TABLE A.6.6.1 : TYPICAL STRENGTH AND CARPET AREA FOR MUNICIPAL SECRETARIAT/TOWN HALL

Grades/ Categories	(a) Strength of staff in Muncipal Corp.	Muncipal Comm.	Town Comm.	(b) Carpet Area (m^2) Municipal Corp.	Muncipal Comm.	Town Comm.
Sect. Staff w/o public dealing.	75	28	12	338	126	54
Sect. Staff with public dealing	69	30	15	380	165	113
BPS 17-18	10	2	2	150	30	30
BPS 19-20	1	–	–	23	–	–
BPS 21-22	–	–	–	–	–	–
Total	155	60	29	891	321	197

a- Employment data pertains to Quetta Municipal Corporation, Dera Ismail Khan Municipal Committee and Havelian Town Committee.
(PEPAC Survey, 1983.)

b- The carpet areas have been calculated as per methodology given in Table 5.5

Table : A.6.6.2: SITE AREA CALCULATIONS (a)

	Components	Municipal Corporation	Municipal Committee	Town Committee
1.	Covered Area Secretariat (Carpet Area x 1.33), m^2	1188	428	263
2.	Town Hall, m^2	418	209	209
3.	Sub-Total covered area, m^2	1606	637	472
4.	Peak Use Demands (Nos.)			
i)	Peak Bus Parking	100	50	20
ii)	Peak Car Parking	1000	500	200
iii)	Peak Motor Cycle Parking	2000	1000	400
iv)	Peak Outdoor Seating for Ceremonial Occasions.	4000	2000	800
5.	Site Outdoor Demands (m^2)			
i)	Peak Bus Parking Demand (@ 93 m^2/bus).	9300	4650	1860
ii)	Peak Car Parking Demand (@ 24.89 m^2/car).	24890	12445	4978
iii)	Peak Motor Cycle Parking Demand (6 m^2/motor cycle)	12000	6000	2400
iv)	Outdoor seating area demand (@ 0.65 m^2/seat)	2600	1300	520
6.	Sub-Total Outdoor Site	48790	24395	9758
7.	Grand Total Site Demand (m^2) (3+6)	50396	25032	10230

a- Since ceremonies and a lot of public dealing is involved, the methodology described in Table 5.5 has not been followed.

APPENDIX 6.7 HOTELS

TABLE A.6.7.1: GROUND FLOOR AREAS AND COMPONENT DETAILS

(m^2)

General Data	Five Star 100 rooms	Four Star 75 rooms	Three Star 50 rooms	Two Star 25 rooms	One Star 15 rooms	Others 10 rooms
Food and Beverage Service Space						
– Main Dining Hall	135	125	80	70	50	20
– Main Kitchen	100	50	35	25	15	12
– Bake Shop	18	15	–	–	–	–
– Banquet Hall	NGF	NGF	–	–	–	–
– Banquet Serving Pantry	NGF	–	–	–	–	–
– Employees' Dining Room	NGF	NGF	–	–	–	–
– Steward's Store Room	36	30	–	–	–	–
– Beverage Store Room	16	12	10	–	–	–
– China Glass and Silver Storage	NGF	NGF	–	–	–	–
– Receiving Room	7	5	–	–	–	–
– Garbage Room	7	5	–	–	–	–
Guest Room Space						
– Room area including bath closet + Vestibule	NGF	(a) 350	(b) 400	(c) 200	(d) 100	(d) 75
– Auxiliary Space for corridors, etc. (40% of above)	NGF	140	160	80	40	30
General Service Space						
Manager's Office	10	10	10	6	5	–
– Accounting Office	13	13	–	–	–	–
– Linen Room	NGF	10	–	–	–	–
– Laundry	25	20	–	–	–	–
Maintenance Shop	NGF	–	–	–	–	–
– Furniture Storage	NGF	NGF	–	–	–	–
– Records Store Room	NGF	NGF	–	–	–	–
– General Store Room	NGF	NGF	10	10	6	5
– Boiler Room	NGF	NGF	–	–	–	–
– Water Heater Tank Space.	NGF	NGF	–	–	–	–
– Transformer Vault	NGF	NGF	–	–	–	–
Miscellaneous						
– Lobby and Front Office	75	40	25	–	–	–
– Lounge	50	30	20	–	–	–
– Men's toilet for guests	12	10	10	10	6	4
– Women's toilet for guests	9	10	–	–	–	–
– Barber Shop	16	14	–	–	–	–
Storage Space	NGF	NGF	15	10	5	–
Total Ground Floor Area (m^2)	529	889	785	411	227	146

'NGF' : Not on ground floor.
'–' : Facility does not exist.
a) 25% rooms on ground floor.
b) 50% rooms on ground floor.
c) 65% rooms on ground floor.
d) 75% rooms on ground floor.

TABLE A.6.7.2 : GROSS SITE AREA CALCULATIONS

Hotel Type	Ground Floor Area (m^2)	Gross Site Area (m^2)	Formulae for gross area calculations
5-Star	529	54648 5.46 ha	(Ground floor area x 3 for lawns) + swimming pool + Six-hole mini golf course. = (529 x 3) + 2586* + 50475** m^2 = 54648 m^2 = 5.46 ha.
4-Star	889	2223	Ground floor x 2.5
3-Star	785	1963	–do–
2-Star	411	1028	–do–
1-Star	227	568	–do–
Others	146	365	–do–

*Urban Planning and Design Criteria (De Chiara, Koppelman, 1975)

**Six-hole mini golf course from existing facilities.

HIGHWAYS AND RURAL ROADS

A.7.1.0 General

The network of national highways is planned by the Ministry of Communications, Directorate-General of National Highways, in consultation with Planning & Development Division, National Transport Research Centre, Islamabad. Highways which do not cross provincial boundaries are planned and designed by the Communications & Works Department, Highway Division of each province. These agencies have chalked out programmes for highways upto 2010 AD. The bulk of the programme comprises grade-up work and rehabilitation. Opportunities and occasions for new route selection are therefore, rare, except for small percentage of farm-to-market roads. Thus when preparing a regional plan or a farm-to-market road programme, the planner is mainly called upon to suggest road/track upgrading priorities. For this purpose, he needs broad guidelines for estimating highway traffic growth and related pavement design considerations. Given standard cost estimates, (per kilometre or per sq.m), of various types of pavement, the planner can then derive the initial estimate of outlays on the highway component of the regional plan or the farm-to-market roads programme.

A.7.1.1 Traffic Growth

A.7.1.1.1 Design Traffic

The loads imposed by private cars do not contribute significantly to structural damage to road. Therefore, for the purpose of structural design of road pavements, cars can be ignored and the total number and axle load of commercial vehicles that will use the road during its designed life need to be considered. In this context, a commercial vehicle is defined as goods or public services vehicle that has an unladen weight of 1500 kg or more.

For estimating the total number of commercial vehicles, the following information is essentially required.

- o Number of commercial vehicles that will use the road when it is first opened to traffic.
- o Annual rate of growth of this traffic.
- o Design life.

A.7.1.1.2 Growth Rate

Forecasting annual growth rate of the traffic is more difficult than estimating the initial volume of traffic. There is likely to be a sudden increase of traffic after the development of a Project, but stable increase at normal rate later on.

Growth rate can be estimated by studying recent trends from traffic count.

It can also be estimated, (if the traffic census series are not available), from the growth rate of the GNP/capita; it is normally between 1.2 to 1.5 times the GNP/capita growth rate.

If GNP/capita forecast is not available, an average growth rate of 4% p.a. is a reasonable assumption for traffic forecasts for highways and rural roads.

A.7.1.1.3 Design Life

Planned stage construction is a convenient method of road design and construction, resulting in economical and accurate design on long-term basis. The pavement is generally designed for a shorter life using the predicted design traffic and the subgrade strength value. A structure adequacy survey is then performed at the end of the first stage design life and an overlay is designed for the next few years. Such design life selected for road pavements in developing countries is often about 10 years compared to 20 years in more developed countries.

This approach, a form of stage construction', can be applied to most roads outside urban areas. In towns and industrial zones the restriction on road surface levels due to fixed access levels to buildings, drainage arrangements, etc; make substantial overlay impractical. Under such circumstnces, a 40-year design life is normally adopted.

A.7.1.1.4 Standard Axles

For the design of pavement, it is necessary to consider not only the total number of commercial vehicles that will ply on the road, but also wheel loads (or, for convenience, the axle loads) of these vehicles.

The average number of axles per commercial vehicle varies with the type of road. Observations of axle loads have been made by the British Road Research Laboratory on typical roads, and these are considered in conjunction with the axle load equivalence factors as given in Table A.7.1, derived from the AASHO Road Test to enable number of commercial axles to be expressed as equivalent numbers of 8,200 kg. (18,000 lbs) axles, as standard axles.

TABLE A.7.1: CONVERSION FACTORS TO DETERMINE EQUIVALENT NUMBER OF STANDARD AXLES

Road Type	Number of axles per commercial vehicle (a)	Number of Standard axles per commercial axle (b)	Number of Standard axles per commercial vehicle (a)x(b)
1. Road designed to carry 250-1000 commercial vehicles per day in each direction at the time of construction.	2.4	0.3	0.72
2. All other public roads.	2.25	0.2	0.45

A.7.1.2 **Types of Pavements**

To permit vehicular traffic to ply on a road at all times of year at a reasonable speed and with economical fuel consumption, the road pavement is to be of an adequate rigidity, uniformity and resistance to wear. These requirements can be satisfied by means of various combinations of pavement structural layers consisting of different road building material. Considering the pavement service qualities stated above, the road pavement can be divided into two types i.e. rigid pavement and flexible pavement.

Rigid pavements are constructed with cement concrete and are of high rigidity and high resistance and have a very high inherent strength and temperature stability. The flexibile pavements on the other hand are constructed by various layers of stone metal and finished with bituminous servicing.

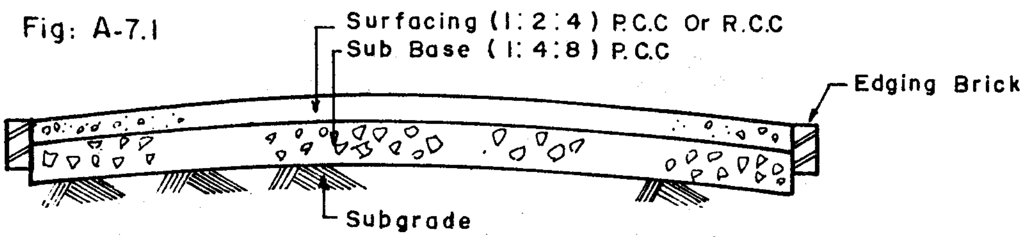
Depending upon the riding quality, road pavements are classified as high, intermediate or inferior quality and decisive factors for such classification are the permissible traffic, speed and the rate of strain accumulation. A broad classification of such types of roads is given in Table A.7.1.

While selecting a particular type of pavement, consideration should be given to traffic requirements; local natural conditions, availability of local building materials, machinery and equipment available for the construction and the availability of finance for the project.

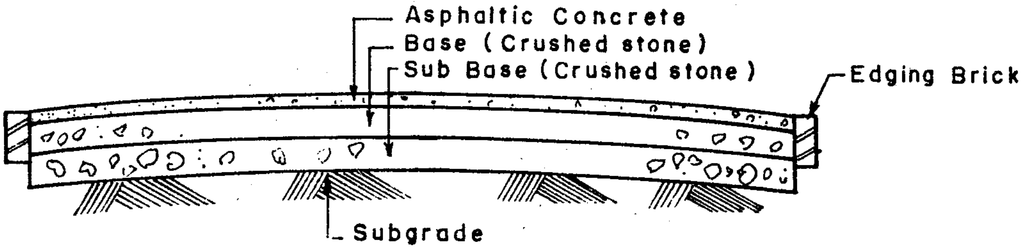
Various types of equal strength pavements should be considered and preference should be given to the most economical solution, taking into account the cost of construction as well as cost of maintenance, repair and vehicle operation.

Various types of road pavements are indicated in Fig. A.7.1 for final selection under various local conditions.

Fig: A-7.1

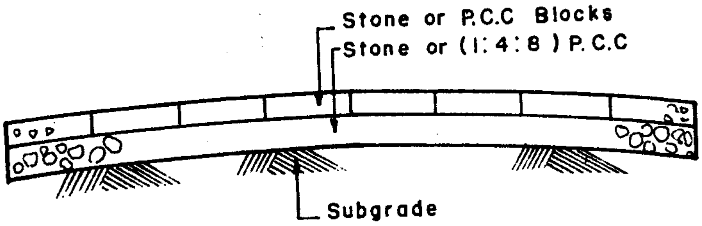


CONCRETE PAVEMENT

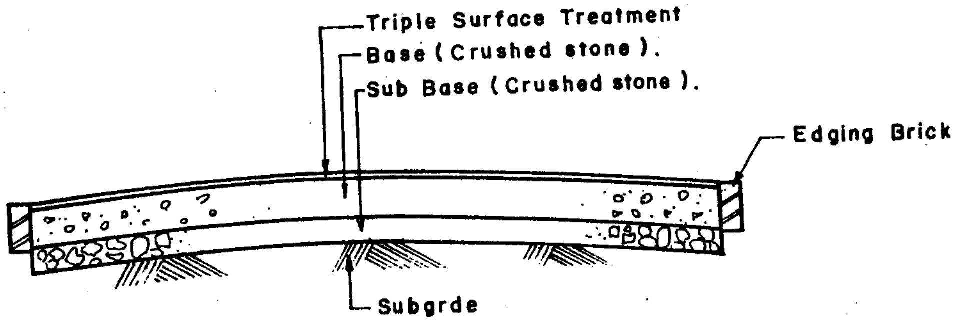


HOT AND WARM ASPHALTIC CONCRETE

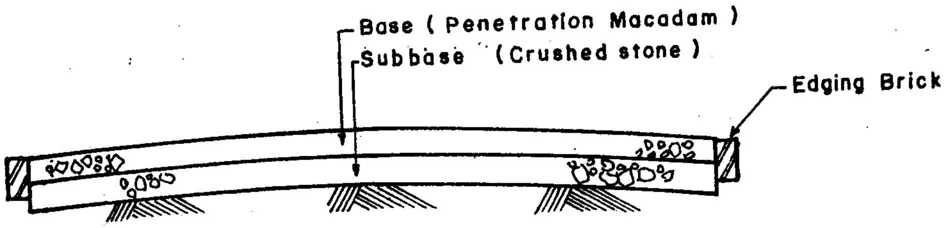
Fig: A-7·1 (Contd.)



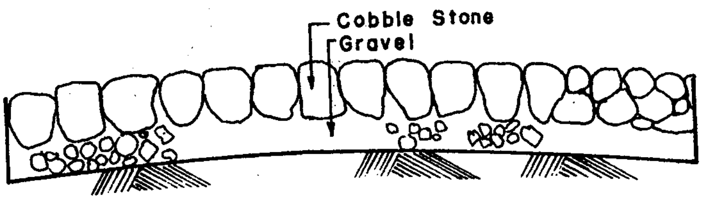
STONE OR CONCRETE BLOCK PAVEMENT



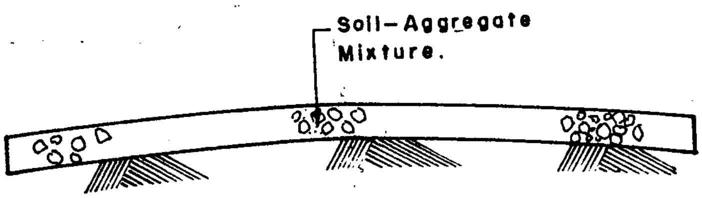
CRUSHED STONE PAVEMENT WITH SURFACE TREATMENT BY BITUMEN.



CRUSHED STONE PAVEMENT STABILIZED WITH ORGANIC BINDERS



COBBLESTONE PAVEMENT.



SOIL PAVEMENT STABILIZED WITH LOCAL MATERIALS.

TABLE A.7.2: TYPES OF PAVEMENTS, KINDS OF PAVEMENTS & MAXIMUM TRAFFIC INTENSITY FOR EACH:

Types of pavements	Main kinds of pavements	Maximum traffic intensity for two lanes standard vehicles per day
High-quality heavy-duty	i) Cement concrete	> 3,000
	ii) Hot & Warm asphalt concrete	> 3,000
	iii) Pavements of strong broken-stone graded materials processed in mixers with viscous bitumens or tars.	1,500
	iv) Stone block or mosaic pavings on stone or concrete base course	3,000
High-quality light-duty	i) Cold asphalt concrete pavements	1,500 - 3,000
	ii) Pavements of crushed stone & gravel materials stabilized with viscous organic binders.	1,500 - 3,000
	iii) -ditto-, with liquid bitumens.	1,500
	iv) -ditto-, of soil processed in a plant with viscous bitumens.	1,500
Intermediate	i) Broken-stone pavements of natural stone materials, gravel or slags (with surface finishings).	1,000
	ii) Of soils and local weak aggregates stabilised with liquid organic binders.	500
	iii) Cobblestone & broken stone pavements.	500
Inferior	i) Soil pavements stabilized with various local materials.	100

Source: Babkov and Zamakhayev, Highway Engineering, Mir. Publishers, Moscow, 1967.

APPENDIX 7.2 BUS DEPOT SITES

TABLE A.7.2.1 ELEMENTS OF BUS DEPOT

		PUTC Bus Depot, Islamabad	KTC Mehran Depot Malir Cantt, Karachi	KTC Bus Depot, North Karachi.
i)	Parking Area (Bays and Internal Circulations)	(116x23)x3=8004 m^2	19570.49 m^2	14067.36 m^2
ii)	Security Rooms	7 x 10 = 70 m^2	–	–
iii)	Administration Block	13x49 = 637 m^2	512.121 m^2	268.64 m^2
iv)	Transformed Pad	4.5x4.5 = 20.25 m^2	–	–
v)	Kitchen and Toilets	7 x 7 = 49 m^2	–	–
vi)	Cash and Audit Room	7 x 27 = 189 m^2	–	–
vii)	Cycle Stand	15 x 3 = 45 m^2	–	–
viii)	Pumping Room	10 x 5 = 50 m^2	–	–
ix)	Concrete Floor	4.5 x 15 = 67.5 m^2	–	–
x)	Washing Ramp	15x44 = 660 m^2	–	(2 Nos.) 198.4 m^2
xi)	Washing Platform (including washing plant)	15 x 20 = 300 m^2	384.022 m^2	240.80 m^2
xii)	Cloak Room	–	–	27.20 m^2
xiii)	Flood Light Tower	–	–	5.12 m^2
xiv)	Filling Station	–	3.15 x 6.15 = 19.372 m^2	16.8 m^2
xv)	Yard Office	–	84.547 m^2	77.28 m^2
xvi)	Water Tank	–	73.8 m^2	82.24 m^2
xvii)	Gate Houses	–	(2 Nos.) 70.454m^2	(2 Nos.) 73.60 m^2
xviii)	Electric Sub-Station	–	–	63.84 m^2
xix)	Circulation	20652.25 m^2	17195.67 m^2	6899.36 m^2
xx)	Total Area	168x188=30744m^2	37910.48 m^2	22020.64 m^2
–	Area of Workshop (including sheds and circulation).	107x168=17976m^2	74.25x21.30 = 1581.525 m^2	1575.36 m^2
–	Grand Total (Site Area)	168 x 290 = 48720 m^2	39492 m^2	23596 m^2
–	No. of Buses	150	144	85
–	Space requirement/Bus	325 m^2	274 m^2	278 m^2

APPENDIX 8.1: WATER TREATMENT PROCESS DESCRIPTION

A.8.1 PROCESS DESCRIPTION

This appendix provides a brief description of the various unit operations involved in water treatment.

1. Rapid Sand Filter System.

1.1 Rapid Mixing

Rapid mix unit is generally the first step in conventional treatment system and carries out flash or instantaneous mixing of coagulants (commonly alum) with the raw water stream. It essentially furnishes the destabilization of negatively charged colloidal particles and makes them chargeless. (For quantitative standards. See Appendix - 8.2 Sec.1).

1.2 Flocculation

Flocculation is the slow agitation of coagulated water to achieve agglomeration of the destabilized colloidal particles. The particles grow in size in the flocculator. (Appx. 8.2 Sec. 2).

1.3 Sedimentation

The function of sedimentation basin is to settle the discrete and agglomerated suspended particles so that water fed to the filter has turbidity less than 10 JTU (Jackson Turbidity Units). (Appx.8.2 Sec.3).

1.4 Rapid Sand Filtration.

The small suspended particles which are left in the water stream, after sedimentation, are removed by filtration. The filtration rates in rapid sand filters are 30-40 times than in slow sand filters so area requirement for rapid sand filters is less in the same proportion: (Appx. 8.2 Sec.4).

1.5 Disinfection.

The purpose of disinfection is to inactivate pathogenic organisms. Most commonly employed disinfectants are chlorine gas, calcium hypochlorite or sodium hypochlorite solutions. (Appx. 8.2, Sec.5).

2. Slow Sand Filtration System.

2.1 Presedimentation.

Plain sedimentation is carried out to remove the readily settleable particles from raw water before it can be fed to slow sand filters. (Appx.8.2, Sec.6).

2.2 Slow Sand Filtration.

Slow sand filter carries out the same function as rapid sand filter except that it requires more area and in addition to the removal of suspended solids, it assists in BOD removal due to the microbial growth developed on the sand particles during long operation periods. In contrast with rapid sand filters, slow sand filters beds are cleaned by scraping top layer instead of daily back washing. (Appx.8.2,Sec.7).

A.8.2 WATER TREATMENT DESIGN CRITERIA

1 RAPID MIXING

Detention Time	=	20 - $\overline{60}$ seconds
Power requirement	=	0.25 - $\overline{0.5}$-1 HP/mgd

2 FLOCCULATION

Detention Time	=	20-$\overline{50}$-60 minutes
Velocity gradients	=	25-$\overline{60}$-65 1/seconds

3 SEDIMENTATION

Detention Time	=	2-3-4 h
Overflow Rate	=	0.25-$\overline{0.3}$-0.38 gpm/sq.ft

4 RAPID SAND FILTRATION

Rate of filtration	=	1-$\overline{2}$-4 gpm/sq.ft
Backwash rate	=	12.5-$\overline{15}$-16.5 gpm/sq.ft
Backwash time	=	5 - $\overline{10}$ minutes
Backwash head above top of trough	=	25-$\overline{30}$ ft.
Terminal Head Loss	=	$\overline{7}$-9 ft.

5 DISINFECTION

Chlorinator capacity	=	Sufficient to produce a free residual chlorine of 2 mg/l after a contact period of 20 minutes.

6 PRESEDIMENTATION BASIN

Detention Time	=	4-$\overline{8}$-10 h
Depth	=	5-$\overline{8}$-10 ft.

7 SLOW SAND FILTRATION

Rate of filtration	=	2-$\overline{3}$-6 mgd/acre
Head Loss	=	$\overline{4}$ ft.
Filter Run	=	20-$\overline{30}$-60 days

APPENDIX 8.3: WASTEWATER TREATMENT PROCESS DESCRIPTION

A.8.3. PROCESS DESCRIPTIONS

Description of various treatment processes is provided in this appendix.

1. Coarse Screen.

   It consists of a series of closely spaced mild steel bars placed across the flow, to remove large floating objects so that they may not damage pumps and other mechanical equipments employed in treatment plant. (Appx. 8.4, Sec.1).

2. Grit Chamber.

   Generally rectangular in plan, it is provided to remove grit, consisting of sand, gravel and other inorganic materials that have subsiding velocities substantially greater than those of organic materials. (Appx.8.4, Sect.2).

3. Primary Sedimentation Tank.

   Circular or rectangular in plan, its function is to separate readily settleable organic suspended solids. (Appx.8.4, Sec.3).

4. Secondary Clarifier

   Circular or rectangular in plan, its function is to settle the sludge produced as a result of biological oxidation. (Appx.8.4, Sec.4).

5. Sludge Thickener.

   The purpose of sludge thickener is reduce the volume of sludge so that sludge digester capacity can be reduced. (Appx.8.4 Sec.5).

6. Sludge Digester.

   After thickening, mixed primary and secondary sludge are fed to the anaerobic sludge digester for stabilization. Sludge digesters are generally cylindrical in shape. (Appx.8.4 Sec.6).

7. Sludge Drying Bed.

   The sludge drying beds may be open or covered. In hot climate of Pakistan, they may be left open for sun drying. (Appx.8.4,Sec.7).

8. Waste Stabilization Ponds.

   Waste stabilisation ponds are classified as anaerobic, facultative, aerobic and maturation ponds. Most commonly used are anaerobic and facultative ponds. Anaerobic ponds are generally employed as a first biological treatment step, for strong wastes such as industrial waste. But for domestic waste-water, it may sufficient to provide two or more facultative ponds, preferably in series. (Appx.8.4, Sec.8).

9. For description of activated sludge process, trickling filter and oxidation ditch, refer Section 8.2.3.1. (Appx. 8.4,Sec.9, 10, 11).

APPENDIX 8.4: WASTEWATER TREATMENT DESIGN CRITERIA

A.8.4 WASTEWATER TREATMENT DESIGN CRITERIA

1. COARSE SCREEN

Bar spacing (ahead of pumps only)	=	2-$\overline{3}$-4 inch
Bar spacing (ahead of other devices)	=	3/4 -1-2 inch
Channel velocity	=	1-$\overline{2}$-3 fps
Initial headloss	=	6 inch.
Terminal headloss	=	2.5 ft.

2. GRIT CHAMBER

Type	=	Horizontal flow chamber
Detention time	=	45-$\overline{60}$-90 seconds
Horizontal velocity	=	0.8-$\overline{1}$-1.3 fps.

3. PRIMARY SEDIMENTATION TANK

Detention time	=	1.5-$\overline{2}$-2.5 hours
Overflow rate (prior to aeration tank)	=	800-$\overline{900}$-1000 gpd/sq.ft
Overflow rate (prior to trickling filter)	=	500-$\overline{600}$-700 gpd/sq.ft.
Suspended solid removal	=	50-$\overline{60}$ %
BOD removal	=	20-$\overline{30}$-40 %

4. SECONDARY CLARIFIER

Overflow rates	=	800-$\overline{900}$-1000 gpd/sq.ft.
Detention time	=	1 - 2 hours

5. SLUDGE THICKENER

Solid Loading (for primary sludge)	=	$18-\overline{20}-25$ lb/day-sq.ft
Solid Loading (for secondary sludge)	=	$4-\overline{5}-6$ "

6. SLUDGE DIGESTER

Organic solid loading	=	0.1-0.2 LbVS/cft-day
SRT	=	20-30 days

7. SLUDGE DRYING BED

Drying bed area	=	0.5-2 sq.ft/capita

8. WASTE STABILIZATION PONDS

i) Anaerobic Ponds

Loading rate	=	$8-\overline{10}$ Lb BOD/1000 cft-day
Depth	=	$8-\overline{10}-15$ ft.
Detention time	=	4-5 days

ii) Facultative Ponds

Mean Monthly Temp.of coldest month (C)	Loading Rate (Lb/acre-day)
5	60
10	90
15	150
20	240

Depth	=	$4-\overline{5}-6$ ft.

9. ACTIVATED SLUDGE AERATION TANK

General shape	=	Rectangular

F.M.Ratio	=	$0.3-\overline{0.5}$ day
MLSS	=	$1500-\overline{2000}-3500$ mg/l
Air requirement	=	$500-\overline{600}-700$ cft/lb.BOD
Return sludge	=	$25-\overline{100}$% of flow rate
SVI	=	$100-\overline{125}-150$ ml/g
Aeration tank depth	=	$10-\overline{12}-15$ ft.
Hydraulic Detention time	=	4-8 hrs.
Solid retention time	=	2 - 3 days

10. TRICKLING FILTER (STANDARD RATE)

Hydraulic overflow rate	=	$25-\overline{50}-100$ gpd/sq.ft.

11. OXIDATION DITCH PROCESS

Hydraulic Detention time	=	$0.5-\overline{1}-1.5$ days
SRT	=	$20-\overline{25}-30$ days
F.M. Ratio	=	$0.1-0.3$ day^{-1}
MLSS	=	$\overline{3000}-5000$ mg/l
Depth	=	$3-\overline{5}$ ft.

12. SEPTIC TANK

No. of compartments	=	$\overline{2}-3$
Sewage depth	=	$3-\overline{4.5}-7$ ft.
Length to Breadth ratio	=	2:1 to 3;1
Detention time	=	$1-\overline{2}-3$ days

A.8.5 STORM WATER DESIGN CRITERIA

1. HYDRAULIC DESIGN

1. Minimum Velocity

Unlined channel	=	1.5 fps.
Lined channel	=	2.0 fps

2. Roughness coefficient, n

Unlined rough channel	=	0.024
Unlined dressed channel	=	0.020
Brick lined channel	=	0.015
Concrete finished channel	=	0.013

3. Side Slope

Earthern channel	=	1:1.5 to 1:2
Lined channel	=	1:1

APPENDIX 9.1 : AIRPORT DESIGN

CRITERIA FOR AIRPORT PLANNING & DESIGN

Following is a brief summary of standards and elements relevant to planning and designing of airports:

1. Runways (R/W):

Runway lengths range from 1000 m for STOL aircrafts to 3350 m for wide bodied commercial aircrafts. Large airports have multiple runways. Runways are numbered according to their compass bearing.

2. Over-Run:

The length of the over-run is to be 275 m with a width of 229 m from either side of the runway axis. This area will invariably be acquired. A width equal to that of the runway for the full length of over-run is to be constructed of flexible pavements to a bearing strength equal to 1/3 of that of the runway. Over-run is to be described as stopway for the runway on which an aircraft after landing rolls to the end of runway and reaches the over-run e.g. over run for R/W17 would mean the stopway at the end of R/W17.

3. Over-run Extension:

The length of the extension to the over-run area is to be 915 m. It is to be acquired and cleared of all obstructions including canals and ditches.

4. Vertical Clearances:

4.1 Funnel:

(a) The flying gap funnel will start 275 m from the end of the runway in line with the runway clearance line, spreading out to a maximum width of 610 m on either side of runway axis over-run.

(b) The elevation clearance of the funnel is to be 1:50 commencing 1189 m from the ends of the runway and rising to a maximum of 55.5 m at a distance of 3962 m from the end of the runway. The maximum height of 55 m is to be maintained for a further distance of 4572 m with a width of 610 m on either side of the runway.

(c) To facilitate the maintenance of the funnel, the funnel area is to be demarcated by boundary pillars along the two outer sides upto distance of 610 m from end of extension of over-run. The approximate distance between the pillars is to be 91 m and the height about 1 m. The transition area within the inner horizontal surface is to be similarly demarcated.

4.2 Transition Area:-

Transition surface with a slope of 1:7 measured outward and upward is to be provided all along the runway including over-run, over-run extension, flying gap and at its ends. The slope is to be measured at right angles to runway axis except at the ends where it is to be measured parallel to it. The transition area where the above mentioned slope is permitted is shown in Fig. 9.5.

4.3 Reference Points:

Reference points for measuring inner horizontal surface, inner conical surface, outer horizontal surface etc., are to be as follows:

4.3.1 In case of single runway the mid point of the runway axis is to be taken as reference point.

4.3.2 In case of two runway, it is to be the point where the perpendicular bisecting lines intersect.

4.3.3 In case of three runways, it is to be the point equivalent from the centres of each runway.

4.3.4 All heights are to be measured with reference to the ground level of the reference point.

4.4 Surfaces (Fig. 9.6).

4.4.1 Inner Horizontal Surface: It is to be a circle of radius 3,962 m measured from the reference point. Within this area, obstructions are to be limited to a height of 45.7 m above level of the reference point.

4.4.2 Inner Conical Surface: From the circumference of the inner horizontal surface, an outward and upward slope 1 in 20 is to be maintained from the reference point and until reaching a maximum height of 152.4 m.

4.4.3 Outer Horizontal Surface: From the outer circumference of the inner conical surface, a height restriction of 152.4 m above the level of the reference point is to be maintained for a distance of 15,239 m from the reference point.

5.0 Horizontal Clearances:

5.1 Runway Clearance:

A side clearance of 229 m from the centre line of the runway is to be maintained free of all obstructions for the full length of the runway including over-run. The outer margin of the side clearance is to be known as the runway clearance line (Fig. 9.4).

5.2. Clearance of Taxi Tracks.

(a) No taxi track is normally to be built within the runway clearance area i.e. 229 m from centre line of the runway.

(b) Clearance for taxi way is to be 68.5 measured from centre line of the taxi track on either side.

(c) Width of the taxi track is normally to be 15 m. The first 1.5 m width of the shoulders from the edges of the taxi tracks is to be bituminised and an additional width of 13.5 m to be compacted.

(d) All curves on taxiways are to be bituminised for a width of 7.6 m on outer side and an equal width compacted.

5.3 Fair Weather Srips:

The width of a fair weather strips is to be 68.5 m from the sides of the runway. These are to be maintained for the full length of the runway, including the prepared over-run. This area is to be levelled and compacted. The first 1.5 m from the edges of the runway are to be bituminised. The fair weather strips are identified as North, South, East and West of runway and not as right/left side of runway.

5.4 Aprons:

A horizontal clearance of 38 m from the edge of the apron is to be maintained. The first 7.6 m from the edges are to be bituminised and an equal width to be compacted.

6.0 Exemption:

The clearance criteria as specified are laid down to provide the clearance required under ideal conditions. In certain cases, however, it may not be possible to provide the clearance required under this revised policy. Each such case is to be submitted to the Air Headquarters/CAA for consideration on its merits either for granting necessary exemption or ordering removal of the obstruction. This condition is also applicable to radio navigational aids which may, of necessity, have to be situated within the clearance specified.

7.0 Land Acquisition:

Land to be acquired for airports of various categories is given in Table A.9.1. In areas with gusty conditions and more than one axis of dominant wind, necessitating runways angular to each other, the area requirements of domestic and feeder airports markedly increase, as reported in parentheses.

TABLE A.9.1:AREA TO BE ACQUIRED FOR AIRPORTS

		Area (hectares)		Minimum length of long axis (metres)
(i)	International Airports.	346		5791
(ii)	Domestic Airports.	134	(227)	5181
(iii)	Feeder Service Airports.	61	(110)	3505

These area standards are inclusive of spaces for taxi ways, aprons, engineering and service facilities, passenger and cargo terminals and car parks, but do not include affiliated training institutes, hotels for transit passengers, residential colonies for employees of airport operation and management agencies, (CAA, ADA, PIA, ASF), areas for which may be separately computed.

8.0 Air Traffic Control Tower:

For siting, height and horizontal visibility around ATC, consult Aviation Division/CAA.

9.0 Fire Brigade:

For siting and size of Fire Brigade and number and type of vehicles consult Aviation Division/CAA.

10.0 Apron Numbers and Size:

10.1 Calculation Method for Required Number of Aircraft Stands:

The following formula is used to obtain the required number of aircraft stands:

$$S = Ti/60 \times Ni \times 1.2 + 2$$

Where S: Required number of aircraft stands,

Ti: Gate occupancy time in minutes

Ni: Number of arrival of aircrafts during the peak hour.

a : one extra stand for the largest aircraft of the planning year for unexpected peaking occasion. (1 extra for every 10 stands).

Gate Occupancy Time

The gate occupancy time for each category is calculated in Table A.9.2 with a margin for delay.

TABLE A.9.2: GATE OCCUPANCY TIME
(minutes)

		Occupancy Time	
	Flight or Airport	L jet*	Others
Domestic	Primary Airport**	80	55
	Others	70	45
International	PIA	130	70
	Foreign Carrier	70	

* B-747, Airbus class.
**Karachi, Islamabad, Lahore, Peshawar, Quetta.

10.2 Apron Space

Apron space is given in Table A.9.3 taking into account wing span, overall length and operating procedure of aircraft on the apron.

TABLE A.9.3:PARKING SPACE REQUIREMENT:

		(meters) width*	
	i) Procedure	Nose-in/Pushout	Self Maneuvering
	ii) Airport	Karachi,Islamabad Lahore	Other
Domestic/ International	Aircraft B-747, Airbus	70	-
Domestic	Twin Jet	45	60
	F-27	-	50
International	B-747, Wide I	70	-
	Wide II	60	-

* Figures include the clearance between each apron.

11.0 Passenger Terminal Building:

The floor area required for the passenger terminal building is calculated by multiplying the number of the hourly peak passengers by the unit floor area.

The unit floor area per hourly peak passenger at each airport is established to be 15 sq.m. for domestic and 35 sq.m. for international use taking into consideration Japanese standard and rather high well-wisher/passenger ratio in Pakistan. (ICAO has no definite standards and some of the advanced countries have now adopted a standard similar to that of Japan). In addition, 10 sq.m. of floor area is required per international transit passenger at peak hour.

12.0 Cargo Terminal Building:

In case of manual handling system of cargo, JCAB recommends following cargo handling capacities for airline and agency offices:

TABLE A.9.4:CARGO HANDLING CAPACITIES

(ton/sq.m)

	Airline Office	Agency Office
Domestic	0.067	0.02
International	0.166	0.06

Therefore, cargo handling space required is calculated by multiplying the above mentioned values by cargo demand.

13.0 Car Parking:

The following formula is used to calculate the required car parking spaces:

$$A = P \times C \times L$$

Where A : Required car parking spaces

P : Number of peak hour passengers

C : Number of parking spaces per peak hour passenger (0.8 by Japanese & FAA standard).

L : Unit space for one lot (35 sq.m including incident space of general planning value).

STANDARD LAND USE CLASSIFICATION FOR URBAN JURISDICTIONS IN PAKISTAN

Following is the standard land use classification and terminology to be applied in the identification of, and setting standards for, the various land uses in the urban areas of Pakistan, adjacent semi-urban and non-urban land falling within the jurisdiction of any municipal authority, urban development agency, Cantonment Board; also any other Federal/Provincial Government Authority's jurisdiction lying within the area recognised by the Population Census Organisation, Statistics Division as urban.

1. URBAN USES

1.1 **Residentiary Uses _ Residential Uses:**

Includes all land used for dwelling facilities, but does not include land used for lodging facilities operated on a commercial basis. Residential uses may be internally subdivided either by types of structures (e.g., pucca, semipucca, kutcha), or by types of housing programmes (e.g. improvement, regularisation, open plot development, utility wall development, bungalows, town houses, flats). Special sub-classes may be needed to distinguish between urban and rural types of residential uses.

1.2 **Other Residentiary Uses**

1.2.1 **Government Uses:**Includes the use of land for all governmental purposes, such as offices, post offices, police stations, jails and foreign missions, other than uses specifically included in other classifications.

1.2.2 **Health and Welfare Uses:** Includes land used for health and welfare services, such as health centres, clinics, hospitals, maternity homes, medical research institutions, nurseries, mother and child care centres, homes or other institutions for physically disabled persons, mental institutions and homes for the elderly, including green and open spaces essential for the proper functioning of such institutions.

1.2.3 **Education:** Includes all land used for nursery schools, kindergartens, primary schools, secondary schools, high schools, colleges, special colleges, technical colleges, universities, research institutes (other than medical), and fine arts institutes, including green and open spaces essential for the proper functioning of such institutions.

1.2.4 **Assembly Uses:** Includes all land used for libraries, cinemas, theatres, concert halls, planetaria, aquaria or vivaria (if outside of zoos), non-sportive clubs, exhibition halls and exhibition grounds. With the exception of exhibition grounds, open areas of these facilities will be limited by their actual operational needs. Green spaces surrounding such facilities are listed under "parks and playgrounds"

1.2.5 **Religious Uses:** Includes all land used by mosques, Jamat Khanas, Monastaries, Churches, Synagogues, Shrines, Temples, Dargas and Imambargahs, tombs including accessory green and open spaces belonging to the religious body owning the land.

1.2.6 **Commercial** (Trade) **Uses:** Normally includes only the land used for the activity in question, though this may be increased by additional open or green space, if the operation of the facility concerned requires it. Commercial (trade) uses include:

i) **retail shopping**, including shops, shopping centres, department stores, bazars, markets and hawkers areas;

ii) **personal services**, including barbers, hair-dressers, baths, tailoring, shoe-making, laundries and dry cleaners;

iii) **catering**, including restaurants, banquet halls, refreshment stalls, buffets, snack bars and tea and coffee shops;

iv) **lodging**, including hotels, motels and clubs providing lodging;

v) **business offices**; including banks and real estate offices;

vi) **petrol stations.**

1.2.7 **Residentiary Manufacturing:** Includes small and medium size repair shops, handicrafts, and small-scale inoffensive production or manufacturing customarily carried on in or adjacent to residences of the proprietors.

1.2.8 **Parks and Playgrounds**: Includes:-

i) all green spaces, including related cultural or recreational facilities such as aquaria, vivaria, greenhouses, zoological and botanical gardens but excluding green spaces ancillary to welfare or educational facilities, and excluding median or other dividing green strips less than 3 metres wide in transportation right-of-way.

ii) all open spaces designated for sports activities, whether fully developed or not; and

iii) all structures serving sports activities, like gymnasia, swimming pools, stadia, race-courses, sports clubs of all kinds, whether they are part of an open space designated for sports activities or are independent structures.

1.2.9 **Burial Grounds**: Includes graveyards of any religious denomination, towers of silence and crematoria.

1.2.10 **Transportation Right-of-Way**: Includes roads and streets, parking and loading areas therein, and pedestrian lanes, whenever the land uses on both sides of the right-of-way are residentiary, or are residentiary on one side and non-urban on the other When the land uses are residentiary on one side and non-residentiary or semi-urban on the other, only one half of the right-of-way shall be deemed to be residentiary, and the other half be deemed to be non-residentiary.

1.3 Non-Residentiary Uses

1.3.1 **Manufacturing Uses**: Includes all industrial activities other than those included in residentiary manufacturing (1.2.7) and may be subdivided into:

i) large-scale manufacturing; and
ii) small-scale manufacturing.

1.3.2 **Wholesale Uses:** Includes all warehousing, godowns, and wholesale markets.

1.3.3 **Construction:** Includes yards of construction firms, open storage of construction materials, pre-processing of constructional materials, and small pre-fabrication plants serving particular construction projects, but does not include a site under construction which is intended for another ultimate use.

1.3.4 **Utilities and Municipal Service Facilities;** Includes all facilities for utility services, excluding those parts of utility networks that are under or above transportation rights-of-way. Utilities and municipal services facilities may be subdivided into:

i) **water supply,** including protected water resource areas, water purification plants, pumping stations, main water conduits and water reservoirs;

ii) **sewerage,** including treatment plants, sewage farms, oxidation ponds, sludge ponds outside industrial enterprises, pumping stations and main sewers;

iii) **solid waste disposal,** including composting plants and general or special dumps;

iv) **electricity,** including power stations, step-down stations, transformers in separate structures, and high-tension lines;

v) **gas,** including gas works, pressure reducing stations and main conduits;

vi) **communications,** including wireless stations and telecommunication exchanges; and vii **others**, including storm water drains, fire-brigade stations, depots of public works supplies and equipment, and civil defence depots.

1.3.5 **Transportation Terminals**: Includes airports, harbours, railway stations and yards, bus depots, truck terminals/stands and tramway depots and terminals.

1.3.6 **Protection Zones**: Includes buffer areas around industrial facilities, transportation terminals and river beds, which must be kept vacant to protect nearby uses from such facilities/terminals/water courses, but does not include buffer areas suitable for agriculture.

2.0 SEMI-URBAN **USES**

2.1 **Vacant improved land:**

Includes land improved for development, such as through the provision of major roads and trunk utility lines, but not yet developed.

2.2. **Restricted Land;**

Includes land the use of which is governed by national security regulations.

3.0 NON-URBAN **USES:**

3.1 **Agriculture and Forestry Uses:**

3.1.1 Agricultural Lands. Includes arable lands, pastures and grazing grounds and orchards.

3.1.2 Woods grass: Includes woods, forests and tree nurseries.

3.1.3 Fishing: Includes fish harbours, fish ponds and fish farms or hatcharies.

3.1.4 Irrigation: Includes irrigation canals, ditches and dykes.

3.1.5 Mining.

3.1.6 Mines.

3.1.7 Quarries

3.1.8 Salt pans.

3.2 **Non-Urban Vacant:**

a) **Developable Vacant:** Includes vacant land, whether developable for urban or non-urban use, other than vacant land under 2.1.

b) **Un-developable Vacant:** Includes all land not capable of development, including land subject to annual flooding.

3.3. **Water Bodies:** Includes rivers, lakes (whether natural or man-made). Perennial ponds and large irrigation canals classified under 3.1.3 and 3.1.4 above, are also water bodies, in so far as regulations are framed for water bodies.

3.4 **Tourist Spots:** Includes recreational/picnic furniture, beach and other seasonal cottages/kiosks.

EXPLANATION: RULES OF INTERPRETATION:

1. As used in this land use classification the term "includes" or "including" indicates that the listed items are intended to be illustrative and not exclusive.

2. Where land includes mixed uses the designations of the various uses classes may be combined, as appropriate (e.g. "commercial-cum-residential").

ANNOTATED FORMAT OF TOWN PLANNING REGULATIONS

Town Planning Regulations should comprise chapters and schedules in order to be flexible for revision and improvement. The following should be the general format of Town Planning Regulations.

CHAPTERS

1. **Chapter 1 Definitions:**

Defines alphabetically various standard terms used in town planning such as "amalgamation", "area standards",....."land use"; also defines types of plans, types of development permits and no objection certificates; also lists institutional bodies at various levels of Government and concerned public agencies.

2. **Chapter 2. Development Permits & Procedures:**

Explains general requirements for development permission, the types of development permits and publications, conditions attached to development permits, the decision criteria for approval, various types of notices to be placed, and general stages and periods required for the application process and mentions licence fees (details of which are given in a schedule).

3. **Chapter 3.General & Specific Standards and Declaration of Interim Control Areas:**

States in legal terms that general standards are applicable in town/city, mentions that these are overruled by area standards for specific areas (as per an attached schedule), describes procedures for amendments of general or area specific standards, describes the procedures for declaration of interim control areas.

4. **Chapter 4. Procedures relating to subdivision of land:**

Defines major and minor subdivision and procedures for general approval of plans including preliminary enquiries regarding landuse status, procedures for submission of plans and information required for preliminary enquiry, explains procedures for approval of major and minor subdivisions, site inspection and consolidation conditions.

5. **Chapter 5. Preservation of structures of special architectural & historical interest:**

Refers to relevant governing law for designation and declaration of architectural and historical structures, describes the procedure for their conservation, demolition, alteration, etc. (List of designated structures is given in a schedule).

6. **Chapter 6. Miscellaneous Provisions:**

Provisions for delegation of powers and duties to concerned personnel, provisions for removal and prevention of violations, revocation of development permits, penalties, procedures for services of notices and orders, and declaration of final determination, and most importantly, procedures for amendments of town planning regulations.

SCHEDULES

The following schedules are usually attached to the Town Planning Regulations:

Schedule A : Concerned Authorities:

Describes the concerned authorities, and defines their current jurisdiction and powers.

Schedule B : Zoning:

Demarcates the city into distinct land use zones and tracts.

Schedule C : Area Covered by Detailed Plans:

Defines the areas covered by area specific standards alongwith dates of notification, extent of planned area, legal status, restrictive provisions and stage of development.

Schedule D : Areas not covered by Detailed Plans:

Defines other built-up areas where general town development standards and standard permit regulations govern in the absence of a detailed plan.

Schedule E : Sub-division Regulations in areas without Detailed Plans.

Governs subdivision and amalgamation of plots and change of landuse in areas not in Schedule-C.

Schedule F : Scrutiny Fees:

Tabulates the various scrutiny and attestation fee to be realised for various purposes by the concerned authorities.

Schedule G : Interim Control Areas:

Defines interim control areas and the purpose for which brought under development control.

Schedule H : Land Use Codes:

Using the Pakistan urban standard land use classification (Appendix 10.1 of this Manual), defines the land use codes, (e.g. R1, R2...Rn, NR1, NR2...NRn), uniformly applicable in the jurisdiction of the city.

Shedule I : General Standards:

For areas in Schedule D, gives the bulk, height and spatial standards of residential and other types of uses, allocation criteria for new industrial estates, their plot ratios and building heights, defines roads and streets standards, provides standards for various types of transportation systems including street lines and building lines, visibility at cross-sections, defines parking and loading requirements, gives criteria for other facilities such petrol pumps, cinema houses, religious buildings.

Schedule J : Major Roads Improvement Proposals:

Identifies major roads of the town system, alongwith proposals for their improvement.

Schedule K : Area Specific Standards:

For tracts of land for which detailed plans have been prepared, specific area standards are provided. This schedule describes of the specific area standards, such as plot-ratio/FAR standards in each zone etc.

Schedule L: Structures of Architectural and Historic Interest:

This schedule names the structures of architectural and historic interest.

Schedule M: Forms:

This schedule consolidates all the forms required for various types of approvals.

APPENDIX 10.3 READING LIST

BASIC READING LIST ON URBAN MORPHOLOGY

REFERENCE

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