

Maps for planning and development of urban areas

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1. Introduction

Urbanization in the country, at 27.78 % in the year 2001, was low when compared to developed countries. But, the 28.53 Crores of urban population, living in 27 Metros, 396 cities and 4,738 towns was more than the total population of many developed countries. The trend in urbanization continues. It is imperative to prepare development plans to guide the growth of urban areas in a planned manner. Development Plans need to be followed by Zonal Plans and thence by detailed plans at local level for implementation. Base maps scientifically prepared comprehensive and accurate at different scales are necessary for preparation and implementation of development plans. Development plans are the basis on which service providers plan, build and operate the services.

2. Objectives

Objectives of this paper is to highlight the needs of the physical planners for various types of topographical maps with cadastral information at larger scales for physical planning and development of urban areas and to drive the such need to the survey and mapping community.

3. Importance of development plans

3.1 Development plans are to guide the development of urban areas and their environs to address the needs and problems of:

- City planning and development,
- Transportation system and traffic management,
- Planning, development and managing the utilities - water supply, sewerage system, telephone system, electricity supply,
- Planning and development of civic amenities - schools, hospitals, shopping centres, etc.
- Protecting the assets of local authorities
- Monitoring property tax collection
- Monitoring sanitation, parks and playgrounds.
- Managing other services - emergency services, crime detection, etc.

3.2 Preparation of development plans for any urban area involves planning surveys for physical as well as socio-economic scenarios. The maps for socio-economic surveys, for analysis and to make projects for the plan horizon, may be 15 to 20 years, abstract maps at smaller scale will suffice. On the other hand, to study the anatomy of an urban area, including individual properties in all the lanes, scientifically prepared comprehensive and reliable maps at large scale, are essential.

4. Use of large-scale maps

Maps are not new to town planners and engineers. However, preparation and use of large-scale

maps, especially for urban areas, is not as good as in developed and other developing countries. Maps are required by every Department/agency of the Union and State Governments having stake in development of urban area. Local authorities, public undertakings, service organisation require maps. However, the requirement of maps in terms of contents, quality and accuracy vary from organisation to organisation. Also, some organisations use maps every day while some use maps occasionally yet some others use maps once in a way (5 or 10 years).

It is important to note that all the agencies aforementioned and others do not need comprehensive map, i.e. all the information in map. In the myriad of agencies involved in planning and development of towns and cities it is the agencies responsible for planning for physical development, which need maps most. Municipal authorities rank second in use of maps - comprehensive maps are required for planning and execution of works by engineering department, maps of buildings/plots for taxation and election purposes.

The specific users and the quality and contents of the map may be as in **Table 1**.

5. Type of maps

5.1 Maps for different purposes

Full topographic maps at different scales are required by Urban Development Authorities for preparation/ revision of Comprehensive Development Plans, Zonal Plans (Sectoral Plans), Neighbourhood Plans, Sub-division Plans, Town Planning Schemes, etc. in the local planning area. The standard scales, for town surveys and planning from city level down to detail town planning schemes in old areas, set in the Bureau of Indian Standards's IS:963 - "Code of Practice for Architectural and Building Drawings" are: 1:20,000, 1:10,000, 1:5,000, 1:2,000, 1:1,000 and 1:500. The scale of maps required for various purposes at different stages and for different coverage are shown in **Table 2**.

The scale of map to be used for a particular purpose in a project is determined as to what topographical features and what plan elements (details) are required to be shown with a certain degree of clarity on one or more sheets. Thus, to show a concept for circulation system and layout of plots in a sub-division plan (layout), in any urban area, a 1:2,000 scale map may be adequate. But, if details on plot numbers, entrance to plots, plot dimensions, centre line of roads, chamfers, asphalt, alignment of services like water, electricity and telephone, planting of trees, etc. are to be shown, maps at scale 1:1,000 would be needed. If the width of plot and roads is less than 10 m then a 1:500 scale map would be required to show all the afore cited details. A feature/element of specified dimension, when plotted at different scales, what will be its dimension on map is shown in **Table 3**.

5.2 Users of different types of maps (only indicative).

The users of full topographical maps at all scales may include:

Statutory Authorities in a State

- Urban development authorities - Town Planning and Engineering wings
- Local authorities - Engineering and Health Departments
- Agencies for Urban Water Supply and Drainage system
- Agency for Transmission and Distribution of Electricity
- Agency for Clearance/Improvement of Slums

- Agency for Housing.

Departments of a State Government

Department of Town Planning

- Department of Survey Settlement and Land Records (City Survey)
- Public Works Department

Statutory Authorities/ Departments of the Union

- Bharath Sanchar Nigam
- Central Public Works Department

The users of skeletal maps at all scales include:

Departments of a State Government

- Police Department - crime detection, law and order, traffic
- Fire Force Department - reach the fire spot

Statutory Authorities/ Departments of the Union

- Department of Posts
- Election Commission
- Census Commission

6. **Process in planning - BEST PRACTICE**

6.1 Requirement of maps in terms of content, accuracy, scale, etc. in planning and development of urban areas can be appreciated well when the process involved in planning for physical development and implementation is known. Planning urban areas, especially metropolitan areas and cities, may have three stages, although they can vary:

1. Outline Development Plan (ODP) now re-christened as Perspective Plan, at macro (city/town) level;
2. Comprehensive Development Plan (CDP) also at macro level. This can also be called Master Plan;
3. Zonal Plans for part of city/town to elaborate the details; and
4. Town Planning Schemes at micro (local) level to implement the plan.

6.2 These levels are basically to perceive, conceptualise and see details from city/ town level to part of city/town and local level. These levels, naturally require maps at different scales with different content with one or fewer maps to see the area under consideration.

6.3 For instance for planning a metro rail system or a bypass for rail or road, entire metropolitan area or city as the case may be has to be on only one or two sheets for all to see the alignment at metropolitan or city level. To fine tune the alignment, to avoid insurmountable obstacles, more and more details will be needed for which maps have to be at larger and larger scales. Only important features are shown on maps at small scale. All the features would be required at detail planning. What features in base map and what elements in plan proposal need to be shown on map user (planners, public and decision makers) determine

the scale(s) for maps at a particular level.

7. Preparation of Master Plan

7.1 Preparation of Master Plan at Metro/city level is highly complex and needs multi- disciplinary team of experts. However, the experts who steer the work on planning are the physical planners. Before embarking on making projections for demographic aspects to estimate the land required to meet the growth during the plan horizon, several studies are carried out by physical planners apart from other discipline. Most important planning survey is the use of building and parcels of lands, not only in the existing developed area but also in the vicinity, what is called Local Planning Area, a statutory area declared under the Town and Country Planning Acts in all the States.

7.2 **Planning studies:** Statutes on Town and Country Planning in all the States require preparation of **Existing Land Use** of every plot/property. Land uses are classified broadly in to 8 main groups. Not only that, a register showing the land use of every property need to be prepared and maintained along with the existing land use map. Hard copies of maps must be as large as 1:1,000 to mark the land use in field and to prepare fair maps in office. A GIS in deed, but in hard copy form.

Another planning survey for physical aspect is **structural condition survey**. This survey assumes importance in old areas due for redevelopment and/or rejuvenation. Structural condition of buildings are classified in to 4 or 5 classes: very good, good, moderate, poor and obsolete. This survey is for structures for which each and every structure must clearly be available on maps to mark the appropriate condition in the field and to prepare fair maps in office. For this purpose also maps must be at least 1:1,000 if not at 1:500. This is yet another GIS earlier to electronic era.

All these maps need to be documented for reference and record, lest they are called for in courts of law. Large-scale maps show limited area on a sheet. They need to be generalized to prepare smaller scale maps: 1:5,000, 1:10,000, 1:20,000 to depict parts of urban area or the whole urban area on one or two sheets. The principle of **Part to whole** is applied which is similar to preparation of smaller scale maps from survey data at larger scale.

Planning studies other than Land Use and Structural Condition are for:

1. Density of population/house holds;
2. House hold survey for social, economic conditions which is a sample survey;
3. Traffic and transportation survey;
4. Problems in physical condition like congested areas, narrow roads, bottlenecks, bad junctions, low lying areas, pollution from industry, etc.

All these surveys are not aimed at each and every property and maps at small scales, say 1:5,000, 1:10,000 and 1:20,000, may suffice.

Analysis of the physical aspect - Land Use and Structural Condition - and socio-economic aspects, problems in physical form, function, need to be made and results shown on small

scale maps: 1:5,000, 1:10,000 and 1:20,000.

After the land requirement for future growth is established, land availability has to be analysed for suitability for development. To show the results of the analysis as thematic maps also smaller scale maps, say 1:5,000, 1:10,000 and 1:20,000, area required.

Result of each of the study on separate maps (transparencies) at smaller scale (all at same scale) will be compared with one above the other (sounds like GIS in place!) to synthesis the studies and draw inference. The maps showing the results of planning studies at small scales, on one or two sheets, are the basis on which alternative plans at macro level are conceptualised.

7.3 **Concept plans:** Concept plans are free hand sketches on the base of accurate maps, at smaller scale (1:10,000 or 1:20,000 depending on the planning area) on one or two sheets, to show the boundaries of land areas for different uses, arterial and lower order road system, railway system, density of population/ house holds, etc. However, boundaries of proposed land uses and road system will not have any definite geometry.

7.4 **Master Plan:** After a concept or combination of two or three is accepted, Master Plan (CDP) is prepared on accurate map at larger scales, say 1:20,000 or 1:10,000 (for Metros and large cities), and 1:5,000 for others.

8. **Format for large scale topographical maps**

Topographical maps for urban areas at large scales on modular UTM grid system have the following formats and coverage:

Scale	Format	Coverage
1:1,000	1,000 x 500 mm	1.0 x 0.5 km
1:2,000	1,000 x 500 mm	2.0 x 1.0 km
1:5,000	800 x 400 mm	4.0 x 2.0 km
1:10,000	1,000 x 500 mm	10.0 x 5.0 km
1:20,000	1,000 x 500 mm	20.0 x 10.0 km

The format, internationally adopted, generate unique four digit (5 or 6 digit for 1:1,000) sheet numbers. Numbering system is scalable in future for maps of adjacent areas in any direction.

9. **Format of maps for Master Plan/Planning Drawings**

Town planners, Architects and Engineers convert topographical maps in to working drawings to work on. They use the ISO A Series sheet formats for their drawings. Ammonia prints of drawings on A0 to A3 have to be folded to A4 size to have title block on top to go into files, storage, used in field and sent across by mail. Planning drawings must be in **Landscape** format. Planning drawings at any scale for any coverage must always be on base of scientifically prepared topographical map. Planning drawings will have legend and title block column at the right hand side of sheet from top to bottom. Column width can be 100 to 175 mm. Title block must be at bottom-right corner.

The drawings of Master Plan approved by Government are **statutory** and need to be preserved for long time. Album form is best to the purpose. Further, drawings must be compact and handy to go in to album without folding. For this purpose, A1 size (841 x 594 mm) is best both in album and handling on desk and in field. All the drawings in the Master Plan may be to A1 size in modular form. Topographical maps at scale 1:5,000 with a 800 x 400 mm format covering 4 x 2 km (8 sq km) fits within A1size with sufficient margin at bottom for full length for legend and title block and fits in a handy album.

10. **Preparation of Zonal Plans**

The phase of Zonal Plan is between Master Plan and detail plan. Zonal plans are enlargement of Master Plan for part of city or town or for a particular land use zone. Zonal Plan include plan document to supplement the plan (drawing). Zonal plans may show even the minor roads but may not show individual properties which are very small. Maps for Zonal Plan must be at 1:2,000 to

show all details but neither dimensions nor all properties.

Town planners' role does not end on preparation and approval of Master Plan and Zonal Plan at small scale to remain as wall maps for adoration. His role includes translating Master Plan/Zonal Plan in to Action Area Plans.

11. Preparation of Area Plan

Area plans are action plans to implement the proposals in Master Plan. It may be for extension of city/town or rejuvenation or redevelopment of old and blighted areas. Master Plan is the basis for Area Planning. Maps for Area Plan start at the scale of Master Plan (1:5,000) to delineate the area for planning. Site plan at scale 1:1,000 will be required with additional survey data - cadastral boundary and topography and service cadaster. Maps may be in modular form. But, to see the concept (Master Plan content) for the whole area on one sheet site plan has to be at smaller scale. The Master Plan may be fine tuned on the accurate site plan.

Draft details plan, keeping the Master Plan concept as it is or with modifications, is prepared on a large scale, say 1:2,000, to show all the details in the plan - plots with numbers, roads, road elements like carriage way, centre line, junction details, plot dimensions, even entrance to plots, etc. Details plans may be in modular form. After the Draft Plan is approved detailed plan is finalised on maps at scale 1:1,000 to show all details and dimensions. Dimensions are also indicated to help setting-out and to prepare engineering designs. But, Plan is **not fit for allotment** of plots and for development.

Physical planner's responsibilities do not end after preparation of Master Plan at small scale. Physical planner must co-ordinate development as well not only organising and overseeing setting-out of his plan on ground but also there after.

12. Setting-out

12.1 **Draft As-set-out Plan:** Planner's responsibility does not end on preparation of detail plan but includes setting-out on ground. Setting-out is organised in which survey control points used in mapping are referenced. **Draft as-set-out plan** is prepared at scale 1:1,000 in modular form showing dimension of all the sides of plots, spaces and roads. Number to all plots and spaces are assigned. Alpha numeric numbers are assigned to road intersections to identify them.

12.2 **Final as-set-out plan:** Compatibility of roads and plots to ground condition is checked. Plan is amended where necessary. Amended road/plot are reset-out and **final as-set-out plan** is prepared. Final digital data is generated. Number to all plots and spaces are reassigned if necessary. Plan now **fit for allotment** and **fit for development** (engineering operations). Plan now **ready for application of GIS**. Is that the end of planner's responsibility? Not exactly.

13. Enforcement of plan

13.1 Enforcement of plan - Master Plan, Zonal Plan and detail plan - and monitoring developments as per detailed plans, rests with town planners. Planner is coordinator for development including service providing agencies and others for construction of roads, water supply lines, sewerage system, electricity and distribution and telecommunication system.

- 13.2 **Monitoring Maps:** Service agencies have to plan their road system, alignment of service lines on maps obtained from Urban Development/Local Authorities which must be at scale 1:1,000 with topographical and ideally with cadastral details. Planners record his approval for alignment of roads, service lines on a set of hard copies of topographical maps called **Monitoring Maps** large enough to indicate lines and write set back measurements and other details.
- 13.3 **Scale for Monitoring Maps:** Space in the Right of Way (ROW) of narrow roads on maps must facilitate showing service lines and setback measurements. A 6 m wide street will be 6 mm on 1:1,000 scale map. Water/sewer/ electricity/gas and telephone lines and measurements can be indicated in that space, of course on separate sheets. In general maps for monitoring of road construction and service lines must be at scale 1:1,000.
- 13.4 **Format for Monitoring Maps:** Ammonia prints of Monitoring Maps, with approvals on them from UDA/LA, are used intensively in office as record and in field by service providing agencies. Legend, title block will be on the right, from top to bottom. Format must be A1 as it is convenient to use on desk and in field and in album. Topographical maps at 1:1,000 cover 1.0 x 0.5 km area on a 1,000 x 500 mm sheet. Map is divided in to two parts (East and West) each to fit on A1 size sheet and to cover 0.5 x 0.5 km area. Even these sheets can be assigned 6 digit unique numbers which can be scalable.
- 13.5 **Monitoring Planning Permission:** Statutory work of Town Planner include: change of land use for specific properties in the Master Plan / CDP approved, group housing, sub-division planning by other Govt. agencies, private agencies, individuals for sites and services schemes, amalgamation of properties, sub-division of properties. These commitments need to be recorded, ideally on a separate set of Monitoring Maps, or, on Monitoring Maps for line infrastructure. All approvals (commitments) need to be incorporated in the working copy of digital data of Master Plan which include topographical and cadastral details.
14. **Single source for survey data**
The foregoing discussion brings out the **BEST PRACTICE** in the process of planning and monitoring of physical development of urban areas. But, there is a belief in some quarters that maps for planning at macro (Metro/City) level could be from an inexpensive, quickly and easily acquired survey data and maps can be prepared later for detail planning from more accurate and detail survey data. This is a misconception and over simplification of the process of physical planning and monitoring urban development.

Master Plan or Development Plan or even the Zonal Plan must ultimately need to be set-out on ground. Setting-out require details which can be shown clearly on detailed plans at large scale. Unless the relationship between the proposals on plan at small scales at macro level and detail plan are in tact, detailed plan when set-out on ground may go haywire as it happens more often than not. Agencies implementing the plan are well aware of the conflict between plan and the ground reality in the absence of scientifically prepared base maps for planning at macro and micro levels. The relationship between say alignment of roads, boundary of land uses and cadastral boundaries (existing structures) for example, on plan at small scales at macro level must remain

intact when blown up to large scale(s) to show details at micro level. If this relationship is not maintained in tact, it is possible that the planned alignment, when set-out on ground, may hit an insurmountable obstacle, like steep hill or valley or a permanent building. The situation may lead to change (distort) the plan by people implementing it, which may not be satisfactory. It will also amount to varying the approved plan at macro level which may attract objections from affected people, which lead to disputes, court cases and which may stall the whole scheme itself.

Preparation of **Planning Study Maps** from details at large scale to small scale at macro level is synonymous to preparation of small scale town map from large scale maps with complete details. Similarly, preparation of detailed plan at large scale from Master Plan/CDP at small scale (macro level) is synonymous to carrying out detailed survey from hierarchy of survey control from primary to secondary to tertiary level.

Thus it is naive to believe that inexpensive small scale map with lower accuracy can be used for planning at macro level to be followed by mapping at larger scale more accurately for detail planning at micro level. The proposition would ultimately unproductive by way of doubling the effort, cost and more importantly, confusion and difficulties in planning process and problems in enforcing the plan at smaller scale.

It is not prudent to advocate such a proposition.

15. **Conclusions**

From the discussion in the paper the following conclusion are made:

1. *Survey data for large scale mapping of urban areas must be as much detail as possible whatever method is adopted.*
2. *Small-scale maps for planning at macro level must be derived from large-scale maps.*
3. *For BEST PRACTICE in the process of planning and monitoring of physical development in urban areas maps at different scales will be required.*
4. *Planning study maps grow shrink from large scale to small scale to details from micro to macro level.*
5. *Plan for macro (City/Town) level is conceptualised on map at small scale.*
6. *Plan for micro (local) level is derived by blowing up the Master Plan.*

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TABLE 1: MAP USER BY INTENSITY

<i>Sl. No.</i>	<i>Type of maps and Agencies</i>	<i>Daily basis</i>	<i>Occasionally</i>
	FULL TOPOGRAPHIC MAPS		
1.	Urban development authorities	.	
2.	Local authorities - Engineering and Health Departments	.	
3.	Power Transmission and distribution agencies	.	
4.	Agencies for Urban Water Supply and Drainage system	.	
5.	Bharath Sanchar Nigam for telecommunication	.	
6.	Public Works Departments		.
7.	Central Public Works Department		.
8.	Ministry of Surface Transport / National Highways Authority		.
9.	Railways		.
10.	Survey, Settlement and Land Records (City Survey) Department	.	
11.	Housing boards		.
12.	Slum clearance boards	.	
	SKELETAL MAPS		
1.	Local authorities – Revenue Dept.		.
2.	Agencies for city transport system	.	
3.	Fire Force	.	
4.	Education Department		.
5.	Health Department		.
6.	Police Department - Traffic & Law and Order	.	
7.	Postal Department	.	
8.	Election Commission		.
9.	Census Commission		.
10.	Railways		.

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TABLE 2 : MAP SCALES AND COVERAGE

Sl. No.	For Presentation of	Scale of map					
		1:20,000	1:10,000	1:5,000	1:2,000	1:1,000	1:500
1.	City / town						
2.	Part of city						
3.	Sector (district)						
4.	Part of sector						
5.	Neighborhood						
6.	Sub-division						
7.	Cluster						
8.	Old parts / EWS housing schemes						

TABLE 3 : FEATURES ON HARD COPIES AT DIFFERENT SCALES

Dimension of Feature (m)	Feature in mm on maps at scales:				
	1:1,000	1:2,000	1:5,000	1:10,000	1:20,000
50	50	25	10	5	2
30	30	15	6	3	1.5
20	20	10	4	2	1
18	18	9	3.6	1.8	0.9
15	15	7.5	3	1.5	0.75
12	12	6	2.4	1.2	0.6
10	10	5	2	1	0.5
9	9	4.5	1.8	0.9	0.45
6	6	3	1.2	0.6	0.3

Features or spaces with the dimensions in the **shaded** cells cannot be easily perceived by human eye. Therefore, such spaces and features need to be generalized.