CHAPTER XIII
COMPUTATION OF AREAS
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CHAPTER XIV

COMPUTATION OF AREAS

13.1 The District Superintendent (Senior Superintendent of Surveys) is responsible for the accuracy of all computations.

13.2 The surveyor should compute and certify the extents of all the lots and the Supervising Officer (Supdt. of Surveys) should carry out an independent computation for all the lots and on the plan and compare the results. The computed extent will be entered in the tenement list but not on the plan.

13.3 The S128 form will be generated automatically while computing the extents using the functionality available in CAD software. The Supervising Officer should counter sign the computation sheet (S128) to certify the correctness of the computations and it should be filed with the coordinate sheet in the requisition file.

13.4 In Demarcation Surveys the areas of Block Survey lots must be retained. However, the new extent (after digital computation) has to be compared with old extent (sliding ruler computation) and action should be taken as DSR 13.12.4.

13.5 Whenever the usage of computers/calculators to compute an area of a land parcel with the help of original co-ordinates (i.e., digital computation), overcome the errors occur in area computation, but it is advisable to do the check computation using the software provided by the department to see whether the correctness of computed area.

13.6 The Supervising Officer should personally check the computations of each and every lot.

13.7 Where part of a state area in a Final Village Plan is cut out, the balance area, if one hectare or under, must be completed on the same plan, and for this purpose the old boundaries and the tenementary information must be verified except where such balance area is a reservation, a path, a stream or other State land which will not be alienated, when, with prior approval from the District Superintendent, it need not be completed on the same plan.

13.8 Where the balance area is over one hectare, or has not been surveyed in accordance with paragraph 4.46, or the proceding sentence, it need not be completed on the same plan, but the area can be derived by deduction, without a connected plan. In such cases the following remark should be entered against the lot. “Balance area by deduction. No action should be taken on this lot without a fresh survey and connected plan”. The boundaries of the new work should be inserted in pencil on the old sheets, with a pencil reference to the new sheet.

13.9 Where specified extents have to be cut out for exchange, the computations must be carefully checked by the Surveyor before plans are forwarded.

13.10 In Demarcation Surveys, where the remainder of a lot, after subdivisions have been made, is greater than 75 per cent of the original area, and is not less than one hectare in extent, it need not be computed. The area can be obtained by subtracting the total area of the subdivisions from the original extent of the lot. The total extent cut out and each of the subdivision must however, in these cases be computed separately, and the extents of the subdivisions must be adjusted to agree with the computation of the total extent cut out, instead of being adjusted to the area of the original lot. "Balance area by deduction" should be noted in the remarks column of the supplementary tenement list against the lots in these cases.

13.11 Any correction to standard area should be applied and a certificate made in red in Form S 128 to indicate that this has been done before passing the plan by Supdt. of Surveys.

13.12 Determination of permissible error in area calculation

You are instructed to adapt the equation defined in this chapter in calculating the permissible error in area of a land parcel based on the nature of boundaries defined on the specified accuracy levels below. It should be noted that the method of ground survey technique and the number of points on the boundaries of the land parcel are irrelevant in adapting this equation.

13.12.1 Definition of boundaries

Fixed boundary: It is a boundary that is made of man-made features and consists of permanent features such as landmarks, boundary walls, walls, wire fences, wire and live fences etc. Missing features on a fixed boundary should be able to be re-established accurately.

General boundary: It is a boundary that consists of natural features of which position is vague (cannot be determined precisely). Some of the examples are: live fences, hedges, banks, ridges, ditches, grass lines etc.

13.12.2 Accuracy levels

Class I

Plannimetric positional uncertainty (σ_d) in this class is ± 7.5cm.

Table 1: Equation to determine Class I accuracy and the specification to be adhered to achieve this accuracy level

Permissible error in area calculation based on equation: $\sqrt{Area}$ x σ_d x $\sqrt{2}$ where area in square meters (m^2) and σ_d – Plannimeric uncertainty of each detail point on the boundary of land parcel in meters (m)	
Plannimetric uncertainty (σ_d) of a detail point on fixed and identical boundaries	Permissible error (m^2)
0.075m (7.5cm)	0.1061 x $\sqrt{Area}$

Specifications	
Instrument and target centring errors	<= 2mm
Minimum length of a detail traverse line	30m
Maximum length of a detail traverse line	750m
Minimum length of a side shot to a detail point	3m
Maximum length of a side shot to a detail point	100m
Maximum length of an offset to a detail point	3m (no oblique offsets allowed)
Detail traverse closeness factor	$0.4\sqrt{k}$, k is the total length of traverse in km
Angle measurement	Whole circle bearing
Azimuth control	20 lines
Azimuth closure	3 minutes

Class II

Plannimetric positional uncertainty (σ_d) in this class is ± 15cm.

Table 2: Equation to determine **Class II** accuracy and the specification to be adhered to achieve this accuracy level

Permissible error in area calculation based on equation: $\sqrt{Area}$ x σ_d x $\sqrt{2}$ where area in square meters (m^2) and σ_d – Plannimetric uncertainty of each detail point on the boundary of land parcel in meters (m)	
Plannimetric uncertainty (σ_d) of a detail point on general boundaries or a mix of fixed and general boundaries or non-identical fixed boundaries	Permissible error in area (m^2)
0.15m (15cm)	0.2121 x $\sqrt{Area}$
Specifications	
Instrument and target centring errors	<= 2mm
Minimum length of a detail traverse line	20m
Maximum length of a detail traverse line	750m
Minimum length of a side shot to a detail point	2m
Maximum length of a side shot to a detail point	100m
Maximum length of an offset to a detail point	5m (no oblique offsets allowed)
Detail traverse closeness factor	$0.4\sqrt{k}$, k is the total length of traverse in km
Angle measurement	Whole circle bearing
Azimuth control	20 lines
Azimuth closure	3 minutes

Class III

Plannimetric positional uncertainty in this class depends on the positional accuracy of the hand-held GPS device and nature of the boundaries is irrelevant in adapting this equation.

Table 3: Equation to determine **Class III** accuracy and the specification to be adhered to achieve this accuracy level

Permissible error in area calculation in surveys carried out for planning purposes and topographic map updating with hand-held GPS	
Plannimetric accuracy(σ_d):	Plannimetric accuracy of hand-held GPS (generally between 0.5m – 5m)
Permissible error in area (m^2)	$\sqrt{Area}$ x σ_d x $\sqrt{2}$ where area in square meters (m^2) and σ_d – Plannimetric accuracy of detail point on the boundary of land parcel in meters (m)

13.12.3. Establishment of boundary points

Boundary points should be established to a positional accuracy of at least ± 7.5 cm in a cadastral map area on a subsequent survey. The same positional accuracy should also be maintained in establishing new points or re-establishing missing boundary points in surveys falling under other categories.

13.12.4 Area calculation

Use of decimal places in area of a land parcel

Extent	**Class accuracy**	**No. of decimal places in extent (Hectares)**
Up to 8093.7120 m^2 (2A - 0R – 0P)	I	Four (04) decimals
Greater than 8093.7120 m^2 (2A - 0R - 0P)		Three (03) decimals
Up to 2023.4280 m^2 (0A-2R-0P)	II	Four (04) decimals
Greater than 2023.4280 m^2 (0A-2R-0P)		Three (03) decimals
No limit	III	Three (03) decimals or lesser depending on the requirement of the accuracy level of the work.

Adaptation of the area in a land parcel

Following criteria should be adapted in comparison of the area of the same identical land parcel based on a new survey with the existing area of a previous survey(s).

i. If the difference in area between the new survey and the previous survey is within the permissible error given by the equation (some pre-calculated values are depicted in DSR 13.12.5), previous area must be adapted as the area of the new survey.

ii. If the difference obtained is outside the permissible error allowed for the area of the new survey of the land parcel, relevant area of the previous survey must be re-ascertained to do the following:

(a) If the area of Lot X of the previous survey is found to have a significant difference after digital re-computation and the re-computed extent of Lot X in the previous survey is within the permissible error compared to the new survey, re-computed extent must be accepted and the statement "Extent amended from X.XXXX to Y.YYYY after digital re-computation of Lot X" should be made on the remarks column of the tenement list only if there is no significant boundary deviations on a further verification by way of a graphical comparison of the boundaries of the newly surveyed land parcel with that of previously surveyed same land parcel.

(b) If the area of Lot X of the previous survey is found to have no significant difference after digital re-computation, area of the new survey must be accepted and the statement "Extent amended from X.XXXX to Y.YYYY after resurvey and digital computation" should be made on the remarks column of the tenement list.

13.12.5 This equation has been incorporated in the standard survey data processing software used by the survey department. However, since computed values for easy reference has given at the end of this chapter.

Pre-calculated values for permissible error for Class I and Class II accuracy levels (for easy reference)

Area in Perches	Area in square meters	Permissible error (σ_{area}) in square meters (m^2) = $\sqrt{Area}$ x σ_D x $\sqrt{2}$	
		For Class I accuracy: 0.1061 x $\sqrt{Area}$	**For Class II accuracy:** 0.2121 x $\sqrt{Area}$
1	25.2928	0.53	1.06
2	50.5857	0.75	1.51
5	126.4642	1.19	2.39
8	202.3428	1.51	3.02
10	252.9285	1.69	3.37
15	379.3927	2.06	4.13
20	505.8570	2.39	4.77
25	632.3212	2.67	5.33
30	758.7855	2.92	5.84
35	885.2497	3.16	6.31
40	1011.7140	3.37	6.75
80	2023.4280	4.77	9.54
120	3035.1420	5.84	11.69
160 (1A-0R-0P)	4046.8560	6.74	13.49
240 (1A-2R-0P)	6070.2840	8.27	16.53
320 (2A-0R-0P)	8093.7120	9.54	20.24
400 (2A-2R-0P)	10117.1400	10.67	21.33
480 (3A-0R-0P)	12140.5680	11.69	23.37
560 (3A-2R-0P)	14163.9960	12.63	25.24
640 (4A-0R-0P)	16187.4240	13.50	26.99
720 (4A-2R-0P)	18210.8520	13.32	28.62
800 (5A-0R-0P)	20234.2800	15.09	30.18
1600 (10A-0R-0P)	40468.5600	21.33	42.67
3200 (20A-0R-0P)	80937.1200	30.18	60.34
4800 (30A-0R-0P)	121405.6800	36.97	73.90
6400 (40A-0R-0P)	161874.2400	42.69	85.34
8000 (50A-0R-0P)	202342.8000	47.73	95.41

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