TRIANGULATION FIGURES OR SYSTEMS

Triangulation figures may be defined as a system consisting of triangulation stations connected by a chain of triangles. The complete figure is called triangulation figure or triangulation system. The most common type of figures used in a triangulation system are triangles, quadrilaterals and polygons. All of these figures should fulfil the rigid **geometric conditions** given as follows:

1. The sum of the interior angles should be $(2n - 4) \times 90°$, where n is the number of sides of the figure. The average number of seconds by which the sum of angles deviates from 180°, plus the required spherical excess is known as triangular misclosure.
2. If all the angles are measured at a station, their sum should be 360°.
3. The length of sides calculated through more than one routes should agree.

It is impossible to fulfil all the geometrical conditions, owing to the errors, until the field measurements have been adjusted.

CLASSIFICATION

The classification of a triangulation system is based upon the degree of accuracy required, the extent of the area to be surveyed, length of the base, length of the sides, and triangular misclosure.

Primary or First-order Triangulation

A first order triangulation is the highest-order triangulation and is employed for very large areas, for example, for the earth's figure, for obtaining the most precise control in map ping, and for small-scale mapping.

It consists of forming large, well-conditioned triangles. Precise instruments are used for observations and every possible refinement is exercised. The following are the general specification of the primary triangulation.

1.	Average triangle closure	: Less than 1 second
2.	Maximum triangle closure	: Not more than 3 seconds
3.	Length of base line	: 5 to 15 kilometres
4.	Length of the sides of triangles	: 30 to 150 kilometres
5.	Actual error of base	: 1 in 300,000
6.	Probable error of base	: 1 in 1,000,000
7.	Discrepancy between two measures of a section	: 10 mm $\sqrt{\text{kilometres}}$
8.	Probable error of computed distance	: 1 in 60,000 to 1 in 250,000
9.	Probable error in astronomic azimuth	: 0.5 seconds

Secondary or second-order Triangulation

A second-order triangulation is employed for running a second series of triangles by fixing points at close intervals inside the primary series of triangles. It consists of forming small, well-conditioned triangles with less precise instruments. the general specification of the second-order triangulation are:

1. Average triangle closure : 3 sec
2. Maximum triangle closure : 8 sec
3. Length of base line : 1.5 to 5 km
4. Length of sides of triangles : 8 to 65 km
5. Actual error of base : 1 in 150,000
6. Probable error of base : 1 in 500,000
7. Discrepancy between two measures of a section : 20 mm $\sqrt{\text{kilometres}}$
8. Probable error of computed distance : 1 in 20,000 to 1 in 50,000
9. Probable error in astronomic azimuth : 2.0 sec.

Tertiary or Third-order Triangulation

A third-order triangulation is employed for running in a third series of triangles, by fixing points inside the secondary triangles at short intervals to furnish horizontal control for details on a topographic survey. The triangles are of the smallest size in comparison with the other two orders of triangulation. The specifications for a third order triangulation are

1. Average triangle closure : 6 sec
2. Maximum triangle closure : 12 sec
3. Length of base line : 0.5 to 3 km
4. Length of sides of triangles : 1.5 to 10 km
5. Actual error of base : 1 in 75,0000
6. Probable error of base : 1 in 250,000
7. Discrepancy between two measures of a section : 25 mm $\sqrt{\text{kilometres}}$
8. Probable error of computed distance : 1 in 5,000 to 1 in 20,000
9. Probable error in astronomic azimuth : 5 sec.