

### 3.3 CLASSIFICATION OF TRIANGULATION SYSTEM

The basis of the classification of triangulation figures is the accuracy with which the length and azimuth of a line of the triangulation are determined. Triangulation systems of different accuracies depend on the extent and the purpose of the survey. The accepted grades of triangulation are:

First order or Primary Triangulation

Second order or Secondary Triangulation

Third order or Tertiary Triangulation

#### 1 FIRST ORDER OR PRIMARY TRIANGULATION:

The first order triangulation is of the highest order and is employed either to determine the earth's figure or to furnish the most precise control points to which secondary triangulation may be connected. The primary triangulation system embraces the vast area (usually the whole of the country). Every precaution is taken in making linear and angular measurements and in performing the reductions.

The following are the general specifications of the primary triangulation:

Average triangle closure	: Less than 1 second
Maximum triangle closure	: Not more than 3 seconds
Length of base line	: 5 to 15 kilometers
Length of the sides of triangles	: 30 to 150 kilometers
Actual error of base	: 1 in 300,000
Probable error of base	: 1 in 1,000,000
Discrepancy between two measures of a section:	10 mm kilometers
Probable error or computed distance	: 1 in 60,000 to 1 in 250,000
Probable error in astronomic azimuth	: 0.5 seconds

## SECONDARY ORDER OR SECONDARY TRIANGULATION

The secondary triangulation consists of a number of points fixed within the framework of primary triangulation. The stations are fixed at close intervals so that the sizes of the triangles formed are smaller than the primary triangulation. The instruments and methods used are not of the same utmost refinement. The general specifications of the secondary triangulation are:

Average triangle closure	: 3 sec
Maximum triangle closure	: 8 sec
Length of base line	: 1.5 to 5 km
Length of sides of triangles	: 8 to 65 km
Actual error of base	: 1 in 150,000
Probable error of base	: 1 in 500,000
Discrepancy between two measures of a section:	20 mm kilometers
Probable error or computed distance	: 1 in 20,000 to 1 in 50,000
Probable error in astronomic azimuth	: 2.0 sec

## THIRD ORDER OR TERTIARY TRIANGULATION:

The third-order triangulation consists of a number of points fixed within the framework of secondary triangulation, and forms the immediate control for detailed engineering and other surveys. The sizes of the triangles are small and instrument with moderate precision may be used. The specifications for a third-order triangulation are as follows:

Average triangle closure	: 6 sec
Maximum triangle closure	: 12 sec
Length of base line	: 0.5 to 3 km
Length of sides of triangles	: 1.5 to 10 km
Actual error of base	: 1 in 75, 0000
Probable error of base	: 1 in 250,000
Discrepancy between two Measures of a section	: 25 mm kilometers
Probable error or computed distance	: 1 in 5,000 to 1 in 20,000
Probable error in astronomic Azimuth:	5 sec.

### **Factors to be considered while selecting base line.**

The measurement of base line forms the most important part of the triangulation operations. The base line is laid down with great accuracy of measurement and alignment as it forms the basis for the computations of triangulation system. The length of the base line depends upon the grades of the triangulation. Apart from main base line, several other check bases are also measured at some suitable intervals. In India, ten bases were used, the lengths of the nine bases vary from 6.4 to 7.8 miles and that of the tenth base is 1.7 miles.

**Selection of Site for Base Line.** Since the accuracy in the measurement of the base line depends upon the site conditions, the following points should be taken into consideration while selecting the site:

The site should be fairly level. If, however, the ground is sloping, the slope should be uniform and gentle. Undulating ground should, if possible be avoided.

The site should be free from obstructions throughout the whole of the length. The line clearing should be cheap in both labour and compensation.

The extremities of the base should be intervisible at ground level.

The ground should be reasonably firm and smooth. Water gaps should be few, and if possible not wider than the length of the long wire or tape.

The site should suit extension to primary triangulation. This is an important factor since the error in extension is likely to exceed the error in measurement.

In a flat and open country, there is ample choice in the selection of the site and the base may be so selected that it suits the triangulation stations. In rough country, however, the choice is limited and it may sometimes be necessary to select some of the triangulation stations that are suitable for the base line site.

**Standards of Length.** The ultimate standard to which all modern national standards are referred is the international meter established by the Bureau International des Poids et Mesures and kept at the Pavillon de Breteuil, Sevres, with copies allotted to various national surveys. The meter is marked on three platinum-iridium bars kept under standard conditions. One great disadvantage of the standard of length that are made of metal are that they are subject to very small secular change in their dimensions. Accordingly, the meter has now been standardized in terms of wavelength of cadmium light.