

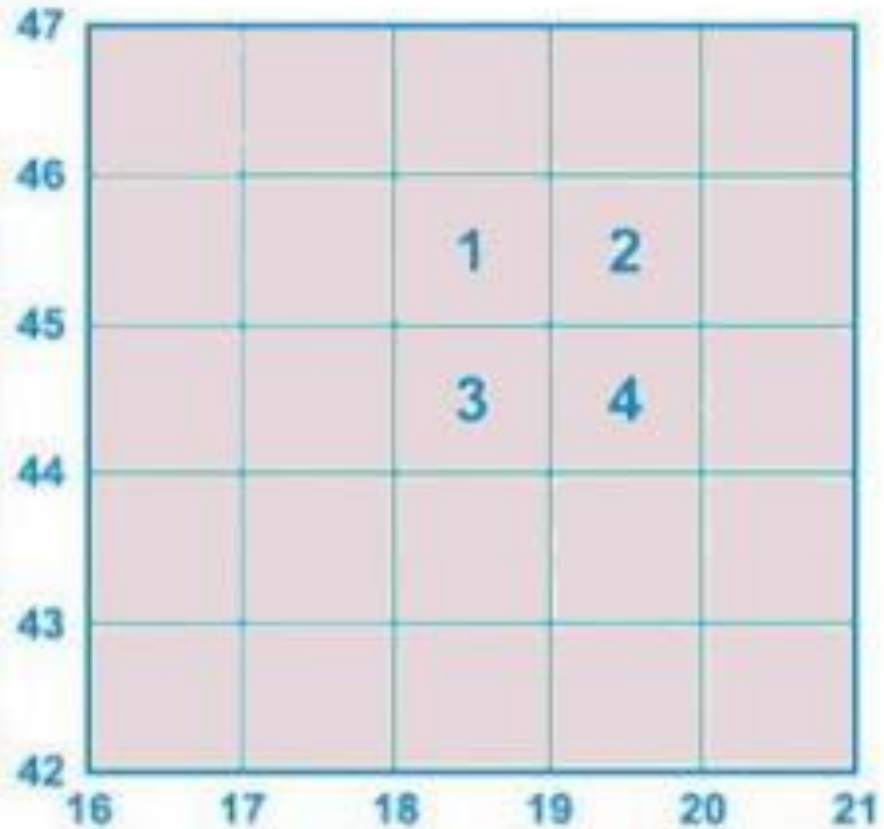
GEO-A-CC-1-02-TH – Cartographic Techniques

Grids: Angular and linear systems of measurement

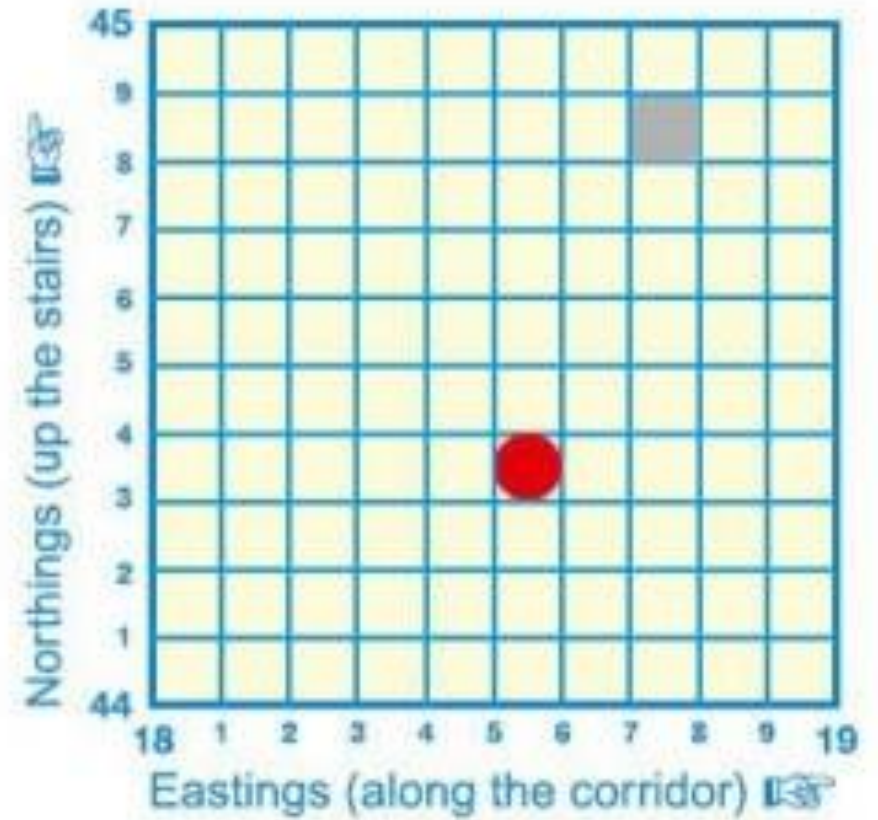
MANAS PAUL

ASSISTANT PROFESSOR

RAMMOHAN COLLEGE, KOLKATA



- ▶ 1=18 45
- ▶ 2=19 45
- ▶ 3=18 44
- ▶ 4=19 44




Red dot grid reference=185 443

Grey box grid reference=187 448

The National Grid

- ▶ The national grid is a common reference point throughout the country with reference to the single prime meridian coincident with the point of origin at Greenwich.
- ▶ The grid reference system of the map is the defined location in the map in the geographical coordinate system. The surface of the earth has nature in curved it is impossible to show on flat paper with the parallel meridian. It is shown on the map to a plane grid system coordinate system is referred to as a map projection.
- ▶ The national grid reference system is different from the geographical coordinate system. It is referred to in the cartesian coordinate system. The grid reference system has required a datum for measuring the distance in a coordinate system.

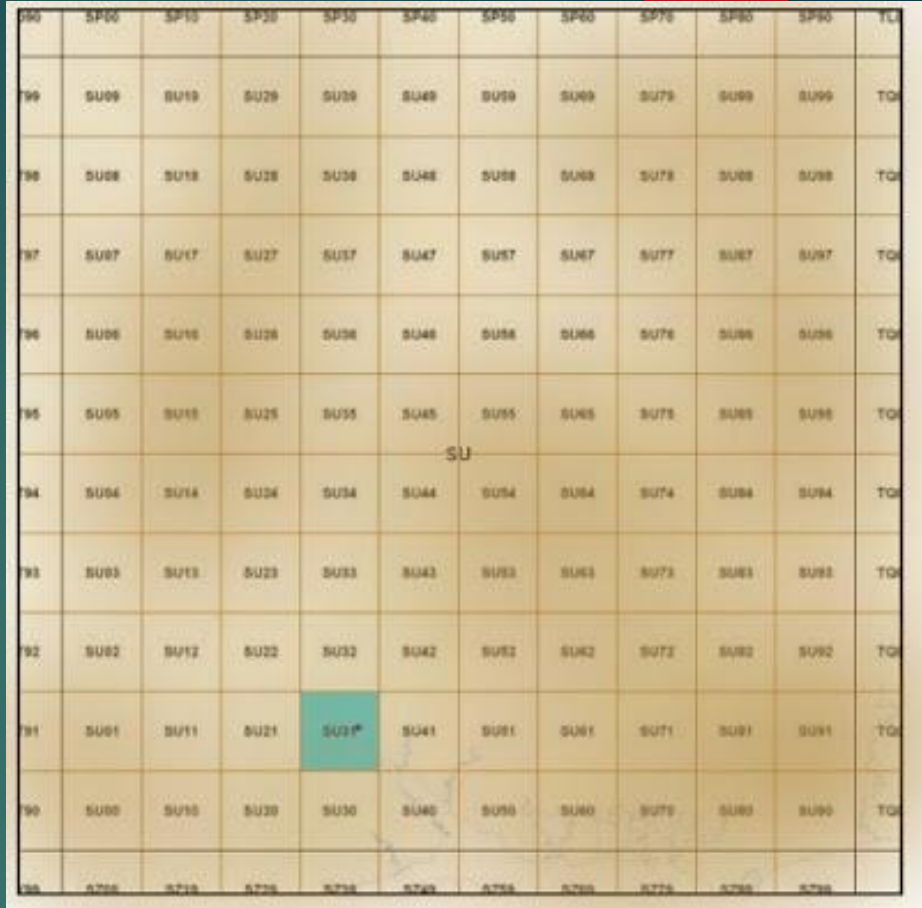
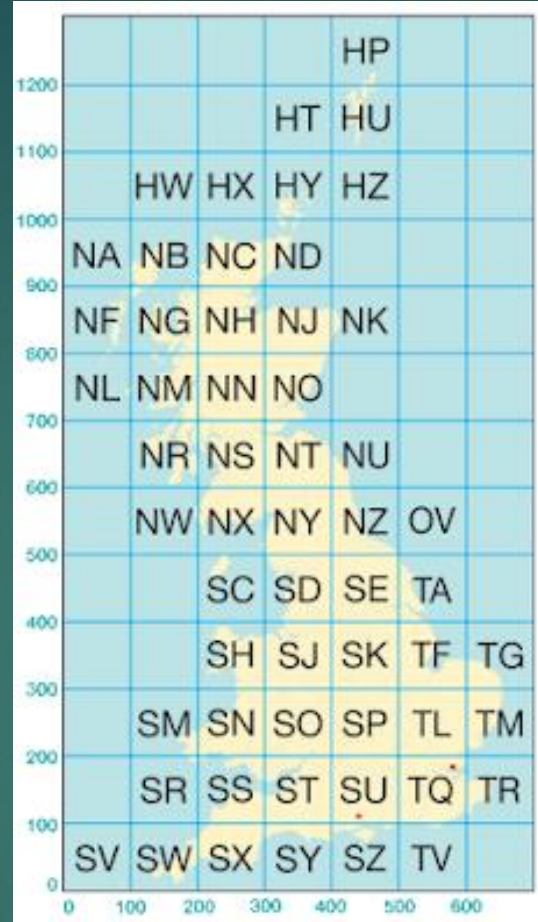
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- ▶ The National Grid is started 500 km by 500 km squares and has 25 squares. All squares are denoted by an alphabet from A-Z.
 - ▶ Each of these 500 km squares is then subdivided into a no. of squares 25, 100 km by 100 km squares, again each with a letter of the alphabet A-Z. It has a scale of 1:250000. It is represented by two alphabetical letters.
 - ▶ The 100 km square is now divided by 100 in 10km by 10 km squares. These squares is represented by 0 to 99 numbers.
 - ▶ Now 10 square is divided into 1km by 1km squares & it has a scale 1:50000.




A	B	C	D	E
F	G	H	J	K
L	M	N	O	P
Q	R	S	T	U
V	W	X	Y	Z

False origin

500 km



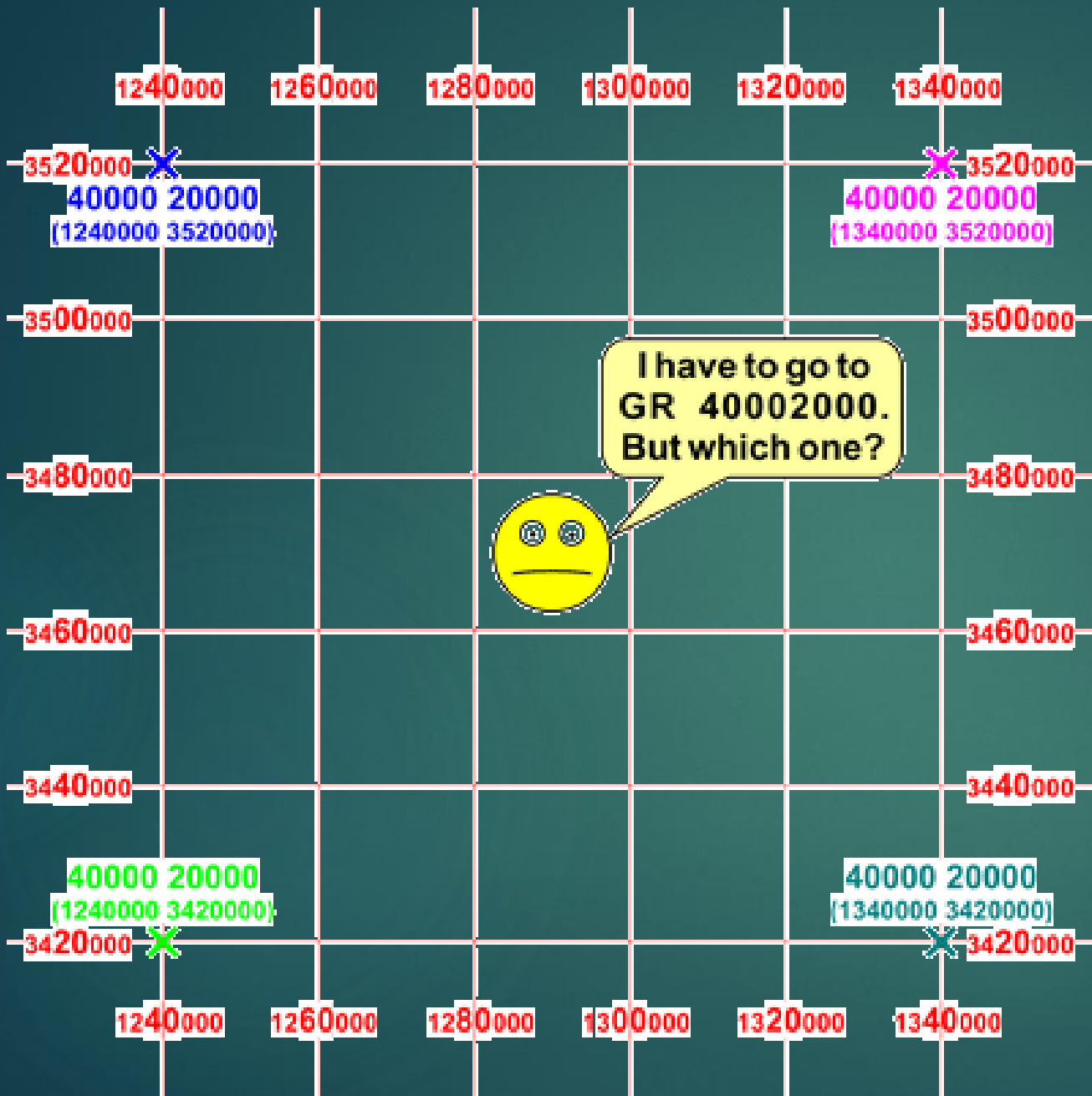
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- ▶ In the National Grid Reference System, there are two types of numbers in use easting and northing. The number going toward the east is called the eastward number and the number going toward the north is called the northward number.

 - ▶ Generally used four figure and six-figure grid reference.

 - ▶ The digits used in locating a point as national grid reference numbers.
 - Ten digits.....23371 06519.....Locating a point within a 1m square
 - Eight digits.....2337 0651.....Locating a point within a 10 m square
 - Six digits.....233 065..... Locating a point within a 100m square
 - Four digits.....23 06.....Locating a point within a 1 km square
 - Two digits.....2 0Locating a point within a 1 km square

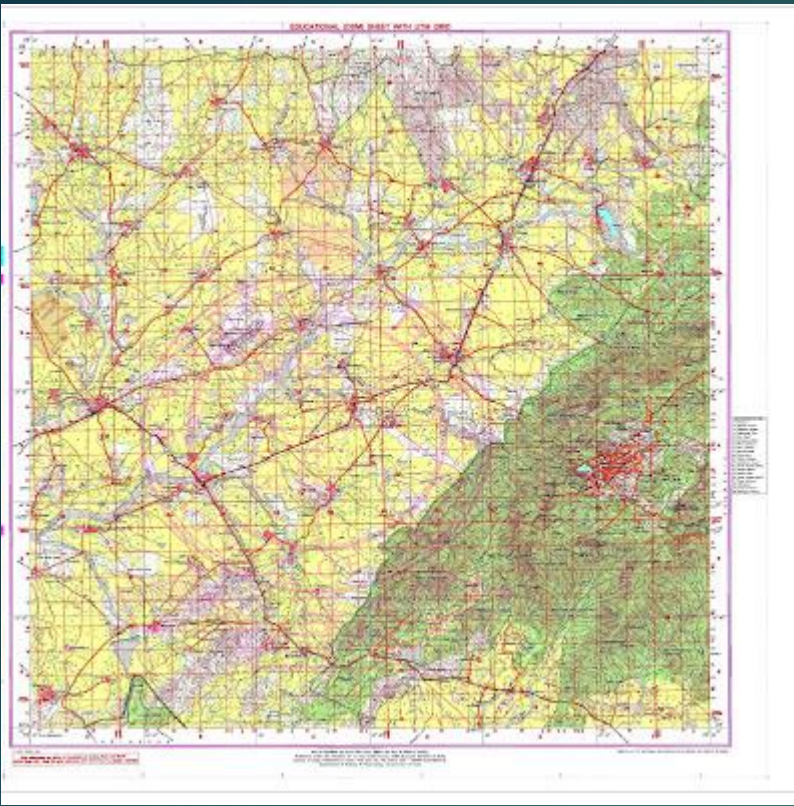
Expressing a Location

- ▶ Any location in the Indian Grid is denoted numerically by a grid reference, given as a pair of Easting and Northing (x, y; with Easting increasing from West to East and similarly Northing increasing from South to North). Originally these were in Indian yards (0.9143988m), but was changed to meters subsequently. Easting and Northing each is a seven digit number giving a resolution of 01 meter. Thus the complete grid reference with the Easting first and the Northing next. For e.g. Easting: 1234567; Northing: 3456789 will be denoted as 1234567 3456789. Also, do keep in mind, only knowing the Easting and Northing is not adequate. One also needs to know the Zone (there are a total of nine of them as brought out earlier) to which the grid reference belongs, as without knowing the correct Zone, there are total of nine totally different possible locations! So it is equally important to be aware of the Zone.
- ▶ At times, the grid reference may be expressed with lesser than the full seven digits of the Easting and Northing for brevity. This can be done in two ways...
- ▶ The first common practise is to do away with the first two digits and use the last five digits each. This is especially used with Grid Letters. This is as the first two digits correspond to 10^5 meters i.e. 100,000 meters (100 Kilometres). So this can be resorted to if we are concerned with a specific area smaller than 100 Kilometres. But for large distances this will lead to confusion. The same is explained in the figure below. All the four marked positions (1340000 3520000, 1340000 3420000, 1240000 3420000 and 1240000 3520000) have the same grid reference (40000 20000) with the first two digits omitted



- Confusion while omitting first two digits of Easting and Northing

- ▶ So, it is preferable to use the complete grid reference. Omitting the first two digits (or even a single for that matter) of the Easting and Northing will not pinpoint the exact location, as there will be a number of possible combinations within the Zone.
- ▶ The second common practise is to do away with equal number of last digits of the Easting and Northing. This leads to lesser resolution in the location. For e.g. if the grid reference is 1234567 3456789. It can be expressed as 12345 34567 (~~12345673456789~~) i.e. with a resolution of only 100 meters. So the grid reference 12345 34567 would be taken as 1234500 3456700. Note this is off the actual grid reference by almost 111 meters! Thus, the resolution will decrease in case this practise is adopted. However, this is less of concern as the resolution of maps and methods of determining position have limited accuracy. Even with standard commercial GPS receivers errors of up to 10m are common.
- ▶ These omissions can be made in combination. For e.g. the grid reference 1234567 3456789 can be expressed as 345 567 (~~1234567 3456789~~). These again suffer from the limitation as discussed for omission of the first two digits of Easting and Northing and also reduced resolution.
- ▶ Thus the grid references 1234567 3456789 can be expressed as per specific figures:
 - 4 figures - resolution of 1Km/1,000m : 34 56 (~~1234567 3456789~~).
 - 6 figures - resolution of 100m : 345 567 (~~1234567 3456789~~).
 - 8 figures - resolution of 10m : 3456 5678 (~~1234567 3456789~~).
 - 10 figures - resolution of 1m : 3456 5678 (~~1234567 3456789~~).



- ▶ Dhandhpur is located between 258 km and 259 km in the eastward direction and is located between 2726 km and 2727.
- ▶ Then the grid reference on UTM will be 2584 27264.
- ▶ WGS 1984 coordinate of Dhandhpur
 - ▶ Longitude= $72^{\circ}36'48.207''$
 - ▶ Latitude= $24^{\circ}38'1.318''$
- ▶ UTM Coordinate
 - ▶ Easting= 258412.962m
 - ▶ Northing= 2726486.8481m


Datum in India

- ▶ In India there are generally two datum is used for mapping WGS1984 and Everest 1956 or India Nepal datum. Now a day survey of India used Datum WGS 1984 and projection UTM.
- ▶ Projection is used to defined as the curved surface of the earth or part to represent a flat surface
- ▶ India used generally two types of projection Lambert conformal conic projection and Universal Transverse Mercator(UTM).

- ▶ The Indian National Grid system uses the Everest Spheroid as a reference surface. It was originally defined in 1830 by Colonel George Everest (Surveyor-General Of India from 1830 to 1843) and updated in 1956. Kalianpur (Madhya Pradesh) was chosen as the initial point of origin.
- ▶ It is a local datum. The Centre of this reference surface is estimated to about 1 kilometer off from the center of mass of the Earth.
- ▶ India Nepal datum the area of covered in nine zones.

1. Zone 0:-India and Pakistan North of $35^{\circ}35'$ North
2. Zone IA:- India and Pakistan 28°N - 35°N
3. zone IB:-Unknown parts of china.
4. Zone IIA:-India 21° - 28°N & west of 82° and Pakistan south of 28°N
5. Zone IIB:-Complete Bangladesh, India North 21°N & East of 82° and Myanmar North of 21°N .
6. Zone IIIA:- India 15°N - 21°N .
7. Zone IIIB:-Myanmar 15°N - 21°N
8. Zone IVA:-India south of 15°N
9. Zone IVB:-Myanmar south of 15°





► For Indian Grid, 'Indian (India, Nepal)' Datum is used with following parameters :-

a. Everest 1956 Ellipsoid

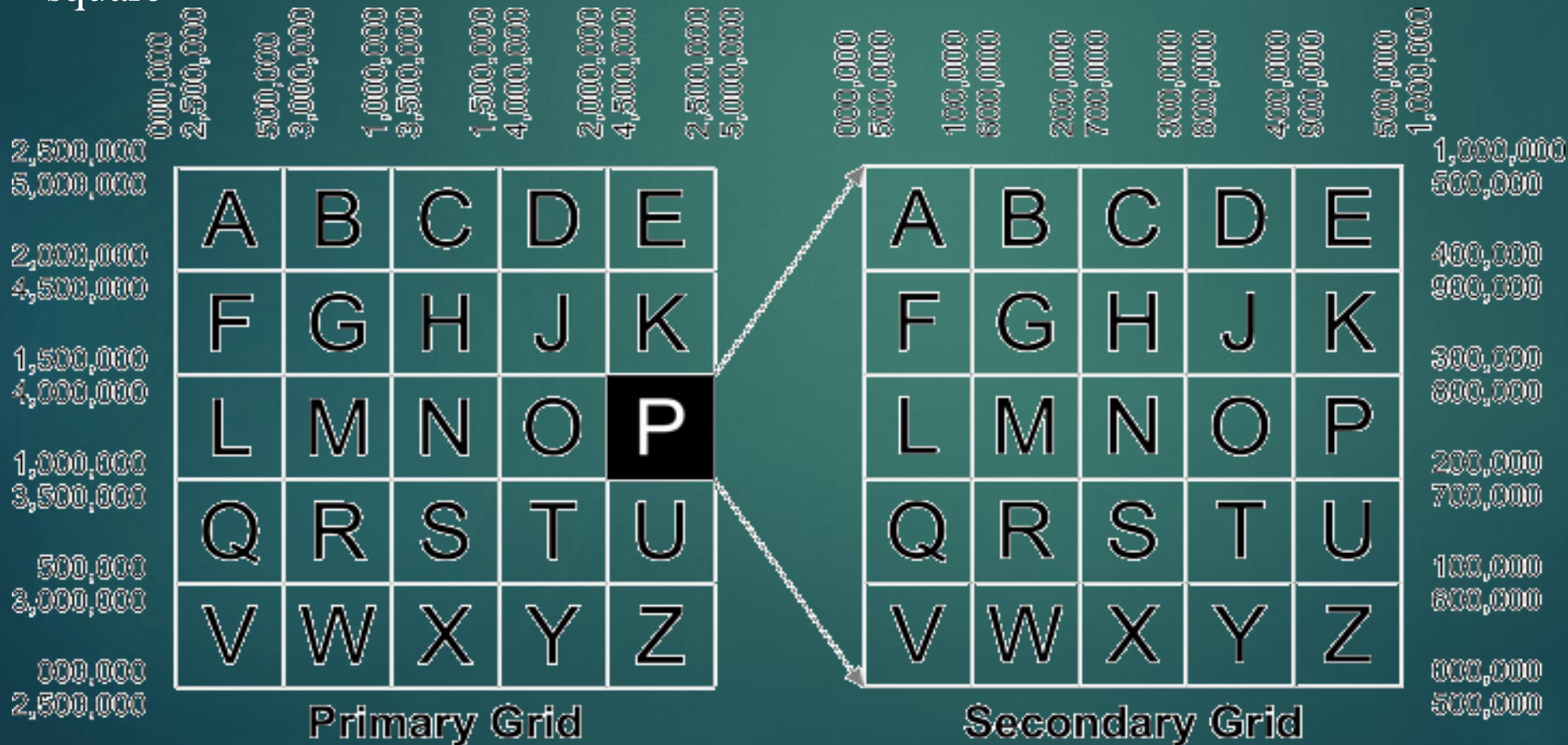
- a. Semi-Major axis/Equatorial Radius - 6,377,301.243m.
- b. Inverse flattening (1/f) - 300.8017.
- c. Semi-Minor axis/Polar Radius - 6,356,100.228m (calculated from 1/f).

b. Datum Transformation Parameters to WGS 1984

- a. Delta X - 295m.
- b. Delta Y - 736m.
- c. Delta Z - 257m.

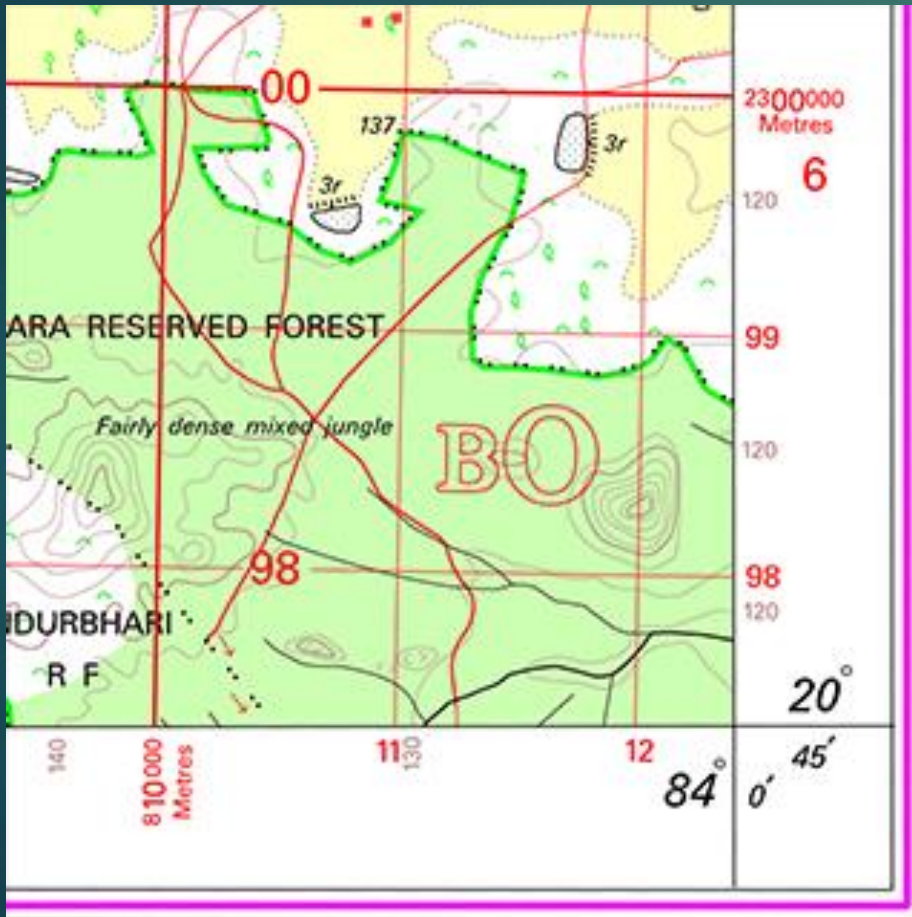
Grid Letters

- To reduce the number of figures needed to express a Indian Grid reference, a system of Grid Letters is also used. Each Zone is divided into primary squares of 500,000 units (metres). Each of these 500,000 primary square is further divided into twenty five secondary squares of 100,000 units. For both of these the squares are lettered increasing from west to east and then from top to down. The letter I is omitted. Thus two letters can denote a specific 100,000 unit square

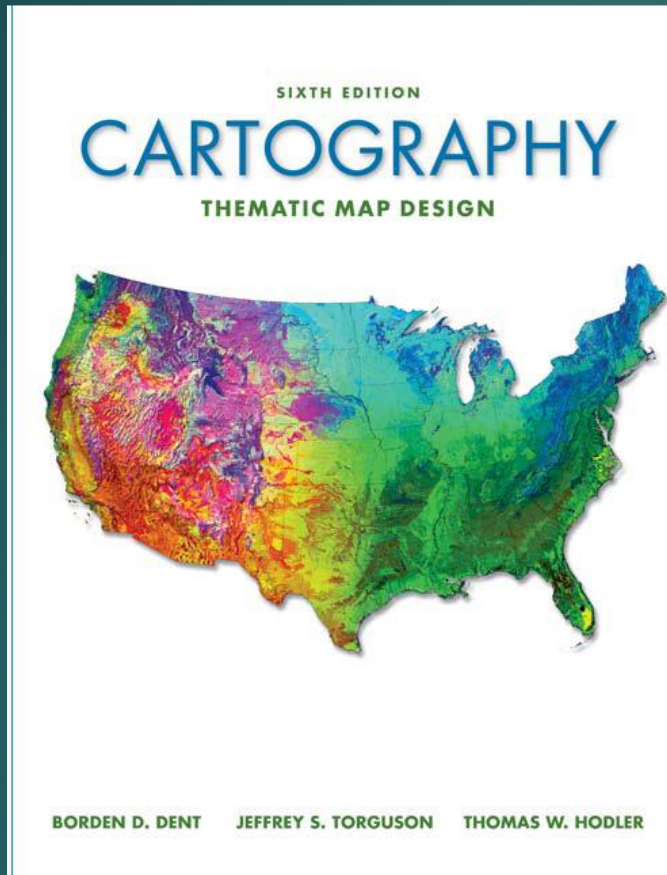


- Difference:**
- I. 2,500,000
 - II. 500,000

- ▶ The second letter of the Grid Letters is printed bigger than the letter of the primary grid square on maps. All the four corners have the relevant Grid Letters marked. Also, every tenth line is made thick and the full grid value is written on the map margin.



Grid Letters marked in corner and full grid values on margin of a sample 1:50,000 map



- ▶ **Source: Cartographic Map Design, Borden D. Dent, Jeffrey S. Torguson, Thomas W. Hodler, pp.23-32**