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South African co-ordinate systems

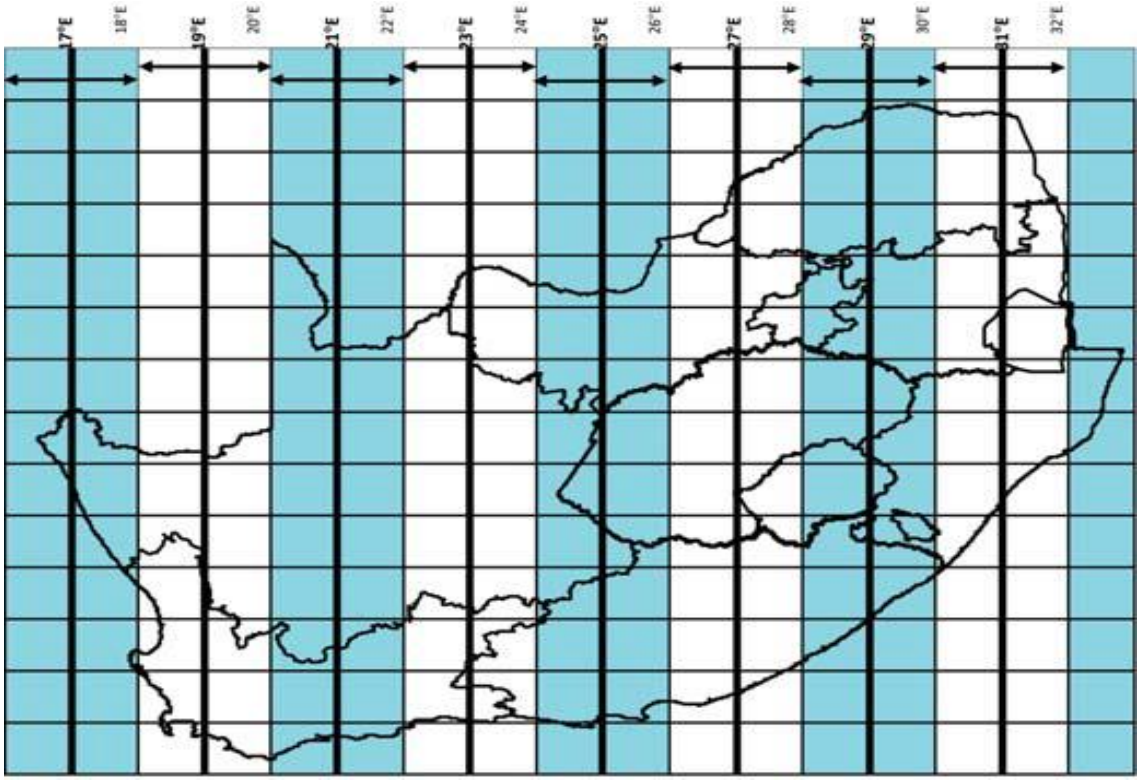
Introduction

The Hartebeesthoek 1994 Datum is the official geodetic datum for SA. This datum was implemented in 1999 when it replaced the Cape Datum which was referenced to the Modified Clarke 1880 ellipsoid and had its origin point at Buffelsfontein, near Port Elizabeth. The Hartebeesthoek 1994 is based on the World Geodetic System 1984 ellipsoid, known as WGS84, with the International Terrestrial Reference Frame 1991 (ITRF91 (epoch 1994.0)) coordinates of the Hartebeesthoek Radio Astronomy Observatory Telescope used as the origin of the system. At this stage all heights still remain referenced to mean sea level.

The national coordinate system network was extended to eventually cover the entire country and now it has about 29 000 highly visible trigonometrical beacons on mountains, high buildings and water towers, as well as about 20 000 easily accessible town survey marks. Because of computational limitations there are many distortions in the Cape Datum coordinates which have been removed in the computation of Hartebeesthoek94 Datum coordinates using modern positioning techniques such as the Global Positioning System (GPS).

Transverse Mercator Projection

The Transverse Mercator projection, in its various forms, is the most widely used projected coordinate system for world topographical and offshore mapping. All versions (e.g. Gauss Conform, Gauss Kruger, and Universal Transverse Mercator) have the same basic characteristics and formulas. The differences which distinguish the different forms of the projection, and which are applied in different countries arise from variations in the choice of the coordinate transformation parameters, namely the latitude of the origin, the longitude of the origin (central meridian which embody the units of measurement given to the origin).



Gauss Conform zones

The South African National Coordinate system

2° longitude wide zones (belts) are centred on every odd meridian, i.e. (17°E, 19°E … 31°E). The origin of each zone is the intersection of each uneven degree of longitude and the equator. These coordinate zones were referred to as Lo17, Lo19 … Lo31 (Cape Datum) until 1999 when the national system changed from one based on the Clarke 1880 modified ellipsoid to the more internationally recognised WGS84 ellipsoid. The coordinate zones are now referred to as Wg17, Wg19 … Wg31 (Haartebeeshoek 1994 datum).

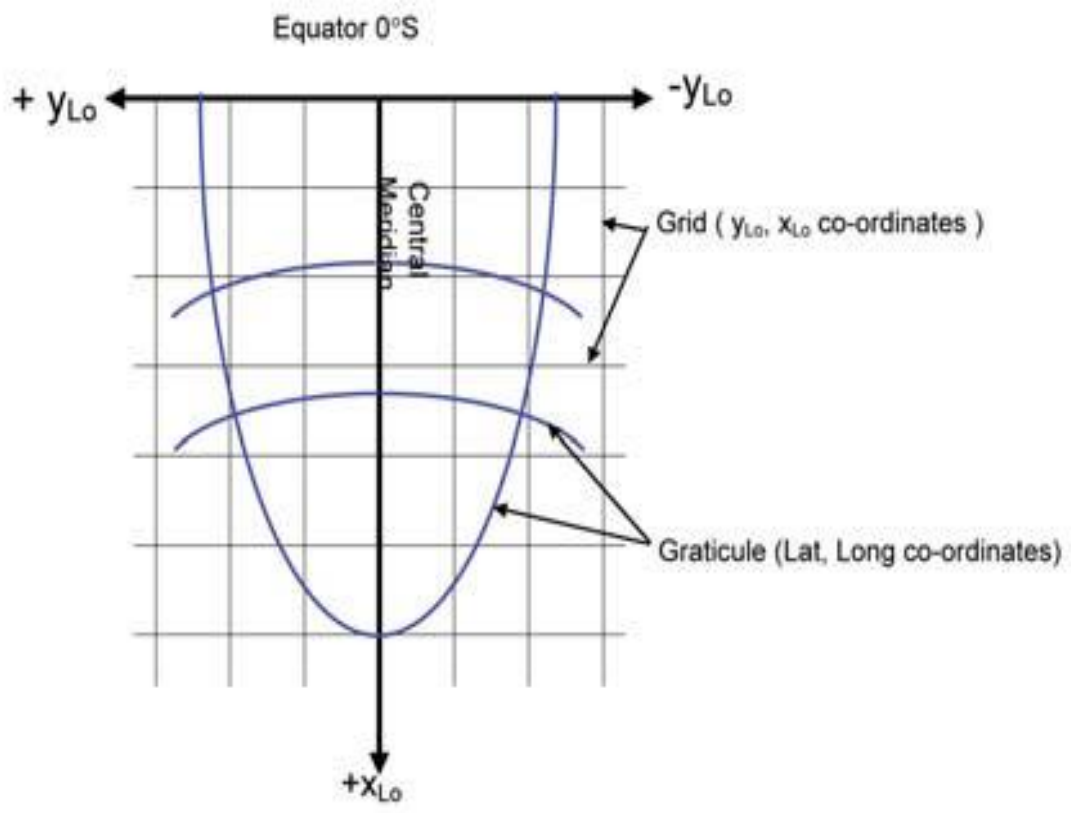
The equator 0° is the latitude of reference or origin of the Gauss Conform Coordinate System.

x (Southings)

- Coordinates are measured southwards from the equator
- Increases from the equator (where x = 0 m) towards the south pole
- Similar to the "northing" coordinates but sign in opposite.

y (Westings)

- Coordinates are measured from the central meridian (CM) of the respective zone.
- Increases from the CM (where y = 0) in a westerly direction.
- "y" is +ve west of the CM and –ve east of the central meridian.



Gauss conform coordinate conventions

The effect on South African National System coordinates when used in International Software

International software such as the ESRI products (ArcGIS) and AutoDesk products (AutoCad) coordinate values in Universal Transverse Mercator are referred to as Eastings and Northings (X's & Y's). South African National Coordinates are referred to as Y's and X's. If our South African values are simply entered without correction, then the software will interpret our Y's as Northings and our X's as Eastings. In order to view South African National Coordinate System values in their correct relative positions, it is necessary to enter their values as follows:
X value (UTM) = Y value (SA) x(–1)
Y value (UTM) = X value (SA) x(–1)

Conclusion

When undertaking survey work it needs to be connected to the National Survey Control and this is a requirement in cadastral surveys. There are two methods for a point/data to be referenced to Hartebeesthoek94 datum:

- *Direct connection:* the position/s must be determined relative to any point in the national control survey network (horizontal), such as the 29 000 trigonometrical beacons and 20 000 town survey marks. This would constitute direct connection.
- *Indirect connection:* can be achieved by determining positions relative to points that have already been directly connected.

References

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