3.2 Map Projection

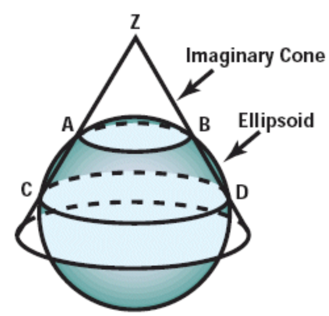
A. What is a Map Projection

A map projection is the means by which a map is produced. It is a transformation between the curved reference surface of the earth and the flat plane of the map.

Each projection has a set of equations, which allow one to transform a set of Geographic Coordinates (latitude and longitude) representing positions on the reference surface of the earth (an ellipsoid) to a set of Cartesian Coordinates (x and y) representing positions on the flat two-dimensional surface of the map. Scale is not constant throughout the map, thus the various scales of the map projection need to be understood and known.

The projections in common use fall into one of three categories: conic, cylindrical (regular or transverse) or azimuthal. The State Plane Coordinate Systems in the USA are based on either the Transverse Mercator Projection - a conformal cylindrical projection, or on the Lambert Conformal Conic Projection - a conformal conic projection. **The California State Plane Coordinate System uses the "Lambert Conformal Conic Projection"**.

B. The Lambert Conformal Conic Projection



Lambert Conformal Conic Projection

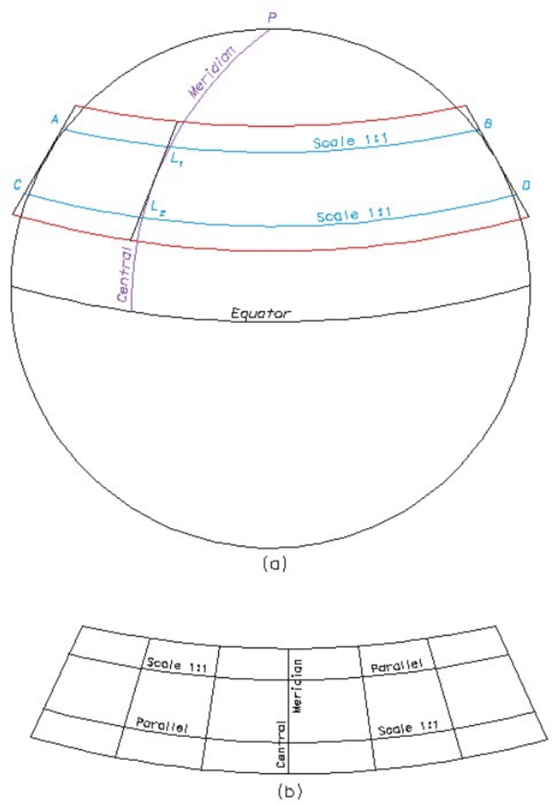
The "Lambert Conformal Conic Projection" projects shapes from the earth's surface onto a cone. It corrects for the distortions that occur in both distance and direction. The projection cone enters the earth at a standard parallel (AB) and emerges at a different standard parallel (CD). These parallels are known as standard parallels of the projection. Direction is the same at any point on the map, and the distance scale at a particular point is the same in all directions. At the standard parallels of the projection, the distance scale for the whole map is 1.000. In other words, along these two parallels the distances on the projection are the same as the distance on the sea-level surface. The area/plane of the cone between the standard parallels has a distance scale for the whole map less than 1.00, which means that between the two parallels a distance on the projection is smaller than the corresponding distance on the sea-level surface. The area/plane outside of the standard parallels has a distance scale for the whole map greater than 1.00. This means that outside of the parallels a distance on the projection is greater than the corresponding distance on the sea-level surface.

The discrepancy between these corresponding distances depends on the position of the line being considered with respect to the two standard parallels. It is seen that the scale of a line running in a north-south direction varies from point to point. It is also seen, however, that a due east-west line (a parallel of latitude) has a constant scale through its length, whether this scale be larger than, equal to, or less than that on the corresponding sea-level line.

To apply the Lambert conformal conic projection to a state or a zone, the width of the projection in a north-south direction is limited to 158 miles (or 254 km), and the standard parallels are separated by about two-thirds this distance. At no point within these limits will the discrepancy between a sea-level distance and the grid distance be greater than 1 part in 10,000.

Diagram (a) below shows the sea-level surface of the earth or the spheroid intersected by the cone along two parallels of latitude AL_1B and CL_2D.

Diagram (b) below shows a portion of the conical surface developed into a plane surface on which the meridians and parallels of the earth's surface have been projected mathematically.



Lambert Conformal Projection

Reference: "Surveying -Ninth Edition" - written by Francis H. Moffitt and Harry Bouchard