## 2. PROJECTION SYSTEMS - *A) CLASSIFICATION OF MAP PROJECTIONS*

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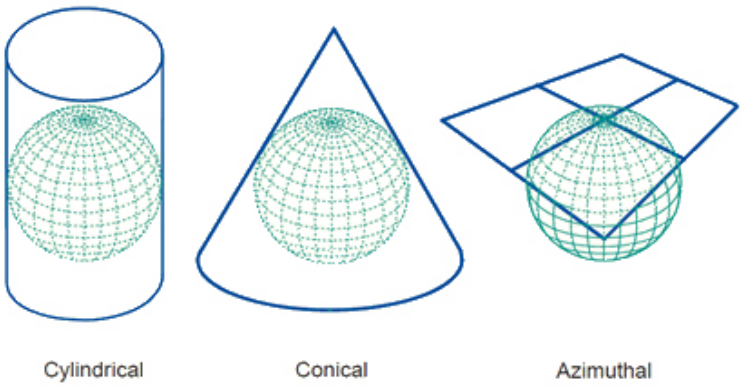
Map projections can be described in terms of their:

1. ***class*** (cylindrical, conical or azimuthal),
2. point of ***secancy*** (tangent or secant),
3. ***aspect*** (normal, transverse or oblique), and
4. distortion ***property*** (equivalent or equidistant or conformal or another property, or no propery).

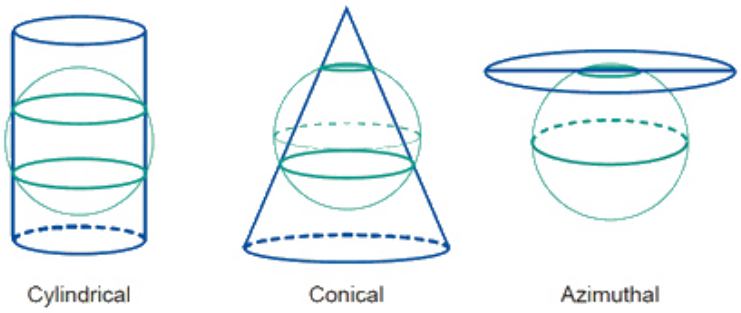
Ad 1) The three classes of map projections: cylindrical, conical and azimuthal. The projection planes are respectively a cylinder, cone and plane.




Source: Geometric aspects of mapping, ITC

The Earth's reference surface projected on a map wrapped around the globe as a cylinder produces a cylindrical map projection. Projected on a map formed into a cone gives a conical map projection. When projected directly onto the mapping plane it produces an azimuthal (or zenithal or planar) map projection. The figure above shows the surfaces involved in these three classes of projections.

Ad 2) In the figure above the surfaces are all tangent surfaces; they ***touch*** the horizontal reference surface in one point (plane) or along a closed line (cone and cylinder) only. But it is also possible that the surfaces ***intersect*** with (secant to) the horizontal reference surface (see image below). Then, the reference surface is intersected along one closed line (plane) or two closed lines (cone and cylinder). Secant map surfaces are used to reduce or average scale errors because the line(s) of intersection are not distorted on the map.




Source: Geometric aspects of mapping, ITC

Ad 3) The three possible apects are ***normal***, ***transverse*** and ***oblique***. In a normal projection, the main orientation of the projection surface is parallel to the Earth's axis (as in the figures above for the cylinder and the cone). A transverse projection has its main orientation perpendicular to the Earth's axis. Oblique projections are all other, non-parallel and non-perpendicular, cases.

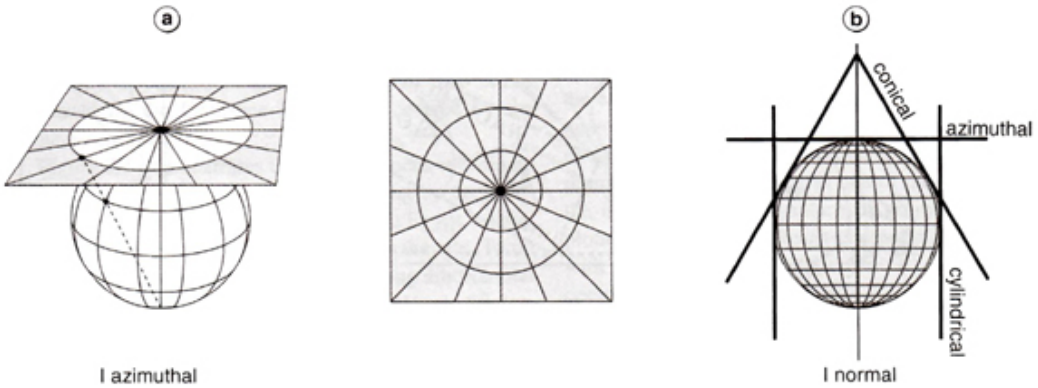
Transverse cylindrical

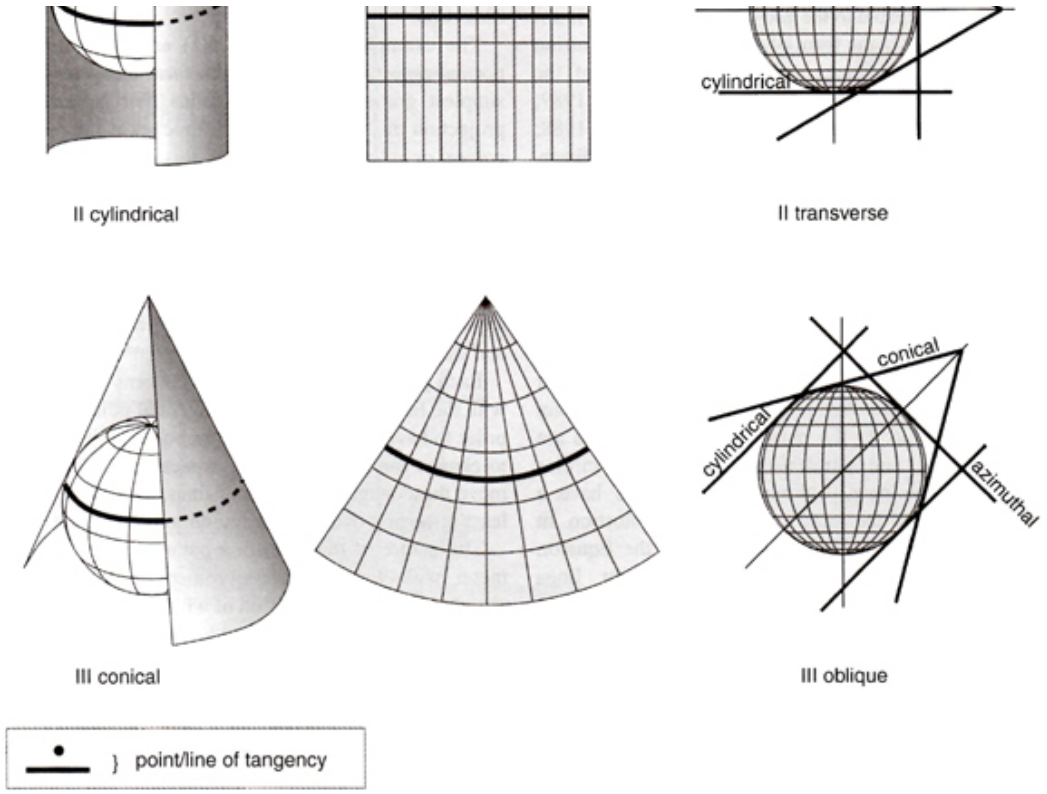


Oblique conical

Source: Geometric aspects of mapping, ITC

Image below from Kraak and Ormeling (2003/2010) summarizes it all.






Click here (or on image) for enlargement.

Ad 4) The distortion properties of a map are typically classified according to what is not distorted on the map:

- In a ***conformal*** (***orthomorphic***) map projection the angles between lines in the map are indentical to the angles between the original lines on the curved reference surface. This means that angles (with short sides) and shapes (of small areas) are shown correctly on the map.
- In an ***equal-area*** (***equivalent***) map projection the areas in the map are identical to the areas on the curved reference surface (taking into account the map scale), which means that areas are represented correctly on the map.
- In an ***equidistant*** map projection the length of particular lines in the map are the same as the length of the original lines on the curved reference surface (taking into account the map scale).

A particular map projection may have any one of these three properties. No map projection can be both conformal and equal-area. A projection can only be equidistant (true to scale) at certain places or in certain directions. Other properties are for instance that great circles are always drawn as straight lines (in the conformal projection). Other projections present images that try to present an average between conformity and equal area.

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