ii. $d = \frac{\pi \times 5.77}{180} \times 10 \Rightarrow 1.097$ cm

iii. $r_\phi = 5.77 \cot\phi$ cm (Table 2.13)

iv. $d_\phi = \frac{2\pi \times 5.77 \cos\phi}{360^\circ} \times 10^\circ$

$= 1.00705 \cos\phi$ cm (Table 2.14)

Cylindrical Equal-Area Projection

Principle

Lambert developed this projection in which a simple right circular cylinder touches the globe along the equator. Parallels and meridians are both projected as straight lines intersecting one another at right angles (Fig. 2.35). Tangential scale along all the parallels is kept equal to that along the equator. To maintain true area, radial scale along a meridian is made reciprocal to the tangential scale at that point. Hence, parallels lie at different heights above the equator. The interparallel spacing decreases rapidly towards the poles as parallels are all of same length as the equator.

In Fig. 2.33, let the cylinder ABCD touch the globe along the equator.

The parallel PQ is projected as straight line at PM distance away from WE.

$P_1Q_1 \parallel WE$ and $\angle POM = \phi$

Length of parallel (ϕ) on globe $= 2\pi R \cos\phi$.

Length of parallel (ϕ) on projection $= 2\pi R$.

$\therefore$ tangential scale $= \frac{2\pi R}{2\pi R \cos\phi}$

$= \sec\phi$ ... (i)

Let S be another parallel at $d\phi$ angle away from P(ϕ)

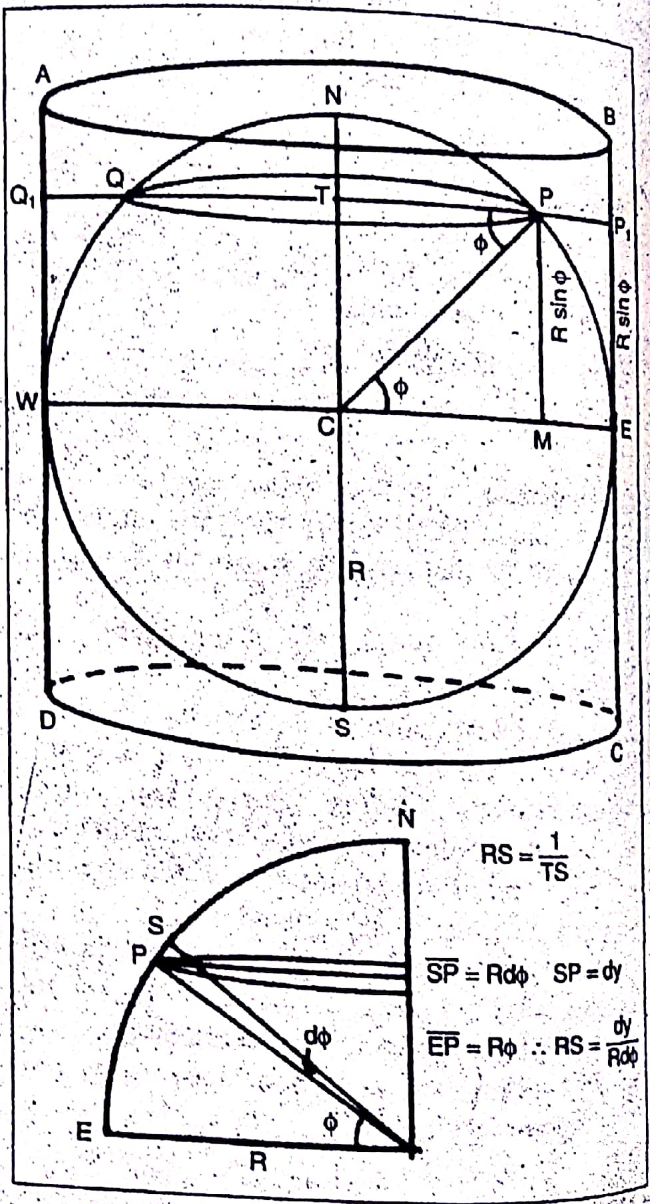


Fig. 2.35 Principles of Cylindrical Equal-Area Projection

$\therefore$ the true angular distance of $d\phi$ on globe $= R.d\phi$

Let dy be the corresponding linear distance of $d\phi$ from the equator on projection.

$\therefore$ radial scale $= \dfrac{dy}{R.d\phi}$ ... (ii)

Since it is an equal area projection,
radial scale × tangential scale = 1

or, $\dfrac{dy}{R.d\phi}.\sec\phi = 1$

or, $dy = R\cos\phi.d\phi$

By integration,

$$\int dy = R\int \cos\phi.d\phi$$

$$\therefore \quad y = R\sin\phi$$

Theory

i. Radius of the generating globe, R = Actual radius of the earth ÷ Denominator of R.F.
ii. Division along the equator for spacing the meridians at i° interval,

$$d = \frac{2\pi R}{360°} \times i°$$

iii. Height of any parallel above equator,

$$y_\phi = R\sin\phi$$

Construction

i. A straight line is drawn horizontally through the centre of the paper to represent the equator.
ii. It is then divided by d for spacing the meridians.
iii. Through each of these division points, straight lines are drawn perpendicular to the equator to represent the meridians.
iv. On the central meridian, heights of different parallels (y_ϕ) from the equator are marked.
v. Through each of these points, straight lines are drawn perpendicular to the central meridian to represent the parallels.
vi. The graticules are then properly labelled (Fig. 2.36).

Properties

i. Parallels are represented by a set of parallel straight lines.
ii. Parallels are of same the length as the equator (2πR).
iii. Parallels are variably spaced on the meridians.
iv. Interparallel spacing decreases rapidly toward the pole.
v. The tangential scale rapidly increases poleward and is infinity at the poles.
vi. Meridians are parallel straight lines truly spaced on the equator.
vii. Meridians are of same length equal to the diameter of the globe (2R).
viii. The intermeridian spacing is uniform on all the parallels.
ix. The pole is represented by a straight line of length 2πR.

(17)

Table 2.15 Computation of y_ϕ

ϕ	30° N/S	60° N/S	90° N/S
$y_\phi = 2.15 \sin\phi$ (cm)	1.075	1.862	2.150

x. At any point, the product of the two principal scales is unity.

xi. It is an equal-area projection.

xii. The shape is largely distorted near the poles.

Example

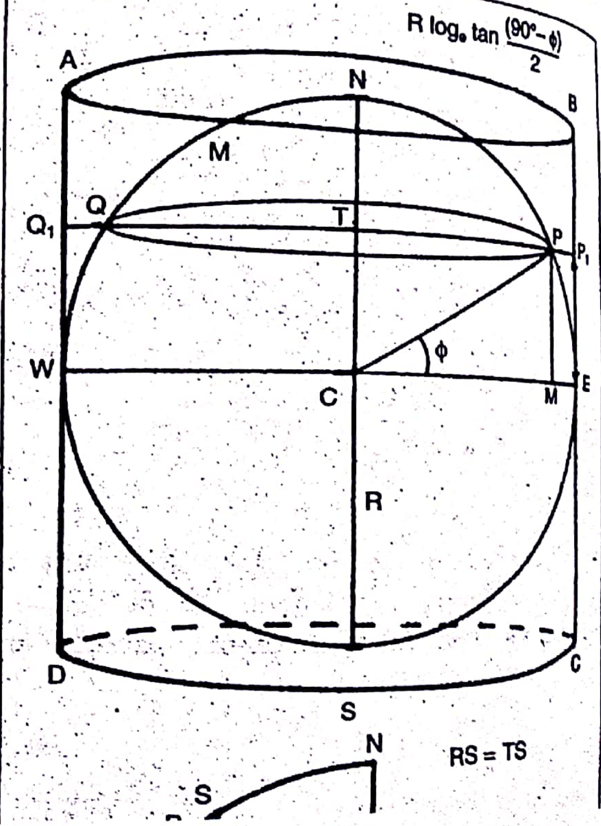
Draw graticules at 30° interval on scale, 1:297 × 10⁶ for the whole globe.

Calculation

i. $R = \dfrac{640 \times 10^6 \text{ cm}}{297 \times 10^6} \Rightarrow 2.15 \text{ cm}$

ii. $d = \dfrac{2\pi \times 2.15}{360°} \times 30° \Rightarrow 1.128 \text{ cm}$

iii. $y_\phi = 2.15 \sin\phi$ cm (Table 2.15).



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