PERMANENT WAY MATHEMATICS (1)

THESE NOTES ARE INTENDED FOR THE GUIDANCE AND ASSISTANCE OF STAFF ENGAGED UPON PERMANENT WAY WOR[K] THEY DO NOT IN ANY WAY MODIFY, SUPPLEMENT OR AMEND THE INSTRUCTIONS LAID DOWN IN E.D.I.', STANDAR[D] DRAWINGS, CIRCULARS ETC., WHICH SHOULD BE REFERRED TO IN ALL CASES.

VALUES OF ANGLES IN 'N' RATIOS.

WHEN ANGLE N IS θ.

$$N = \tfrac{1}{2}\operatorname{Cot}\frac{\theta}{2}. \qquad \theta = 2\operatorname{Cot}^{-1}2N.$$

IN RADIANS. WHEN $N \leqslant \tfrac{1}{2}$

$$\theta_N = \pi - 4N\left[1 - \frac{(2N)^2}{3} + \frac{(2N)^4}{5} - \frac{(2N)^6}{7} + \cdots\cdots\right]$$

WHEN $N \geqslant \tfrac{1}{2}$

$$\theta_N = \tfrac{1}{N}\left[1 - \tfrac{1}{3}\left(\frac{1}{2N}\right)^2 + \tfrac{1}{5}\left(\frac{1}{2N}\right)^4 - \tfrac{1}{7}\left(\frac{1}{2N}\right)^6 + \cdots\cdots\right]$$

IN 'N' RATIOS.

$$N = \frac{1}{\theta} - \frac{\theta}{12} - \frac{\theta^3}{720} - \frac{\theta^5}{30240} - \frac{\theta^7}{1209600}\cdots$$

TRIGONOMETRIC RATIOS.

$$\operatorname{Sin} N = \frac{N}{N^2 + \tfrac{1}{4}} \qquad \operatorname{Sin}\frac{N}{2} = \frac{1}{2\sqrt{N^2 + \tfrac{1}{4}}} \qquad N_A = \frac{1 \pm \sqrt{1 - \operatorname{Sin}^2 A}}{2\operatorname{Sin} A} \quad (\text{GEN } +)$$

$$\operatorname{Cos} N = \frac{N^2 - \tfrac{1}{4}}{N^2 + \tfrac{1}{4}} \qquad \operatorname{Cos}\frac{N}{2} = \frac{N}{\sqrt{N^2 + \tfrac{1}{4}}} \qquad N_A = \tfrac{1}{2}\sqrt{\frac{1 + \operatorname{Cos} A}{1 - \operatorname{Cos} A}}$$

$$\operatorname{Tan} N = \frac{N}{N^2 - \tfrac{1}{4}} \qquad \operatorname{Tan}\frac{N}{2} = \frac{1}{2N} \qquad N_A = \frac{1 \pm \sqrt{1 + \operatorname{Tan}^2 A}}{2\operatorname{Tan} A} \quad (\text{GEN } +)$$

ADDITION AND SUBTRACTION OF 'N' RATIOS.

Sum Angle N + Angle M $= \dfrac{NM - \tfrac{1}{4}}{N + M}$

Difference Angle N − Angle M $= \dfrac{NM + \tfrac{1}{4}}{M - N}$

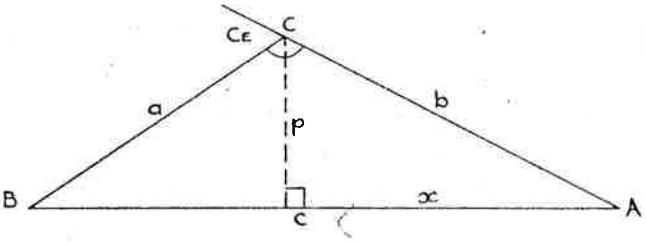
180° − Angle N $= \dfrac{1}{4N}$

90° − Angle N $= \tfrac{1}{2}\left(\dfrac{2N + 1}{2N - 1}\right)$

Twice Angle N $= \dfrac{N^2 - \tfrac{1}{4}}{2N}$

Half Angle N $= N \pm \sqrt{N^2 + \tfrac{1}{4}}$ (GEN +)

SOLUTION OF TRIANGLES



SINE FORMULA.

$$\frac{a}{\operatorname{Sin} A} = \frac{b}{\operatorname{Sin} B} = \frac{c}{\operatorname{Sin} C} \qquad a = \frac{c N_A (N_B^2 + \tfrac{1}{4})}{N_A (N_B^2 - \tfrac{1}{4}) + N_B (N_A^2 - \tfrac{1}{4})}$$

COSINE FORMULA.

$$c = \sqrt{(a - b)^2 + \frac{ab}{N_C^2 + \tfrac{1}{4}}}$$

$$N_C = \sqrt{\frac{s(s - c)}{4(s - b)(s - a)}} \qquad N_{CE} = \sqrt{\frac{(s - b)(s - a)}{4s(s - c)}}$$

$$N_C = \sqrt{\frac{s(s - c)}{4[ab - s(s - c)]}} \qquad N_{CE} = \sqrt{\frac{ab - s(s - c)}{4s(s - c)}}$$

$$N_C = \tfrac{1}{2}\sqrt{\frac{ab}{(s - a)(s - b)}} - 1 \qquad N_{CE} = \tfrac{1}{2}\sqrt{\frac{(s - a)(s - b)}{ab - (s - a)(s - b)}}$$

When $a = b$

$$N_C = \frac{\sqrt{a^2 - \left(\tfrac{c}{2}\right)^2}}{c} \qquad N_B = \sqrt{\frac{a + \tfrac{c}{2}}{4\left(a - \tfrac{c}{2}\right)}}$$

$$p = \frac{2}{c}\sqrt{s(s - a)(s - b)(s - c)} \qquad N_A = \frac{b + x}{2p} \qquad \operatorname{Tan} A = \frac{a \operatorname{Sin} C}{b - a \operatorname{Cos} C}$$

Where S is equal to the semi-perimeter of the triangle.