

Sidemeasurement relation of two right angled triangle in trigonometric form (Relation All Mathematics)

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Abstract : In this research paper, explained trigonometric sidemeasurement relation of two right angled triangle when Area of both right angled triangle are equal. And that explanation given between base ,height ,hypogenous and Area of right angled triangles with the help of formula.here be remember that, Area of both right angled triangle are same.

Keywords: Sidemeasurement, Relation, Right angled triangle, Sidemeasurement, Trigonometry,

I. INTRODUCTION

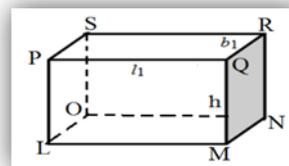
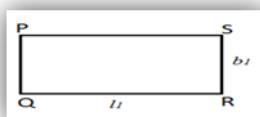
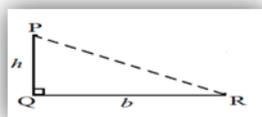
Relation All Mathematics is a new field and the various relations shown in this research“Sidemeasurement relation of two right angled triangle in trigonometric form” is the one of the important research paper in the Relation All Mathematics and in future, any research related to this concept, that must be part of “ Relation Mathematics ” subject. Here, we have studied and shown new variables, letters, concepts, relations, and theorems. Inside the research paper, new concept of Trigonometry about right angled triangle is explained.We have explained a new concept i.e. Sidemeasurement, which is very important related to ‘Relation Mathematics’ subject.Here the relation between base ,height ,hypotenuse ,angle and Sidemeasurement in two right angled triangle is explained in the form of trigonometry with the help of formula when the side-measurement of both the right angled triangles is same. here be remember that Area of both right angled triangle are same.

In this “Relation All Mathematics” we have shown quadratic equation of rectangle. This “Relation All Mathematics” research work is near by 300 pages. This research is prepared considering the Agricultural sector mainly, but I am sure that it will also be helpful in other sector.

II. BASIC CONCEPT

2.1. Sidemeasurement (B) :-If sides of any geometrical figure are in right angle with each other , then those sides or considering one of the parallel and equal sides after adding them, the addition is the sidemeasurement .sidemeasurement indicated with letter ‘B’

Sidemeasurement is a one of the most important concept and maximum base of the Relation All Mathematics depend



apoun this concept.

Figure I : Concept of sidemeasurement relation

I) Area of right angled triangle - B (ΔPQR) = $b + h$

In ΔPQR , sides PQ and QR are right angle, performed to each other.

II) Area of rectangle-B($\square PQRS$) = $l_1 + b_1$

In $\square PQRS$, opposite sides PQ and RS are similar to each other and $m\angle Q = 90^\circ$. here side PQ and QR are right angle performed to each other.

III) Area of cuboid- $E_B(\square PQRS) = l_1 + b_1 + h_1$

In $E(\square PQRS)$, opposite sides are parallel to each other and QM are right angle performed to each other. Area of cuboid written as = $E_B(\square PQRS)$

2.2) Important points of square-rectangle relation :-

I) For explanation of square and rectangle relation following variables are used

- i) Sidemeasurement - A
- ii) Perimeter - P
- iii) Side measurement - B

II) For explanation of two right angled triangle relation, following letters are used

- In isosceles right angled triangle $\Delta ABC [45^\circ - 45^\circ - 90^\circ]$, side is assumed as 'l' and hypotenuse as 'X'
- In scalene right angled triangle $\Delta PQR [\theta_1 - \theta_1' - 90^\circ]$ it's base 'b₁' height 'h₁' and hypotenuse assumed as 'Y'
- In scalene right angled triangle $\Delta LMN [\theta_2 - \theta_2' - 90^\circ]$ it's base 'b₂' height 'h₂' and hypotenuse assumed as 'Z'

- i) Area of isosceles right angled triangle ABC - A (ΔABC)
- ii) Side-measurement of isosceles right angled triangle ABC - B (ΔABC)
- iii) Area of scalene right angled triangle PQR - A (ΔPQR)
- vi) Area of scalene right angled triangle PQR - B (ΔPQR)

2.3) Important Reference theorem of previous paper which used in this paper:-

Theorem : Basic theorem of Sidemeasurement relation of isosceles right angled triangle and scalene right angled triangle.

The Area of isosceles right angled triangle and scalene right angled triangle is same then Area of isosceles right angled triangle is more than Area of scalene right angled triangle, at that time Area of isosceles right angled triangle is equal to sum of the, Area of scalene right angled triangle and Relation Sidemeasurement formula of isosceles right angled triangle - scalene right angled triangle('K').

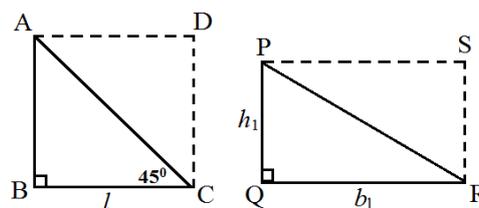


Figure II : Sidemeasurement relation of isosceles right angled triangle and scalene right angled triangle

Proof formula :- $A(\Delta ABC) = A(\Delta PQR) + \frac{1}{2} \left[\frac{(b_1 + h_1)}{2} - h_1 \right]^2$

[Note :- The proof of this formula given in previous paper and that available in reference]

Theorem : Basic theorem of sidemeasurement relation of isosceles right angled triangle and scalene right angled triangle.

Area of isosceles right angled triangle and scalene right angled triangle is same then Area of scalene right angled triangle is more than Area of isosceles right angled triangle, at that time Area of scalene right angled triangle is equal to product of the, Area of isosceles right angled triangle and Relation sidemeasurement formula of isosceles right angled triangle-scalene right angled triangle('V').

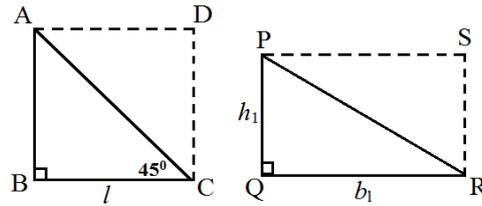


Figure III : Sidemeasurement relation of isosceles right angled triangle-scalene right angled triangle

Proof formula :- $B(\Delta PQR) = B(\Delta ABC) \times \frac{1}{2} \left[\frac{(n^2+1)}{n} \right]$

[Note :- The proof of this formula given in previous paper and that available in reference]

III. TRIGONOMETRIC SIDEMEASUREMENT RELATION IN TWO RIGHT ANGLED TRIANGLE

Relation –I: Proof of hypotenuse –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle .

Given :- In ΔABC , $m\angle A=45^\circ$, $m\angle B=90^\circ$ and $m\angle C=45^\circ$

In ΔPQR , $m\angle P= \theta_1$, $m\angle Q=90^\circ$ and $m\angle R= \theta'_1$

$b_1 = Y \cos \theta_1$, $h_1 = Y \sin \theta_1$ & $l^2 / 2 = X^2 / 4$

here , $A(\Delta ABC) = A(\Delta PQR)$

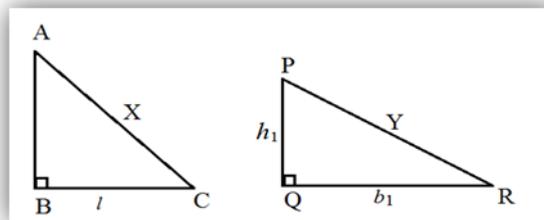


Figure IV: Trigonometric hypotenuse –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle

To prove :- $X^2 = Y^2 (\sin 2\theta_1)$

Proof :- In ΔABC and ΔPQR ,
 $B(\Delta PQR) = \frac{1}{2} B(\Delta ABC) \times \left[\frac{(n^2+1)}{n} \right]$

...(Basic theorem of Sidemeasurement relation of isosceles right angled triangle and scalene right angled triangle)

$$(b_1+h_1) = \frac{1}{2} \cdot (2l) \times \frac{b_1^2-l^2}{lb_1}$$

$$(b_1+h_1) = \frac{b_1^2-l^2}{b_1}$$

$$(Y \cos \theta_1 \cdot Y \sin \theta_1) = \frac{Y \cos^2 \theta_1 + X \sin \theta_1}{Y \cos \theta_1}$$

$$Y^2 (\cos \theta_1^2 + \sin \theta_1 \cdot \cos \theta_1) = y^2 \cos^2 \theta_1 + \frac{x^2}{2}$$

$$Y^2 (\cos \theta_1^2 + \sin \theta_1 \cdot \cos \theta_1 - \cos^2 \theta_1) = \frac{x^2}{2}$$

$$X^2 = Y^2 \cdot 2 \sin \theta_1 \cdot \cos \theta_1$$

$$X^2 = Y^2 (\sin 2\theta_1) \quad \dots [\sin 2\theta = 2 \sin \theta_1 \cdot \cos \theta_1 \quad , \quad \sin 2\theta \leq 1]$$

Hence , we have Prove that , Proof of hypotenuse –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle.

This formula clear that , when given the sidemeasurement and angle of any right angled triangle then we can be find hypogenous of the right angled triangle .

Relation –II: Proof of hypotenuse –Sidemeasurement relation in two scalene right angled triangles

Given :- In ΔABC , $m\angle A=45^\circ$, $\angle B=90^\circ$ and $m\angle C=45^\circ$

In ΔPQR , $m\angle P= \theta_1$, $\angle Q=90^\circ$ and $m\angle R= \theta'_1$

In ΔLMN , $m\angle L= \theta_2$, $\angle M=90^\circ$ and $m\angle N= \theta'_2$

here , $A(\Delta ABC) = A(\Delta PQR) = A(\Delta LMN)$

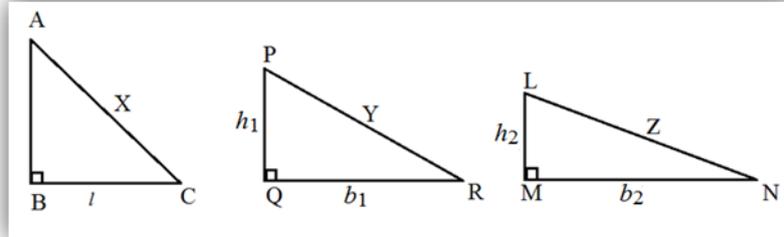


Figure V : Trigonometric hypotenuse –Sidemeasurement relation in two scalene right angled triangle

To prove :- $Y^2 = Z^2 \frac{(\sin 2\theta_2)}{(\sin 2\theta_1)}$

Proof :- In ΔABC and ΔPQR ,
 $X^2 = Y^2 (\sin 2\theta_1)$

...(Proof of hypotenuse –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

In ΔABC and ΔLMN ,
 $X^2 = Z^2 (\sin 2\theta_2)$... (ii)

... (Proof of hypotenuse –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$Y^2 (\sin 2\theta_1) = Z^2 (\sin 2\theta_2)$... From equation (i) and (ii)

$$Y^2 = Z^2 \frac{(\sin 2\theta_2)}{(\sin 2\theta_1)}$$

Hence , we have Prove that , Proof of hypotenuse –Sidemeasurement relation in two scalene right angled triangles.

This formula clear that ,when given the hypogenous and angle of any right angled triangle then we can be find angle of another right angled triangle when given the hypotenious and vise versa which both right angled triangle are sidemeasurement is equal but not required to known .

Relation –III: Proof of base –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle

Given :- In ΔABC , $m\angle A=45^\circ$, $m\angle B=90^\circ$ and $m\angle C=45^\circ$

In ΔPQR , $m\angle P= \theta_1$, $m\angle Q=90^\circ$ and $m\angle R= \theta'_1$

$b_1 = Y \cos \theta_1$, $h_1 = Y \sin \theta_1$ & $l^2 / 2 = X^2 / 4$

here , $A(\Delta ABC) = A(\Delta PQR)$

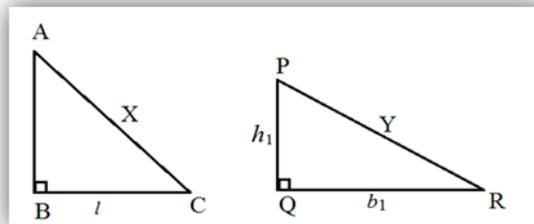


Figure VI : Trigonometric base –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle

To prove :- $l^2 = b_1^2 \tan^2 \theta_1$

Proof :- In ΔABC and ΔPQR ,
 $X^2 = Y^2 (\sin 2\theta_1)$

... (Proof of hypotenuse –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$$\begin{aligned}
 X^2 &= Y^2 (\sin 2\theta_1) \\
 2l^2 &= \frac{b_1^2}{\cos^2 \theta_1} \times \sin 2\theta_1 \quad \dots \text{Given} \\
 l^2 &= \frac{b_1^2 \cdot \sin 2\theta_1}{2 \cdot \cos^2 \theta_1} \\
 l^2 &= \frac{b_1^2 \cdot 2\sin\theta_1 \cdot \cos\theta_1}{2 \cdot \cos^2 \theta_1} \quad \dots \sin 2\theta_1 = 2\sin\theta_1 \cdot \cos\theta_1 \\
 l^2 &= b_1^2 \tan\theta_1
 \end{aligned}$$

Hence, we have Prove that, Proof of base –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle.

This formula clear that, when given the sidemeasurement and angle of any right angled triangle then we can be find base of the right angled triangle.

Relation –IV: Proof of base –Sidemeasurement relation in two scalene right angled triangles

Given :- In ΔABC , $m\angle A=45^\circ$, $m\angle B=90^\circ$ and $m\angle C=45^\circ$

In ΔPQR , $m\angle P= \theta_1$, $m\angle Q=90^\circ$ and $m\angle R= \theta'_1$

In ΔLMN , $m\angle L= \theta_2$, $m\angle M=90^\circ$ and $m\angle N= \theta'_2$

here, $A(\Delta ABC) = A(\Delta PQR) = A(\Delta LMN)$

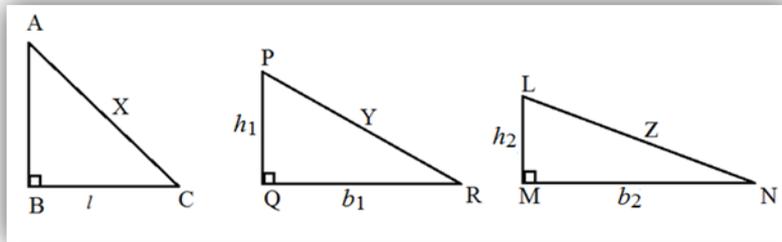


Figure VII : Trigonometric base –Sidemeasurement relation in two scalene right angled triangle

To prove :-
$$b_1^2 = b_2^2 \frac{\tan\theta_2}{\tan\theta_1}$$

Proof :- In ΔABC and ΔPQR ,

$$l^2 = b_1^2 \tan\theta_1 \quad \dots(i)$$

... (Proof of base –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

In ΔABC and ΔLMN ,

$$l^2 = b_2^2 \tan\theta_2 \quad \dots(ii)$$

...(Proof of base –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$$b_1^2 \tan\theta_1 = b_2^2 \tan\theta_2 \quad \dots \text{From equation no (i) and (ii)}$$

$$b_1^2 = b_2^2 \frac{\tan\theta_2}{\tan\theta_1}$$

Hence, we have Prove that, Proof of base –Sidemeasurement relation in two scalene right angled triangles.

This formula clear that, when given the base and angle of any right angled triangle then we can be find angle of another right angled triangle when given the base and vise versa which both right angled triangle are sidemeasurement is equal but not required to known.

Relation –V: Proof of height –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle

Given :- In ΔABC , $m\angle A=45^\circ$, $m\angle B=90^\circ$ and $m\angle C=45^\circ$

In ΔPQR , $m\angle P= \theta_1$, $m\angle Q=90^\circ$ and $m\angle R= \theta'_1$

$$b_1 = Y \cos\theta_1, \quad h_1 = Y \sin\theta_1$$

here, $A(\Delta ABC) = A(\Delta PQR)$

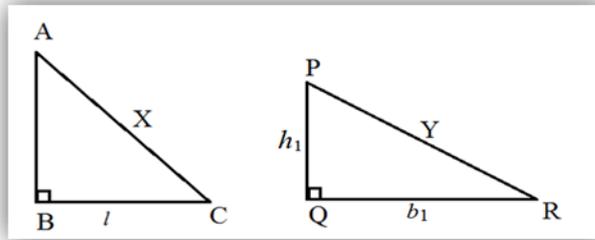


Figure VIII : Trigonometric height –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle

To prove :- $h_1^2 = h^2 \tan\theta_1$

Proof :- In ΔABC and ΔPQR ,
 $\dots X^2 = Y^2 (\sin 2\theta_1) \dots (i)$

...(Proof of hypotenuse –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$$2l^2 = \frac{b_1^2}{\cos^2 \theta_1} \times \sin 2\theta_1 \quad \text{Given}$$

$$2l^2 = \frac{h_1^2 \sin 2\theta_1}{\sin^2 \theta_1} \quad \dots (X = \sqrt{2}l^2, Y = h_1/\sin\theta_1)$$

$$h^2 = \frac{h_1^2 \sin 2\theta_1}{2 \sin^2 \theta_1} \quad \dots l = h$$

$$h^2 = h_1^2 \frac{2 \sin \theta_1 \cdot \cos \theta_1}{2 \sin^2 \theta_1}$$

$$h^2 = h_1^2 \cot \theta_1$$

$$h_1^2 = h^2 \tan \theta_1$$

Hence, we have Prove that, Proof of height –Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle.

This formula clear that ,when given the sidemeasurement and angle of any right angled triangle then we can be find height of the right angled triangle .

Relation –VI: Proof of height –Sidemeasurement relation in two scalene right angled triangles

Given :- In ΔABC , $m\angle A = 45^\circ$, $m\angle B = 90^\circ$ and $m\angle C = 45^\circ$

In ΔPQR , $m\angle P = \theta_1$, $m\angle Q = 90^\circ$ and $m\angle R = \theta'_1$

In ΔLMN , $m\angle L = \theta_2$, $m\angle M = 90^\circ$ and $m\angle N = \theta'_2$

here , $A(\Delta ABC) = A(\Delta PQR)$

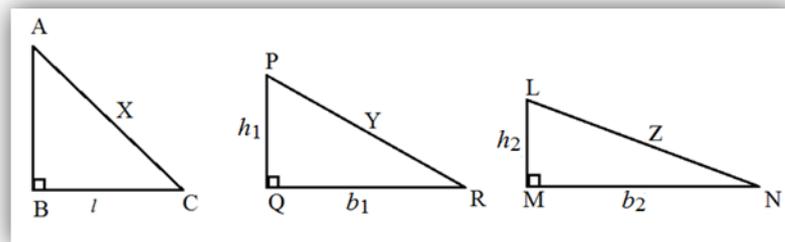


Figure IX : Trigonometric height –Sidemeasurement relation in two scalene right angled triangle

To prove :- $h_1^2 = h_2^2 \frac{\tan \theta_1}{\tan \theta_2}$

Proof :- In ΔABC and ΔPQR ,
 $h^2 = h_1^2 \cot \theta_1 \quad \dots (i)$

...(Proof of height –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

In ΔABC and ΔLMN ,
 $h^2 = h_2^2 \cot \theta_2 \quad \dots (ii)$

...(Proof of height –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$$h_1^2 \cot\theta_1 = h_2^2 \cot\theta_2 \quad \dots \text{From equation no (i) and (ii)}$$

$$h_1^2 = h_2^2 \frac{\cot\theta_2}{\cot\theta_1}$$

$$h_1^2 = h_2^2 \frac{\tan\theta_1}{\tan\theta_2}$$

Hence , we have Prove that , Proof of height –Sidemeasurement relation in two scalene right angled triangles . This formula clear that ,when given the height and angle of any right angled triangle then we can be find angle of another right angled triangle when given the height and vise versa which both right angled triangle are sidemeasurement is equal but not required to known .

Relation –VII: Proof of base –height Sidemeasurement relation in two scalene right angled triangles

Given :-In ΔABC , $m\angle A=45^\circ$, $m\angle B=90^\circ$ and $m\angle C=45^\circ$

In ΔPQR , $m\angle P= \theta_1$, $m\angle Q=90^\circ$ and $m\angle R= \theta'_1$

In ΔLMN , $m\angle L= \theta_2$, $m\angle M=90^\circ$ and $m\angle N= \theta'_2$

here , $A(\Delta ABC) = A(\Delta PQR) = A(\Delta LMN)$

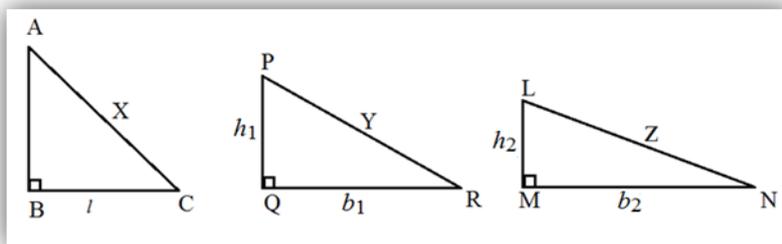


Figure X : Trigonometric base –height Sidemeasurement relation in two scalene right angled triangle

To prove :- $h_2^2 = b_1^2 \tan\theta_1 \times \tan\theta_2$

Proof :- In ΔABC and ΔPQR ,
 $l^2 = b_1^2 \tan\theta_1 \dots (i)$

...(Proof of base –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$$h^2 = h_2^2 \cot\theta_2 \quad \dots (ii)$$

...(Proof of height –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$$b_1^2 \tan\theta_1 = h_2^2 \cot\theta_2 \quad \dots \text{From equation no (i) and (ii)}$$

$$h_2^2 = b_1^2 \frac{\tan\theta_1}{\cot\theta_2}$$

$$h_2^2 = b_1^2 \tan\theta_1 \times \tan\theta_2$$

Hence , we have Prove that , Proof of base –height Sidemeasurement relation in two scalene right angled triangles.

This formula clear that ,when given the base and angle of any right angled triangle then we can be find angle of another right angled triangle when given the height and vise versa which both right angled triangle are sidemeasurement is equal but not required to known .

Relation –VIII: Proof of Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle

Given :-In ΔABC , $m\angle A=45^\circ$, $m\angle B=90^\circ$ and $m\angle C=45^\circ$

In ΔPQR , $m\angle P= \theta_1$, $m\angle Q=90^\circ$ and $m\angle R= \theta'_1$

here , $A(\Delta ABC) = A(\Delta PQR)$

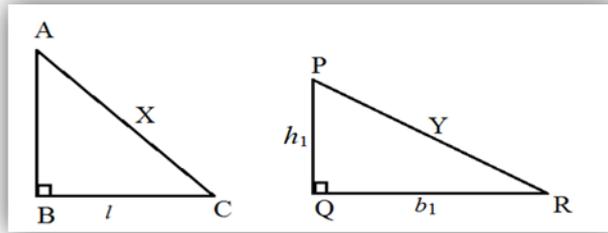


Figure XI : Trigonometric Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle

To prove :- $B(\Delta ABC) = B(\Delta PQR) \sqrt{\tan \theta_1} + l(1 - \tan \theta_1)$

Proof :- In ΔABC and ΔPQR ,
 $l^2 = b_1^2 \tan \theta_1$... (i)

...(Proof of base –Sidemeasurement relation in isosceles right angled triangle and scalene right angled)

$$l = b_1 \sqrt{\tan \theta_1}$$

$$2l - l = [(b_1 + h_1) - h_1] \sqrt{\tan \theta_1}$$

$$B(\Delta ABC) = B(\Delta PQR) \sqrt{\tan \theta_1} - h_1 \sqrt{\tan \theta_1} + l \quad \dots \text{Given, } h_1 = l \sqrt{\tan \theta_1}$$

$$B(\Delta ABC) = B(\Delta PQR) \sqrt{\tan \theta_1} + l - l \sqrt{\tan \theta_1} \sqrt{\tan \theta_1}$$

$$B(\Delta ABC) = B(\Delta PQR) \sqrt{\tan \theta_1} + l - l \tan \theta_1$$

$$B(\Delta ABC) = B(\Delta PQR) \sqrt{\tan \theta_1} + l(1 - \tan \theta_1)$$

Hence, we have Prove that, Proof of Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle.

This formula clear that, when given the sidemeasurement and angle of any right angled triangle then we can be find Area of the right angled triangle.

Relation –IX: Proof of Sidemeasurement relation in two scalene right angled triangles

Given :- In ΔABC , $m\angle A = 45^\circ$, $m\angle B = 90^\circ$ and $m\angle C = 45^\circ$

In ΔPQR , $m\angle P = \theta_1$, $m\angle Q = 90^\circ$ and $m\angle R = \theta'_1$

In ΔLMN , $m\angle L = \theta_2$, $m\angle M = 90^\circ$ and $m\angle N = \theta'_2$

here, $A(\Delta ABC) = A(\Delta PQR) = A(\Delta LMN)$

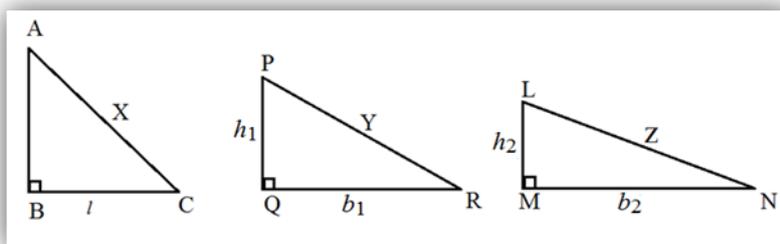


Figure XII : Trigonometric Sidemeasurement relation in two scalene right angled triangle

To prove :- $B(\Delta PQR) = B(\Delta LMN) \times \frac{\sqrt{\tan \theta_2}}{\sqrt{\tan \theta_1}} + l \left[\frac{(1 - \tan \theta_2) - (1 - \tan \theta_1)}{\sqrt{\tan \theta_1}} \right]$

Proof :- In ΔABC and ΔPQR ,

$$B(\Delta ABC) = B(\Delta PQR) \sqrt{\tan \theta_1} + l(1 - \tan \theta_1) \quad \dots (i)$$

...(Proof of Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle)

$$B(\Delta ABC) = B(\Delta LMN) \sqrt{\tan \theta_2} + l(1 - \tan \theta_2) \quad \dots (ii)$$

...(Proof of Sidemeasurement relation in isosceles right angled triangle and scalene right angled triangle)

$$B(\Delta PQR) \sqrt{\tan \theta_1} + l(1 - \tan \theta_1) = B(\Delta LMN) \sqrt{\tan \theta_2} + l(1 - \tan \theta_2)$$

$$B(\Delta PQR) \sqrt{\tan \theta_1} = B(\Delta LMN) \sqrt{\tan \theta_2} + l(1 - \tan \theta_2) - l(1 - \tan \theta_1)$$

$$B(\Delta PQR) \sqrt{\tan \theta_1} = B(\Delta LMN) \sqrt{\tan \theta_2} + l [(1 - \sqrt{\tan \theta_2}) - (1 - \tan \theta_1)]$$

$$B(\Delta PQR) = B(\Delta LMN) \times \frac{\sqrt{\tan \theta_2}}{\sqrt{\tan \theta_1}} + l \left[\frac{(1 - \tan \theta_2) - (1 - \tan \theta_1)}{\sqrt{\tan \theta_1}} \right]$$

Hence, we have Prove that, Proof of Sidemeasurement relation in two scalene right angled triangles
 This formula clear that, when given the Sidemeasurement and angle of any right angled triangle then we can be find angle of another right angled triangle when given the Sidemeasurement and vice versa which both right angled triangle are sidemeasurement is equal but not required to known.

IV. CONCLUSION

“Sidemeasurement relation of two right angled triangle in trigonometric form” this research article conclude that Trigonometric Sidemeasurement relation between two right angele explained with the help of formula, when Area of both are equal.

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Note: This research paper is also part of Relation mathematics subject and all details concept explained in the book, "The great method of the Relation All Mathematics"..