# Drive Formula for Sars Length of Wire Hanging Between Two Electric Poles and Some Applications

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**Abstract**

Base on sars length of wire hanging between two electric poles makes angles θ & ∝ with horizontal. Drive the formula for sars length of wire makes angles with horizontal θ & ∝ where (θ > ∝).

Find the volume, Sars surface area,Total surface area of many kinds of Sars cuboid and Sars cube like as LL-Sars cuboid, UU-Sars cuboid, LU-Sars cuboid, LL-Sars cube, UU-Sars cube, LU-Sars cube . All kind of Sars cuboid and Sars cube used in optics instruments like as Sars lens, Sars mirror. When a ray of light incident on the Sars surface area then it is refracted or reflected depending on the sars surface area and angles $\theta$&$\propto$. Base on Sars length of wire used 170 applications and more. But in this paper some application are used.

To find the Sars length of wire hanging between two electric poles. If f(x) is a smooth curve on [a, b] and length of curve y=f(x) from a to b is given by

$$L=\int_a^b \sqrt{1+\left(\frac{dy}{dx}\right)^2}\,dx$$

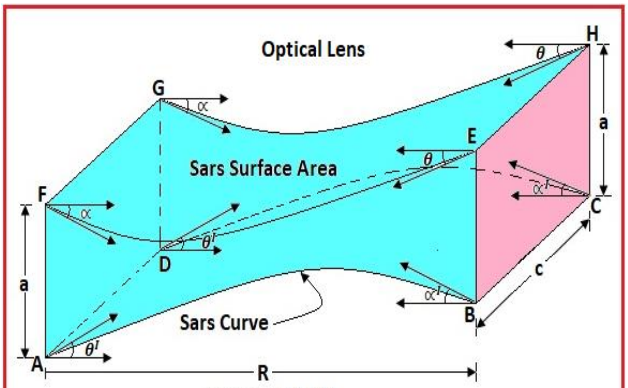
**Keywords:** Sars length of wire with same angles ($\theta$) is denoted by $\mathcal{S}$ and Sars length of wire with different angles ($\theta and \propto$) makes with horizontal is denoted by $\mathcal{S}$. S.S.A.-Sars surface area, T.S.A.-Total surface area, LL-lower lower, LU-lower upper, UU-upper upper, UL-upper lower.

## Introduction

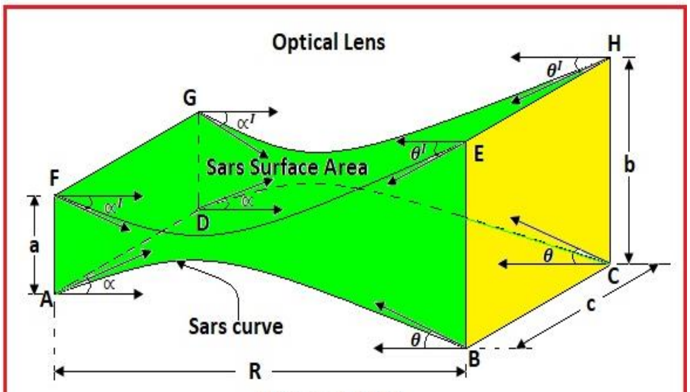
Sars length of wire hanging between two electric poles make angles θ & α with horizontal. Drive formula for Sars length of wire hanging between two electric poles. The heights of poles are same and different. Sars length of wire depends on the distance between two electric poles and make angles at the end point of electric poles with horizontal. The angles at the end point of electric poles are same or different depends on the height of two poles. If heights of two poles are same then angles are equal. If heights of two poles are not same then angles are different $\theta$ and $\propto$.

If angles at the end point of electric poles are different then distance between two electric poles is denoted by R. If angles at the end point of electric poles are same then distance between two electric poles is denoted by d. Depending on Sars length of wire to solve 170 applications and more. Some application used in optics instruments like as LL-Sars cube lens, UU-Sars cube lens, LL-Sars cuboid lens, UU-Sars cuboid lens and some application used in mathematics.

In this paper we introduce some applications like LL-Sars cuboid, UU-Sars cuboid, LU-Sars cuboid, LL-Sars cube, UU-Sars cube, LU-Sars cube. All kind of Sars cuboid used in optics instruments like as Sars lens, Sars mirror. In Sars optics instrument when a ray of light incident on Sars surface area then it is refracted or reflected depend on the Sars surface area. In this paper we introduce to find the Sars surface area, Total surface area and volume of (LL-Sars cube, LL-Sars cuboid, LU-Sars cube, LU-Sars cuboid, L-half Sars cube, U-half Sars cube, LU-Sars cuboid, UU- Sars cuboid, L- half Sars cuboid, LU-half Sars cuboid).



(Figure:-3.14A)



(Figure:-3.13A)

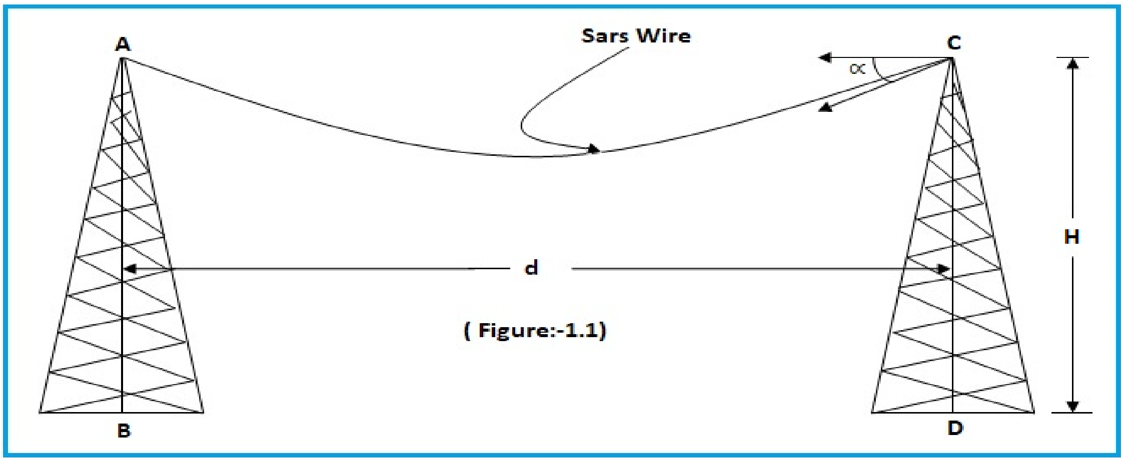
**1. Drive formula for Sars length of wire hanging between two electric poles of same height.**

The equation of Sars wire in XY-axis

$y \propto x^2 \Rightarrow y = kx^2$ when height of Sars wire at the centre is h then distance is $\frac{d}{2}$ at the centre of Sars wire. $h = k\left(\frac{d}{2}\right)^2 \Rightarrow k = \frac{h}{\left(\frac{d}{2}\right)^2}$ put the value of k we get.

$$y = \frac{h}{\left(\frac{d}{2}\right)^2}x^2 \quad \text{or} \quad y = \frac{4h}{d^2}x^2$$

To find the length of Sars wire when a wire hanging between two electric poles of same height. Make an angle ∝ with horizontal as show in ( Figure:-1.1)



( Figure:-1.1)

By the length of curve. If f(x) is smooth on [a, b] and the length of curve y=f(x) from a to b

$\frac{dy}{dx}=\frac{8h}{d^2}x$ or $\left(\frac{dy}{dx}\right)^2=\frac{64h^2}{d^4}x^2$

$$L=\int_a^b\sqrt{1+\left(\frac{dy}{dx}\right)^2}\,dx$$

The Sars length of wire is denoted by $\mathcal{S}$

$$\mathcal{S}=\int_{-d/2}^{d/2}\sqrt{1+\frac{64h^2}{d^4}x^2}\,dx=\int_{-d/2}^{d/2}\frac{8h}{d^2}\sqrt{\frac{d^4}{64h^2}+x^2}\,dx=\frac{8h}{d^2}\int_{-d/2}^{d/2}\sqrt{\frac{d^4}{64h^2}+x^2}\,dx$$

$$=\frac{8h}{d^2}\left[\frac{x}{2}\sqrt{\frac{d^4}{64h^2}+x^2}+\frac{d^4}{128h^2}\ln\left|x+\sqrt{\frac{d^4}{64h^2}+x^2}\right|\right]_{-d/2}^{d/2}$$

$$=\left[\frac{4hx}{d^2}\sqrt{\frac{d^4}{64h^2}+x^2}+\frac{d^2}{16h}\ln\left|x+\sqrt{\frac{d^4}{64h^2}+x^2}\right|\right]_{-d/2}^{d/2}$$

$$=\frac{4h\times d/2}{d^2}\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}+\frac{d^2}{16h}\ln\left|\frac{d}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}\right|+\frac{4h\times d/2}{d^2}\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}-\frac{d^2}{16h}\ln\left|\frac{-d}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}\right|$$

$$=\frac{2h}{d}\sqrt{d^2\left(\frac{d^2}{64h^2}+\frac{1}{4}\right)}+\frac{d^2}{16h}\ln\left|\frac{d}{2}+\sqrt{d^2\left(\frac{d^2}{64h^2}+\frac{1}{4}\right)}\right|+\frac{2h}{d}\sqrt{d^2\left(\frac{d^2}{64h^2}+\frac{1}{4}\right)}-\frac{d^2}{16h}\ln\left|\frac{-d}{2}+\sqrt{d^2\left(\frac{d^2}{64h^2}+\frac{1}{4}\right)}\right|$$

$$=2h\sqrt{\frac{d^2}{64h^2}+\frac{1}{4}}+\frac{d^2}{16h}\ln\left|\frac{d}{2}+d\sqrt{\frac{d^2}{64h^2}+\frac{1}{4}}\right|+2h\sqrt{\frac{d^2}{64h^2}+\frac{1}{4}}-\frac{d^2}{16h}\ln\left|\frac{-d}{2}+d\sqrt{\frac{d^2}{64h^2}+\frac{1}{4}}\right|$$

$$=\frac{1}{4}\sqrt{16h^2+d^2}+\frac{d^2}{16h}\ln\left|\frac{d}{2}+\frac{d}{8h}\sqrt{16h^2+d^2}\right|+\frac{1}{4}\sqrt{16h^2+d^2}-\frac{d^2}{16h}\ln\left|\frac{-d}{2}+\frac{d}{8h}\sqrt{16h^2+d^2}\right|$$

$$=\frac{\sqrt{16h^2+d^2}}{2}+\frac{d^2}{16h}\left[\ln\left|\frac{d}{2}+\frac{d}{8h}\sqrt{16h^2+d^2}\right|-\ln\left|\frac{-d}{2}+\frac{d}{8h}\sqrt{16h^2+d^2}\right|\right]$$

$$=\frac{\sqrt{16h^2+d^2}}{2}+\frac{d^2}{16h}\ln\left|\frac{d\left(4h+\sqrt{16h^2+d^2}\right)}{d\left(-4h+\sqrt{16h^2+d^2}\right)}\right|=\frac{\sqrt{16h^2+d^2}}{2}+\frac{d^2}{16h}\ln\left|\frac{4h+\sqrt{16h^2+d^2}}{-4h+\sqrt{16h^2+d^2}}\right| \quad \text{......... (i)}$$

We know that,

$$\operatorname{Sin}\theta=\frac{4h}{\sqrt{16h^2+d^2}} \text{ or } \sqrt{16h^2+d^2}=\frac{4h}{\sin\theta}, \quad \operatorname{Cos}\theta=\frac{d}{\sqrt{16h^2+d^2}} \text{ or } \sqrt{16h^2+d^2}=\frac{d}{\operatorname{Cos}\theta} \quad \text{......(ii)}$$

From equation (i) and (ii)

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$$\mathcal{S} = \frac{d}{2\cos\theta} + \frac{d\cos\theta}{4\sin\theta}\ln\left|\frac{\sin\theta+1}{1-\sin\theta}\right| \quad \text{and} \quad \boxed{\mathcal{S} = \frac{d\left(2\sin\theta + \cos^2\theta.\ln\left|\frac{\sin\theta+1}{1-\sin\theta}\right|\right)}{2\sin 2\theta}}$$

**1.1 Relation between two horizontal angles and distance between two electric poles.**

Let AD=d be the distance two points of sars curve and AO=OD= $\frac{d}{2}$ behalf of AD.

Let OP=h be the maximum height of sars curve and OE=$h^I$ be the minimum height as show in (Figure:-2.1)

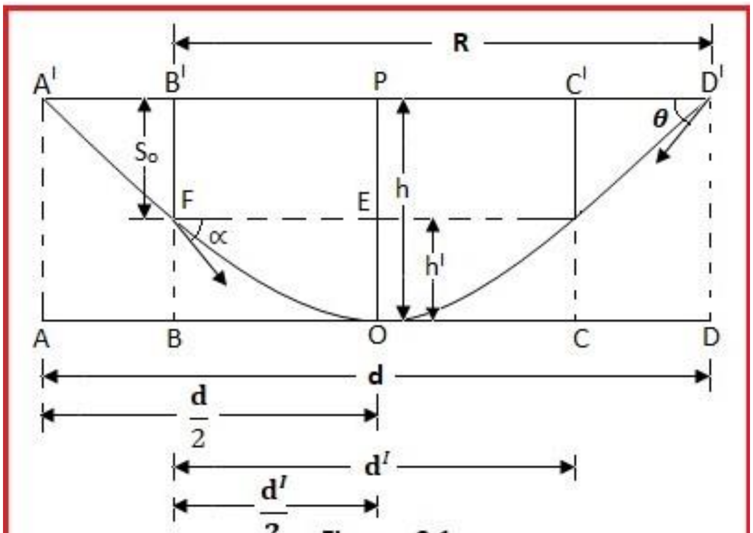


Figure:-2.1

Let BC=$d^I$ be the small distance and OB=OC = $\frac{d^I}{2}$ be half distance of BC.

At point F, ∝ be the angle and at point $D^I$ ,θ be the angle.

Let $S_0 = h - h^I$ and $R = \frac{d+d^I}{2}$

As we go from origin to the point of Sars curve then height is increasing. We get

$$h^I = \frac{h}{\left(\frac{d}{2}\right)^2}\left(\frac{d^I}{2}\right)^2 \Rightarrow h^I = \frac{hd^{I2}}{d^2} \quad \Rightarrow \frac{h^I}{h} = \frac{d^{I2}}{d^2} \quad \text{……….. (i)}$$

We know that, $\tan\alpha = \frac{4h^I}{d^I} \Rightarrow d^I \tan\alpha = 4h^I$

$$\boxed{h^I = \frac{d^I \tan\alpha}{4}} \text{…………………….. (ii)}$$

Comparing the equation (i) & (ii) we get

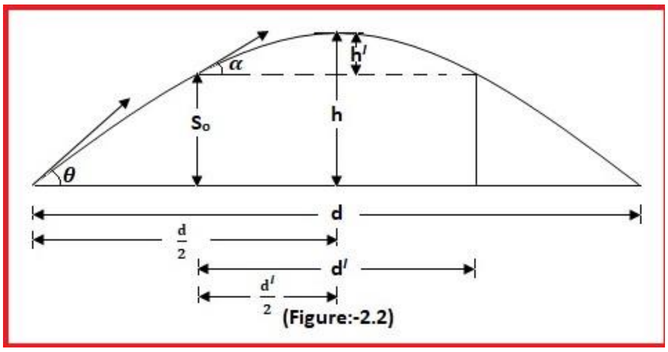
$$\frac{d^I \tan\alpha}{4} = \frac{hd^{I2}}{d^2}$$

$$\boxed{\tan\alpha = \frac{4hd^I}{d^2}} \quad \text{…………………….. (iii)}$$

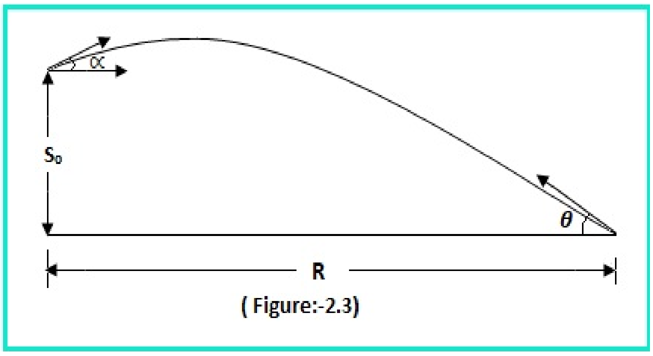
Put the value of $\tan\theta = \dfrac{4h}{d}$ in equation (iii) we get

$$\boxed{d\tan\alpha = d^{I}\tan\theta} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(iv)}$$

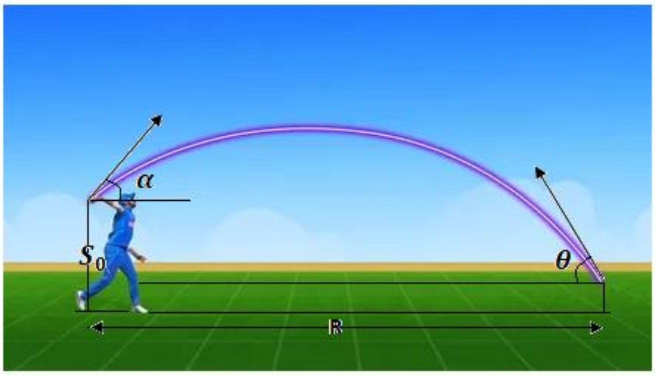
$$S_0 = h - h^{I} \quad = \quad h - \frac{hd^{I2}}{d^2}$$



(Figure:-2.2)



( Figure:-2.3)




$$\boxed{S_0 = h\left(\frac{d^2 - d^{I2}}{d^2}\right) \text{ OR } S_0 = h^{I}\left(\frac{d^2 - d^{I2}}{d^{I2}}\right)} \ldots \text{(v)}$$

$$S_0 = \frac{d\tan\theta}{4} - \frac{d^{I}\tan\alpha}{4}$$

$$\boxed{S_0 = \frac{1}{4}\left(d\tan\theta - d^{I}\tan\alpha\right)} \quad \ldots\ldots\ldots\ldots \text{(vi)}$$

From equation (iv) we obtain

$$\tan\alpha = \frac{d^{I}}{d}\tan\theta \qquad \text{OR} \qquad \tan\theta = \frac{d}{d^{I}}\tan\alpha$$

$$S_0 = \frac{1}{4}\left(d\tan\theta - \frac{d^{I2}\tan\theta}{d}\right)$$

$$S_0 = \frac{1}{4}\tan\theta\left(\frac{d^2 - d^{I2}}{d}\right)$$

$$\boxed{S_0 = \frac{\tan\theta\left(d^2 - d^{I2}\right)}{4d} \text{ OR } S_0 = \frac{\tan\alpha\left(d^2 - d^{I2}\right)}{4d^{I}}} \ldots\ldots\ldots\ldots\ldots\ldots \text{(vii)}$$

Where $R=\left[\frac{d+d^I}{2}\right]=\frac{\left[\frac{4h}{\tan\theta}+\frac{4h^I}{\tan\alpha}\right]}{2}$

$\left\{\because h^I\tan^2\theta=h\tan^2\alpha\right\}$

$$R=\frac{2\left(h\tan\alpha+h^I\tan\theta\right)}{\tan\theta.\tan\alpha}\ \text{OR}\ R=\frac{2h\left(\tan\theta+\tan\alpha\right)}{\tan^2\theta}$$

$$R=\frac{2h^I\left(\tan\theta+\tan\alpha\right)}{\tan^2\alpha}\quad \text{OR}\quad R=\frac{2\left(d^Ih+h^Id\right)}{d\tan\alpha}$$

$$S_0=\tan\alpha\frac{\left(d+d^I\right)}{2}\frac{\left(d-d^I\right)}{2d^I}$$

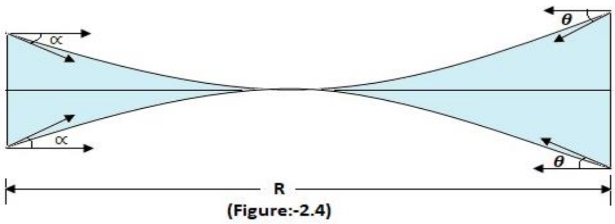
$$S_0=R\tan\alpha\frac{\left(d-d^I\right)}{2d^I}\quad \text{OR}\quad S_0=\frac{R}{2}\left(\frac{d}{d^I}-1\right)\tan\alpha$$

$$S_0=\frac{R}{2}\left(\frac{\tan\theta}{\tan\alpha}-1\right)\tan\alpha$$

$$\boxed{S_0=\frac{R}{2}\left(\tan\theta-\tan\alpha\right)}\qquad \text{………………….}\qquad \text{(viii)}$$

Which is a formula for projectile fire from above ground level $S_0$. The projectile hits the ground at an angle θ if $S_0$ ,R & angle α are given. Where θ is an angle hits the ground as show in (Figure:-2.3).

### 1.2 Area of shaded region.



(Figure:-2.4)

**Area** $=2\int_{-d^I/2}^{d/2}\frac{h}{\left(\frac{d}{2}\right)^2}x^2dx$

$$=\frac{2}{3}\left[\frac{h}{\left(\frac{d}{2}\right)^2}x^3\right]_{-d^I/2}^{d/2}=\frac{2}{3}\left[\frac{h}{\left(\frac{d}{2}\right)^2}\left(\frac{d}{2}\right)^3-\frac{h}{\left(\frac{d}{2}\right)^2}\left(\frac{-d^I}{2}\right)^3\right]$$

$$=\frac{2}{3}\left[\frac{hd}{2}+\frac{hd^{I3}}{2d^2}\right]\quad=\frac{h}{3d^2}\left[d^3+d^{I3}\right]\quad\left\{\because d\tan\alpha=d^I\tan\theta\right\}$$

$$=\frac{h}{3d^2}\left[d^3+\frac{d^3\tan^3\alpha}{\tan^3\theta}\right]=\frac{hd^3}{3d^2}\left[\frac{\tan^3\theta+\tan^3\alpha}{\tan^3\theta}\right]=\frac{4h}{3}.\frac{d}{4}\left[\frac{\tan^3\theta+\tan^3\alpha}{\tan^3\theta}\right]=\frac{4h}{3}.\frac{h}{\tan\theta}\left[\frac{\tan^3\theta+\tan^3\alpha}{\tan^3\theta}\right]$$

$$=\frac{4h^2}{3}\left[\frac{\tan^3\theta+\tan^3\alpha}{\tan^4\theta}\right]=\frac{4h^2}{3}\left[\frac{\cos\theta}{\sin\theta}+\frac{\sin^3\alpha}{\cos^3\alpha}\times\frac{\cos^4\theta}{\sin^4\theta}\right]\quad\left\{\because Where\ h=\frac{R\cos\alpha\sin^2\theta}{2\sin(\theta+\alpha)\cos\theta}\right\}$$

$$=\frac{4R^2\cos^2\alpha\sin^4\theta}{3.4\left[\sin(\theta+\alpha)\right]^2\cos^2\theta}\left[\frac{\cos\theta}{\sin\theta}+\frac{\sin^3\alpha}{\cos^3\alpha}\frac{\cos^4\theta}{\sin^4\theta}\right]=\frac{R^2}{3\left[\sin(\theta+\alpha)\right]^2}\left[\frac{\cos^2\alpha\sin^3\theta}{\cos\theta}+\frac{\sin^3\alpha\cos^2\theta}{\cos\alpha}\right]$$

$$=\frac{R^2}{3\left[\sin(\theta+\alpha)\right]^2}\left[\cos^2\alpha\sin^2\theta\tan\theta+\cos^2\theta\sin^2\alpha\tan\alpha\right]$$

$$\textbf{Area}=\frac{R^2}{3(\tan\theta+\tan\alpha)^2}\left[\tan^3\theta+\tan^3\alpha\right]$$

If $\propto=\theta$ then distance R will be increases as show in (Figure:-2.4a)

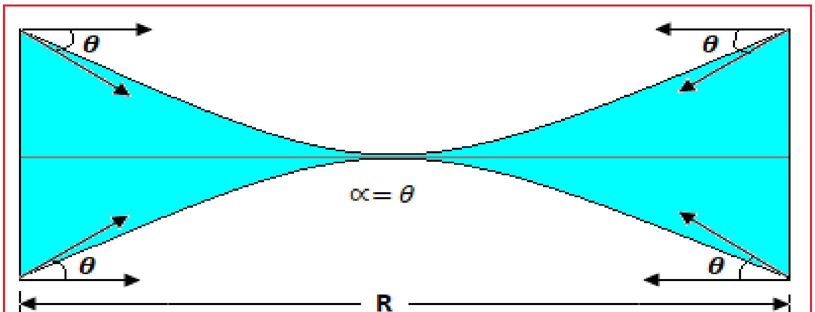
$$\textbf{Area}=\frac{R^2}{3(\tan\theta+\tan\propto)^2}[tan^3\theta+tan^3\propto]$$

$$\textbf{Area}=\frac{R^2}{3(\tan\theta+\tan\theta)^2}[tan^3\theta+tan^3\theta]$$

$$\textbf{Area}=\frac{R^2}{3(2\tan\theta)^2}[2tan^3\theta]$$

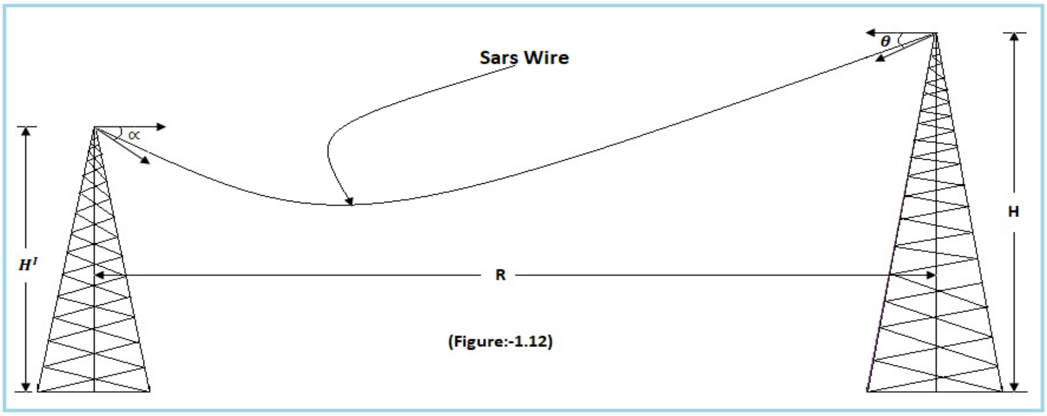
$$\textbf{Area}=\frac{R^2}{12(\tan\theta)^2}[2tan^3\theta]$$

$$\textbf{Area}=\frac{R^2}{6}tan\theta$$



(Figure:-2.4a)

**1.3 Drive formula for Sars length of wire hanging between two electric poles of different height.**



(Figure:-1.12)

To find the length of Sars wire when a wire hanging between two electric poles of different height. Make angles ∝ and θ (θ>∝) with horizontal as show in (Figure:-1.12)

$$\text{ℜ} = \frac{8h}{d^2}\int_{-d^I/2}^{d/2}\sqrt{\frac{d^4}{64h^2}+x^2}\,dx = \frac{8h}{d^2}\left[\frac{x}{2}\sqrt{\frac{d^4}{64h^2}+x^2}+\frac{d^4}{128h^2}\ln\left|x+\sqrt{\frac{d^4}{64h^2}+x^2}\right|\right]_{-d^I/2}^{d/2}$$

$$=\frac{8h}{d^2}\left[\frac{d}{4}\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}+\frac{d^4}{128h^2}\ln\left|\frac{d}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}\right|\right]-\frac{8h}{d^2}\left[\frac{-d^I}{4}\sqrt{\frac{d^4}{64h^2}+\frac{d^{I2}}{4}}+\frac{d^4}{128h^2}\ln\left|\frac{-d^I}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^{I2}}{4}}\right|\right]$$

$$=\frac{2h}{d}\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}+\frac{d^2}{16h}\ln\left|\frac{d}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}\right|+\frac{2hd^I}{d^2}\sqrt{\frac{d^4}{64h^2}+\frac{d^{I2}}{4}}-\frac{d^2}{16h}\ln\left|\frac{-d^I}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^{I2}}{4}}\right|$$

$$=\frac{2h}{d}\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}+\frac{2hd^I}{d^2}\sqrt{\frac{d^4}{64h^4}+\frac{d^{I2}}{4}}+\frac{d^2}{16h}\left[\ln\left|\frac{d}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^2}{4}}\right|-\ln\left|\frac{-d^I}{2}+\sqrt{\frac{d^4}{64h^2}+\frac{d^{I2}}{4}}\right|\right]$$

$$=\frac{2h}{d}\sqrt{\frac{d^2}{64h^2}\left(d^2+16h^2\right)}+\frac{2hd^I}{d^2}\sqrt{\frac{d^{I2}}{64h^I}\left(d^{I2}+16h^{I2}\right)}+\frac{d^2}{16h}\ln\left|\frac{\frac{d}{2}+\frac{d}{2}\frac{\sqrt{d^2+16h^2}}{4h}}{\frac{-d^I}{2}+\frac{d^I}{2}\frac{\sqrt{d^{I2}+16h^{I2}}}{4h^I}}\right|$$

$$=\frac{2h}{d}\cdot\frac{d}{8h}\sqrt{d^2+16h^2}+\frac{2hd^I}{d^2}\cdot\frac{d^I}{8h^I}\sqrt{d^{I2}+16h^{I2}}+\frac{d^2}{16h}\ln\left|\frac{\frac{d}{2}\left(1+\frac{1}{\sin\theta}\right)}{\frac{d^I}{2}\left(-1+\frac{1}{\sin\alpha}\right)}\right|$$

$$=\frac{1}{4}\sqrt{d^2+16h^2}+\frac{hd^{I2}}{d^2}\cdot\frac{1}{4h^I}\sqrt{d^I+16h^{I2}}+\frac{d^2}{16h}\ln\left|\frac{\frac{d\left(1+\sin\theta\right)}{\sin\theta}}{\frac{d^I\left(-1+\sin\alpha\right)}{\sin\alpha}}\right|$$

$$=\frac{1}{4}\sqrt{d^2+16h^2}+\frac{h^I}{4h^I}\sqrt{d^{I2}+16h^{I2}}+\frac{d^2}{16h}\ln\left|\frac{d\sin\alpha\left(1+\sin\theta\right)}{d^I\sin\theta\left(1-\sin\alpha\right)}\right|$$

$$=\frac{h}{\sin\theta}+\frac{h^I}{\sin\alpha}+\frac{d^2}{16h}\ln\left|\frac{\cos\alpha\left(1+\sin\theta\right)}{\cos\theta\left(1-\sin\alpha\right)}\right|=\frac{4h^I\sin\theta+4h\sin\alpha+d\cos\theta\sin\alpha.\ln\left|\frac{\cos\alpha\left(1+\sin\theta\right)}{\cos\theta\left(1-\sin\alpha\right)}\right|}{4\sin\theta.\sin\alpha}$$

$$=\frac{\sin\theta\left(h^I\sin\theta+h\sin\alpha\right)+h\cos^2\theta\sin\alpha\ln\left|\frac{\cos\alpha\left(1+\sin\theta\right)}{\cos\theta\left(1-\sin\alpha\right)}\right|}{\sin\alpha\sin^2\theta}$$

$$=\frac{h^I}{\sin\alpha}+\frac{h}{\sin\theta}+\frac{h^I\cos^2\alpha}{\sin 2\alpha}\ln\left|\frac{\cos\alpha\left(1+\sin\theta\right)}{\cos\theta\left(1-\sin\alpha\right)}\right|\;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (i)$$

Put all values, we have

$$R = \frac{2h(\tan\theta + \tan\alpha)}{\tan^2\theta} = \frac{2h^I(\tan\theta + \tan\alpha)}{\tan^2\alpha}$$

$$R = \frac{2h\left(\frac{\sin\theta}{\cos\theta} + \frac{\sin\alpha}{\cos\alpha}\right)}{\frac{\sin^2\theta}{\cos^2\theta}} = \frac{\frac{2h(\mathrm{Sin}\,\theta\,\mathrm{Cos}\,\alpha + \mathrm{Cos}\,\theta\,\mathrm{Sin}\,\alpha)}{\mathrm{Cos}\,\theta\,\mathrm{Cos}\,\alpha}}{\frac{\mathrm{Sin}^2\theta}{\mathrm{Cos}^2\theta}}$$

$$R = \frac{2h(\mathrm{Sin}(\theta+\alpha))\mathrm{Cos}\,\theta}{\mathrm{Cos}\,\alpha\,\mathrm{Sin}^2\theta}, h = \frac{R\,\mathrm{Cos}\,\alpha\,\mathrm{Sin}^2\theta}{2\mathrm{Sin}(\theta+\alpha)\mathrm{Cos}\,\theta} \quad \ldots\ldots\ldots\ldots \text{(ii)}$$

$$R = \frac{\frac{2h^I(\mathrm{Sin}\,\theta\,\mathrm{Cos}\,\alpha + \mathrm{Cos}\,\theta\,\mathrm{Sin}\,\alpha)}{\mathrm{Cos}\,\theta\,\mathrm{Cos}\,\alpha}}{\frac{\mathrm{Sin}^2\alpha}{\mathrm{Cos}^2\alpha}} = \frac{2h^I(\mathrm{Sin}(\theta+\alpha))\mathrm{Cos}\,\alpha}{\mathrm{Cos}\,\theta\,\mathrm{Sin}^2\alpha}$$

$$h^I = \frac{R\,\mathrm{Cos}\,\theta\,\mathrm{Sin}^2\alpha}{2\mathrm{Sin}(\theta+\alpha)\mathrm{Cos}\,\alpha} \quad \ldots\ldots\ldots\ldots \text{(iii)}$$

Put the value of h and $h^I$ from equation (ii) & (iii) in equation (i) we get.

$$= \frac{R\,\mathrm{Cos}\,\theta\,\mathrm{Sin}^2\alpha}{2\mathrm{Sin}(\theta+\alpha)\mathrm{Cos}\,\alpha\,\mathrm{Sin}\,\alpha} + \frac{R\,\mathrm{Cos}\,\alpha\,\mathrm{Sin}^2\theta}{2\mathrm{Sin}(\theta+\alpha)\mathrm{Cos}\,\theta\,\mathrm{Sin}\,\theta} + \frac{R\,\mathrm{Cos}\,\theta\,\mathrm{Sin}^2\alpha\,\mathrm{Cos}^2\alpha}{2\mathrm{Sin}(\theta+\alpha)\mathrm{Cos}\,\alpha\,\mathrm{Sin}^2\alpha}.\ln\left|\frac{\mathrm{Cos}\,\alpha(1+\mathrm{Sin}\,\theta)}{\mathrm{Cos}\,\theta(1-\mathrm{Sin}\,\alpha)}\right|$$

$$= \frac{R\,\mathrm{Cos}\,\theta\,\mathrm{Sin}\,\alpha}{2\mathrm{Sin}(\theta+\alpha)\mathrm{Cos}\,\alpha} + \frac{R\,\mathrm{Cos}\,\alpha\,\mathrm{Sin}\,\theta}{2\mathrm{Sin}(\theta+\alpha)\mathrm{Cos}\,\theta} + \frac{R\,\mathrm{Cos}\,\theta\,\mathrm{Cos}\,\alpha}{2\mathrm{Sin}(\theta+\alpha)}.\ln\left|\frac{\mathrm{Cos}\,\alpha(1+\mathrm{Sin}\,\theta)}{\mathrm{Cos}\,\theta(1-\mathrm{Sin}\,\alpha)}\right|$$

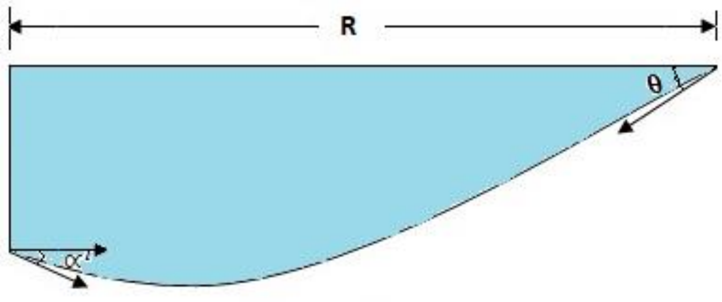
$$\boxed{\mathcal{S} = \frac{R\left[\mathrm{Tan}\,\alpha\,\mathrm{Cos}\,\theta + \mathrm{Tan}\,\theta\,\mathrm{Cos}\,\alpha + \mathrm{Cos}\,\theta\,\mathrm{Cos}\,\alpha.\ln\left|\frac{\mathrm{Cos}\,\alpha(1+\mathrm{Sin}\,\theta)}{\mathrm{Cos}\,\theta(1-\mathrm{Sin}\,\alpha)}\right|\right]}{2\mathrm{Sin}(\theta+\alpha)}}$$

Note:- Formula are same but change only angles in given below.

$$\ln\left|\frac{\cos\alpha(1+\sin\theta)}{\cos\theta(1-\sin\alpha)}\right| = \ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right| \text{ or } \frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)} = \frac{\cos\alpha(1+\sin\theta)}{\cos\theta(1-\sin\alpha)}$$

$$\cos^2\theta(1-\sin^2\alpha) = \cos^2\theta(1-\sin^2\theta) \text{ or } \cos^2\theta\cos^2\alpha = \cos^2\alpha\cos^2\theta$$

**1.4 Area of Shaded Region.**




( Figure:-2.5)

To find the area of shaded region as show in (Figure:-2.5)

$$\textbf{Area}=\left[hx-\frac{h}{3\left(\frac{d}{2}\right)^2}x^3\right]_{\frac{-d^I}{2}}^{\frac{d}{2}}$$

$$=h\left(\frac{d^I+d}{2}\right)-\frac{h}{6}\left[d+\frac{d^{I3}}{d^2}\right]$$

$$=hR-\frac{h}{6d^2}\left[d^3+d^{I3}\right]$$

$$=hR-\frac{hd^3}{6d^2}\left[\frac{\tan^3\theta+\tan^3\alpha}{\tan^3\theta}\right]$$

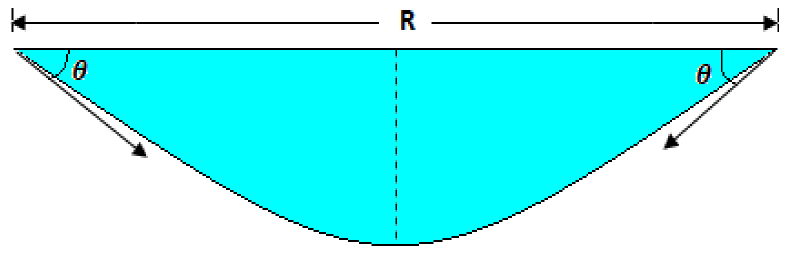
$$=hR-\frac{R^2}{6(\tan\theta+\tan\alpha)^2}\left[\tan^3\theta+\tan^3\alpha\right]=\frac{R^2\tan^2\theta}{2(\tan\theta+\tan\alpha)}-\frac{R^2}{6(\tan\theta+\tan\alpha)^2}\left[\tan^3\theta+\tan^3\alpha\right]$$

$$\boxed{\textbf{Area}=\frac{R^2}{2(\tan\theta+\tan\alpha)}\left[\tan^2\theta-\frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]}$$

If $\propto=\theta$ then distance R will be increases as show in (Figure:-2.5a)

$$\textbf{Area}=\frac{R^2}{2(\tan\theta+\tan\propto)}\left[tan^2\theta-\frac{(tan^3\theta+tan^3\propto)}{3(\tan\theta+\tan\propto)}\right]$$

$$\textbf{Area}=\frac{R^2}{2(\tan\theta+\tan\theta)}\left[tan^2\theta-\frac{(tan^3\theta+tan^3\theta)}{3(\tan\theta+\tan\theta)}\right]$$




(Figure:-2.5a)

$$\textbf{Area}=\frac{R^2}{4\tan\theta}\left[tan^2\theta-\frac{2tan^3\theta}{6tan\theta}\right]$$

$$\textbf{Area}=\frac{R^2}{4\tan\theta}\left[tan^2\theta-\frac{tan^2\theta}{3}\right]$$

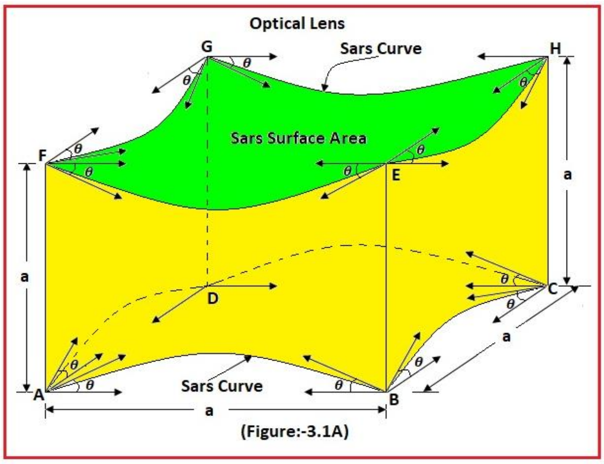
$$\textbf{Area}=\frac{R^2}{4\tan\theta}\left[\frac{2tan^2\theta}{3}\right]$$

$$\textbf{Area}=\frac{R^2}{6}tan\theta$$

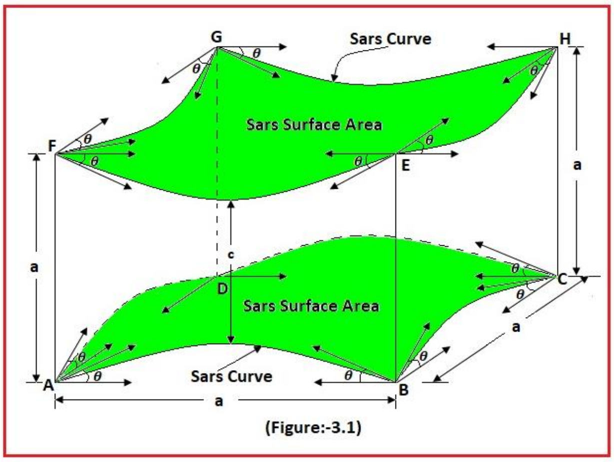
**2. LL-Sars Cube:-**In this Sars Cube

Length of AB=BC=DC=DA= a of lower face, same length of upper face of Sars cube as show in (Figure:-3.1). The length of Sars curve depends on the angle θ and distance between two points.

In this Sars cube angles are same and distance between two points are same. This Sars cube used in optics instruments like as mirrors or lens and other field of science. But in mathematics to find the Sars surface area , Total surface area and volume of Sars cube.



(Figure:-3.1A)



(Figure:-3.1)

**2.1 Sars Surface Area:-**The Sars length of wire (Sars Curve) lower face AB=BC= CD =DA and upper face FE=EH=HG=GF are same and angles of lower face ∠A=∠B=∠C=∠D=θ and upper face ∠E=∠F=∠G=∠H=θ are same.

$$\textbf{S.S.A=}\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{(1+\sin\theta)}{(1-\sin\theta)}\right|\right]}{2\sin 2\theta}\times\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{(1+\sin\theta)}{(1-\sin\theta)}\right|\right]}{2\sin 2\theta}$$

$$\boxed{\textbf{S.S.A=}\frac{a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{(1+\sin\theta)}{(1-\sin\theta)}\right|\right]^2}{4\sin^2 2\theta}}$$

**2.2 Total Surface Area:-**To find area total surface area as in (Figure:-3.1A) Upper Sars surface area + lower Sars surface area+4×area of one face (EBCH). Upper area = Lower area, because the angle and distance are same. So, 2×Sars surface area +4× area of one face (EBCH)

$$\textbf{T.S.A=}\frac{2\times a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{(1+\sin\theta)}{(1-\sin\theta)}\right|\right]^2}{4\sin^2 2\theta}+4\times\frac{a}{6}\left[a\tan\theta+6c\right]$$

$$\textbf{T.S.A=}\frac{a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{(1+\sin\theta)}{(1-\sin\theta)}\right|\right]^2}{2\sin^2 2\theta}+\frac{2a}{3}\left[a\tan\theta+6c\right]$$

where c is the distance between upper Sars length of wire at the centre to the lower Sars length of wire at the centre.

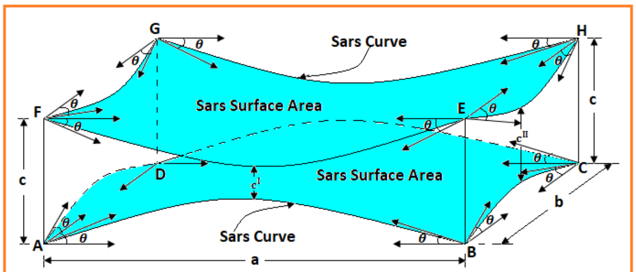
**OR**

$$\mathbf{T.S.A} = \frac{a^2\left[2sin\theta + cos^2\theta \ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{2sin^2 2\theta} + 4a^2 - 8\times\frac{a^2}{6}tan\theta$$

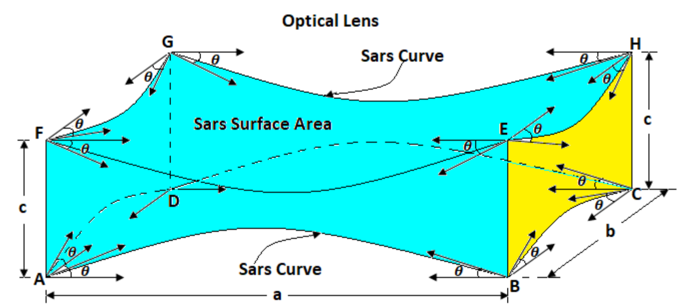
$$\mathbf{T.S.A} = \frac{a^2\left[2sin\theta + cos^2\theta \ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{2sin^2 2\theta} + 4a^2\left[1 - \frac{tan\theta}{3}\right]$$

**3. LL-Sars Cuboid:-**In this Sars cuboid as show in (Figure:-3.2)

Length of lower face AB=DC=a, BC=AD=b and HC=EB=FA=GD=c, length of upper face FE=GH=a, EH=FG=b. length of Sars curve depending on the angles & distance between two points. But angles of lower & upper face are equal ∠A=∠B=∠C=∠D=θ & ∠E=∠F=∠G=∠H=θ.



(Figure:-3.2)



(Figure:-3.2A)

This is used in optics instruments likes as mirror and lens and other field of science. But in mathematics to find the Sars surface area, total surface area and volume as show in (Figure:-3.2A)

**3.1 Sars Surface Area:-**In upper face length of Sars curve FE, EH are different because distance FE=GH=a, EH=FG=b and in lower face length of Sars curve AB, BC are different because distance AB=DC=a, BC=AD=b.

$$\mathbf{S.S.A=} \frac{a\left[2\sin\theta+\cos^2\theta.\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}\times\frac{b\left[2\sin\theta+\cos^2\theta.\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}$$

$$\boxed{\mathbf{S.S.A=} \frac{ab\left[2\sin\theta+\cos^2\theta.\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{4\sin^2 2\theta}}$$

**3.2 Total Surface Area:-**To find whole surface area.

**T.S.A=**2×Sars surface area+2×one face area(BCHE)+2×one face area(ABEF).

$$\mathbf{T.S.A=} \frac{2ab\left[2\sin\theta+\cos^2\theta.\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{4\sin^2 2\theta}+\frac{2a\left[a\tan\theta+6c^I\right]}{6}+\frac{2b\left[b\tan\theta+6c^{II}\right]}{6}$$

$$\mathbf{T.S.A} = \frac{ab\left[2\sin\theta+\cos^2\theta.\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{2\sin^2 2\theta}+\frac{a^2\tan\theta+6ac^I}{3}+\frac{b^2\tan\theta+6bc^{II}}{3}$$

$$\textbf{T.S.A}=\frac{ab\left[2\sin\theta+\cos^2\theta.\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{2\sin^2 2\theta}+\frac{\left(a^2+b^2\right)\tan\theta+6\left(ac^I+bc^{II}\right)}{3}$$

Where $C^I$ and $C^{II}$ are the distance between upper Sars length of wire at the centre to the lower Sars length of wire at the centre.

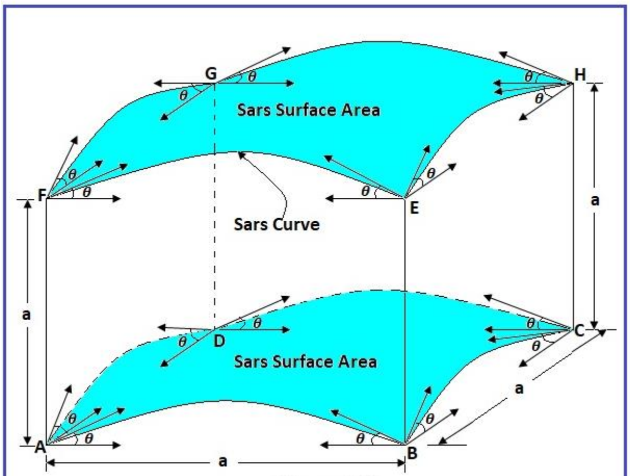
**OR**

$$\textbf{T.S.A}=\frac{2ab\left[2sin\theta+cos^2\theta\ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{4sin^2 2\theta}+2ac-\frac{4a^2tan\theta}{6}+2bc-\frac{4b^2tan\theta}{6}$$

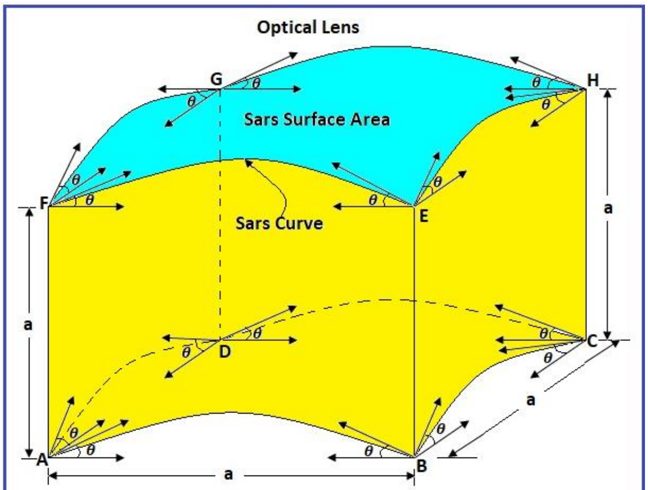
$$\textbf{T.S.A}=\frac{ab\left[2sin\theta+cos^2\theta\ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{2sin^2 2\theta}+2c(a+b)-\frac{2tan\theta}{3}(a^2+b^2)$$

**4. LU-Sars Cube:-**In this Sars cube distance of AB=BC=CH=a as show in given (Figure:-3.3) equal length of upper and lower face.

Sars length of wire depending on the angle θ & distance between two poles. In this cube angles & distance are equal, so Sars length of wire are equal. This Sars cube used in optics instrument like as Sars lens and Sars mirror.




(Figure:-3.3)




(Figure:-3.3A)

To find the Sars surface area, total surface area and volume of Sars cube.

**4.1 Sars Surface Area:-**The length of Sars wire AB=FE=BC=EH are same and angle at ∠A=∠F=∠E=∠B=θ are equal.

$$\textbf{S.S.A}=\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}\times\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}$$

$$S.S.A=\frac{a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{4\sin^2 2\theta}$$

**4.2 Total Surface Area:-**To find total surface area as show in (Figure:-3.3A)

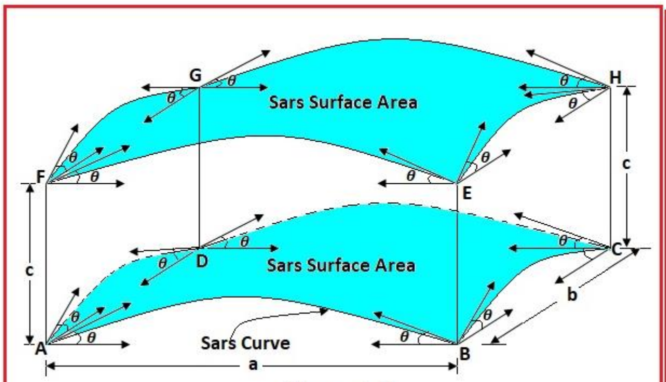
**T.S.A=** 2×Sars surface area +4×one face area (BCHE)

$$\textbf{T.S.A=}\ \frac{a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{2\sin^2 2\theta}+4a^2$$

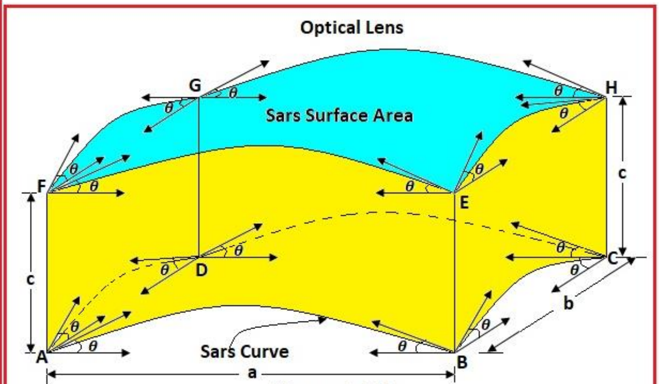
$$\textbf{T.S.A=}\ \frac{a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2+8\sin^2 2\theta}{2\sin^2 2\theta}$$

**5. LU-Sars Cuboid:-**In this Sars cuboid as show in (Figure:-3.4) length AB=FE=DC=GH=a, BC=AD=EH=FG=b, AF=BE=CH=DG=C. Length of Sars curve depending on the angles & distance between two points. But angles are equal & distance is different, so Sars length of wire is different depending on angles and distance between two points.

This LU-Sars cuboid used in optics instruments like as mirror and lens.




(Figure:-3.4)




(Figure:-3.4A)

To find the Sars surface area, Total surface area and volume of Sars cuboid.

**5.1 Sars Surface Area:-**The length of Sars wire FE, EH are different because the distance AB=a, BC=b and angles ∠G=∠A=θ

$$\textbf{S.S.A=}\ \frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}\times\frac{b\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}$$

$$\boxed{\textbf{S.S.A=}\ \frac{ab\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{4\sin^2 2\theta}}$$

**5.2 Total Surface Area:-**To find total surface area as show in (Figure:-3.4A)

**T.S.A=** 2×Sars surface area + 2×one face area (ABEF) +2×one face area (BCHE)

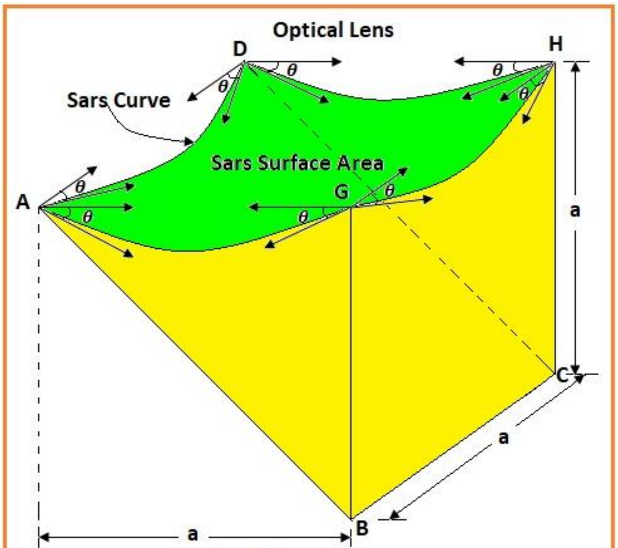
$$\textbf{T.S.A=}\ \frac{2ab\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{4\sin^2 2\theta}+2\times\left[ac+bc\right]$$

$$\textbf{T.S.A=}\frac{ab\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{2\sin^2 2\theta}+2c\left[a+b\right]$$

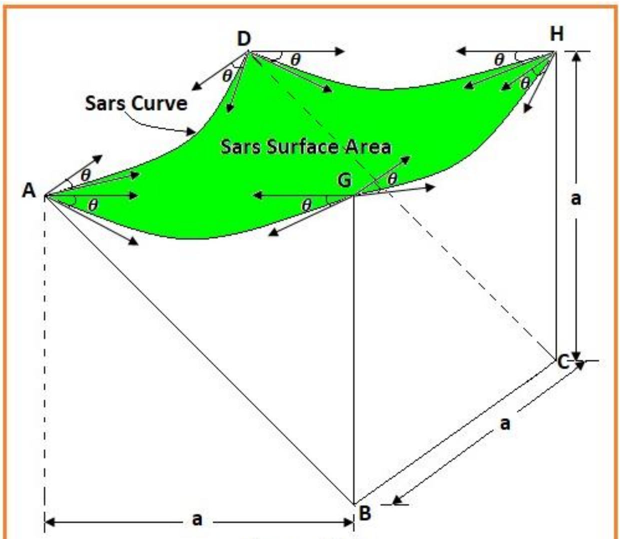
$$\textbf{T.S.A=}\frac{ab\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2+4c\left[a+b\right]\sin^2 2\theta}{2\sin^2 2\theta}$$

Where the area of face (ABFE) are equal as area of rectangle.

**6. L-Half Sars Cube:-** In this Sars cube length of AG=GH=HD=DA=a, equal length of upper face as show in (Figure:-3.5). Length of Sars curve depending on the angles θ and distance between two points. The angles are equal, so the length of Sars curve are equal. This Sars cube used in optics instruments like as mirror and lens.To find the Sars surface area, total surface area and volume of Sars cube.




(Figure:-3.5A)




(Figure:-3.5)

**6(a). Sars Surface Area:-**The Sars length of wire AG=GH are equal because distance AG=GH=a and angles ∠A=∠G=θ

$$\textbf{S.S.A=}\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}\times\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}$$

$$\textbf{S.S.A=}\frac{a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1+\sin\theta}\right|\right]^2}{4\sin^2 2\theta}$$

**6(b).Total Surface Area:-** To find the total surface of L- Half Sars cube.

**T.S.A**= Sars surface area + Area of face (GBCH) + Area of face (ABCD) + 2× Area of face (ABG).

$$\mathbf{T.S.A}=\frac{a^2\left[2sin\theta+cos^2\theta\ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{4sin^2 2\theta}+a^2+\sqrt{2}a^2+2\times\frac{a^2}{2}-4\times\frac{a^2tan\theta}{6}$$

$$\mathbf{T.S.A} = \frac{a^2\left[2sin\theta + cos^2\theta \ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{4sin^2 2\theta} + 2a^2 + \sqrt{2}a^2 - 2\times\frac{a^2 tan\theta}{3}$$

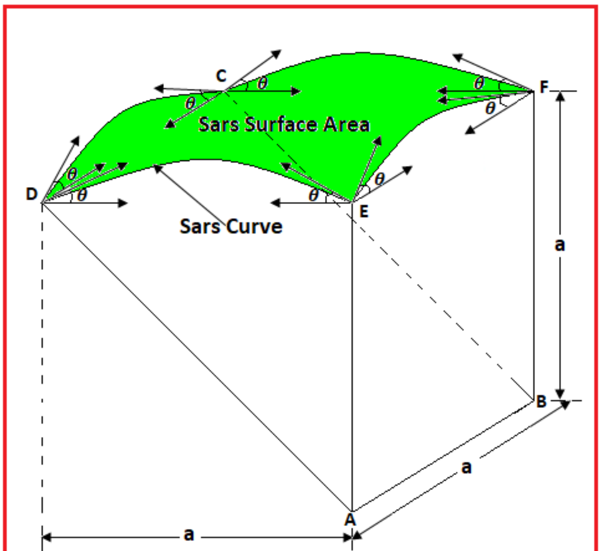
$$\mathbf{T.S.A} = \frac{a^2\left[2sin\theta + cos^2\theta \ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{4sin^2 2\theta} + 2a^2\left(1-\frac{tan\theta}{3}\right) + \sqrt{2}a^2$$

**6.1 U-Half Sars Cube:-** In this Sars cube length of DE=EF=FC=CD=a as show in (Figure:-3.6). Length of Sars wire depends on the angles θ and distance between two points. The angles are equal, so length of Sars curve are equal. This U-half sars cube used in optics instruments likes as mirror and lens. In mathematics to find the Sars surface area, total surface area, volume of U-half Sars cube.

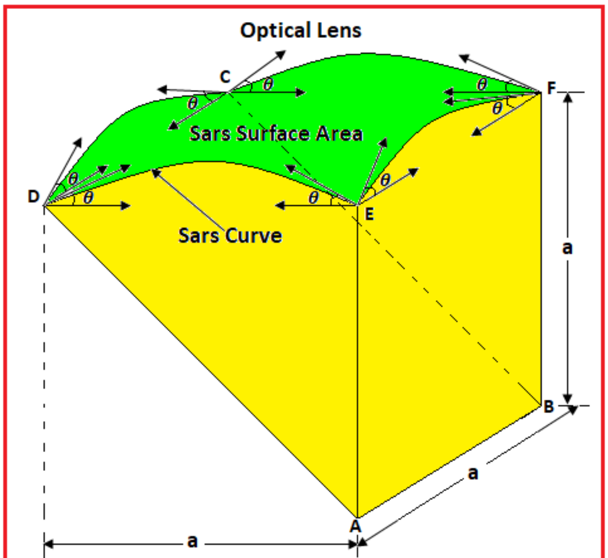
**6.1(a) Sars Surface Area:-** The length of Sars wire DE=EF are equal because distance DE=EF=a and angles ∠F=∠E=θ as show in (Figure:-3.6).

$$\mathbf{S.S.A=}\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}\times\frac{a\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]}{2\sin 2\theta}$$

$$\mathbf{S.S.A=}\frac{a^2\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]^2}{4\sin^2 2\theta}$$



(Figure:-3.6)



(Figure:-3.6A)

**6.1(b) Total Surface Area:-** To find the whole surface area of U-half Sars cube.

**T.S.A**=Sars surface area + 2 × Area of face (AED) + Area of face (ABFE) +Area of face (ABCD).

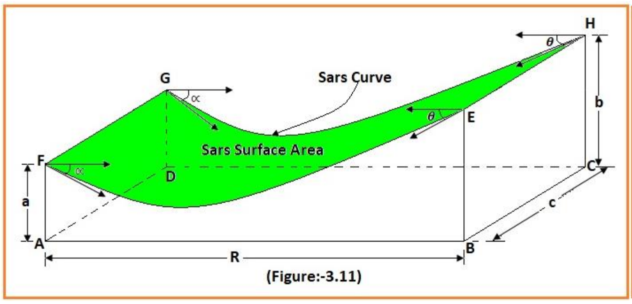
$$\mathbf{T.S.A} = \frac{a^2\left[2sin\theta + cos^2\theta \ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{4sin^2 2\theta} + a^2 + \sqrt{2}a^2 + 2\times\frac{a^2}{2} + 4\times\frac{a^2 tan\theta}{6}$$

$$\mathbf{T.S.A} = \frac{a^2\left[2sin\theta + cos^2\theta \ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{4sin^2 2\theta} + 2a^2 + \sqrt{2}a^2 + 2\times\frac{a^2 tan\theta}{3}$$

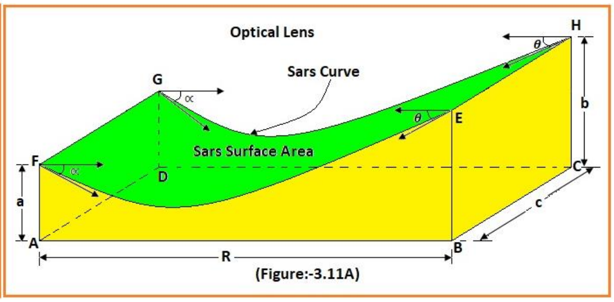
$$\mathbf{T.S.A} = \frac{a^2\left[2sin\theta + cos^2\theta \ln\left|\frac{(1+sin\theta)}{(1-sin\theta)}\right|\right]^2}{4sin^2 2\theta} + 2a^2\left(1+\frac{tan\theta}{3}\right) + \sqrt{2}a^2$$

**7. L-Sars Cuboid:-** In this Sars cuboid length of Sars wire are equal because both side angles ∠E=∠G=α and ∠F=∠H=θ distance AB=DC= R, BC=FH=C, AE=DG=a, BF=CH=b.
Length of Sars wire depends on the distance between two points and angles α, θ (where θ >α) as show in (Figure:-3.11).
This L-Sars cuboid used in optics instruments like as mirror and lens or in mathematics.
Find the Sars surface area, total surface area and volume of L-Sars cuboid.

**7(a) Sars Surface Area:-** Length of Sars curve is equal EF=GH and angles ∠E=∠G=α, ∠F=∠H=θ, distance AB=DC=R. **S.S.A =** Length of Sars wire × C



(Figure:-3.11)



(Figure:-3.11A)

$$\textbf{S.S.A=} \frac{CR}{2\sin(\theta+\alpha)} \times \left[\tan\alpha\cos\theta + \tan\theta\cos\alpha + \cos\theta\cos\alpha \ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right|\right]$$

**7(b)Tsotal Surface Area:-** To find total surface area of L-Sars cuboid

**T.S.A=** S.S.A. + bC + CR + 2 × Area of face (ABFE)

$$\textbf{T.S.A=} \quad S.S.A \quad + \quad (b+R+a)C \quad + \quad 2Rb - \frac{R^2\tan^2\theta}{(\tan\theta+\tan\alpha)} + \frac{R^2}{3(\tan\theta+\tan\alpha)^2}\left[\tan^3\theta+\tan^3\alpha\right]$$

$$\mathbf{T.S.A} = S.S.A + (a+b+R)c + 2bR - \frac{R^2}{(\tan\theta+\tan\propto)}\left[tan^2\theta - \frac{(tan^3\theta + tan^3\propto)}{3(\tan\theta+\tan\propto)}\right]$$

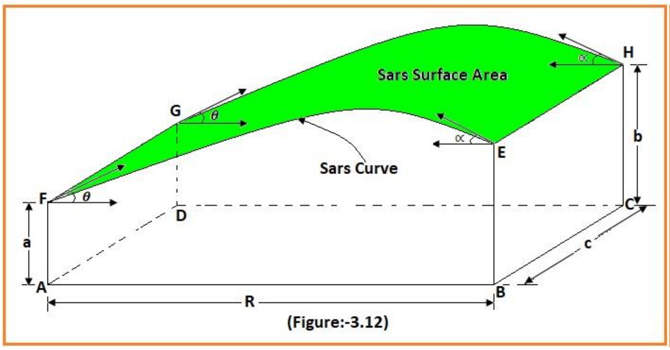
**7(c) Volume:-** To find volume of L-Sars cuboid.

**Volume =** Area of face (ABFE) × Distance BC

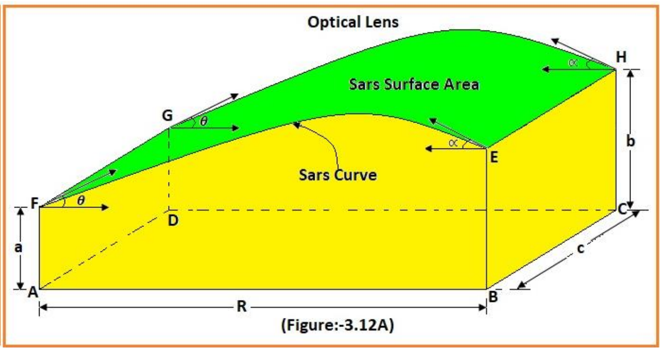
$$\textbf{Volume} = Rbc - \frac{R^2c\tan^2\theta}{2(\tan\theta+\tan\alpha)} + \frac{R^2c}{6(\tan\theta+\tan\alpha)^2}\left[\tan^3\theta+\tan^3\alpha\right]$$

$$\textbf{Volume} = Rbc - \frac{R^2c}{2(\tan\theta + \tan\propto)}\left[tan^2\theta - \frac{(tan^3\theta + tan^3\propto)}{3(\tan\theta + \tan\propto)}\right]$$

**7.1 U- Sars Cuboid:-** In this U-Sars cuboid length of Sars wire is equal because both side angles ∠F=∠G=θ, ∠E=∠H=α distance AB=DC=R, BC=EH=c, BE=CH=b, AF=DG=a.



(Figure:-3.12)



(Figure:-3.12A)

Length of Sars wire depends on the distance R between two points and angles θ, α (where θ>α) as show in (Figure:-3.12).

This U-Sars cuboid used in optics instruments like as mirror and lens or in mathematics.

Find the Sars surface area, total surface area and volume of U-Sars cuboid.

**7.1(a) Sars Surface Area:-**Length of Sars wire is same FE=GH and angles ∠F=∠G=θ, ∠E=∠H=α, distance AB=DC=R.

**S.S.A=** Length of Sars wire × c

$$\textbf{S.S.A=}\frac{Rc}{2\sin(\theta+\alpha)}\times\left[\tan\alpha\cos\theta+\tan\theta\cos\alpha+\cos\theta\cos\alpha\ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right|\right]$$

**7.1(b) Total Surface Area:-**To find total surface area of U-Sars cuboid.

**T.S.A =** S.S.A + bc +Rc +ac + 2× area of face (ABEF)

$$\textbf{T.S.A =} \text{ S.S.A } + (b+R+a)c + 2aR + 2\times\frac{R^2}{2(\tan\theta+\tan\alpha)}\left[\tan^2\theta - \frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

$$\textbf{T.S.A =} \text{ S.S.A } + (b+R+a)c + 2aR + \frac{R^2}{(\tan\theta+\tan\alpha)}\left[\tan^2\theta - \frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

**7.1(c) Volume:-**To find volume of U-Sars cuboid.

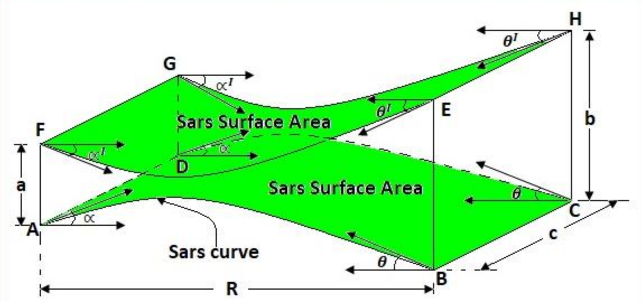
**Volume =** Area of face (ABEF) × C

$$\textbf{Volume =} \ acR + \frac{R^2c}{2(\tan\theta+\tan\alpha)}\left[\tan^2\theta - \frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

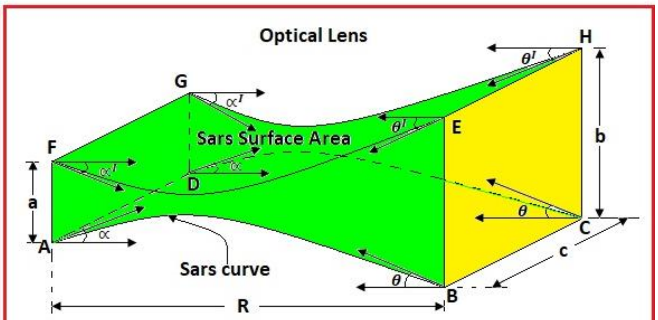
**8. LL-Sars Cuboid:-**In this LL-Sars cuboid length of Sars curve are equal because both side angles ∠E=∠H=θ^I^, ∠F=∠G=α^I^ and ∠A=∠D=α, ∠B=∠C=θ, all upper face angles are equal to the lower face angles $\theta=\theta^I$, $\alpha=\alpha^I$ (where $\theta>\alpha$ and $\theta^I>\alpha^I$).In this LL-Sars cuboid angles may be different or equal. Distance AB=DC=R, BE=CH=b, AF=DG=a, BC=EH=c.

Length of Sars wire depends on the distance between two points and angles θ, α (where θ>α) makes with horizontal as show in (Figure:-3.13).

Find the Sars surface area, total surface area and volume of LL-Sars cuboid.




(Figure:-3.13)




(Figure:-3.13A)

This LL- Sars cuboid used in optics instruments like as mirror and lens.

**8(a) Sars Surface Area:-**Length of Sars wire is equal EF=GH=AB=DC and angles ∠A=∠D=∠F=∠G=$\alpha=\alpha^I$, ∠B=∠C=∠H=∠E=$\theta=\theta^I$ distance AB=R

**S.S.A =** Length of Sars wire × c

$$\textbf{S.S.A} = \frac{cR}{2\sin(\theta+\alpha)} \times \left[\tan\alpha\cos\theta + \tan\theta\cos\alpha + \cos\theta\cos\alpha\ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right|\right]$$

**8(b) Total Surface Area:-**To find total surface area of LL-Sars cuboid.

**T.S.A =**2 × S.S.A + (a+b)c + 2 × Area of face (ABEF)

$$\textbf{T.S.A} = 2\times S.S.A + (a+b)c + 2bR - \frac{2R^2}{(\tan\theta+\tan\alpha)}\left[\tan^2\theta - \frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

**8(c) Volume:-**To find the volume of LL-Sars cuboid.

**Volume =**Area of face (ABEF) × Distance BC

$$\textbf{Volume} = Rbc - \frac{R^2c\tan^2\theta}{(\tan\theta+\tan\alpha)} + \frac{R^2c}{3(\tan\theta+\tan\alpha)^2}\left[\tan^3\theta+\tan^3\alpha\right]$$

$$\textbf{Volume} = Rbc - \frac{R^2c}{(\tan\theta+\tan\alpha)}\left[\tan^2\theta - \frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

**8.1 LL-Sars Cuboid:-**In this LL-Sars cuboid length of Sars wire are equal because both side angles ∠A=∠D=$\theta^I$, ∠B=∠C=$\alpha^I$, ∠F=∠G=α, ∠E=∠H=θ, all upper face angles are equal to the lower face angles $\theta=\theta^I$, $\alpha=\alpha^I$ (where $\theta>\alpha$ and $\theta^I>\alpha^I$).In this LL-Sars cuboid angles may be different or same. Distance AB=DC=R, BE=CH=a, AF=DG=a, BC=EH=c. Length of Sars wire depends on the distance between two points and angles θ, α (where θ>α) makes with horizontal as show in (Figure- 3.14).

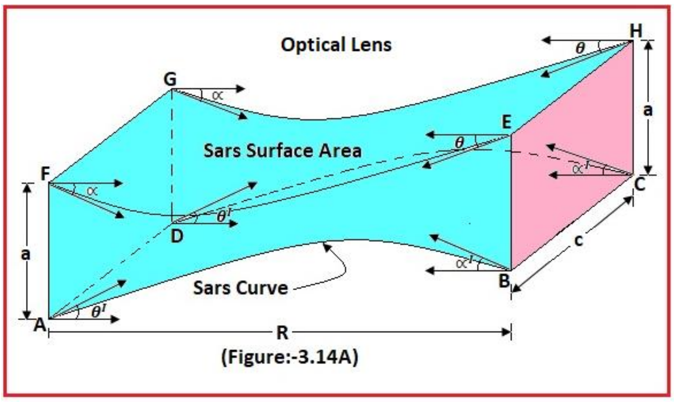
Find the Sars surface area, whole surface area and volume of LL-Sars cuboid.

This LL- Sars cuboid used in optics instruments like as mirror and lens.

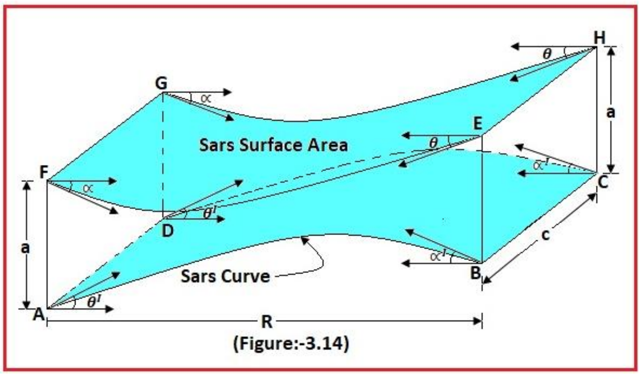
**8.1(a) Sars Surface Area:-**

**S.S.A** = Length of Sars wire × c

$$\textbf{S.S.A} = \frac{cR}{2\sin(\theta+\alpha)} \times \left[ \tan\alpha\cos\theta + \tan\theta\cos\alpha + \cos\theta\cos\alpha \ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right| \right]$$



(Figure:-3.14A)



(Figure:-3.14)

**8.1(b) Total Surface Area:-**To find whole surface area of LL-Sars cuboid.

**T.S.A** = 2×S.S.A + 2ac +2×area of face (ABEF).

$$\textbf{T.S.A} = 2 \times S.S.A + 2ac + 2aR + 2S_0R - \frac{4 \times R^2}{2(\tan\theta + \tan\propto)}\left[tan^2\theta - \frac{(tan^3\theta + tan^3\propto)}{3(\tan\theta + \tan\propto)}\right]$$

$$\textbf{T.S.A} = 2 \times S.S.A + 2ac + 2aR + 2R\left[S_0 - \frac{Rtan^2\theta}{(\tan\theta + \tan\propto)} + \frac{R(tan^3\theta + tan^3\propto)}{3(tan\theta + tan\propto)^2}\right]$$

$$\textbf{T.S.A} = 2 \times S.S.A + 2ac + 2aR + 2R\left[\frac{R}{2}(tan\theta - tan\propto) - \frac{Rtan^2\theta}{(\tan\theta + \tan\propto)} + \frac{R(tan^3\theta + tan^3\propto)}{3(tan\theta + tan\propto)^2}\right]$$

$$\textbf{T.S.A} = 2 \times S.S.A + 2ac + 2aR + 2R^2\left[\frac{(tan\theta - tan\propto)}{2} - \frac{tan^2\theta}{(\tan\theta + \tan\propto)} + \frac{(tan^3\theta + tan^3\propto)}{3(tan\theta + tan\propto)^2}\right]$$

$$\textbf{T.S.A} = 2 \times S.S.A + 2ac + 2aR + 2R^2\left[\frac{tan^2\theta - tan^2\propto - 2tan^2\theta}{2(\tan\theta + \tan\propto)} + \frac{(tan^3\theta + tan^3\propto)}{3(tan\theta + tan\propto)^2}\right]$$

$$\textbf{T.S.A} = 2 \times S.S.A + 2ac + 2aR + 2R^2\left[\frac{-tan^2\theta - tan^2\propto}{2(\tan\theta + \tan\propto)} + \frac{(tan^3\theta + tan^3\propto)}{3(tan\theta + tan\propto)^2}\right]$$

$$\textbf{T.S.A} = 2 \times S.S.A + 2a(R+c) - \frac{2R^2}{(\tan\theta + \tan\alpha)}\left[\frac{(\tan^2\theta + \tan^2\alpha)}{2} - \frac{(\tan^3\theta + \tan^3\alpha)}{3(\tan\theta + \tan\alpha)}\right]$$

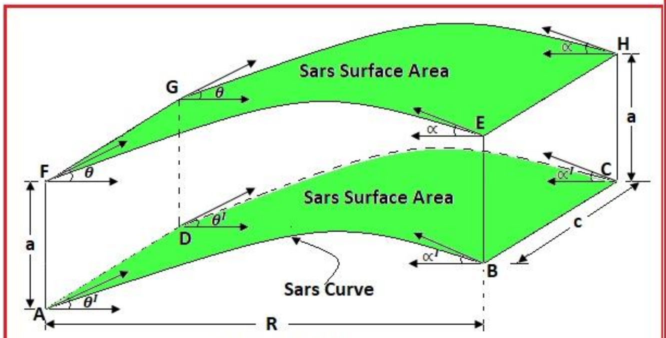
**8.1(c) Volume:-**To find the volume of LL-Sars cuboid.

**Volume** = Area of face (ABEF) × Distance BC

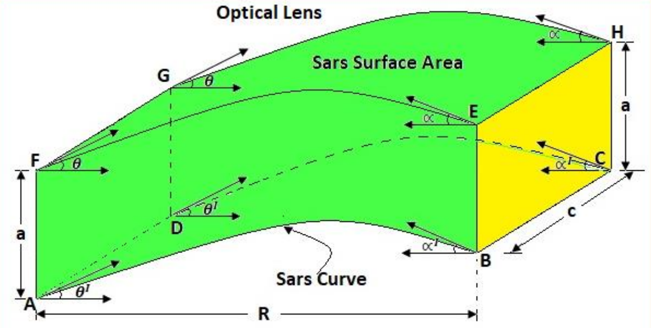
$$\textbf{Volume} = Rac - \frac{R^2c}{(\tan\theta + \tan\alpha)}\left[\frac{(\tan^2\theta + \tan^2\alpha)}{2} - \frac{(\tan^3\theta + \tan^3\alpha)}{3(\tan\theta + \tan\alpha)}\right]$$

**9 LU-Sars Cuboid:-**In this LU-Sars cuboid length of Sars wire is equal because both side angles ∠B=∠C=$\alpha^I$, ∠A=∠D=$\theta^I$, ∠E=∠H=α, ∠F=∠G=θ all upper face angles equal to the lower face angles but angles may be different. Distance AB=DC=R, BC=AD=c, BE=CH=AF=DG=a as show in

(Figure:-3.15).
Length of Sars wire depends on the distance between two points and angles θ, α (where θ>α in this cube $\theta=\theta^I$, $\alpha=\alpha^I$).
Find the Sars surface area, whole surface area and volume of LU-Sars cuboid.
LU- Sars cuboid used in optics instruments like as mirror and lens.



(Figure:-3.15)



( Figure:-3.15A)

**9(a) Sars Surface Area:-**Length of Sars wire is same FE=GH=AB=DC and angle $\theta=\theta^I$ , $\alpha=\alpha^I$.

**S.S.A** = Length of Sars wire × c

$$\textbf{S.S.A} = \frac{cR}{2\sin(\theta+\alpha)} \times \left[ \tan\alpha\cos\theta + \tan\theta\cos\alpha + \cos\theta\cos\alpha \ln\left| \frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)} \right| \right]$$

**9(b) Total Surface Area:-**To find total surface area of LU-Sars cuboid.

**T.S.A** = 2 × S.S.A +2ac + 2aR

**T.S.A** = 2[ S.S.A + a(R + c) ]

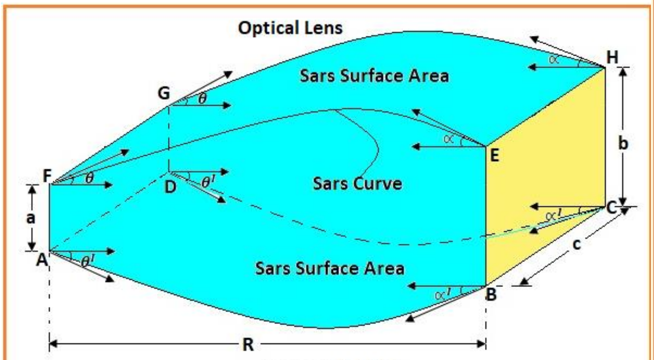
**9(c) Volume:-**To find the volume of LU-Sars cuboid.

**Volume** = Area of face (ABEF) × C

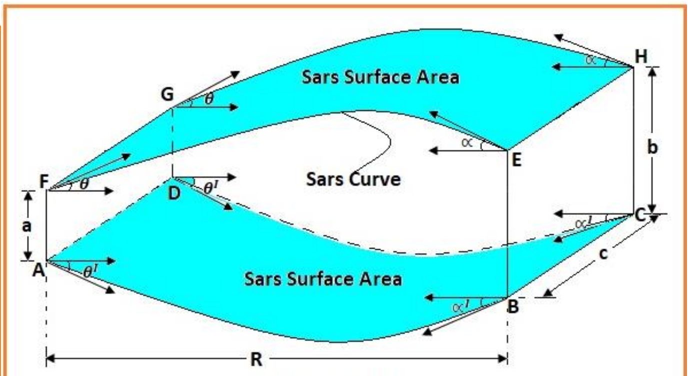
**Volume** = Ra × c

**Volume** = a×c×R

**9.1 UU-Sars cuboid:-**In this UU-Sars cuboid length of Sars wire is equal because both side angles $\angle B=\angle C=\alpha^I$, $\angle A=\angle D=\theta^I$, ∠E=∠H=α, ∠F=∠G=θ all upper face angles equal to the lower face angles but angles may be different. Distance AB=DC=R, BC=AD=c, BE=CH=b, AF=DG=a as show in (Figure:-3.16).
Length of Sars wire depends on the distance between two points and angles θ, α
(where θ>α in this cube $\theta=\theta^I$, $\alpha=\alpha^I$).
Find the Sars surface area, total surface area and volume of UU-Sars cuboid.
UU- Sars cuboid used in optics instruments like as mirror and lens.



(Figure:-3.16A)



(Figure:-3.16)

**9.1(a) Sars Surface Area:-** Length of Sars wires are same EF=GH=AB=DC and angle ∠F=∠G=θ, ∠E=∠H=α and distance AB=FE=R.

**S.S.A =** Length of Sars wire × C

**S.S.A =** $$\frac{cR}{2\sin(\theta+\alpha)}\times\left[\tan\alpha\cos\theta+\tan\theta\cos\alpha+\cos\theta\cos\alpha\ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right|\right]$$

**9.1(b) Total Surface Area:-**To find total surface area of UU-Sars cuboid.

**T.S.A =** 2 × S.S.A + (a+b)c + 2 × Area of face (ABEF)

**T.S.A =** $$2\times \text{S.S.A} + (a+b)c + 2aR + \frac{2R^2}{(\tan\theta+\tan\alpha)}\left[\tan^2\theta-\frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

**9.1(c) Volume:-** To find the volume of UU-Sars cuboid.

**Volume =** Area of face (ABEF) × distance BC

**Volume =** $$acR+\frac{cR^2}{(\tan\theta+\tan\alpha)}\left[\tan^2\theta-\frac{(\tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

**10. LL-Sars cuboid:-** In this Sars cuboid length of Sars wire is different because both side angles ∠B=∠C= ∠A=∠D=$\theta^I$, ∠E=∠H=θ, ∠F=∠G=α, all upper face angles different to the lower face angles but angles may not be equal . Distance AB=DC=R, BC=AD=c, BE=CH=b, AF=DG=a as show in (Figure:-3.17).

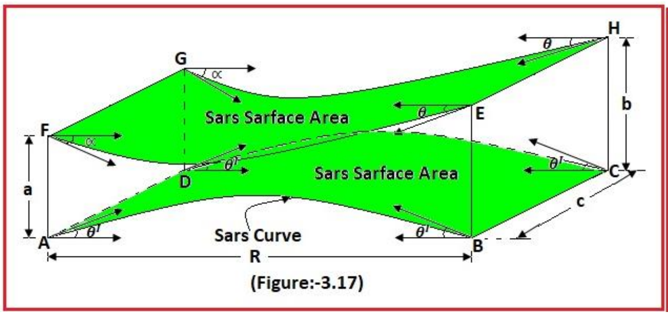
Length of Sars wire depends on the distance between two points and angles θ, α

(where θ>α in this cube θ=$\theta^I$ ).

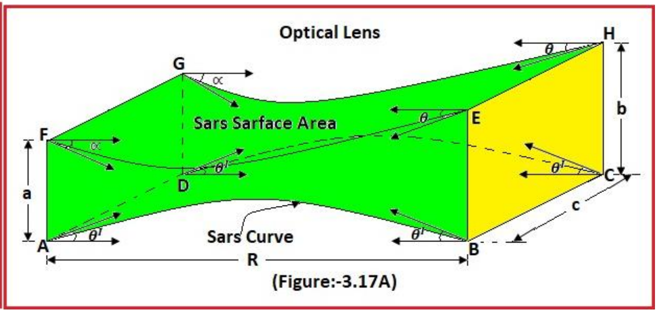
Find the Sars surface area, total surface area and volume of LL-Sars cuboid.

LL- Sars cuboid used in optics instruments like as mirror and lens.

**10(a) Sars Surface Area:-** Length of Sars wire is different EF=GH≠AB=DC and angle ∠E=∠H=θ, ∠A=∠B=∠C=∠D=$\theta^I$, ∠F=∠G=α and distance AB=FE=R.




(Figure:-3.17)




(Figure:-3.17A)

**S.S.A of upper face** = $\dfrac{cR}{2\sin(\theta+\alpha)} \times \left[ \tan\alpha\cos\theta + \tan\theta\cos\alpha + \cos\theta\cos\alpha \ln\left|\dfrac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right| \right]$

$$\textbf{S.S.A of lower face} = \frac{cR\left[2sin\theta^I + cos^2\theta^I \ln\left|\frac{(1+sin\theta^I)}{(1-sin\theta^I)}\right|\right]}{2sin2\theta^I}$$

**10(b) Total Surface Area:-**To find whole surface area of Sars cuboid.

**T.S.A** = S.S.A of upper face + S.S.A of lower face + (a+b)c+2×Area of face (ABEF).

$$\textbf{T.S.A} = \text{S.S.A of upper face} + \text{S.S.A of lower face} + (a+b)c + 2\times bR - \frac{R^2}{(\tan\theta+\tan\propto)}\left[\tan^2\theta - \frac{(\tan^3\theta+\tan^3\propto)}{3(\tan\theta+\tan\propto)}\right] - \frac{2R^2\tan\theta^I}{3}$$

**10(c) Volume:-** To find the volume of LL-Sars cuboid.

**Volume** = Area of face (ABEF) × C

$$\textbf{Volume} = bcR + \frac{R^2c\tan\theta}{12} - \frac{R^2c}{(\tan\theta+\tan\alpha)}\left[\tan^2\theta - \frac{(\tan^3\theta+\tan^3\alpha)}{6(\tan\theta+\tan\alpha)}\right]$$

**10.1 LU- Sars cuboid:-** In this LU-Sars cuboid length of Sars wire is different because both side angles ∠B=∠C= ∠A=∠D=$\theta^I$, ∠F=∠G=θ, ∠E=∠H=α, all upper face angles different to the lower face angles but angles may not be equal . Distance AB=DC=R, BC=AD=c, BE=CH=b, AF=DG=a as show in (Figure-3.18).

Length of Sars wire depends on the distance between two points and angles θ, α

(where θ>α in this cube θ=$\theta^I$ ).

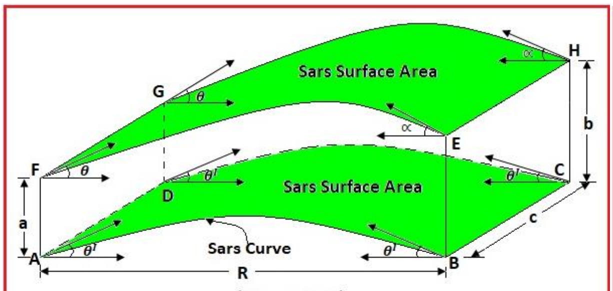
Find the Sars surface area, total surface area and volume of LU-Sars cuboid.

LU- Sars cuboid used in optics instruments like as mirror and lens.

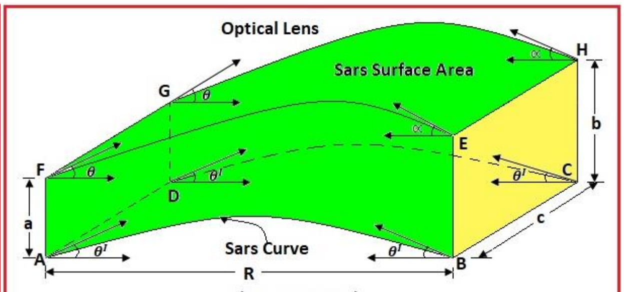
**10.1(a) Sars surface Area:-**Length of Sars wire of upper face and lower face are different because ∠F=∠G=θ, ∠E=∠H=α, ∠B=∠C= ∠A=∠D=$\theta^I$, AB=R.

**S.S.A of upper face** = $\dfrac{cR}{2\sin(\theta+\alpha)} \times \left[ \tan\alpha\cos\theta + \tan\theta\cos\alpha + \cos\theta\cos\alpha \ln\left|\dfrac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right| \right]$

$$\textbf{S.S.A of lower face} = \frac{cR\left[2sin\theta^I + cos^2\theta^I \ln\left|\frac{(1+sin\theta^I)}{(1-sin\theta^I)}\right|\right]}{2sin2\theta^I}$$



(Figure:-3.18)



(Figure:-3.18A)

**10.1(b) Total Surface Area:-**To find total surface area of LU-Sars cuboid.

**T.S.A** = S.S.A of upper face +S.S.A of lower face +(a+b)c +2 × Area of face (ABEF).

**T.S.A** = S.S.A of upper face +S.S.A of lower face +

$$(a+b)c+2aR-\frac{R^2\tan\theta}{3}+\frac{R^2}{(\tan\theta+\tan\alpha)}\left[\tan^2\theta-\frac{(tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

**10.1(c) Volume:-**To find the volume of LU-Sars cuboid.

**Volume =** Area of face (ABEF) × C

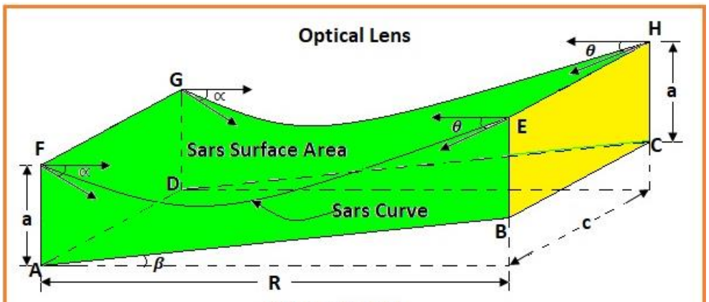
$$\textbf{Volume = } aRc-\frac{R^2c\tan\theta}{6}+\frac{R^2c}{2(\tan\theta+\tan\alpha)}\left[\tan^2\theta-\frac{(tan^3\theta+\tan^3\alpha)}{3(\tan\theta+\tan\alpha)}\right]$$

**11.L-Half Sars cuboid:-**In this L- Sars cuboid length of Sars wire is equal because both side angles ∠E=∠H=θ, ∠F=∠G=α. Distance AB=DC=R, BC=AD=c, BE=CH=a, AF=DG=a as show in (Figure-3.19).

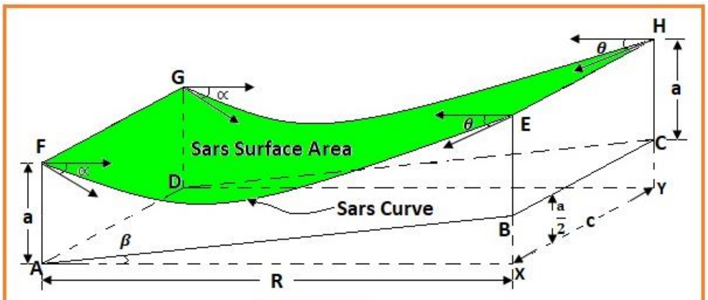
Length of Sars wire depends on the distance between two points and angles θ, α (where θ > α ).

Find the Sars surface area, total surface area and volume of L-half Sars cuboid.

L- half Sars cuboid used in optics instruments like as mirror and lens.



(Figure:-3.19A)



(Figure:-3.19)

**11(a) Sars surface Area:-** Length of Sars wire

is equal FE=GH angles ∠E=∠H=θ, ∠F=∠G=α, distance R.

$$\textbf{S.S.A =}\frac{cR}{2\sin(\theta+\alpha)}\times\left[\tan\alpha\cos\theta+\tan\theta\cos\alpha+\cos\theta\cos\alpha\ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right|\right]$$

**11(b) Total Surface Area:-**To find total surface area of L-Half Sars cuboid.
**T.S.A =** S.S.A +2ac +2 × Area of face (ABEF).

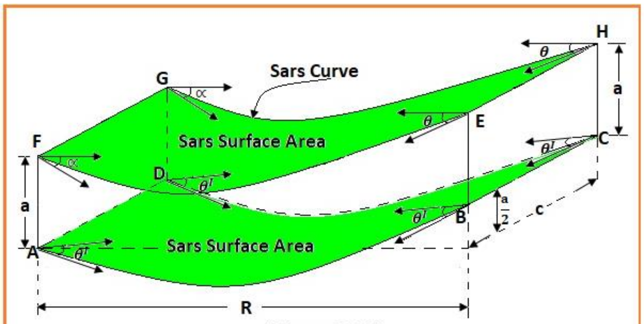
$$\mathbf{T.S.A} = S.S.A + 2ac + \frac{5aR}{2} - \frac{R^2}{(\tan\theta + \tan\propto)}\left[tan^2\theta - \frac{(tan^3\theta + tan^3\propto)}{3(\tan\theta + \tan\propto)}\right] + \frac{c\sqrt{4R^2 + a^2}}{2}$$

**11(c) Volume:-**To find the volume of L-Half Sars cuboid.

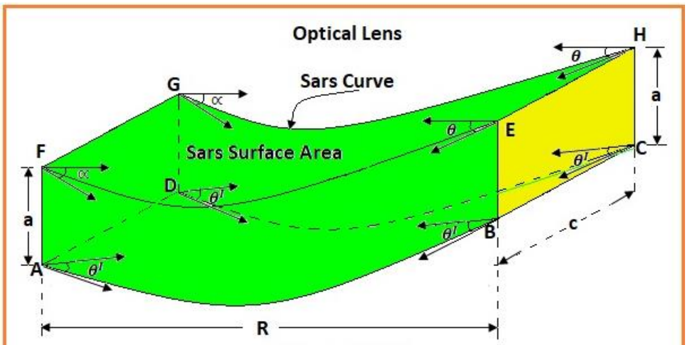
**Volume =** Area of face (ABEF) × C

$$\mathbf{Volume} = \frac{5aR}{4} - \frac{R^2 c}{2(\tan\theta + \tan\propto)}\left[tan^2\theta - \frac{(tan^3\theta + tan^3\propto)}{3(\tan\theta + \tan\propto)}\right]$$

**11.1 LU-Half Sars cuboid:-**In this LU-Half Sars cuboid length of Sars wire is different because both side angles ∠B=∠C= ∠A=∠D=$\theta^I$, ∠E=∠H=θ, ∠F=∠G=α, all upper face angles different to the lower face angles but angles may not be equal . Distance AB=DC=R, BC=AD=c, BE=CH=a, AF=DG=a as show in (Figure-3.20).
Length of Sars wire depends on the distance between two points and angles θ, α
(where θ>α in this cube θ=$\theta^I$ ).
Find the Sars surface area, total surface area and volume of LU-Half Sars cuboid.



(Figure:-3.20)



(Figure:-3.20A)

LU-Half Sars cuboid used in optics instruments like as mirror and lens.

**11.1(a) Sars surface Area:-**Length of Sars wire of upper face and lower face is different because ∠B=∠C= ∠A=∠D=$\theta^I$, ∠E=∠H=θ, ∠F=∠G=α, distance AB=$\frac{\sqrt{4R^2+a^2}}{2}$

$$\textbf{S.S.A of upper face}=\frac{cR}{2\sin(\theta+\alpha)}\times\left[\tan\alpha\cos\theta+\tan\theta\cos\alpha+\cos\theta\cos\alpha\ln\left|\frac{\cos\theta(1+\sin\alpha)}{\cos\alpha(1-\sin\theta)}\right|\right]$$

$$\textbf{S.S.A of lower face}=\frac{c\sqrt{4R^2+a^2}}{4\sin 2\theta}\left[2\sin\theta+\cos^2\theta\ln\left|\frac{1+\sin\theta}{1-\sin\theta}\right|\right]$$

**11.1(b) Total Surface Area:-**To find whole surface area of LU-Half Sars cuboid.

**T.S.A=** S.S.A of upper face +S.S.A of lower face +2ac +2 × Area of face (ABEF).

$$\mathbf{T.S.A} = \text{S.S.A of upper face} + \text{S.S.A of lower face} + 2\text{ac} + \frac{5aR}{2} + \frac{(4R^2 + a^2)tan\theta}{12} - \frac{R^2}{(\tan\theta + \tan\propto)}\left[tan^2\theta - \frac{(tan^3\theta + tan^3\propto)}{3(\tan\theta + \tan\propto)}\right]$$

**11.1(c) Volume:-**To find the volume of LU-Half Sars cuboid.

**Volume** = Area of face (ABEF) ×C

$$\mathbf{Volume} = \frac{5aRc}{4} + \frac{(4R^2 + a^2)c.tan\theta}{24} - \frac{R^2c}{(\tan\theta + \tan\propto)}\left[tan^2\theta - \frac{(tan^3\theta + tan^3\propto)}{3(\tan\theta + \tan\propto)}\right]$$