Bachelor of Architecture

Mathematics

Lecture 3

In this lecture we are going to discuss about the Area of plane figures, Computation of volume of solids and the finally summary.

Area of plane figures:

Area of plane figures is very important in the area of architecture to measure and construct the design the area. The very basic plane figure is square.We know the area of the square can be calculated by multiplying the sides where the area of square is a^2. Then rectangle in square all the sides are equal but in rectangle opposite sides are equal in length and all the angles are equal to 90 degree. Here to find the area of the rectangle length of the rectangle and the breadth of the rectangle are multiplied.

Then circle we know the area of the circle can be calculated by the formula πr^2 where π is constant whose value is 3.14 and r is the radius of the circle.The radius can be in centimeter, millimeter etc.

Next the ellipse we know the ellipse is the bulged circle. Radius of the ellipse will not be equal. In ellipse two types of axis are there i.e., major axis and minor axis. The term major is used to denote the larger length and the term minor is used to denote the smaller length. Here the radius of major axis is given by r_2 and the radius of the minor axis is given by r_1. So the area of the ellipse can be computed using the formula,

$\pi \times r_1 r_2$.

Equilateral triangle:

Then one of the important shapes in the area of plane figure is triangle, in triangle there are many types for each triangle different formula is there to the area of the triangle. Here we took the equilateral triangle as a first case. Equilateral triangle means all the three side are equal. Then the area of this equilateral triangle can be calculated using the formula,

$$= \sqrt{\frac{3}{4}} \times a^2$$

Where ‘a’ is the length of any one side. Then we know that in a triangle sum of allthree angle is equal to 180^0.

Right angle triangle:

Next type of triangle is right angle triangle and the area of this right angle triangle is obtained using the formula

$$= \frac{1}{2}(b.h)$$

Where b is the base of the triangle and h is the height of the triangle. This is called right angle triangle because the angle connecting the base and the height is 90^0. For this right angle triangle pythagoras theorem can be applied which says that sum of square of any two side is equal to the square of other two sides.This theorem is applicable to the right angle triangle.

Obtuse angle triangle:

The next type of triangle is Obtuse angle triangle and the area of this obtuse angle triangle can be obtained using the same formula used for the right angle triangle as,

$$= \frac{1}{2}(b.h)$$

Isosceles Triangle:

And the next one is Isosceles triangle. To find the area of the isosceles triangle the same formula is used as $= \frac{1}{2}(b.h) = 2 \times b.Sinc$

Trapezoid:

Now will see the four side plane area which is trapezoid. We know the square is also a four side area and rectangle is also a four side area. There the four side has the same angles. But here in trapezoid the angles are not equal. In trapezoid the opposite sides are parallel. And area of the trapezoid can be obtained using the formula, $= \frac{1}{2}h(a.b)$

Rhombus:

The next four side shape is Rhombus. Here the diagonals are connected which are $d_1 \& d_2$. So the area of the rhombus can be obtained by, $= \frac{1}{2}(d_1.d_2)$

Parallelogram:

In parallelogram the area can be obtained by the base into height and it is given by, $= b.h$

Scalene triangle:

Area of this Scalene triangle is obtained by the formula, $= \sqrt{s(s-a)(s-b)(s-c)}$

Where $s = (a+b+c)/2$. Here a,b,c are the length of the sides of the triangle.

Regular N-gon:

Here the N represents the number of sides in the gon. If there is four sides we can call it as polygon and if there is five then we can call it as pentagon and if there is six sides we can call it as hexagon. If there is more than eight sides then it is called as N-gon. Where a is the length from center to corner. Then the area of this regular N-gon shape can be calculated by the formula, $= \left(\frac{1}{2}\right) n.Sin(360/n)a^2$

Suppose if we want to find the area of a octagon we can put 8 instead of that n.And the area of octagon will be calculated as, $= 4Sin(45)a^2$

Sector:

Sector is a small area in a circle. That sector will make a angle with the center. If the angle is 60 degree or any angle then the area of the sector can be calculated by the formula,

$$= \frac{\pi r^2}{360^0} \times \theta$$

In this diagram the sector has a angle 60 degree, if we substitute this in the place of θ. The above will equation will be reduced as,

$$= \frac{\pi r^r}{60^0}$$

Surface area of a Cube:

We know a cube is made up of six faces, So each face has area is a^2 hence the area of the cube is $6a^2$.

Curved surface area of Cylinder:

We know in cylinder two type of surface are there one is curved surface area and the other is the flat surface. So the curved surface area of the cylinder is given by $= 2\pi rh$

Cuboid:

The cuboid also has six faces but the area is not equal. Here the two faces will have the equalarea like the opposite faces will be of equal area. The total surface area will be calculated as $= 2(lb + bh + hl)$

Now will see a example to apply all the concepts so far we have seen.

Example 1:

Find the area of the figure given.

Solution:

Here this figure is made up of squares and rectangles. So first we need to find how many squares and the rectangles. So will apply the area formula to find the area of squares.

First filling the missed part will get the total square of 8 units. So the total unit of this square will be $64 Units^2$. In that

$Topcut = 2.2 = 4u^2$

$Leftcut = 2.3 = 6u^2$

$Lowercut = 2.3 = 6u^2$

Then the area of the given figure will be reducing these area from the total area of the figure.

$Area - of - figure = 64 - 4 - 6 - 6 = 48u^2$

So the area of the given figure is $48u^2$. This is how the area can be find for the given figure.

Example 2:

In this example the figure is made up of square, rectangle and then four side shape etc like that many shapes are included. Here what we need to do is first find the area of the square and the area of the triangle. Then all the areas and we will get the total area of this figure.

The figure consist of central square which is (5x5), then three triangles where the first triangle in the top has bass is 5 and the height is 3, then the bottom triangle has bass is 5 and the height is2. And the trapezoid with an upper base is 4 and the lower base is 2 and height is 2.

$$Square = 5.5 = 25u^2$$

$$Top - triangle = \frac{1}{2} \times 5 \times 3 = 7.5u^2$$

$$Bottom - triangle = \frac{1}{2} \times 5 \times 2 = 5u^2$$

$$Trapezoid = \frac{(4+2).2}{2} = 6u^2$$

So sum of all this areas will be,

$$25u^2 + 7.5u^2 + 5u^2 + 6u^2 + 6u^2 = 49.5u^2$$

This is the total area of the given figure.

Volume of Cuboid:

The volume of a cuboid can be calculated using the formula,

$$= basearea \times height = length \times breadth \times height$$

Volume of Cube:

The volume of the cube can be obtained using the formula,

$$= edge \times edge \times edge = a^3$$

Volume of the Cylinder:

The volume of cylinder is given by the formula,

$$= \pi r^2 h$$

Volume of Cone:

Volume of the cone is obtained by the formula,

$= \frac{1}{3}\pi r^2 h$

Volume of sphere:

Volume of the sphere is obtained by the formula, $= \frac{4}{3}\pi r^3$

So like this the volume of different shapes can be calculated.

Summary:

So in this lecture we have learned to calculate area of different shapes and the volume of different shapes. That is area of two dimensional plane figures and the volume of some solids. And we also say some examples to find the area of the given figure.

After listening to this lecture you can answer the following questions.

Questions:

1. Find the volume of a sphere of radius 4 cm.
2. Find the total surface area of a cube of side 5cm.
3. Find the radius of the circle whose area is $20cm^2$.