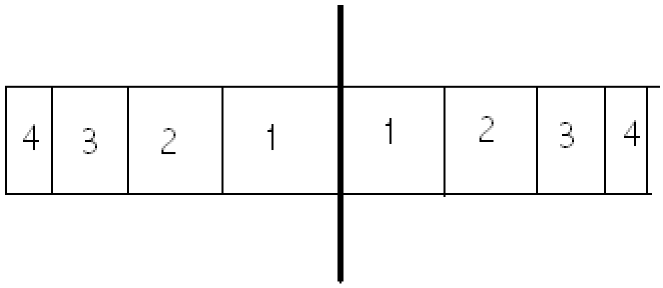
When replicating a cylinder with radius r that has n columns of squares around the outside of it then the actual width of any square on the cylinder would be the width of one column, which would be the circumference ($2\pi r$) divided by the total number of columns, so it would be ($2\pi r/ n$)

The squares would appear a different width however, the width would appear to decrease the further from the middle of the cylinder the square was.

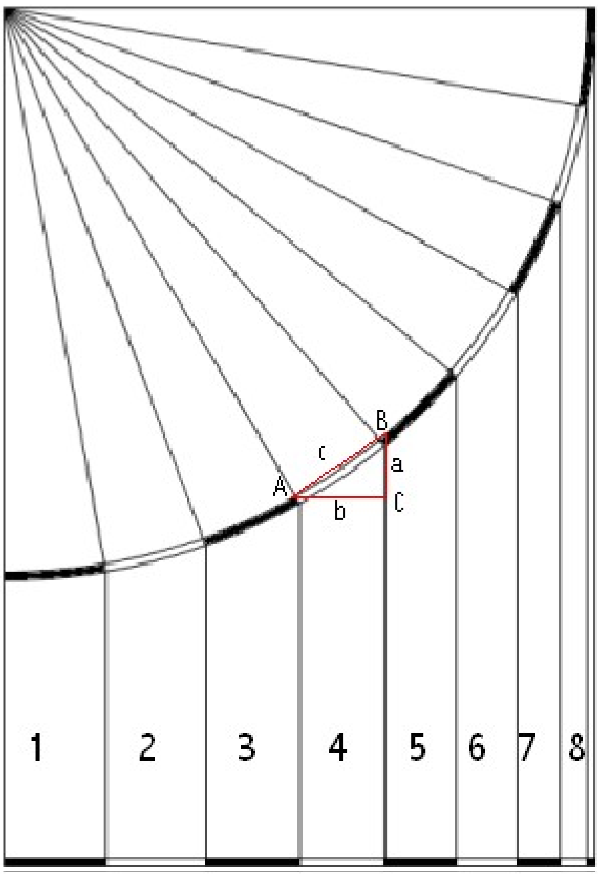
So when replicating a cylinder on a 2D surface using squares, given that you are looking directly at the ‘cylinder’ and that the middle of the cylinder lies in-between two columns of squares then the width of any given ‘square’ will be:

$2 r \text{Sin} (360/2n) \text{Cos}(360c/n – 180/n)$

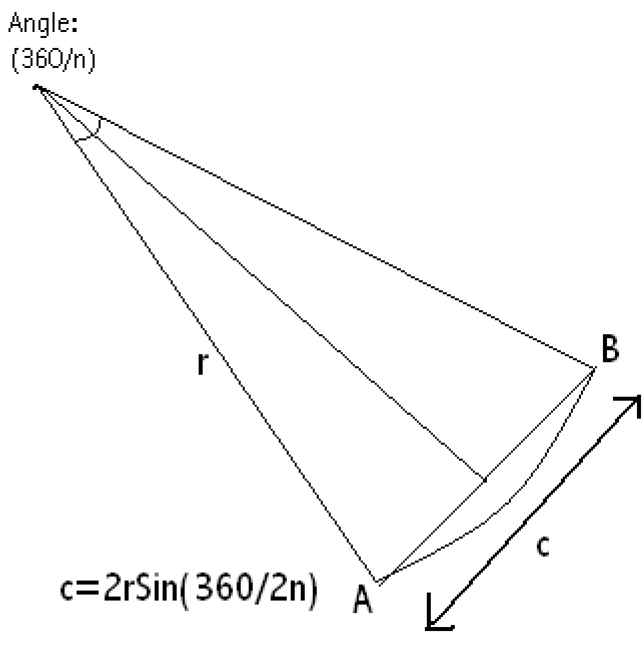
Where r is the radius of the circle, n is the number of columns of squares around the cylinder, and c is how many columns away from the middle of the cylinder the column which the square lies in is: so for example the two columns that boarder the middle of the cylinder have a c number of 1, for the next on from this c= 2 etc up until the number c/4 (as this on either side of the middle will show half of the total columns as would be seen when viewing a real cylinder.

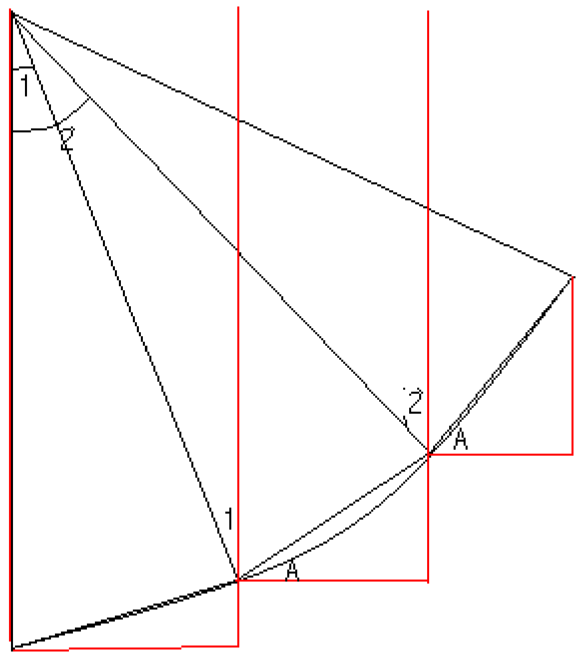


So in the inaccurate picture on the left, the line down the middle is the middle of the replicated cylinder and for each square c is the number shown.



The equation for the width is as such because to find the width of a given square, you must find the length of b in the triangle ABC shown in the diagram on the left in red. To find this you must use b= c Cos (A)





c is calculated by 2rSin(360/2n), this is because each sector of the circle in picture 2 represents a column so in the triangle that c creates with the two radii shown in picture 3, the angle enclosed by the two radii will be 360 divided by total number of columns n (360/n) and so if this triangle is split into two right angled triangles then half of c is given by
r Sin (360/2n) so c = 2 r Sin (360/n).

Therefore as b= c Cos A

b= 2 r Sin (360/2n) Cos (A)

Now we must find what the value of angle A will be for any number of columns around a cylinder and for each column number.

Because of the ‘’Z rule’’ concerning parallel lines and angles you get a set of equivalent angles shown by the 1 and 2 in the diagram, since 1 = 360/n and 2 = 2x360/n, the angle going into the cth sector would be 360c/n.

Using this, angle A would be given by

90-((90-180/n)-((c-1)(360/n))

which simplifies to give

180/n + (360c-360)/n which is equal to

360c/n – 180/n

You can also come to this conclusion by seeing that angle A will increase in a sequence with a common difference of 360/n and a first term (c number of 1) of 360/2n and therefore A can be formulated by $360/n \times c + (360/2n - 360/n) = 360c/n - 360/2n = 360c/n - 180/n$

So if $A = 360c/n - 180/n$
and $b = 2\,r\,\text{Sin}\,(360/n)\,\text{Cos}\,(A)$

Then $b = 2\,r\,\text{Sin}\,(360/2n)\,\text{Cos}\,(360c/n - 180/n)$ as said at the beginning .

So this is how to replicate a cylinder in two dimensions: drawing columns of squares out from the middle of the replicated cylinder you must make the width of each column = $2\,r\,\text{Sin}\,(360/2n)\,\text{Cos}\,(360c/n - 180/n)$ where r is the radius of the cylinder you want to replicate, n is the total number of columns around the replicated cylinder and c is the number of columns away from the middle of the cylinder. This will replicate a cylinder which has squares of actual size ($2\pi r/ n$).