In version 2.5 of AlfaCAD, a 14th (missing) element was introduced, also called a "graphic primitive", which is the Solid Arc. 14th element, next to a line, arc, circle, disk (circular disk), solid (trilateral or quadrilateral area), point, text (and multi-line text), ellipse, elliptical disk, elliptical arc, Bézier curve and graphic image (bmp, pcx, jpg or png). The other objects available in AlfaCAD are not primitives but rather composites of primitives, such as polylines (ordered groups of lines and arcs), rectangles (polylines composed of straight line segments forming rectangles), regular polygons (polylines composed of line segments grouped and forming a polygon with a given number of sides), traces (an ordered group of quadrilateral solids and, starting from version 2.5 - solid arcs), function graphs (polylines composed of line segments approximating the graph of a given real function), or sketches (polylines composed of linear segments approximating handwritten sketch curves with a given accuracy).

## What is a solid arc

A solid arc is an object created on the basis of a circular arc with the attributes of the point of the center of the circle of which the arc is a segment, the length of the radius of the circle, the starting angle of the arc, which is the internal angle between the X axis and the vector spanning between the center of the circle and the starting point of the arc, and the end angle, which is the internal angle between the X axis and the vector spanning between the center of the circle and the end point of the arc. A solid arc has an initial width, i.e. the distance between the starting points of the inner and outer arc, distant from the base arc by half the initial width respectively - towards the center of the circle and in the opposite direction, and - on a similar principle - the final width, regarding the mutual distance of the end points of both arcs.

The starting and ending width can be equal or different.
Additionally, both in the case of the initial and final width, an offset of the central axis of the arc region may be specified towards the center of the circle or away from it.

Here below is how the solid arc is constructed:


1. Arc is drawed from point 1 to 2
2. With center point of the arc the angle kat2-kat1 is calculated
3. With midangle point 4 is found
4. $w m=(w 2+w 1) / 2$ in point 4 is calculated
5. Points 5,6 and 7 are calculated based on radius - w $1 / 2$ and radius - w2/2
then points 8,9 and 10 based on radius $+\mathrm{w} 1 / 2$ and radius $+\mathrm{w} 2 / 2$
6. Beginning-Point-End arcs based on point: 5,6,7 and 8,9,10 are drawed
7. Poligon points are generated

5,8 , arcpoints( $8 \ldots 9 \ldots 10$ ), 10, 7 , arcpoints( $7 \ldots 6 \ldots 5$ );
8. Poligon is filled with color or image pattern
and here is the same with the solid arc drawn. An arc area can have an opacity attribute, and in the example below the opacity is set to $50 \%$.


The construction method described above is only effective for an arc with an internal angle of no more than 180 degrees.

For arcs with a larger angle, a different strategy is adopted, namely the entire arc is divided into 2 equal halves, and the above procedure is used for each half of the arc separately, where the final width of the first arc (cyan color) and at the same time the initial width of the second arc (blue color) is the middle value of the width of the entire arc (black color, points 6 and 9 ).


Here is the final result (with the arcs and construction points left to show that the drawn solid arc coincides with the position of the construction arcs)


The dimensioning of the arc radii shows that both internal and external arcs have different radius lengths and coordinates of the center of the circle of which they constitute a segment.


The solid arc usually constitutes a segment of the so-called a trace, i.e. a polyline composed of foursided solids and solid arc that together create a trace of constant or variable width. Due to the fact that the trace can be constructed based on its theoretical axis, the offset of which in relation to the axis of symmetry may change along the length of each section, the offset of the axis from the center of the arc area may also be different at its starting and ending points, as demonstrated by is in the examples below:


## Practical application

Here is a fragment of the drawing of the insulation details

and close-ups:


Below is an example of multiple traces drawn in different modes (like regular arcs, arc areas can be constructed using 8 different methods, although the default method is an arc tangent to the preceding segment, linear (solid) or arc (solid arc).

In the image below, an example of completely random traces using solid arcs filled with color at $100 \%$ opacity, then $15 \%$ opacity, and finally the same set of traces filled with different sample patterns.



Enjoy AlfaCAD
author

