SoftHVAC

Methods

MagiCAD Ductwork Surface

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General Information

The program allows performing the calculation of surfaces of ducts and their components,
determining the quantity of flanges, and generating a duct specification.
Initial data for calculation is the specification generated by MagiCAD.
Surfaces defined by the program correspond to the surfaces in MagiCAD.
This document provides a general description of the calculation method, namely: the principles of determining the surface, the length, the quantity of elements and their parts.

Formulas

Cylinder side surface

Surface S, m².

$S = \pi \cdot D \cdot h$.

Where:

π – is the pi number.

D – is the cylinder diameter, m.

h – is the cylinder height, m.

Parallelepiped side surface

Surface S, m².

$S = (A + B) \cdot 2 \cdot h$.

Where:

A is the first base size.

B is the second base size, m.

h is the parallelepiped height, m.

Torus surface

Surface S, m².

$S = 4 \cdot \pi^2 R \cdot r$.

Where:

π – is the pi number.

R is the radius of rotation of the torus working circle, m.

r is the radius of the torus working circle, m.

Truncated cone side surface

Surface S, m².

$S = \pi \cdot (r_1 + r_2) \cdot l$.

Where:

π – is the pi number.

r_1 is the lower base radius, m.

r_2 is the upper base radius, m.

l is the truncated cone generator, m.

Truncated pyramid side surface

Surface S, m².

$S = s_1 + s_2 + s_3 + s_4$.

$s_{1..n}$ is the surface of the side edge corresponding to the trapezoid surface, m².

$s_{1..n} = 0,5 \cdot (a + b) \cdot h$, m².

a is the trapezoid lower base, m.

b is the trapezoid upper base, m.

h is the trapezoid height, m.

Circle

Surface S, m².

$S = \pi \cdot r^2$.

Where:

π – is the pi number.

r is the circle radius, m.

Circumference l, m.

$l = \pi \cdot D$.

Where:

D is the circle diameter, m.

Rectangle

Surface S, m².

$S = A \cdot B$.

Where:

A – is the rectangle length, m.

B – is the rectangle height, m.

Perimeter P, m

$P = (A + B) \cdot 2$.

Duct

The Length is determined adjusted for the increase l_{ld}. The surface is determined based on this length.

Round duct

The Surface is determined as the cylinder side surface adjusted for the increase l_{sc}.

Rectangular duct

The Surface is determined as the parallelepiped side surface adjusted for the increase l_{sr}.

Bend

When determining the surface, the increase l_{sf} is used.

Round bend

Bending radius arc is determined based on settings for R/D.

Surface is determined as the total of:

- Torus segment side surface adjusted for the angle of rotation.
- Side surface of a 120 mm high cylinder.

Rectangular bend

Single-section bend surface is determined by the subprogram depending on the type selected in settings.

Variable-section bend surface is determined as the mean value of two different bends.

Reduction

Length is taken from MagiCAD specifications; if not specified, it is determined based on the angle α or the length L using the settings.
When determining the surface, the increase l_{sf} is used.

Round/round

Surface is determined as the total of:

- Truncated cone side surface.
- Side surface of a 120 mm high cylinder.

Rectangular/rectangular

Surface is determined as the truncated pyramid side surface.

Rectangular/round

Surface is determined as the total of:

- Average surface of equivalent round/round and rectangular/rectangular reductions.
- Side surface of a 60 mm high cylinder.

T- and X-branch

When determining the surface, the increase I_{sf} is used. Total surface is equal to the total of passage and outlet surfaces.

Round/round

Passage length is determined as the total of:

- 120 mm.
- Outlet diameter.
- Outlet diameter • 0.4.

Outlet length is determined as the total of:

- 60 mm.
- Outlet diameter • 0.15.
- Passage side overlap size, determined by the subprogram.
- Bevel size, determined by the subprogram. Only for a passage with a variable section.

Passage surface is determined as the cylinder side surface.

Outlet surface is determined as the cylinder side surface.

Rectangular/rectangular

Passage length is determined as the total of:

- 200 mm.
- Outlet width.

Outlet length is determined as the total of:

- 125 mm.
- Bevel size is determined by the subprogram. Only for a passage with a variable section.

Passage surface is determined as the parallelepiped side surface.

Outlet surface is determined as the parallelepiped side surface.

Round/Rectangular

Passage length is determined as the total of:

- 200 mm.
- Outlet width.

Outlet length is determined as the total of:

- 100 mm.
- Passage side overlap size, determined by the subprogram.
- Bevel size, determined by the subprogram. Only for a passage with a variable section.

Passage surface is determined as the cylinder side surface.

Outlet surface is determined as the parallelepiped side surface.

Rectangular/round

Passage length is determined as the total of:

- Outlet diameter.
- Outlet diameter • 0.4.

Outlet length is determined as the total of:

- Outlet diameter • 0.15.
- Bevel size, determined by the subprogram. Only for a passage with a variable section.

Passage surface is determined as the parallelepiped side surface.

Outlet surface is determined as the cylinder side surface.

Note:
Calculation of an X-branch differs from the calculation of a T-branch because the former has two outlets.

Y-branch

When determining the surface, the increase l_{sf} is used.

Total length of all outlets is determined as the total of:

- 180 mm.
- Outlet diameter • 3.

Outlet surface is determined as the cylinder side surface.

Outlet

When determining the surface, the increase l_{sf} is used.

Round cut into the round

Length is determined as the total of:

- Outlet diameter • 0.15.
- Passage side overlap size, determined by the subprogram.

Surface is determined as the cylinder side surface.

Rectangular cut into the rectangular

Length equals 125 mm.

Surface is determined as the parallelepiped side surface.

Rectangular cut into the round

Length is determined as the total of:

- 100 mm.
- Passage side overlap size, determined by the subprogram.

Surface is determined as the parallelepiped side surface.

Round cut into the rectangular

Length equals outlet diameter • 0.15.

Surface is determined as the cylinder side surface.

Box

When determining the surface, the increase l_{sf} is used.
Surface is determined as the parallelepiped full surface.

Plug, plug for outlet

When determining the surface, the increase l_{sf} is used.

Round

Surface is determined as the circle surface.

Rectangular

Surface is determined as the rectangle surface.

Material Thickness

Determined according to intervals of section sizes specified in the program settings.

Ducts Connections

When determining the lengths of flanges and sealing tape, the increase l_{lf} is used.

Quantity of connections is determined as the total of connections:

- Duct fittings with ducts
- Duct segments between each other; determined based on L_r and L_c.

Round

Male and female coupling

Quantity is equal to the quantity of connections of duct segments.

Flange angle

Sealing tape length is determined as the total of lengths of connection circumferences.

Flange length is equal to the sealing tape length • 2.

Quantity of bolts is determined for each connection according to the following conditions:

- At diameters up to 315 mm: one bolt per 120 mm of the circumference.
- At diameters over 315 mm and up to 500 mm: one bolt per 150 mm of the circumference.
- At diameters over 500 mm, one bolt per 200 mm of the circumference.

Rectangular

Flange angle

Sealing tape length is determined as the total of lengths of connections' perimeters.

Flange length is equal to the sealing tape length • 2.

Quantity of bolts is determined for each connection as the total of:

- One bolt for each angle for a total of 4 bolts.
- One bolt per 200 mm of each section size.

Profile flange

Sealing tape length is determined as the total of lengths of connections' perimeters.

Flange length equals the sealing tape length – angle limits dimensioned at 80 mm per each flange.

Quantity of bolts equals 4 bolts per connection.

Quantity of clamps is determined for each connection; one bolt per 400 mm of each section size.