AUTODESK UNIVERSITY 2014

Hydraulic Calculation of Fire Sprinkler Systems Inside of Revit® MEP

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MP6446

This class shows how an extension to Revit software can calculate a fire sprinkler system inside of Revit MEP software. You will learn what additional parameters, such as minimum pressure and water density, you must set at the sprinkler to enable the performance of calculations. The structure of the network has no limits (gridded and looped), and we will show how to define the active area. You will learn how to optimize the network through changing diameters and changing a tree-typed network to a looped one. The calculation is done with the Hazen-Williams formula (or the Darcy-Weisbach formula) according to the rules of the National Fire Protection Association, FM Global, VdS, and others. The result is the minimum pressure and water flow at the pump. You will see how you can show the pressure loss, the water flow, and other elements in a graphic, colored form in Revit software. You can also print the result in a table form.

Learning Objectives

At the end of this class, you will be able to:

- Learn how to design a sprinkler network in Revit software
- Learn how to define necessary parameters for the hydraulic calculation
- Learn how to perform the hydraulic calculation of sprinkler networks
- Learn how to optimize the sprinkler network

About the Speaker

Reinhard is from Austria and studied computer science at the Technical University Vienna. He has been the general manager for the company IDAT (www.idat.de) since 1990. His technical know-how is in the precast industry.

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1. Introduction

What are the IDAT Sprinkler Tools for Revit?

The IDAT Sprinkler Tools are Extensions for Revit MEP to support the hydraulic calculation of sprinkler networks. With the tools the defined sprinkler network from Revit can be calculated. Tree and loop typed systems are supported. Despite the high accuracy of calculation the results are determined very fast due to the optimized calculation method. The calculation is governmentally accepted and according to NFPA FM, VdS and LPC.

The pressure loss is calculated according the Hazen-Williams-Formula. Optionally it can be calculated with the Darcy-Weisbach-Formula (e.g. for foam systems or High-Pressure-Water-Mist-Systems).

The results can be printed in tabular form and are also set to the pipes and sprinklers inside of Revit. With this it is possible to present and analyze the results graphically in Revit. For example the pressure loss or the water flow can be shown with different colors.

These tools are developed by the company IDAT (www.idat.de).

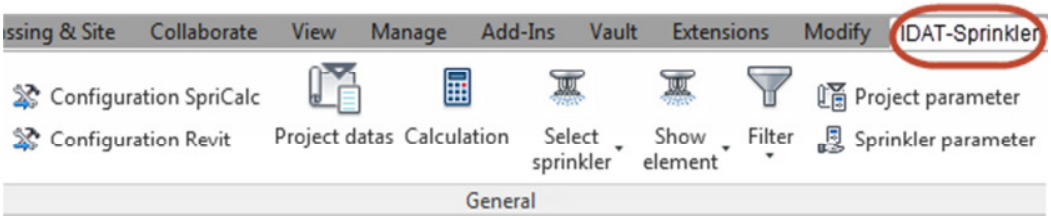
Who is IDAT?

IDAT is a German based company developing software for the Building Industry since 1981.

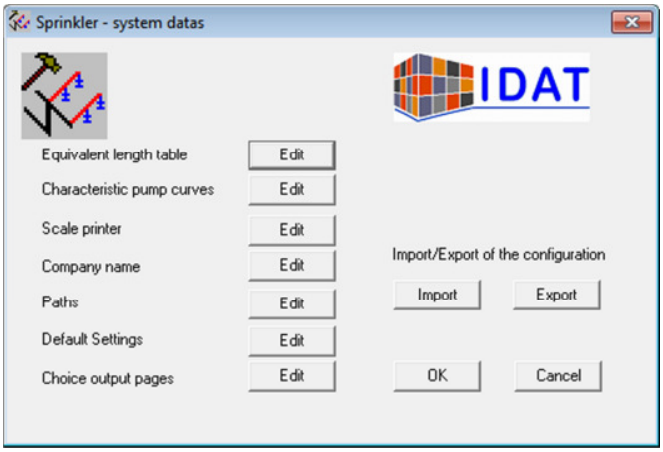
One of the products is a full developed software solution for the hydraulic calculation of sprinkler networks.

2. Configuration

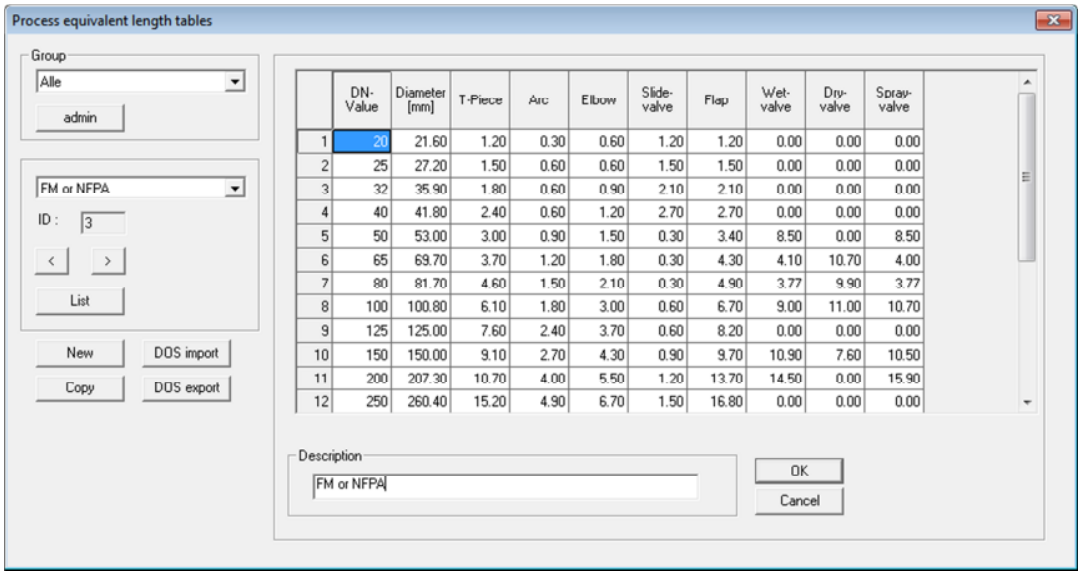
After the installation of the program you will get in Revit MEP the new tab “IDAT-Sprinkler”.



The first command “Configuration SpriCalc” opens an external program:

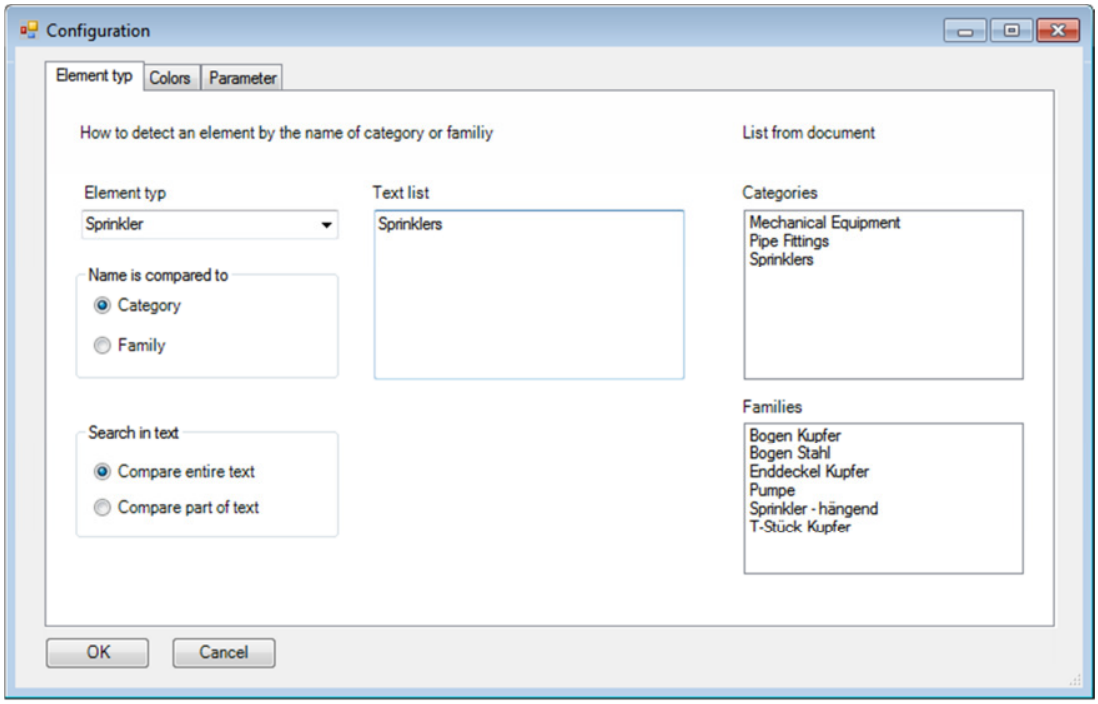


This program is to administrate different settings for the calculation program e.g. the equivalent length table.

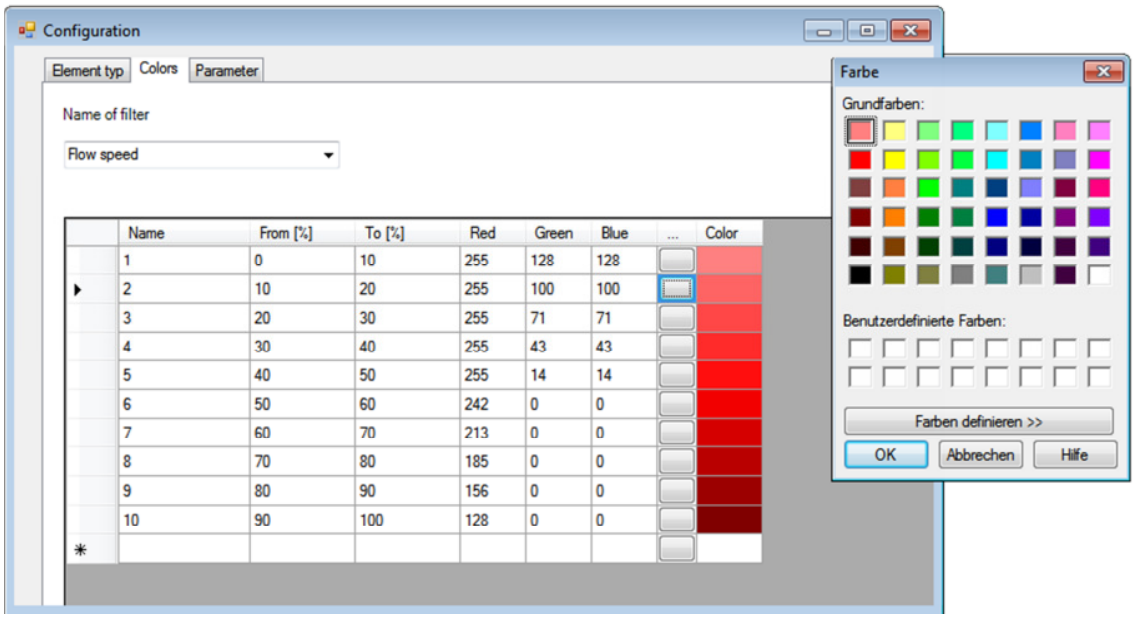


The second command is for settings of the Revit part of the program.

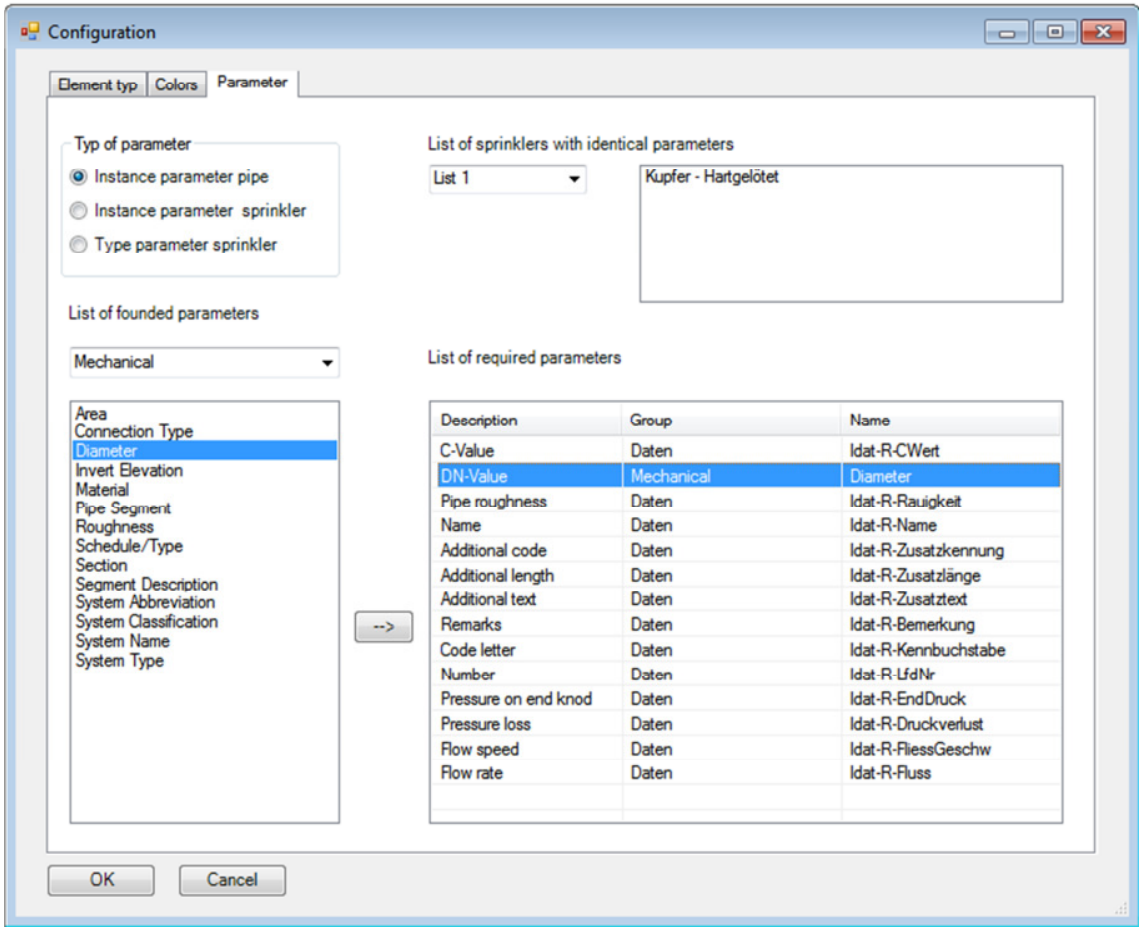
On the first tab you can define how to detect elements. A sprinkler has the Category ***Sprinklers.*** So we are looking for the name of the category to detect a sprinkler.



On the second tab we can set the colors for some filters. You here can e.g. define the colors for different flow speed in the pipe.

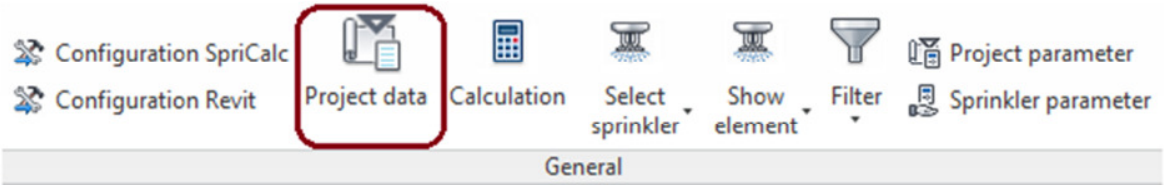


On the third tab you see the used shared parameters of the IDAT system.

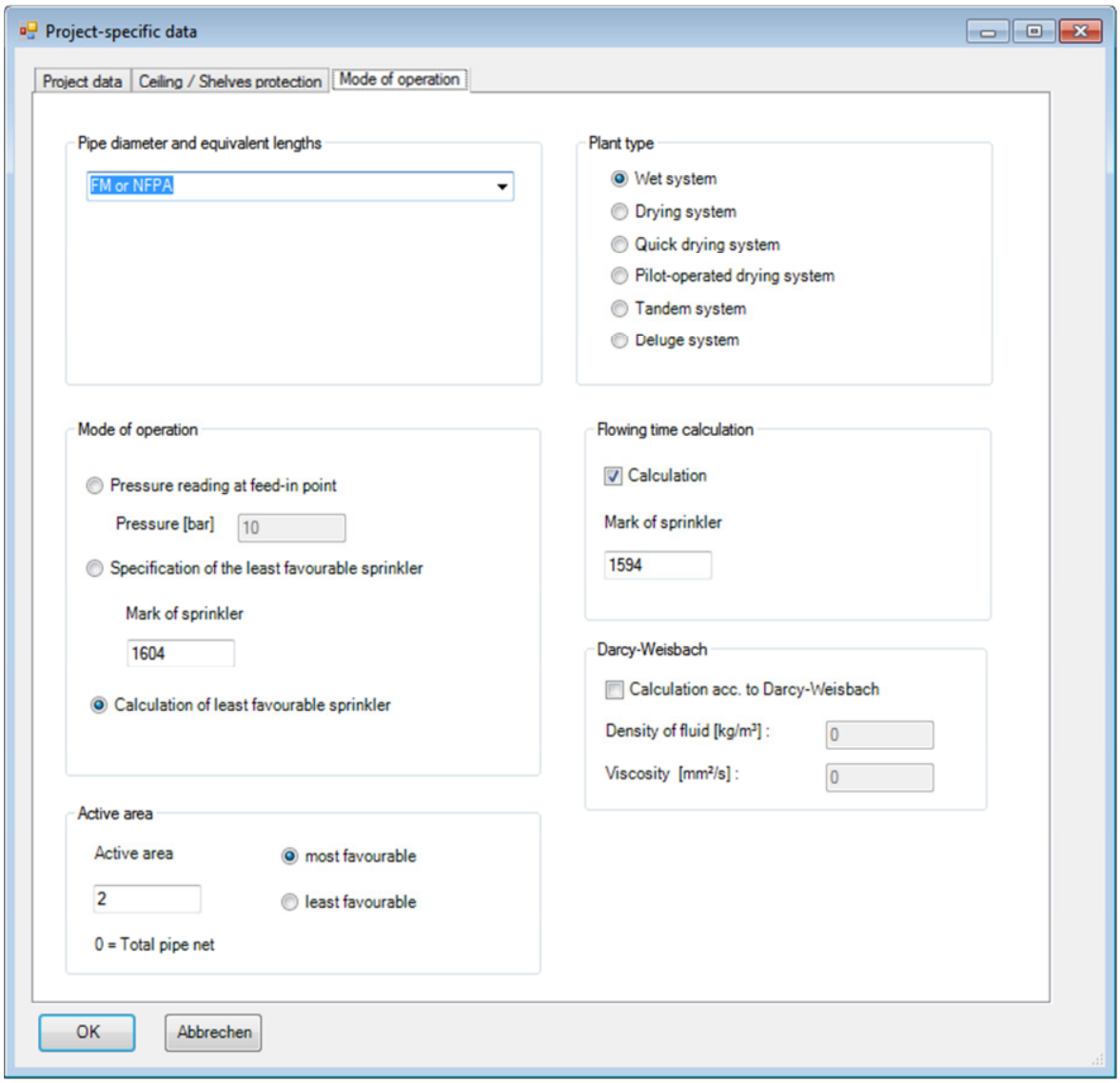


It is possible to define which parameter has to be used in the program. For example, the pipes need the Shared Parameter Idat-DN-Value. But instead of using this parameter you can link the ***Diameter*** from the group ***Mechanical*** to it.

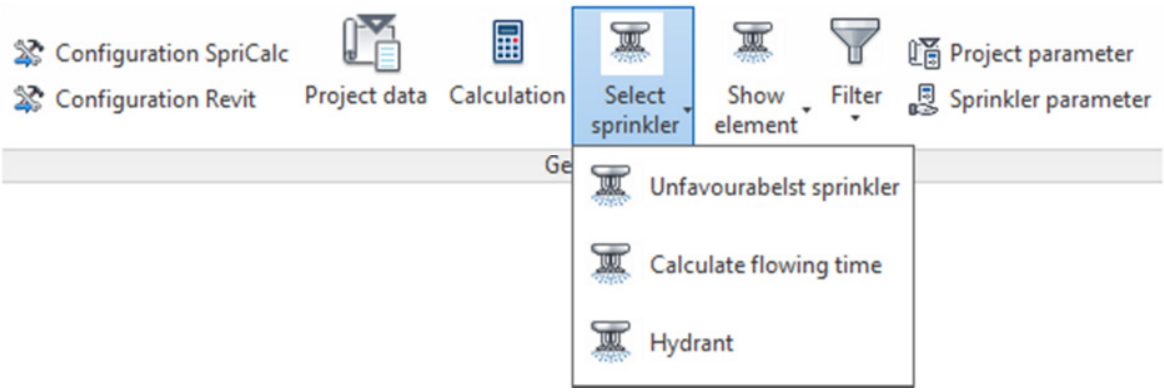
3. Project data



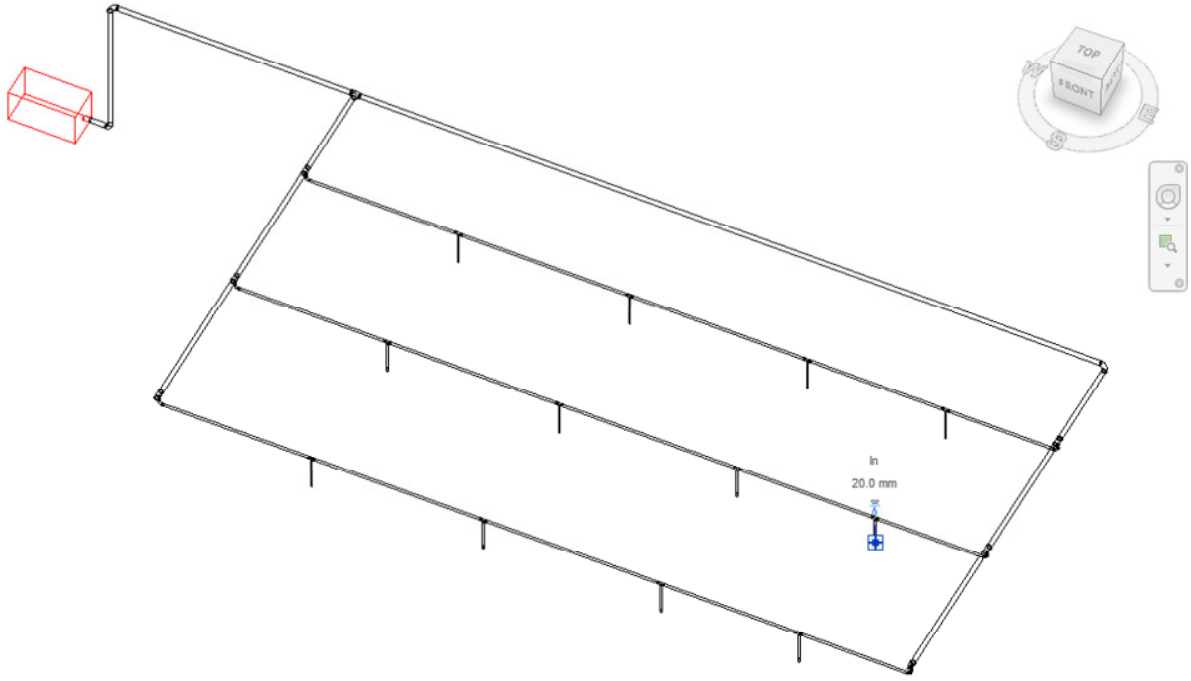
Here we describe the project in a dialog on three tabs. The most important tab is the third tab. We set here the kind of calculation and the active area.



4. Select sprinklers



In the dialog of the previous chapter we can see the most unfavorable sprinkler at the mark 1604 and on the right side the sprinkler for flowing time calculation with the mark 1594. To set these mark numbers we can select sprinkler in Revit and then call the commands above.



Now we can start the calculation.

5. Calculation

The calculation can be done according the Hazen-Williams or the Darcy-Weisbach-Formula. You can choose this in the project data.

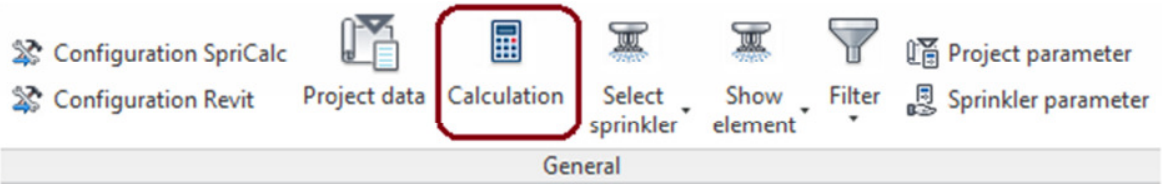
Conditions for the Hazen-Williams-Formula:

Only water with max. 3 % foam
The max. pressure is less than 20 bar

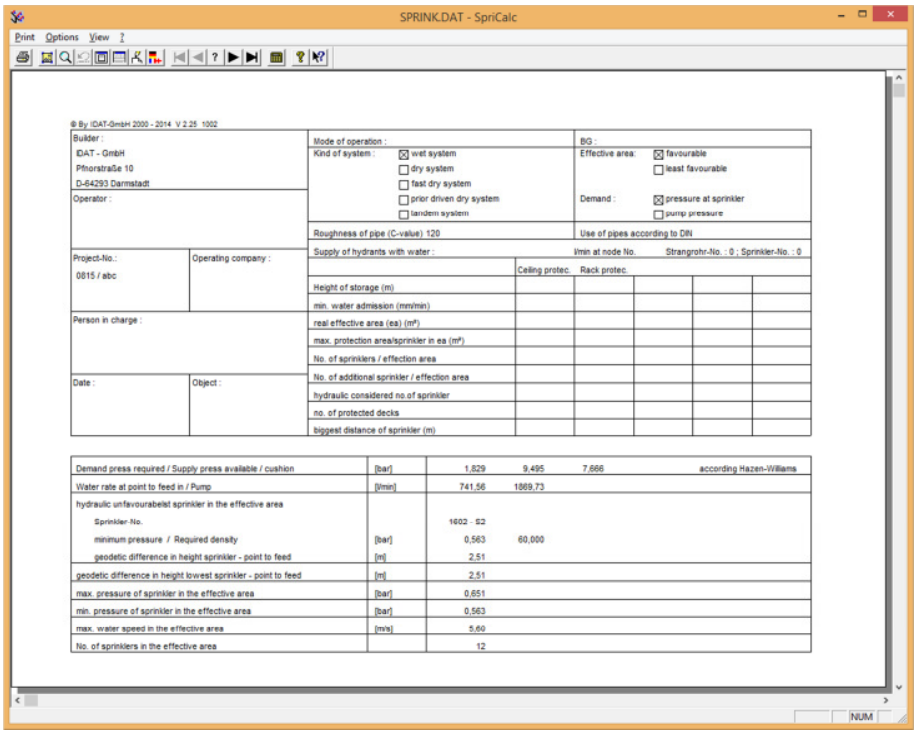
$\Delta p = 6{,}05 * 105 * Q^{1{,}85} * C^{-1{,}85} * d^{-4{,}85} * l$

Δp = pressure loss in bar
Q = water flow in l/min
C = C-Value
d = inner diameter of the pipe in mm
l = length of the pipe in m

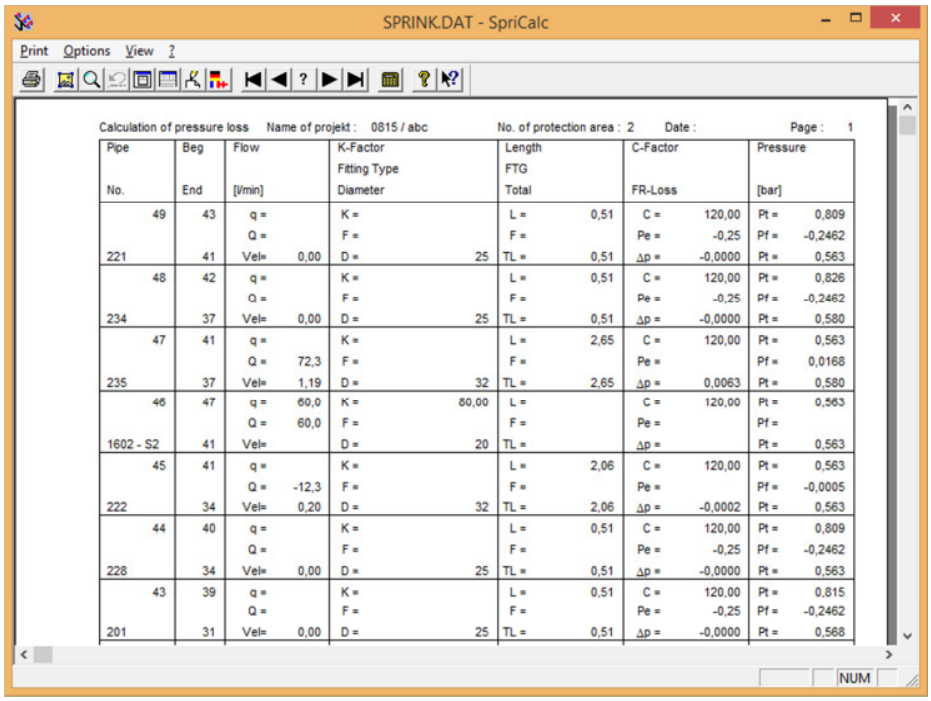
If the mentioned conditions are not fulfilled, the pressure loss must be calculated by the **Darcy-Weisbach-Formula**.



If we start the calculation we get some result forms we can print. The head form shows the project data and the main results.



Some other forms show the results for pipes and sprinklers according to NFPA or VdS.



The results are also written to the pipes and sprinkler in the Revit model. They will be set in the shared parameters of pipes and sprinklers.

6. Shared parameters

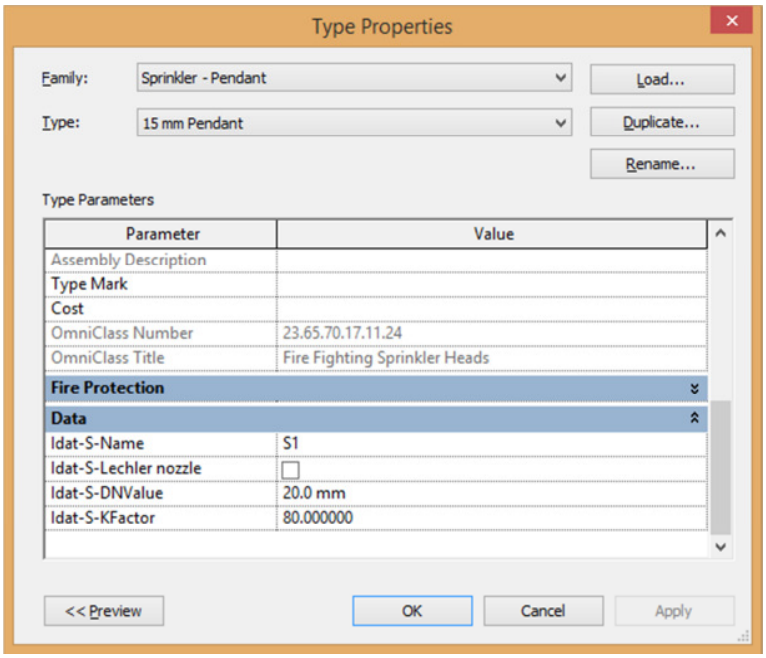
For pipes there are only Instance parameters.

Data	
Idat-R-DNValue	50
Idat-R-CValue	120
Idat-R-Roughness	
Idat-R-Name	
Idat-R-IDLetter	
Idat-R-No	
Idat-R-Add Length	
Idat-R-Add Text	
Idat-R-Add code	
Idat-R-Remark	
Idat-R-EndPress	74070.00 Pa
Idat-R-Loss of pressure	7530.00 Pa
Idat-R-Flow speed	3.08 m/s
Idat-R-Flow	730.10 L/s

For sprinklers the are Instance parameters

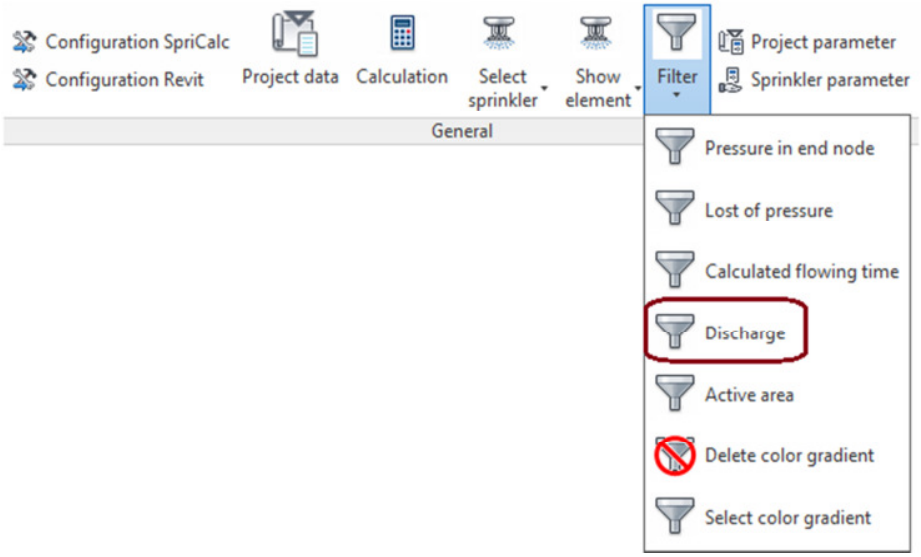
Data	
Idat-S-MinPressure	50000.00 Pa
Idat-S-Area	6.000 m²
Idat-S-Flow rate	0.00 L/s
Idat-S-Water admission	10.000000
Idat-S-Remark	
Idat-S-ActiveArea	1
Idat-S-Add Text	
Idat-S-Add Length	

Sprinklers have also type parameters

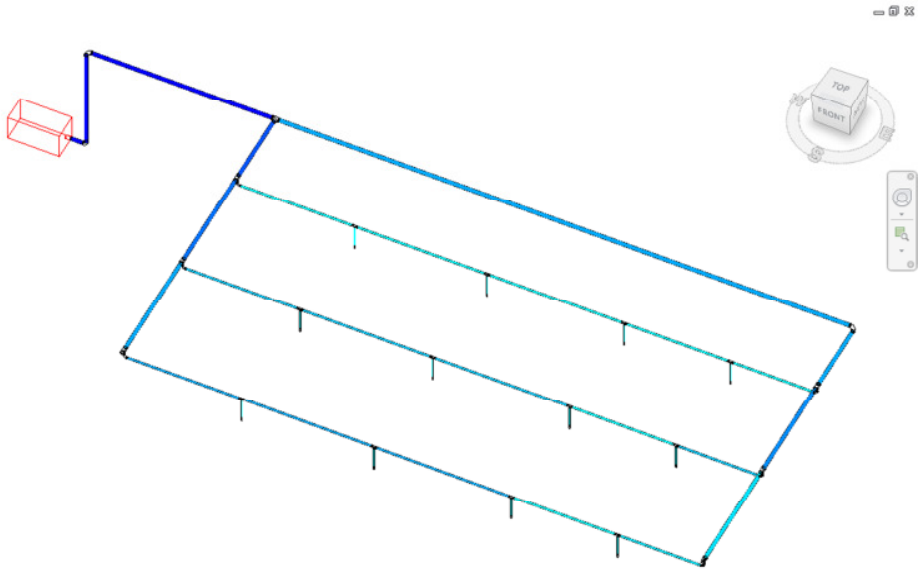


The data for the last four parameters of the pipes are set by the calculation program.

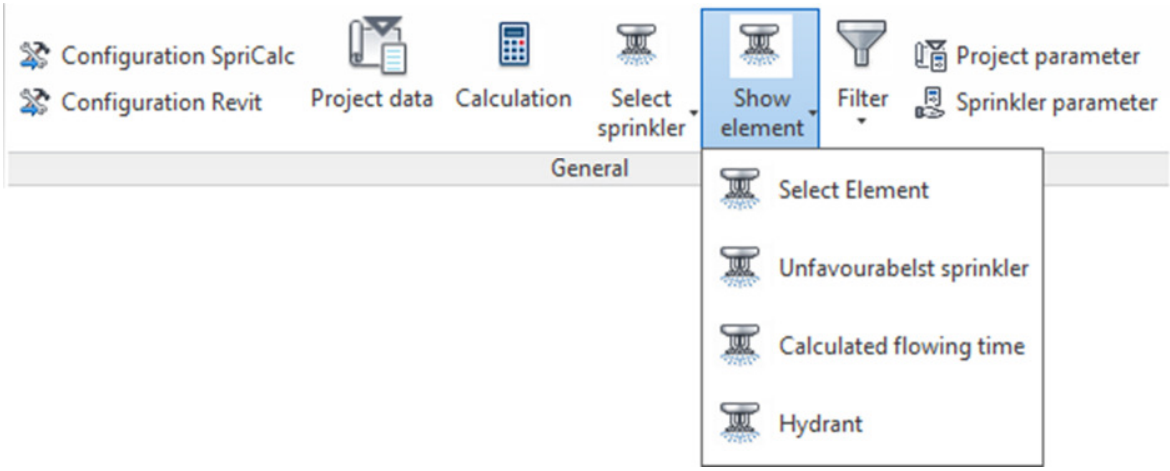
7. Show the results



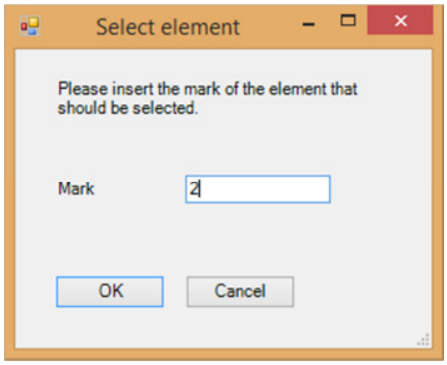
Now we can show different results of the calculation e.g. the discharge. In the configuration we had set colors to different levels of the discharge.

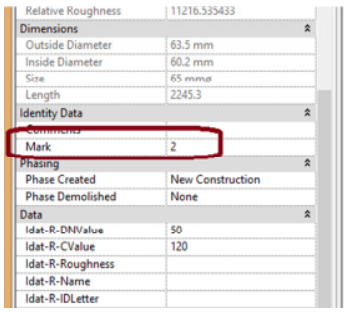


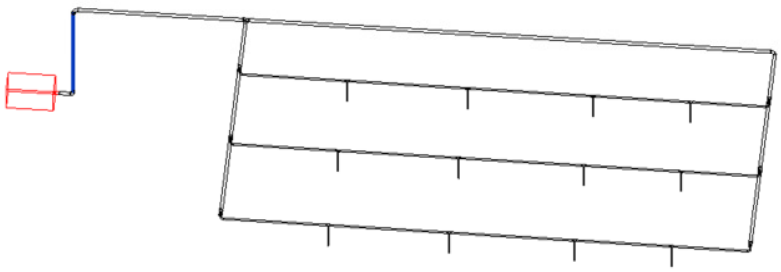
8. Show elements



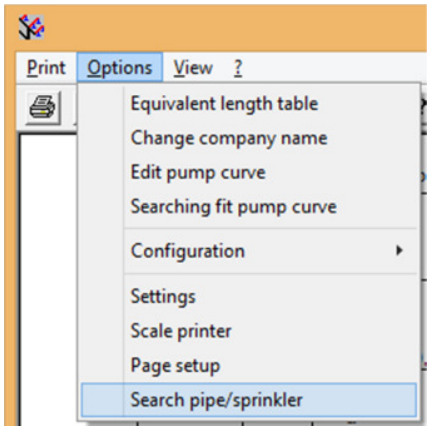
If we see the results in the calculation program it is easy to find the according element in the Revit model. We just need to enter the mark number and the program selects the pipe or the sprinkler for us.

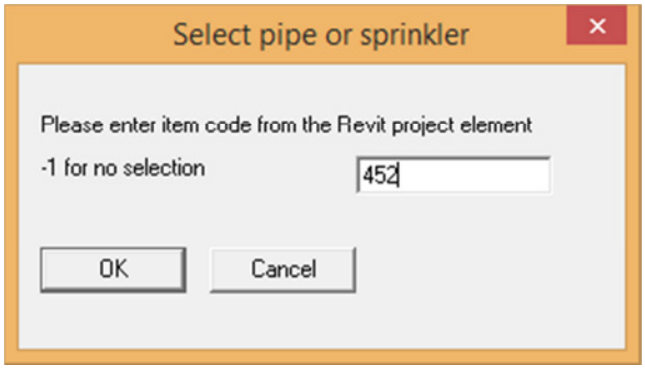




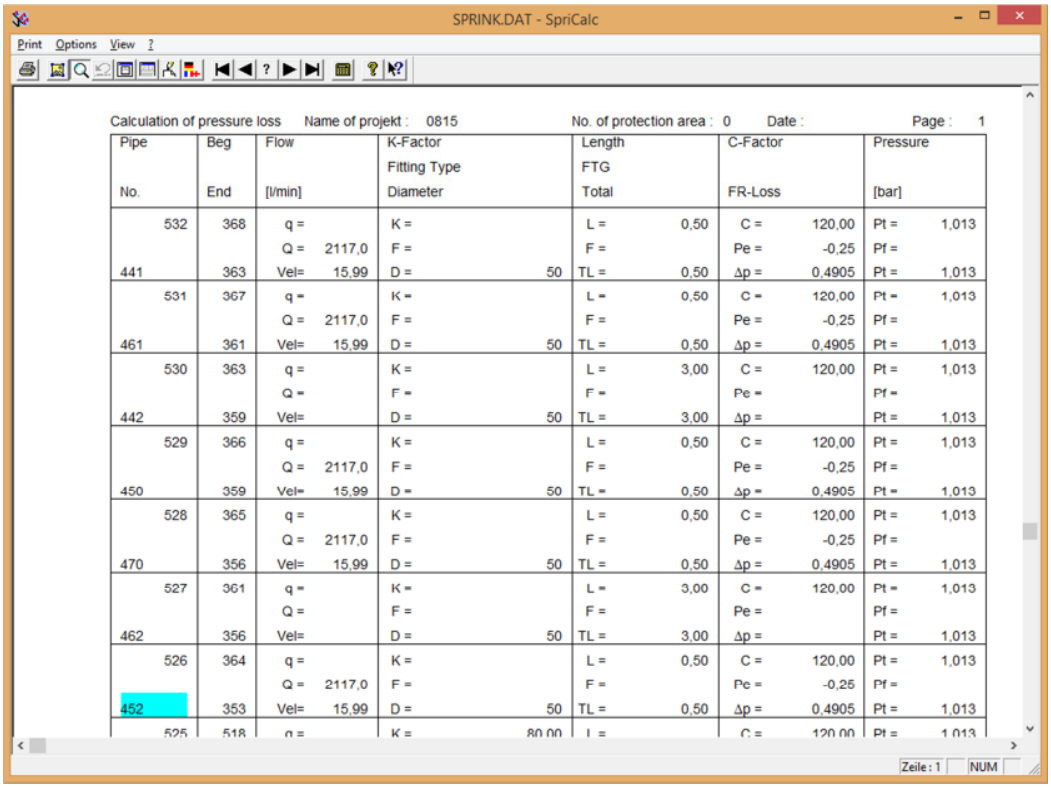


It is also possible to do this in the calculation program.





If we select an element by its mark from the Revit model, it will be selected in the form:

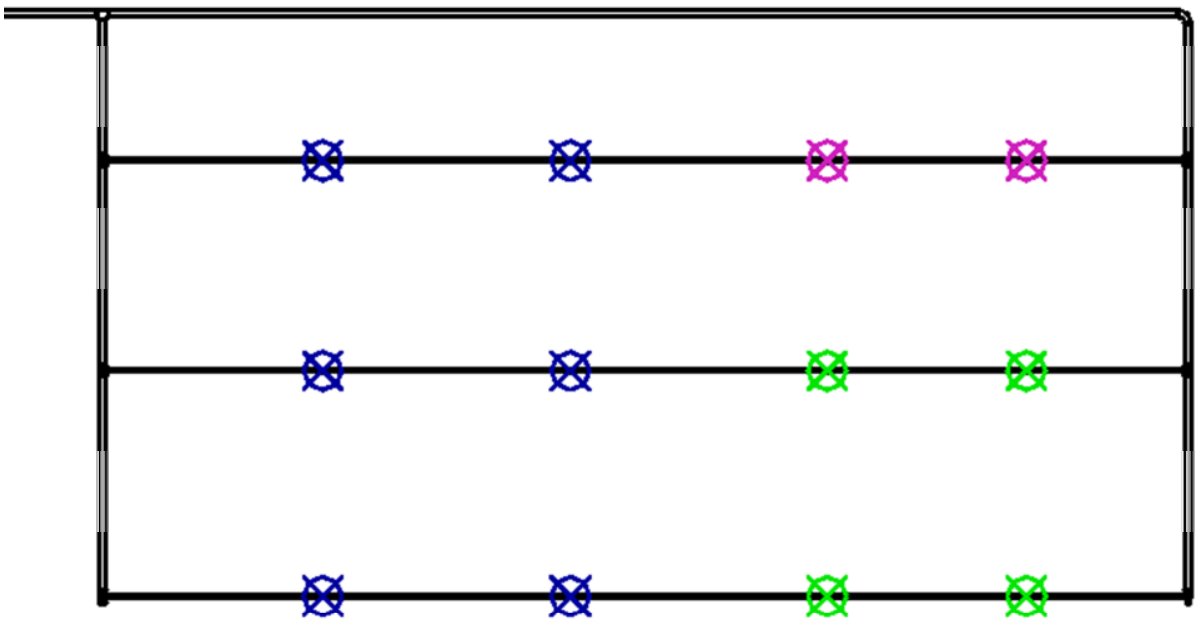


9. The active area

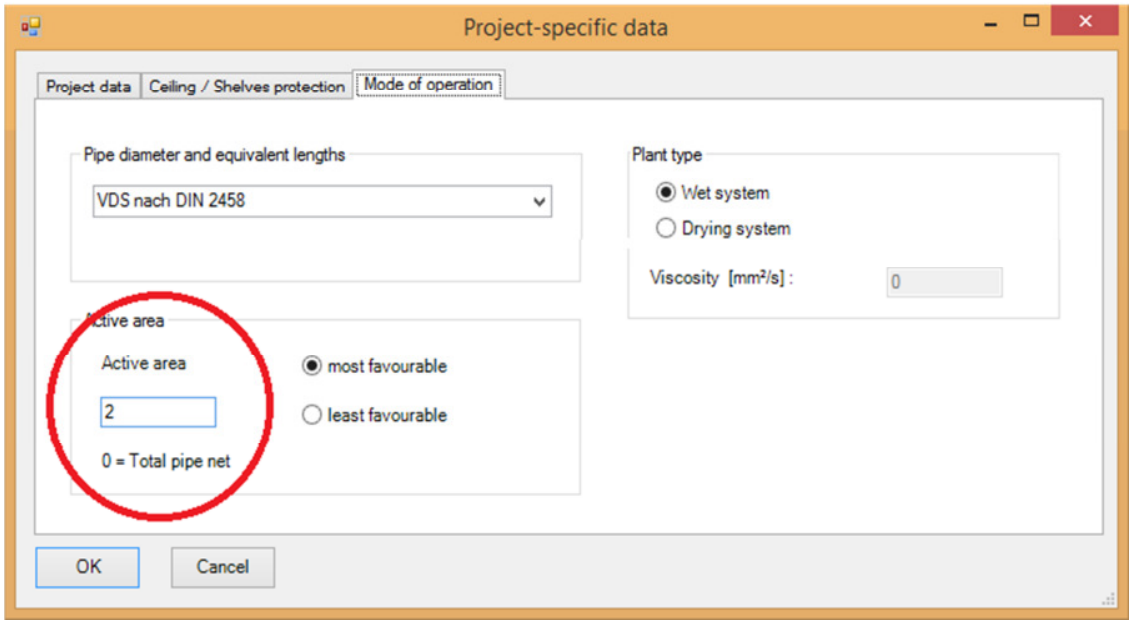
We can set different active (or operation) areas. That means every sprinkler will get an own value for his active area. In this example the active area is 2:

Data	
Idat-S-MinPressure	50000.00 Pa
Idat-S-Area	6.000 m²
Idat-S-Flow rate	0.00 L/s
Idat-S-Water admission	10.000000
Idat-S-Remark	
Idat-S-ActiveArea	2
Idat-S-Add Text	
Idat-S-Add Length	

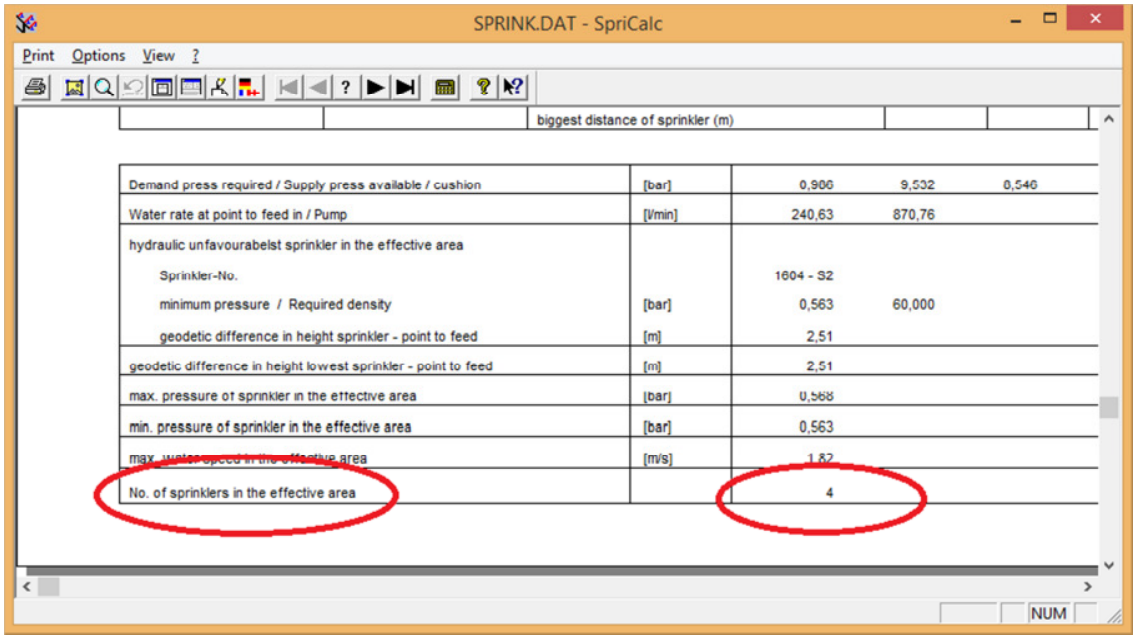
The green sprinklers belong to active area 2. So we have only 4 sprinklers in the calculation and not all 12.



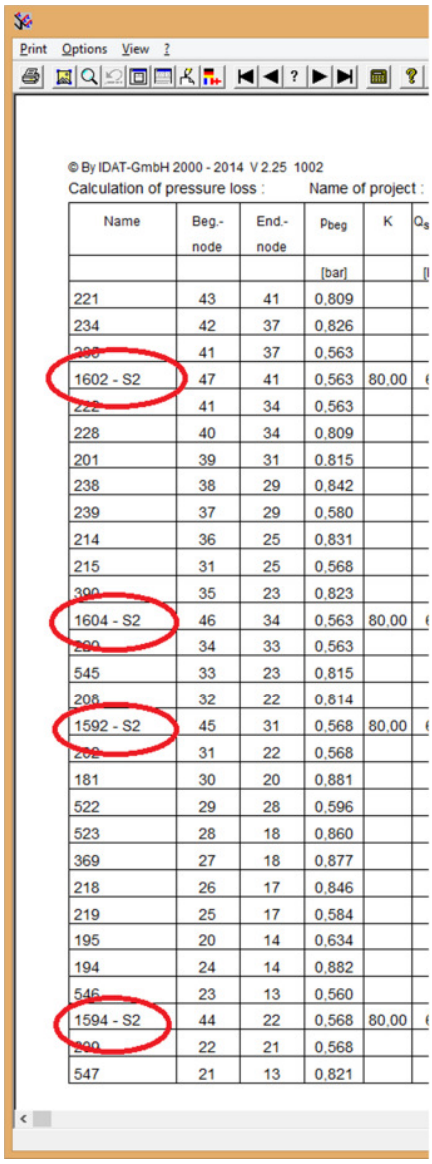
We have to set this value 2 in the dialog of project data.



If we start now the calculation we can see the results.



In the table we also find only 4 sprinklers.



Print Options View ?

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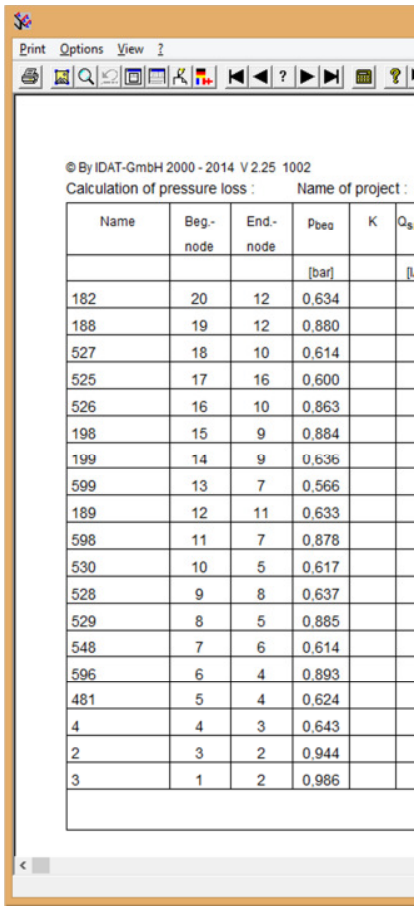
Calculation of pressure loss : Name of project :

Name	Beg.-node	End.-node	P_{beg}	K	Q_s
			[bar]		[l
221	43	41	0,809		
234	42	37	0,826		
233	41	37	0,563		
1602 - S2	47	41	0,563	80,00	
222	41	34	0,563		
228	40	34	0,809		
201	39	31	0,815		
238	38	29	0,842		
239	37	29	0,580		
214	36	25	0,831		
215	31	25	0,568		
390	35	23	0,823		
1604 - S2	46	34	0,563	80,00	
200	34	33	0,563		
545	33	23	0,815		
208	32	22	0,814		
1592 - S2	45	31	0,568	80,00	
202	31	22	0,568		
181	30	20	0,881		
522	29	28	0,596		
523	28	18	0,860		
369	27	18	0,877		
218	26	17	0,846		
219	25	17	0,584		
195	20	14	0,634		
194	24	14	0,882		
546	23	13	0,560		
1594 - S2	44	22	0,568	80,00	
200	22	21	0,568		
547	21	13	0,821		



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Calculation of pressure loss : Name of project :

Name	Beg.-node	End.-node	P_{beg}	K	Q_s
			[bar]		[l
182	20	12	0,634		
188	19	12	0,880		
527	18	10	0,614		
525	17	16	0,600		
526	16	10	0,863		
198	15	9	0,884		
199	14	9	0,636		
599	13	7	0,566		
189	12	11	0,633		
598	11	7	0,878		
530	10	5	0,617		
528	9	8	0,637		
529	8	5	0,885		
548	7	6	0,614		
596	6	4	0,893		
481	5	4	0,624		
4	4	3	0,643		
2	3	2	0,944		
3	1	2	0,986		