METHODOLOGY FOR ESTIMATING THE RISK OF STEEL STRUCTURES DAMAGE

PhD Students‘ Seminar on Fire Safety Science

Andrzej Krauze, Wojciech Kowalski

The Main School of Fire Service

Warsaw, Poland

Fire experience

Source: own picture

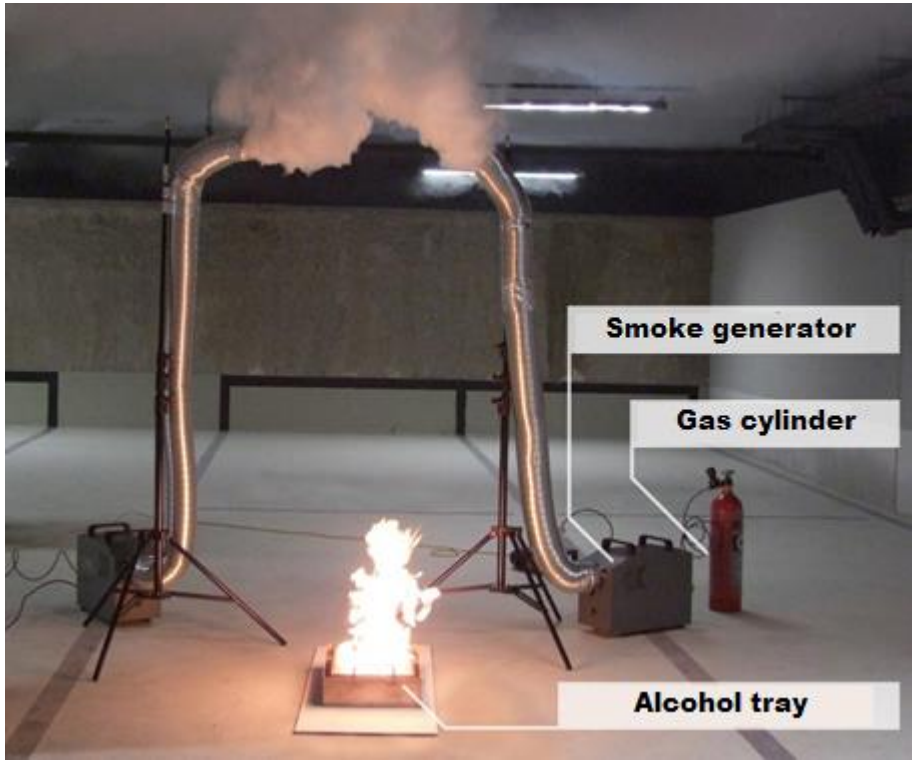
Source: own picture

Prescriptive-Based Building Design

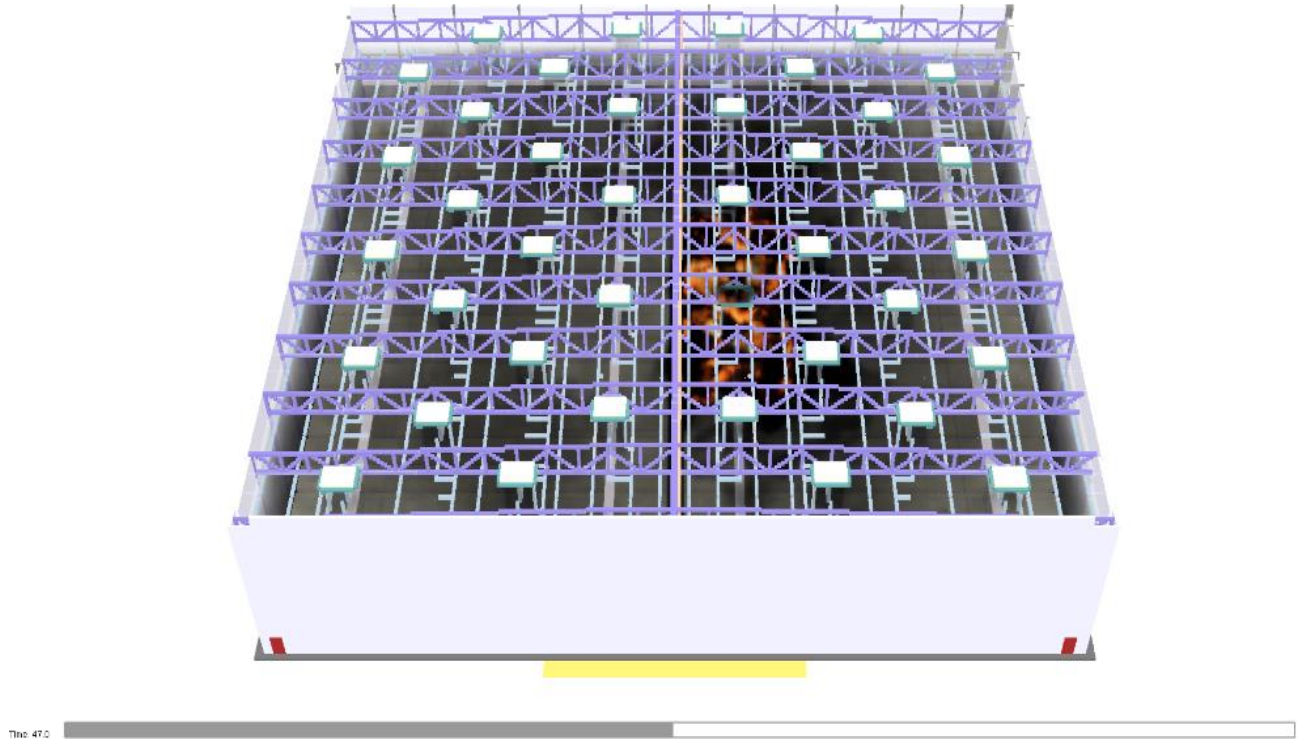
Source: http://www.sitpkrakow.pl/

Source: http://www.sitpkrakow.pl/

Fire Safety Science in practice



Source: own study



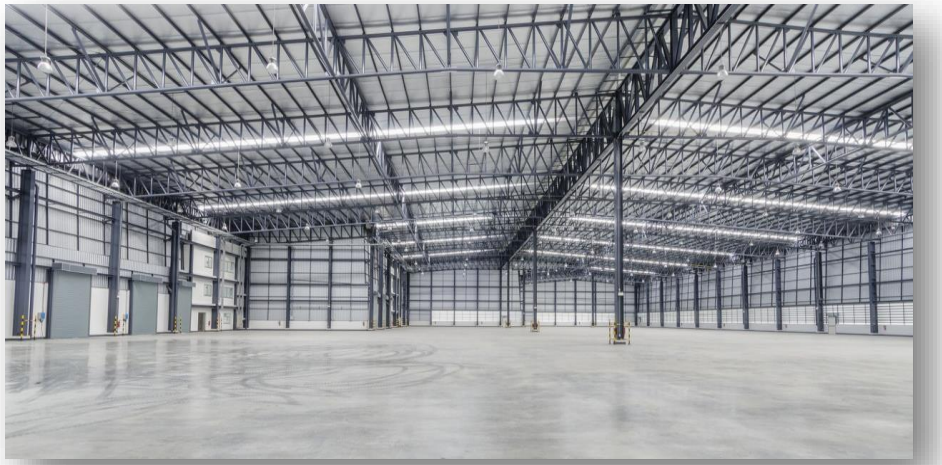
Source: own study

Recent changes in Polish technical and construction regulations

Regulation of the Polish Minister of Infrastructure of April, 2002,

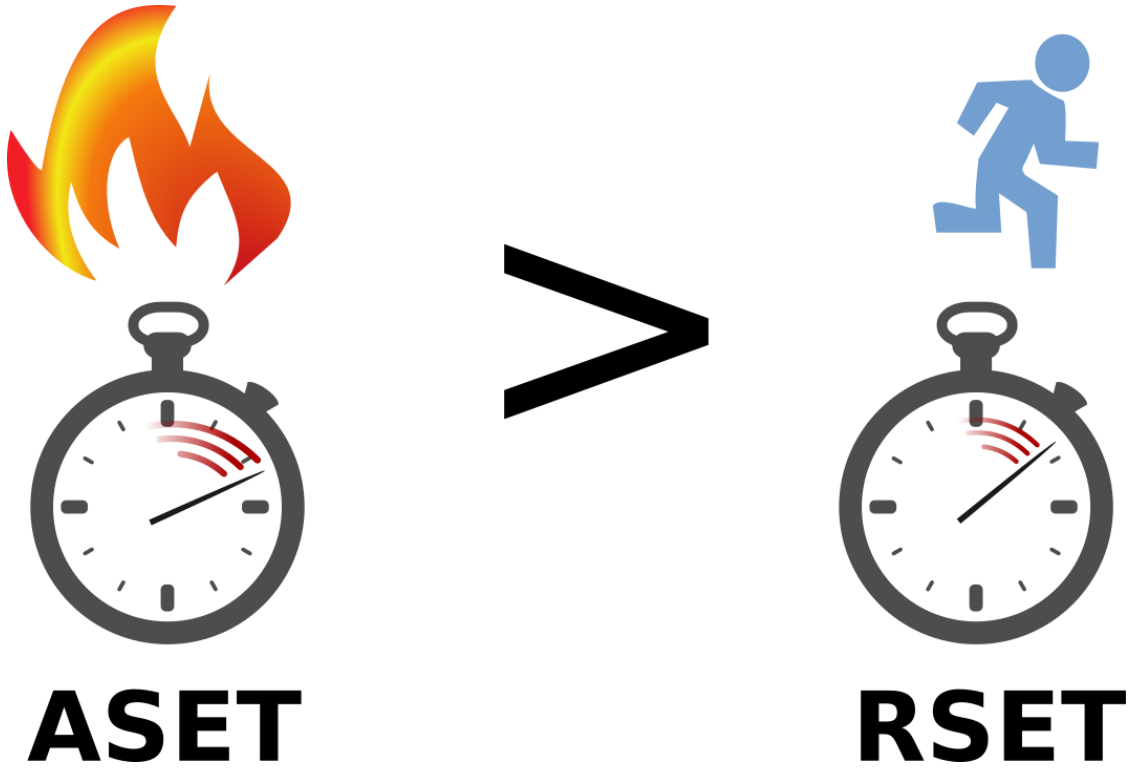
on the technical conditions which should be met by buildings and their location.

Load-bearing capacity time for warehouses



Source: www.inzynieria.com

Performance-based building design



Source: own study

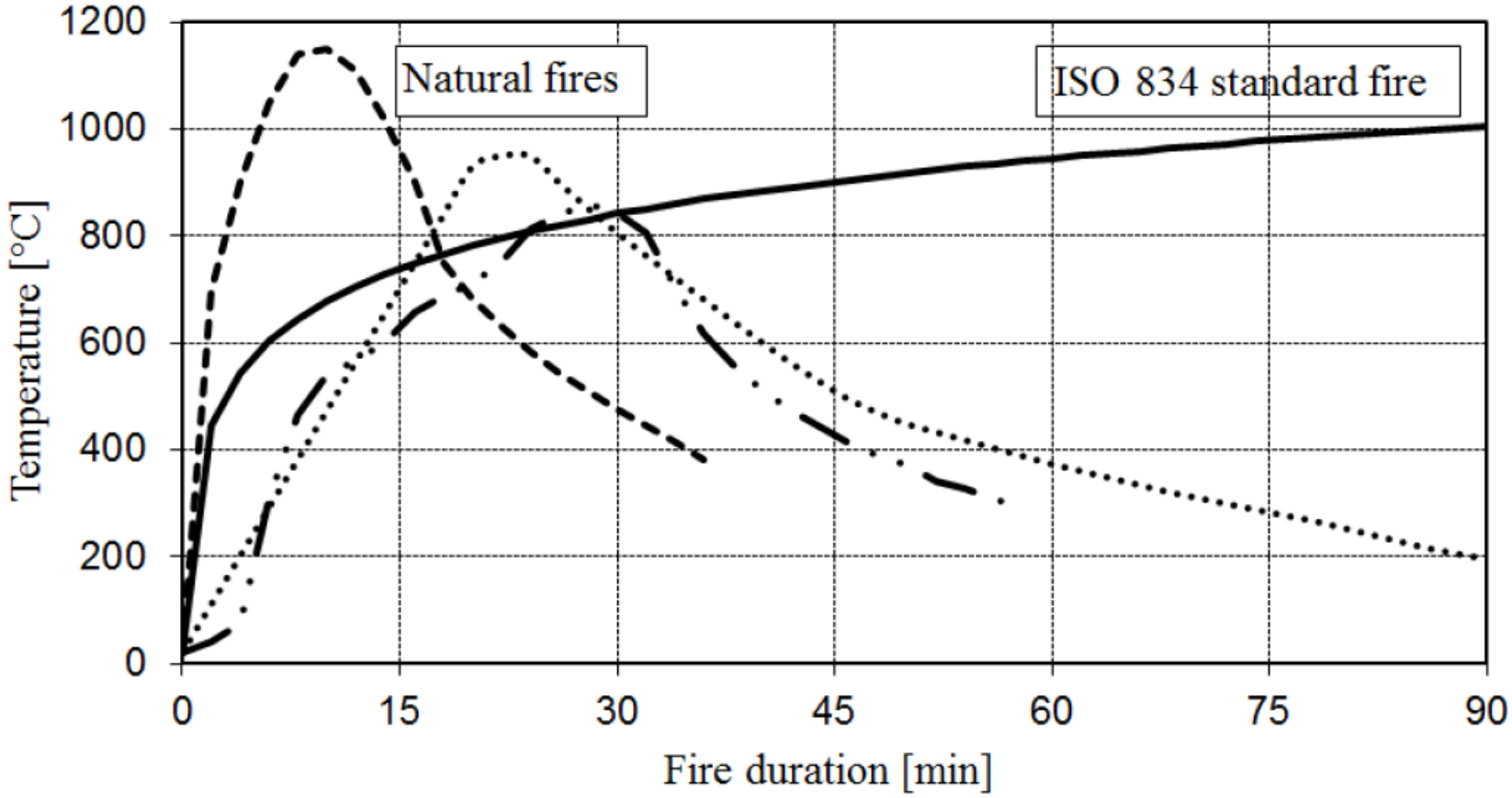
Verification of load-bearing capacity at specific temperatures

$$\theta_{a,cr} = 39.19ln[\frac{1}{0.9674 \cdot \mu^{3.833}} - 1] + 482$$

$$\theta_{a,cr} = 39.19ln[\frac{1}{0.9674 \cdot 0.7^{3.833}} - 1] + 482 = 526^{\circ}C$$

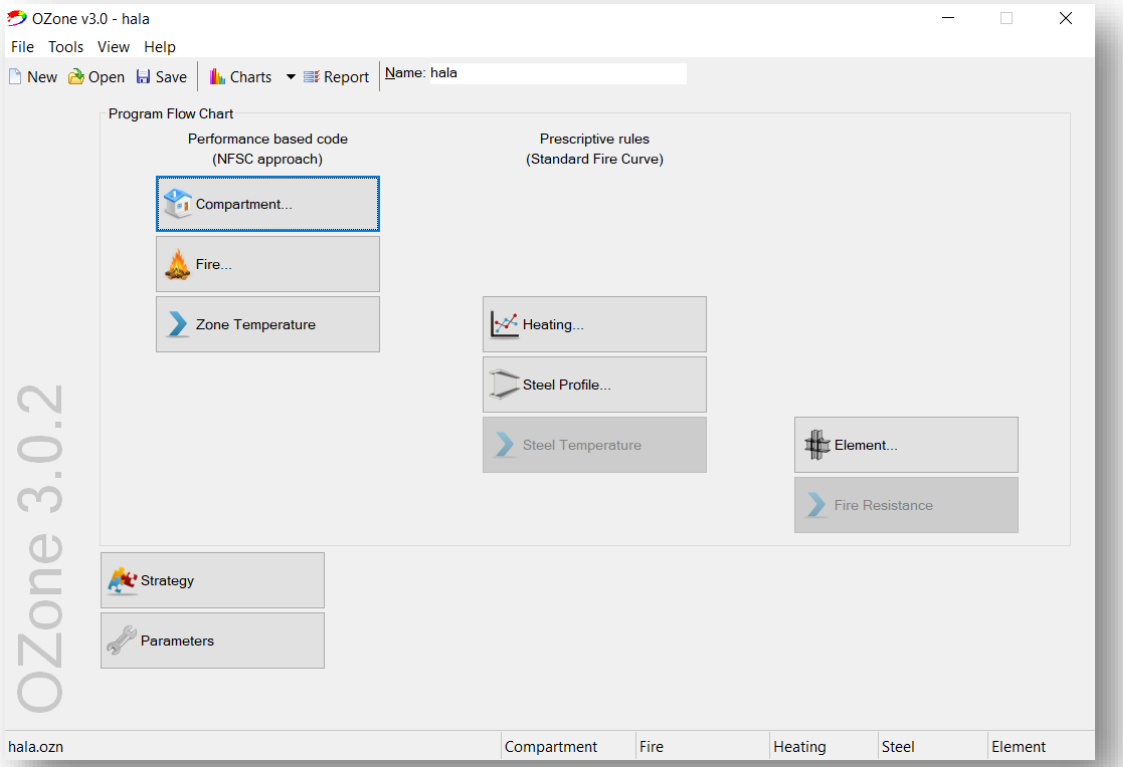
Source: Eurokod 3 - Design of steel structures – Part 1-2 - General rules – Structural fire design

Natural fire model for the structural fire design

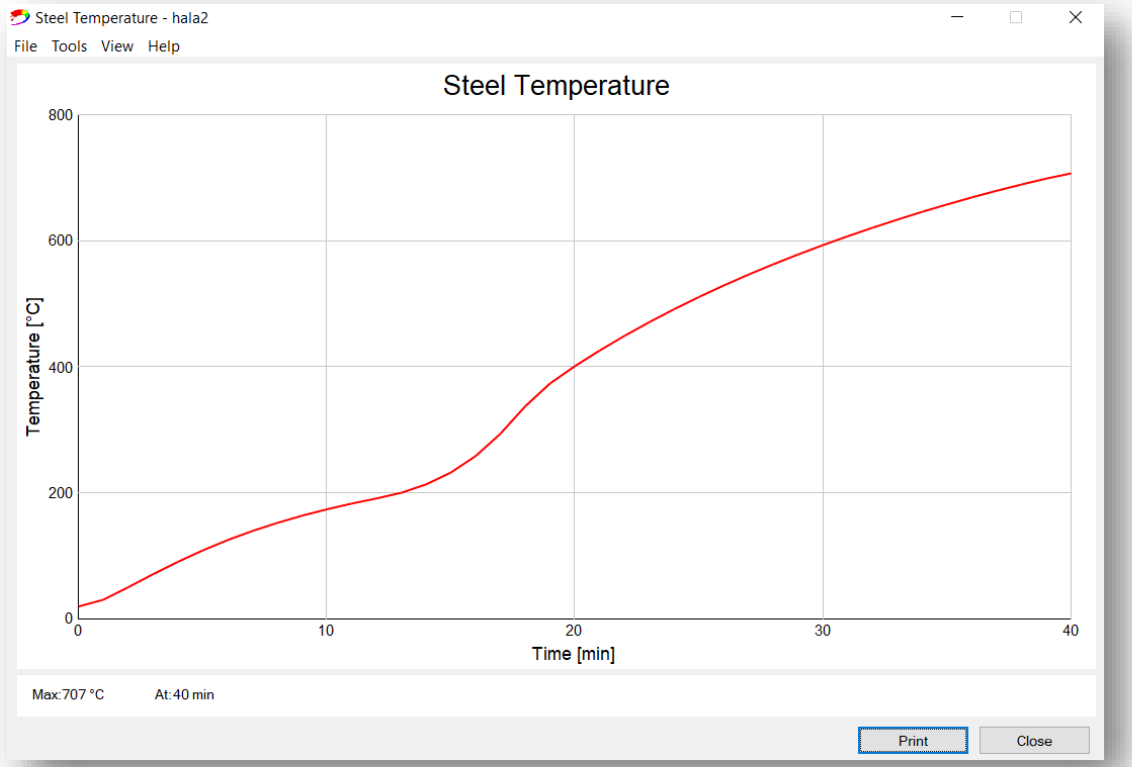


Source: Lyzwa, J., Zehfuss, J.: Thermal material properties of concrete in the cooling phase. ASFE conference 2017

The computer code Ozone V3



Source: Main window (Ozone)

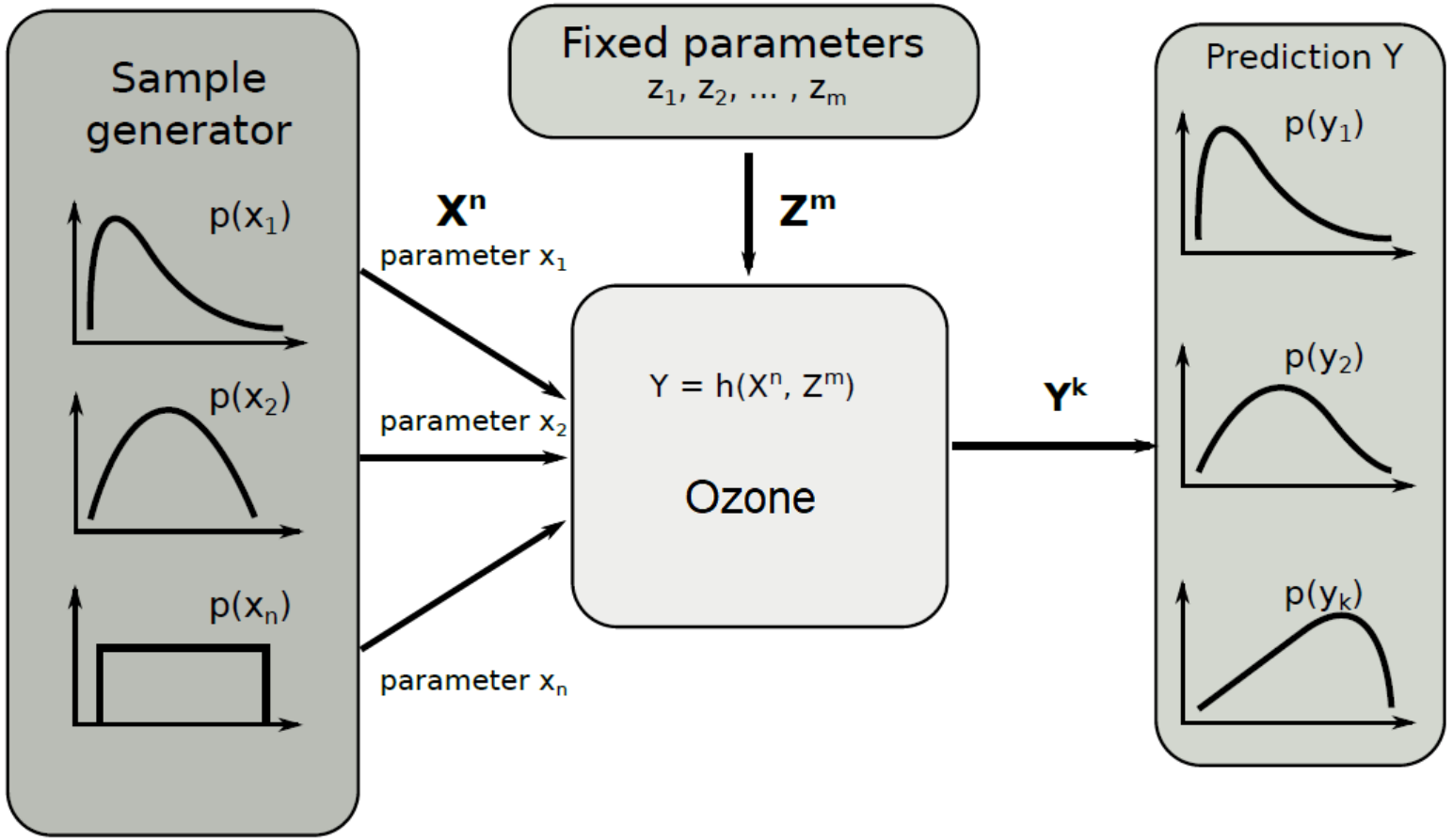


Source: Chart window (Ozone).

Risk assessment

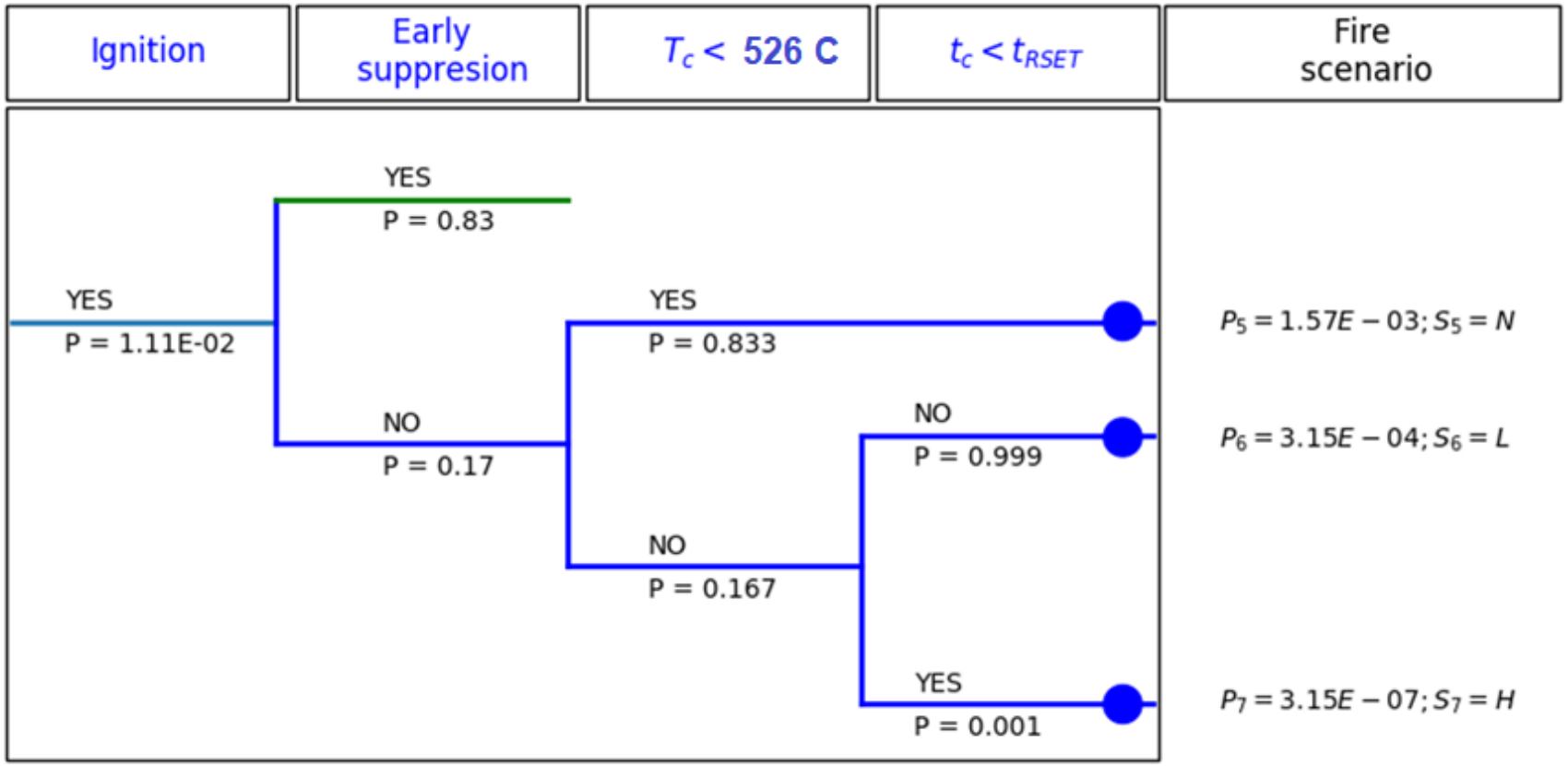
$$\mathbb{R} = \mathbb{P} \times \mathbb{S}$$

The computer code MultiZone



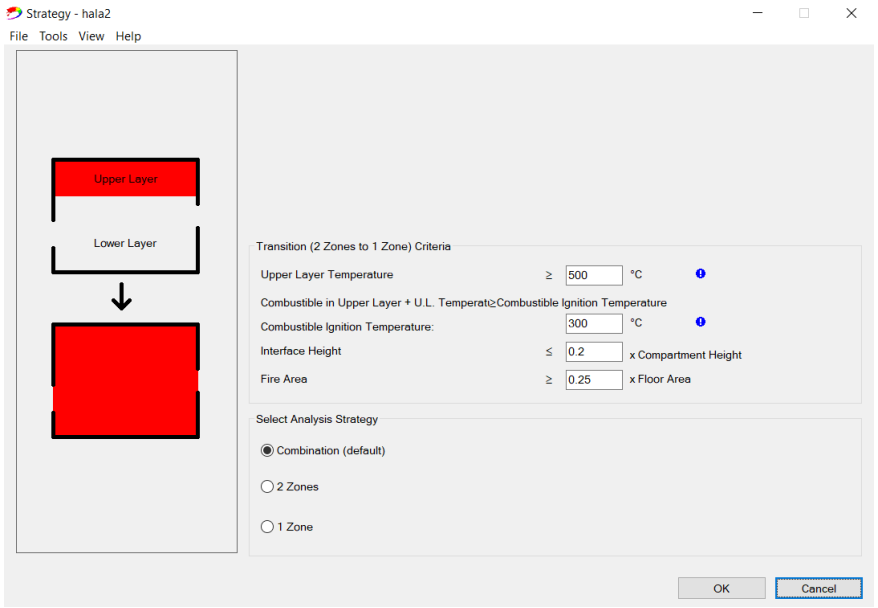
Source: own study

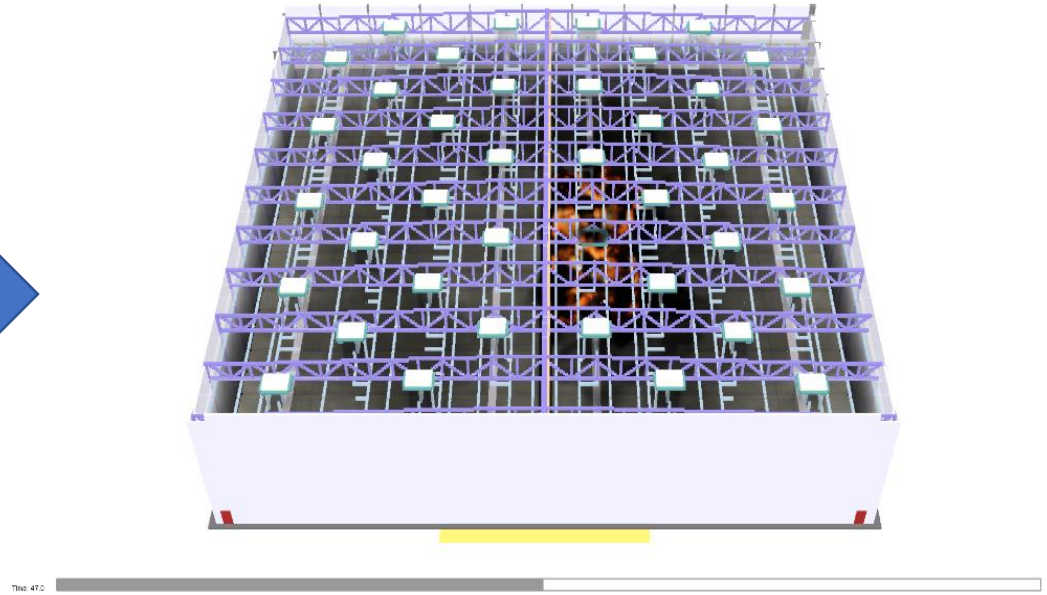
The event tree for the traumatic injury base risk calculation



Source: own study

Computational fluid dynamics, CFD

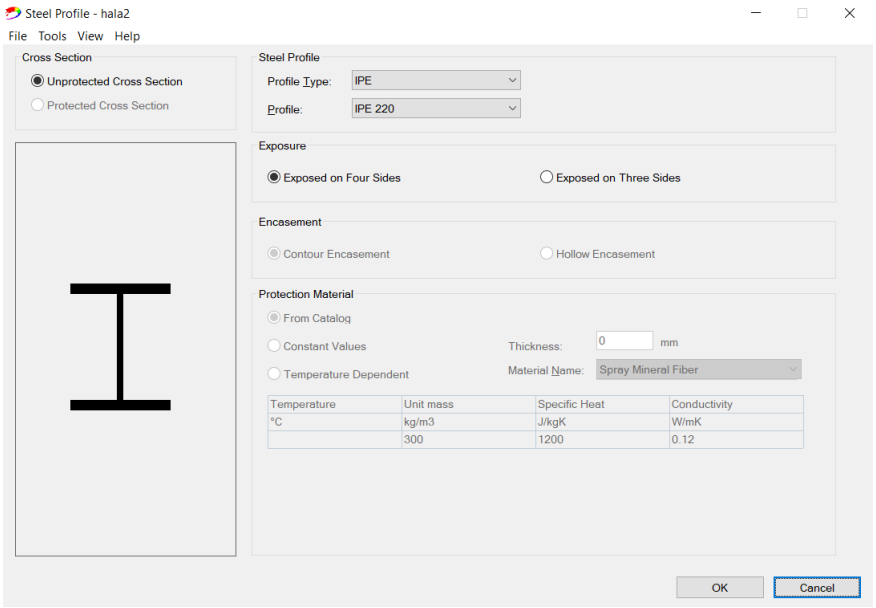


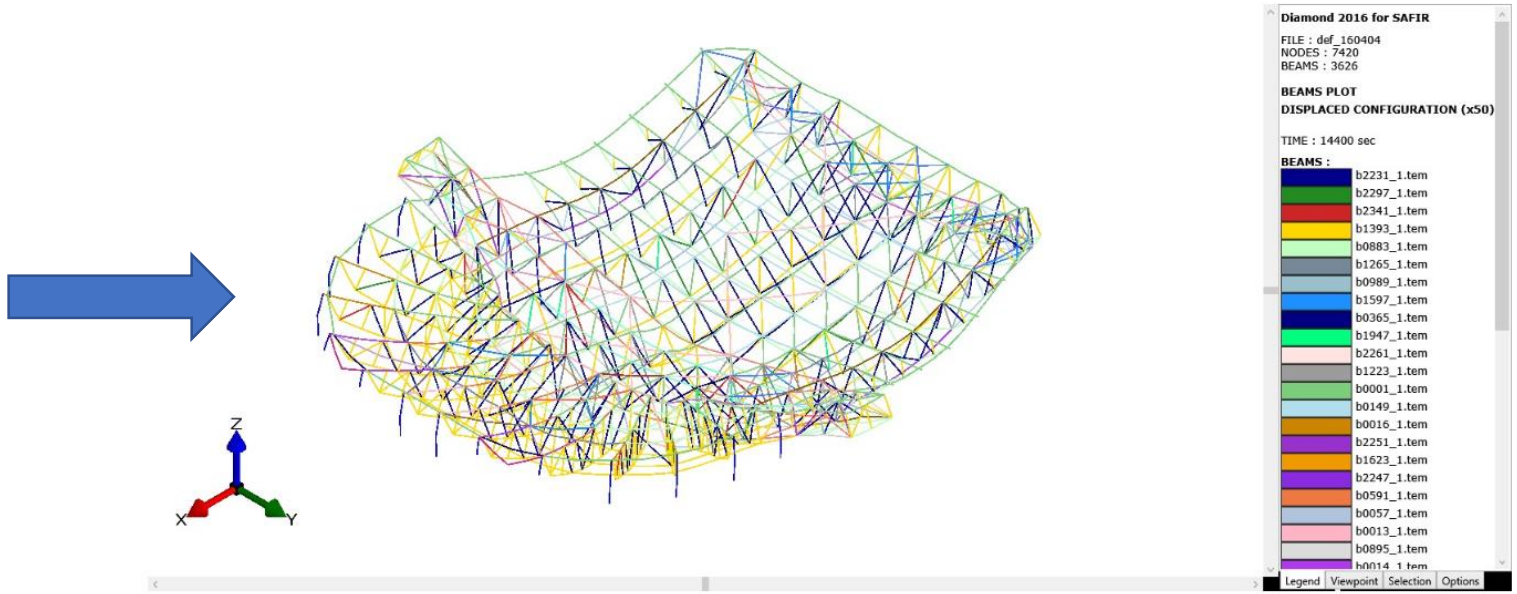


Source: strategy for compartment fires (Ozone)

Source: own study

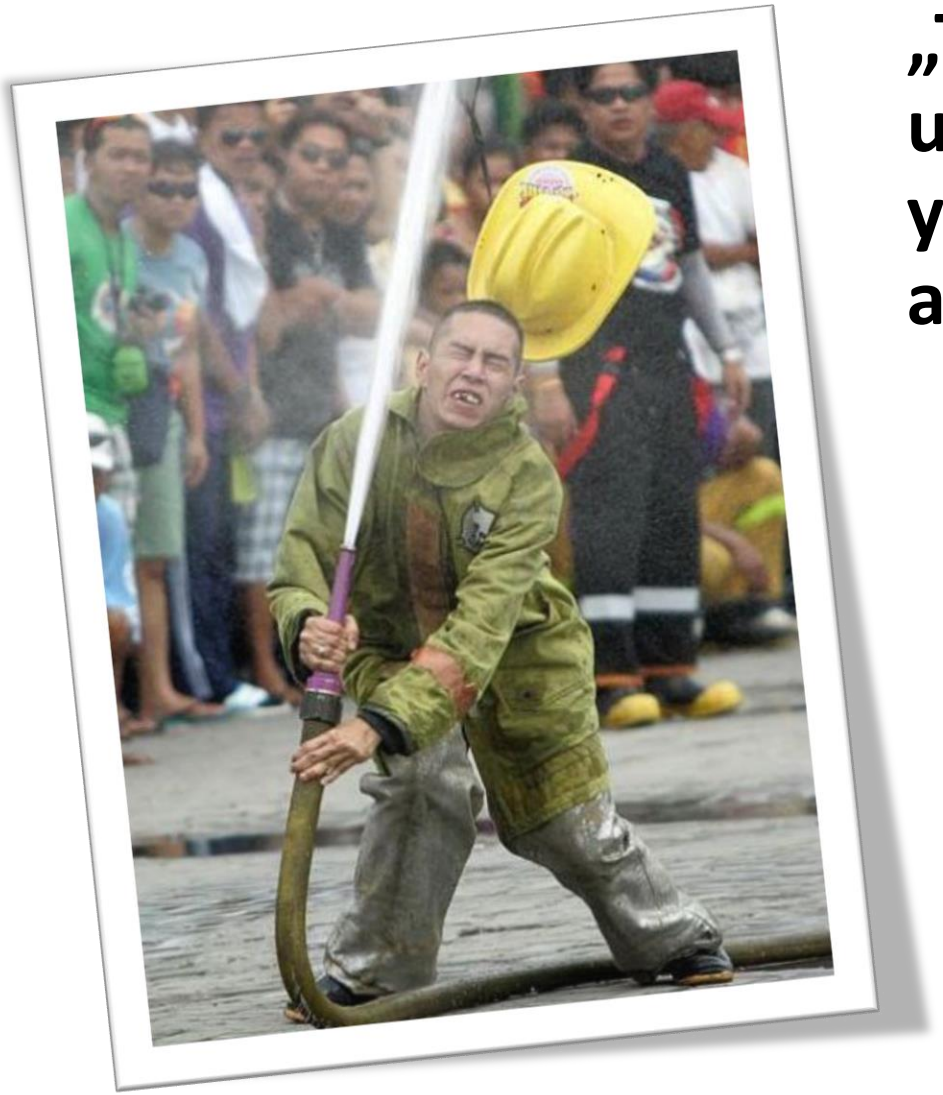
Finite element method, FEM





Source: steel profile window (Ozone)

Source: https://www.uee.uliege.be/cms/c_2383458/en/safir



„These days, there's not much you can understand about what is going on around you if you do not understand the uncertainty attached to pretty much every phenomenon."

- J.N. Tsitsiklis

Andrzej Krauze

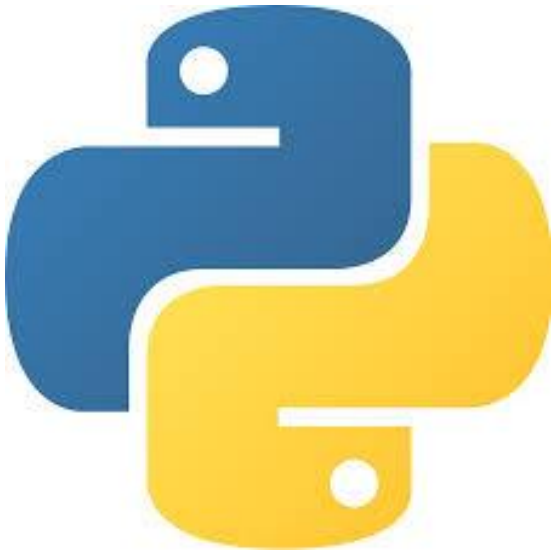
mail: akrauze@sgsp.edu.pl

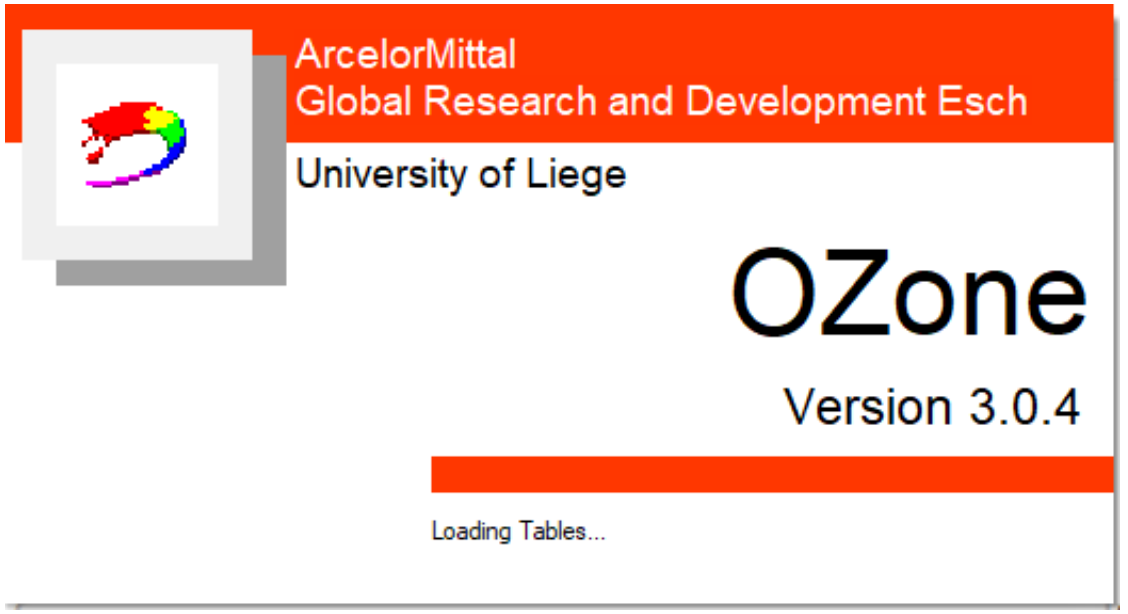
tel.: 510 288 172

MultiZone

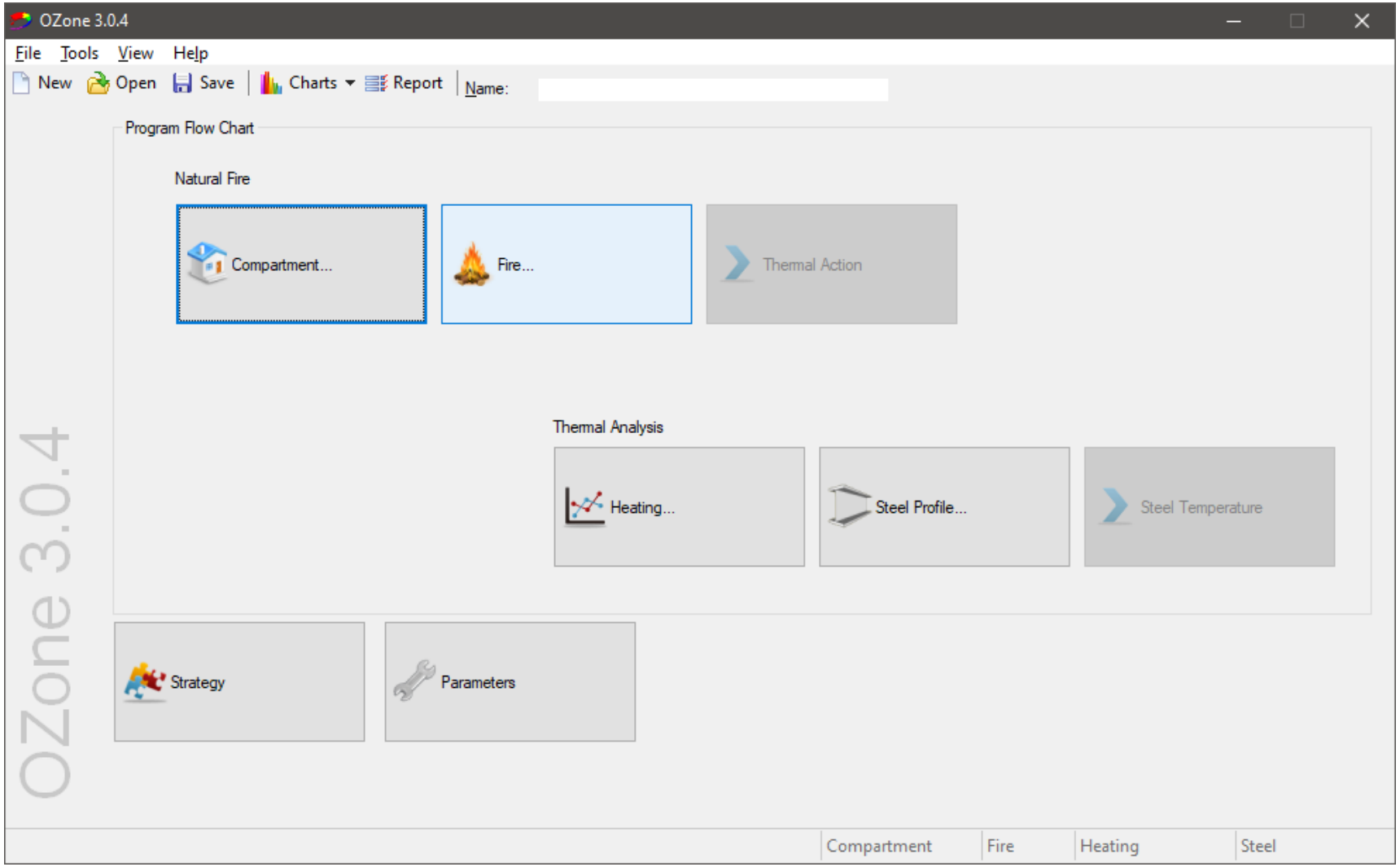
„Software” for stochastic risk assessment
of steel constructions in fire conditions

How does it work ?

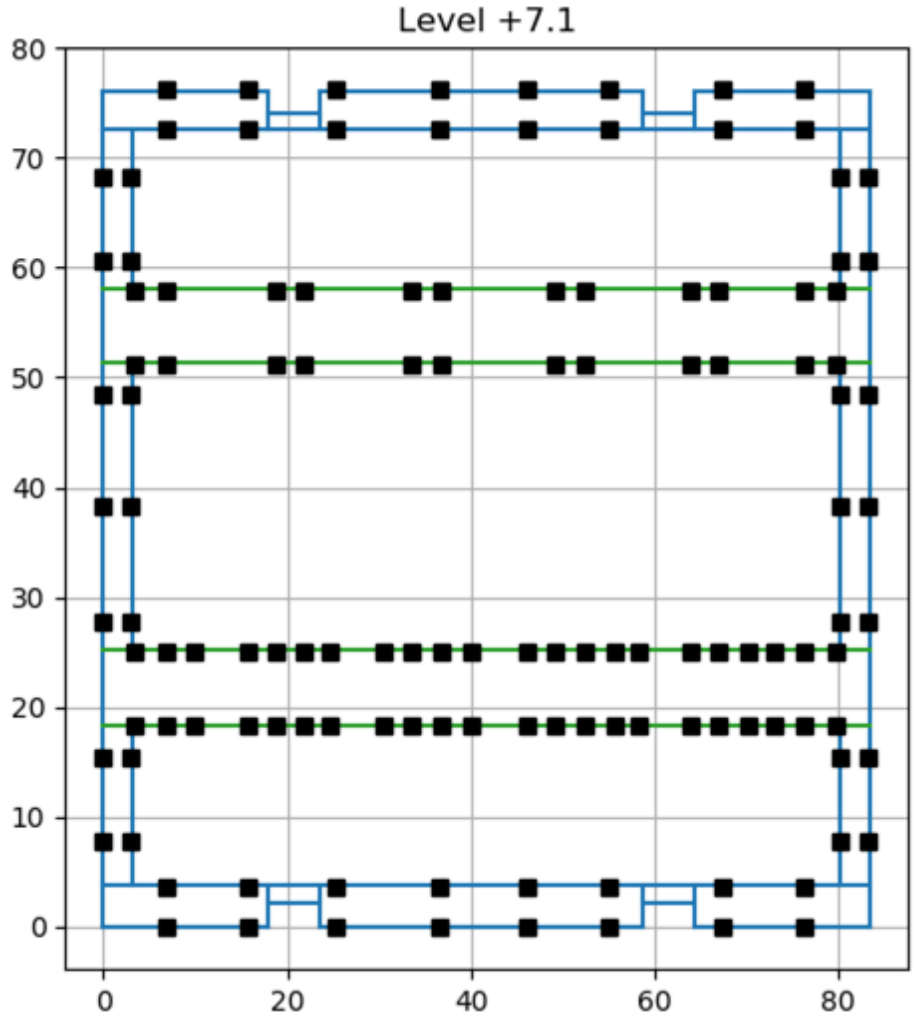




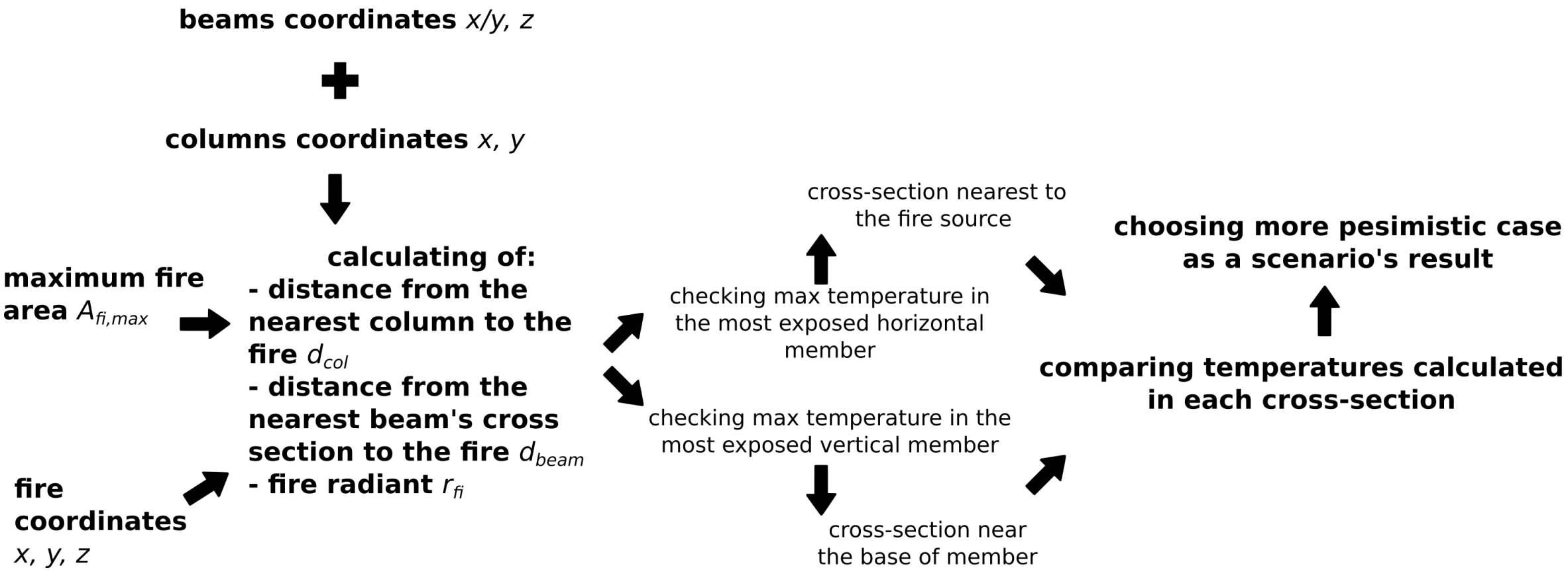
OZone3 – analysis engine



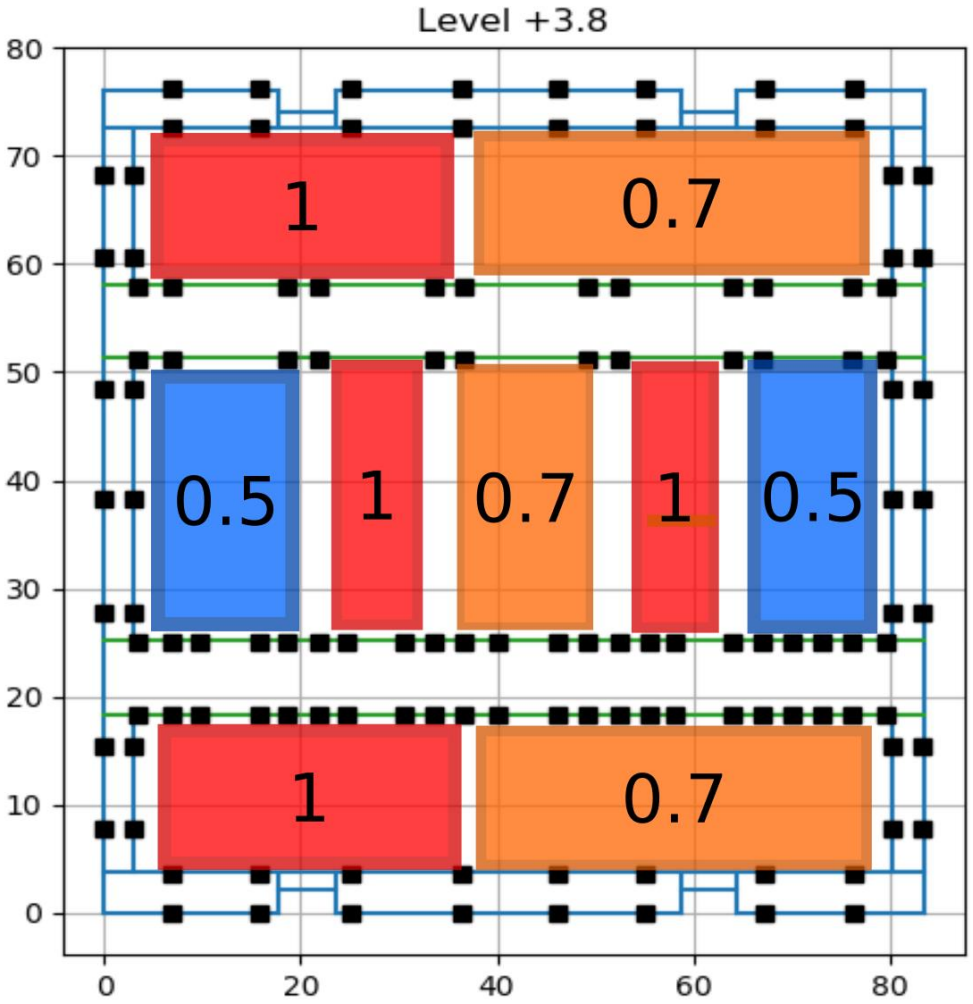
Construction geometry

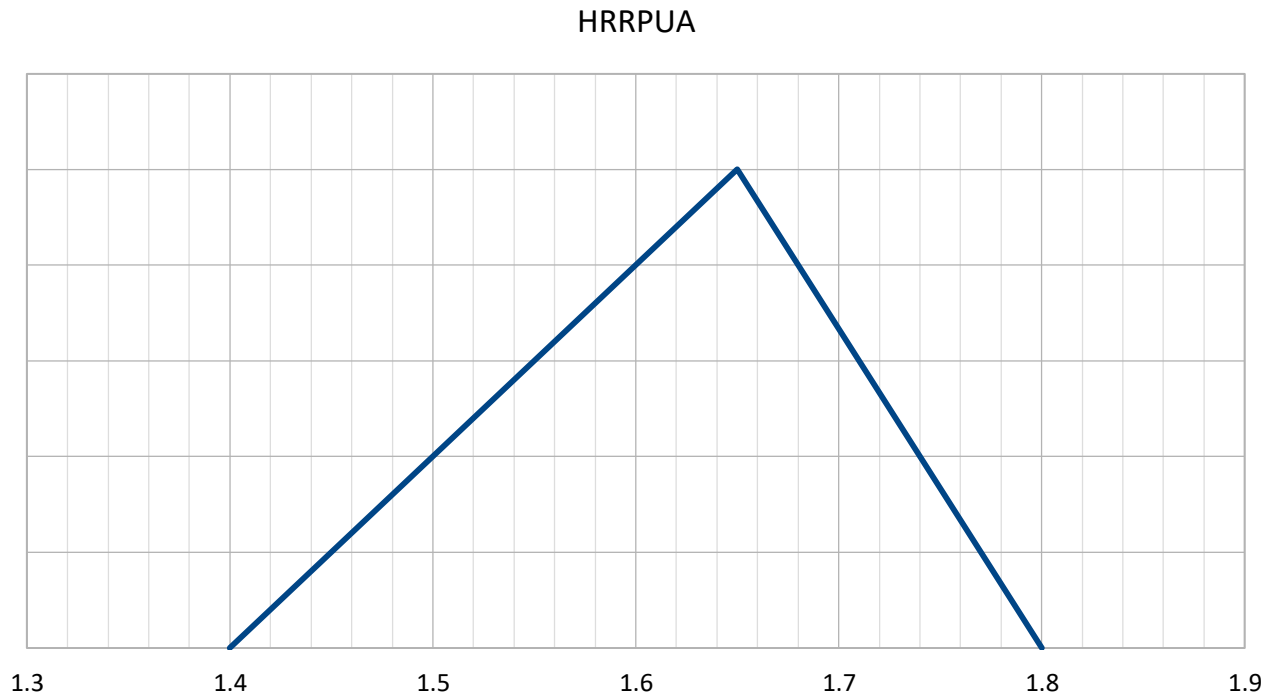


Construction – fire mapping



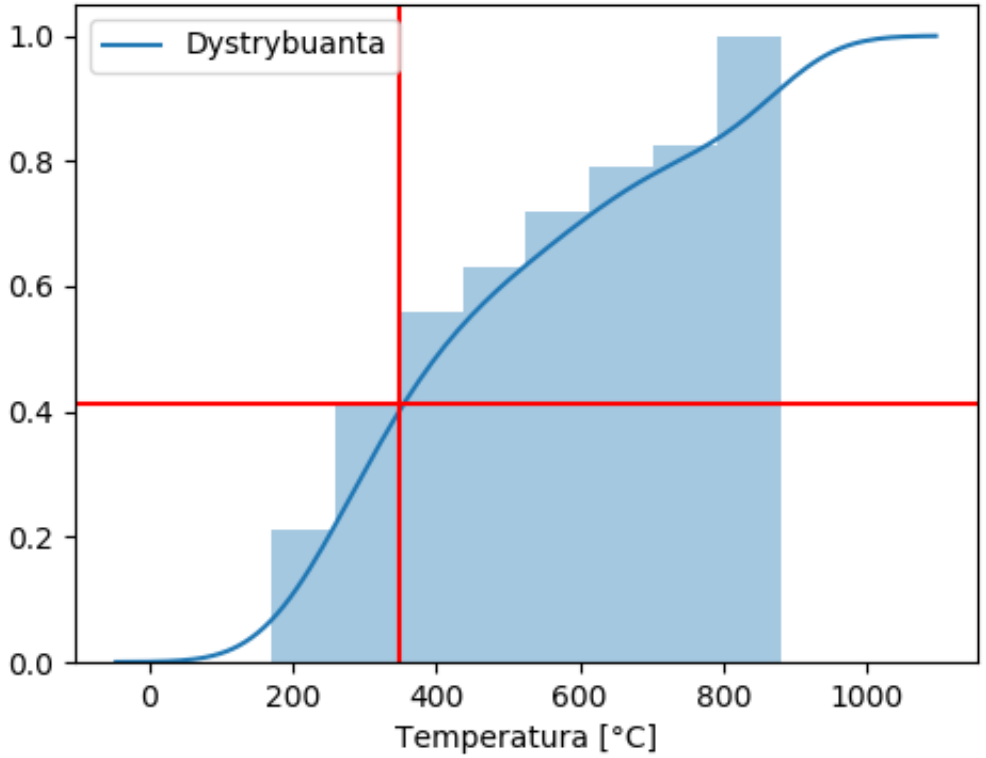
Sampling

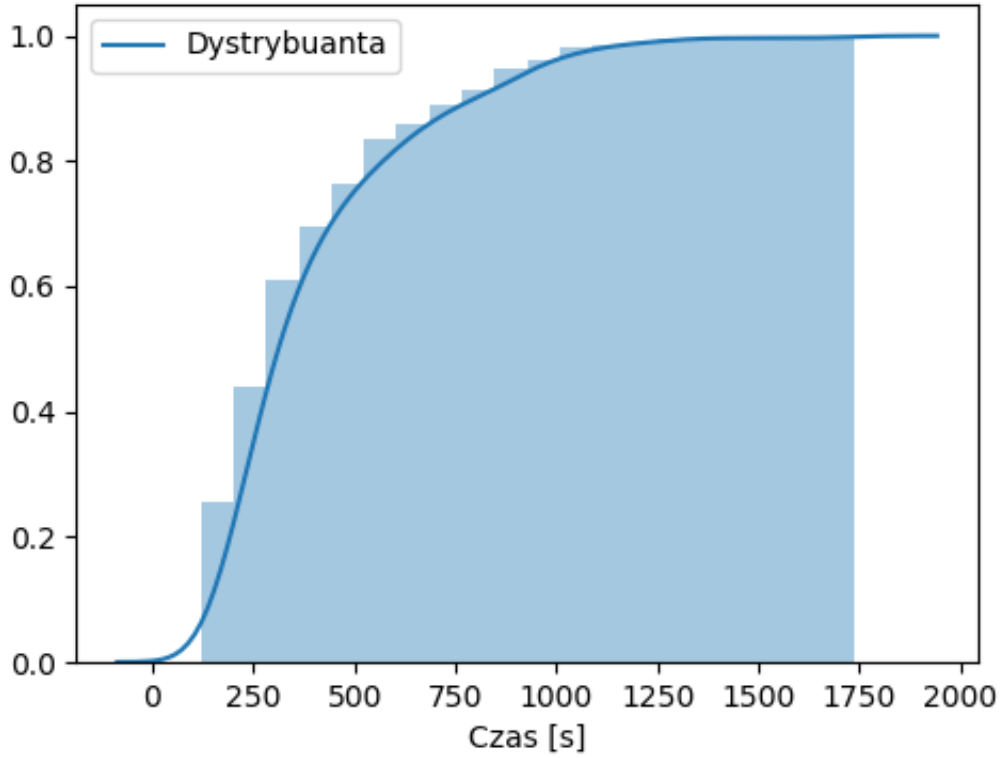

Level +3.8
1
0.7
0.5
1
0.7
1
0.5
1
0.7
0
10
20
30
40
50
60
70
80
0
20
40
60
80


HRRPUA
1.3
1.4
1.5
1.6
1.7
1.8
1.9

Results

38	880.2	180	0	4.23	15.3	69.3	5.3	0.885	0.5999999999999943
39	208.3	0	1	4.23	14.4	70.6	0.0	0.925	1.8999999999999915
40	39.9	0	1	4.23	27.0	75.4	0.1	0.875	6.700000000000003
41	880.2	120	0	4.23	53.1	69.5	7.2	0.865	0.7999999999999972
42	880.2	120	0	4.23	35.2	69.0	7.2	0.93	0.2999999999999716
43	303.7	0	0	4.23	57.7	73.0	0.6	0.905	0.5





Thank you for attention!

GitHub / kowalskiw / multi_zone

kowalskiwojciech986@gmail.com

W. Kowalski