QUESTIONABLE FIRE SAFETY ASSESSMENT OF THE BAKERY PLANT BUILDING

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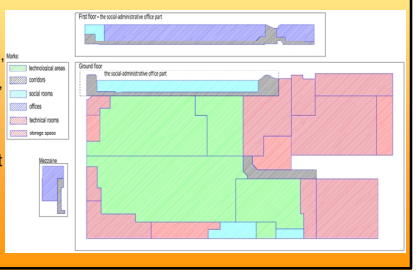
About ...

It is a free-standing bakery plant building, consisting of a single-storey production hall with two mezzanines located in two separate zones of production part, and the internal patio as well as a two-storey part containing the staff rooms for employees and office rooms.

Specific data:

- usable area: 6,280m^2,
- total height: ~10.5 m,
- rectangle-like shape with dim. 127m x 67m,
- employed: 189 total, at the same time about 65 people may stay in the building.



Regulatory requirements

The object has been designed based on the assumptions, that:

- fire load density does not exceed 1,000 MJ/m^2,
- does not contain any spaces and hazardous areas, and ...

... in terms of height - classified as the „low" building which raises some specific consequences

Maximum fire-load density in a fire zone of the building Q [MJ/m^2]	Single-storey building (without limitations of height)	Multi-storey building		
	low	Medium-high	High	High-rise
	(L)	(MH)	(H)	(HR)
Q =< 500	"E"	"D"	"C"	"B"	"B"
500 < Q =< 1,000	"D"	**"D"**	"C"	"B"	"B"
1,000 < Q =< 2,000	"C"	"C"	"C"	"B"	"B"
2,000 < Q =< 4,000	"B"	"B"	"B"	*	*
Q > 4,000	"A"	"A"	"A"	*	*

Fire Protection Requirements for Major Structural Elements of Buildings (rates in minutes)

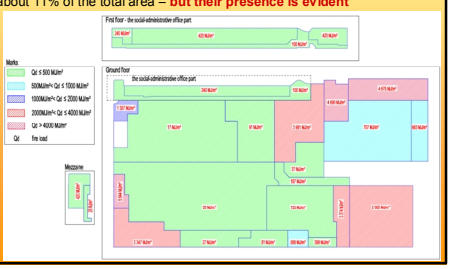
Specified Fire Resistant Class of a Building	Main supporting structural members (columns, walls)	Structure of the roof	Floor slab	External wall	Internal wall	Roof finishing layers
"A"	R 240	R 30	REI 120	EI 120 (o-i)	EI 60	R E 30
"B"	R 120	R 30	REI 60	EI 60 (o-i)	EI 30	R E 30
"C"	R 60	R 15	REI 60	EI 30 (o-i)	EI 15	R E 15
"D"	**R 30**	(-)	**REI 30**	**EI 30 (o-i)**	(-)	(-)
"E"	(-)	(-)	(-)	(-)	(-)	(-)

Detailed analysis of the distribution of a fire load density confirmed the compatibility with the assumptions but **only** in relation to an average value, calculated for the entire fire zone. **Such an approach is fully correct**, but one should realize that the average values of fire load density may not properly reflect the real threat of fire.

Fire load density distribution

- The estimated average fire load density reached 974 MJ/m^2, so ... **it's less than 1,000 MJ/m^2**
- In approx. 47% of the area of the building the fire load density does NOT exceed 100 MJ/m^2.
- In the lowest range of the fire load density which one can find in the technical regulations (i.e. of less than 500 MJ/m^2) falls to approx. 74% of the floor area of the analysed object.
- Surfaces for which the fire load density exceeds 4,000 MJ/m^2 (in extreme cases, it's 5,644 MJ/m^2) represent **only** about 11% of the total area – **but their presence is evident**

In these areas construction of a building designed and executed based on the initial assumptions is not adequately prepared for the likely fire conditions that may occure there.



More on regulatory requirements

- The fire zones, for which the fire load density exceeds 4,000 MJ/m^2, **(but calculated as an average value for the entire fire zone)** due to national regulations and codes of design must meet the criterion R240 of structural fire resistance, so ...
- ... it would be reasonable to separate the office part of the building from the technological part (as different fire zones) and to create completely new fire zone consisting of some storage areas with a high fire load density but it entails costs **(but ONLY if one wants to have a safer but MORE COSTLY building, requiring application of additional technical solutions)**

In addition, the allowed surface area of individual fire zone in a low multi-storey building, in which there are no potentially explosive areas, and the fire load density fits the range 500 <Q ≤ 1,000 is equal 8,000 m^2.
Surface of the analysed object is now nearly 79% of the limit, so it fully meets the formal requirements.

Type of fire zone	Fire-load density Q [MJ/m^2]	Allowable size of a fire zone [m^2]		
		In a single-storey building (without limitation of hight)	In a multi-storey building	
			Low & Medium-high (L) and (MH)	High & High-rise (H) and (HR)
Fire zones without potentially explosive premises	Q > 4 000	2 000	1 000	*
	2 000 < Q ≤ 4 000	4 000	2 000	*
	1 000 < Q ≤ 2 000	8 000	4 000	1 000
	500 < Q ≤ 1 000	15 000	**8 000**	2 500
	Q ≤ 500	20 000	10 000	5 000

Conclusions

- A building design based on the formal requirements conditioned by the fire-load density parameter may lead to unsafe and unsatisfactory solutions,
- An average value of fire-load density (calculated for an entire fire zone) - **especially in fire zones and/or premises of large areas and varied functions** - can lead to significant underestimations of building fire safety and result in incorrect assessment of the construction located in areas of high fire-load density levels,
- **This problem is not generally discussed in the legal regulations**,

THANK YOU FOR YOUR KIND ATTENTION