Introduction of the lecturers and the topic of the lecture

Defect overview of flat roofs (construction, design and materials)

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Examples of malfunctions from the life of a expert witness

Forgotten Work Tool (Liability Issue)

Lifetime

Lifetime is different than warranty. The guarantee is for perfect function. The service life is how long it will last without a comprehensive replacement.

The supporting structures should have a service life of more than 50 years.

Roofs, or easily repairable structures (without interfering with the load-bearing structures) should have a service life of more than 25 years.

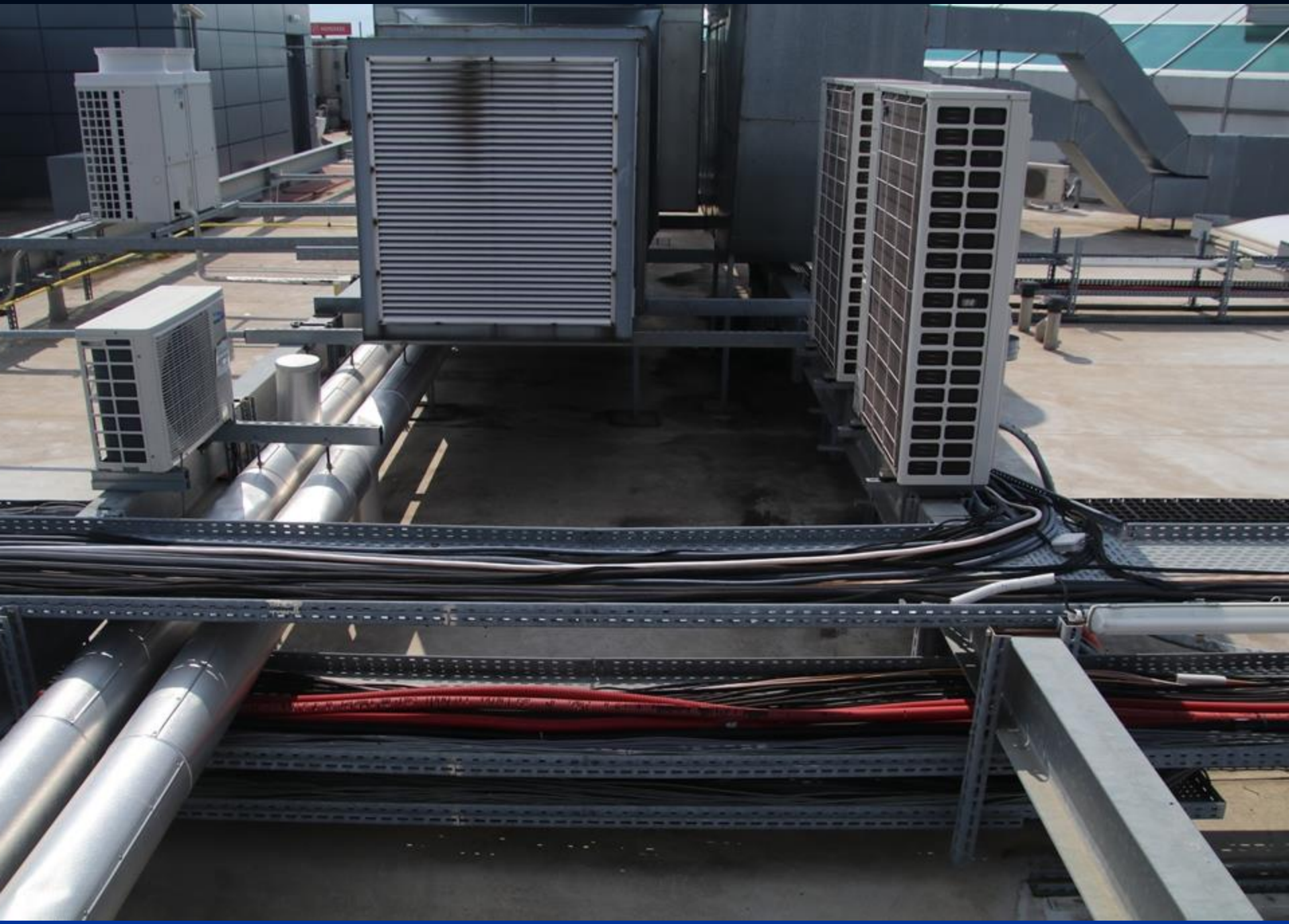
Coatings, sealants, etc. have a shorter lifespan. I.e. even under 10 years. For sealants, the lifespan is within units of years.

System malfunctions

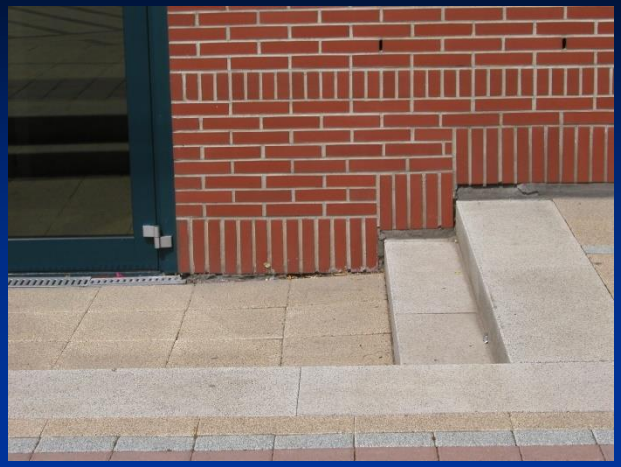
Every building needs to be reconstructed, the question is when. The service life of roof insulation systems is half (even shorter) than the service life of supporting structures.

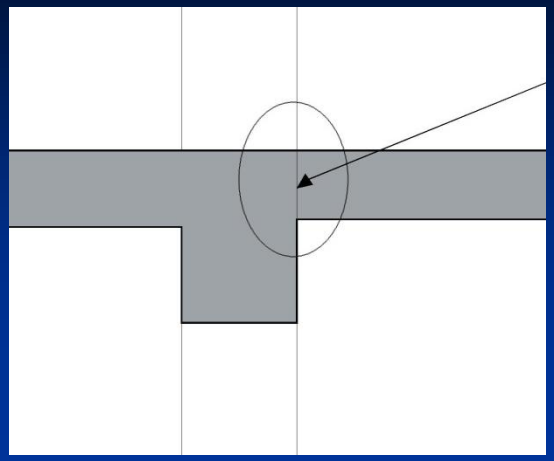
Roof with technical equpitment of buildings

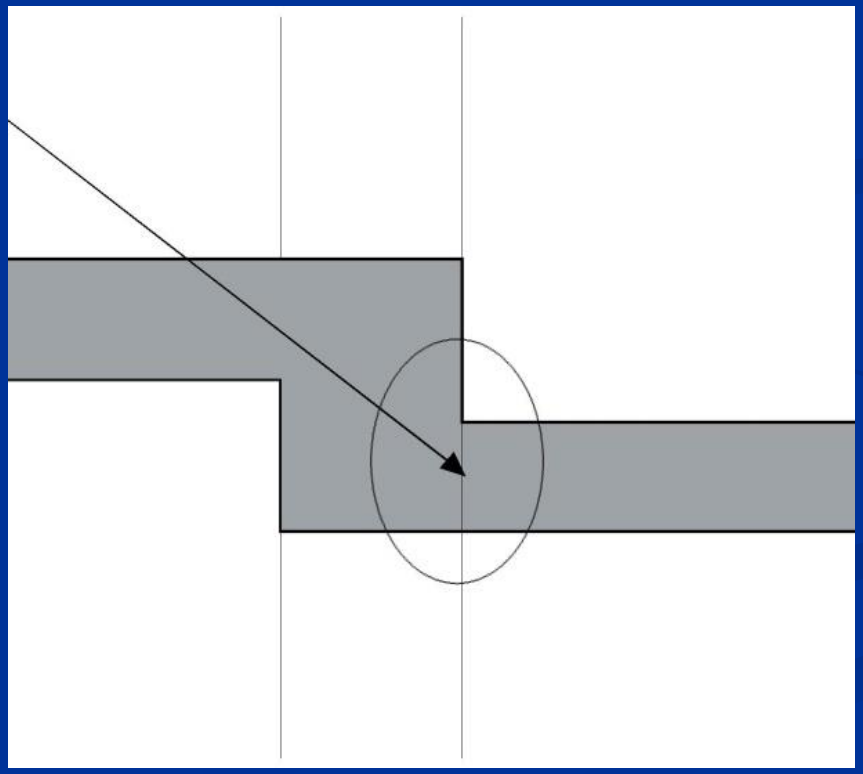

TRANE



For buildings is necessery respect
for the thickness
of building structures







Static faults

As a result of overload:

- Under-dimensioning of load-bearing structures during design or execution.
- Point or surface extraordinary load during assembly - e.g. by stacking several pallets of waterproofing materials in one place.
- Adding additional layers regardless of load-bearing capacity during roof sheathing reconstructions.
- A change in the way of use, the consequence of which is an increase in the payload.
- If the drainage system is blocked or inadequate, it can become loaded with retained rainwater.

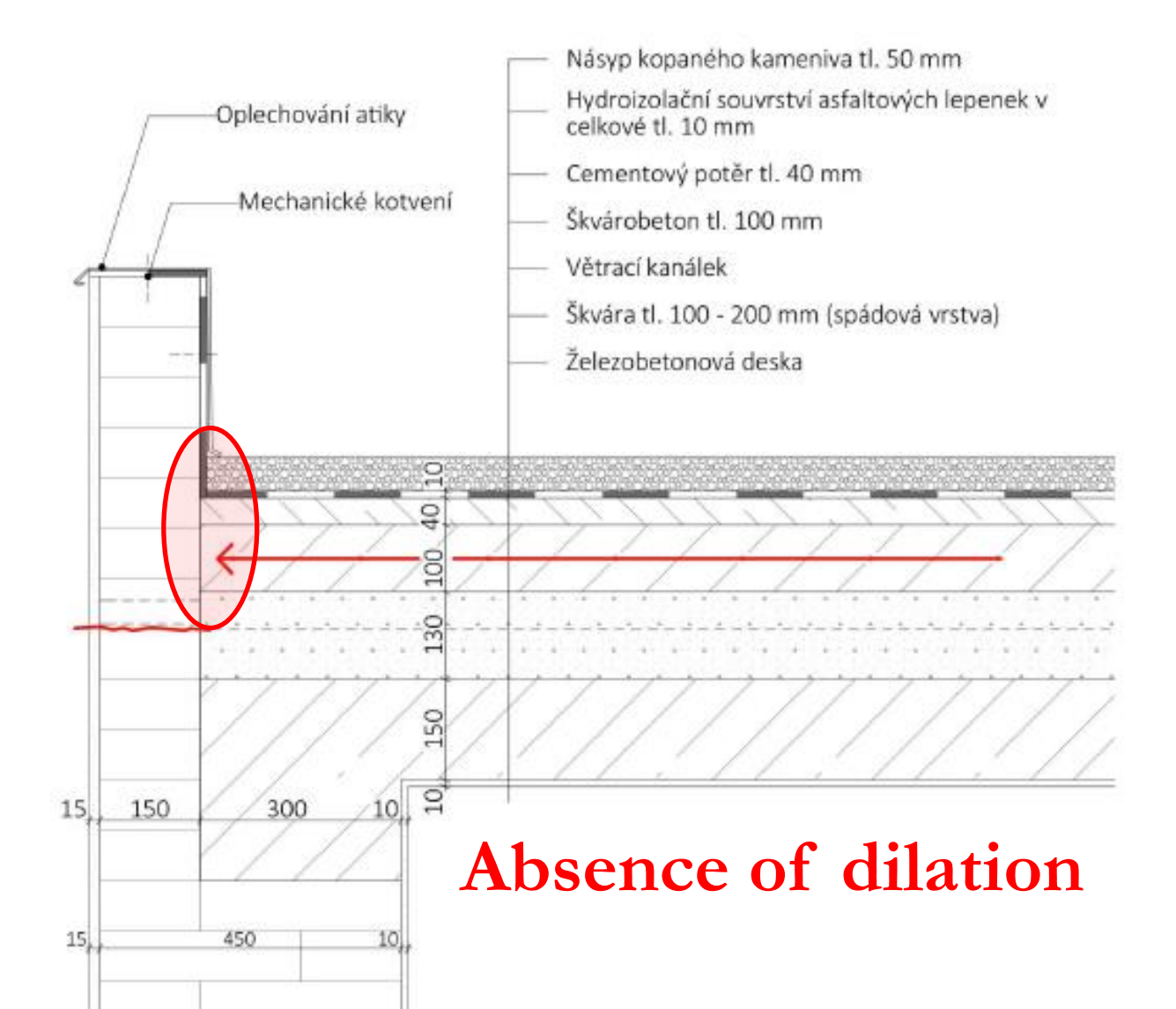
Static faults

Wind load

- Quantitative or qualitative deficiencies in mechanical fastening[1]/ within the roof sheathing - in area or in details (especially in plumbing details)
- Low-quality or insufficient attachment of structural elements, especially skylights
- Poor quality or insufficient connection between the individual layers of the roof covering

[1] / In particular insufficient quantity and corrosion of mechanical fastening elements.

The principle of pushing away of roof parapet



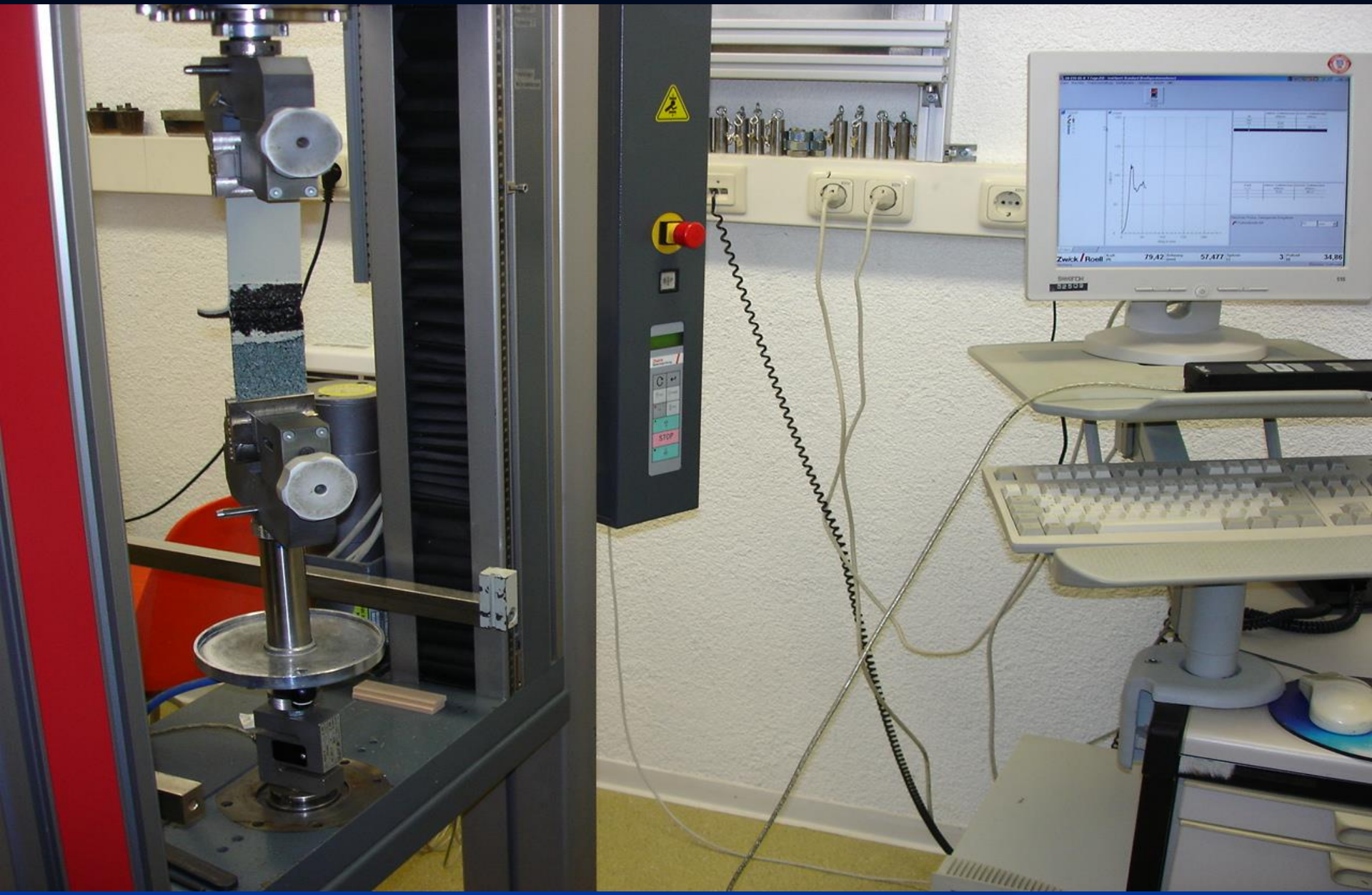
Adding loads

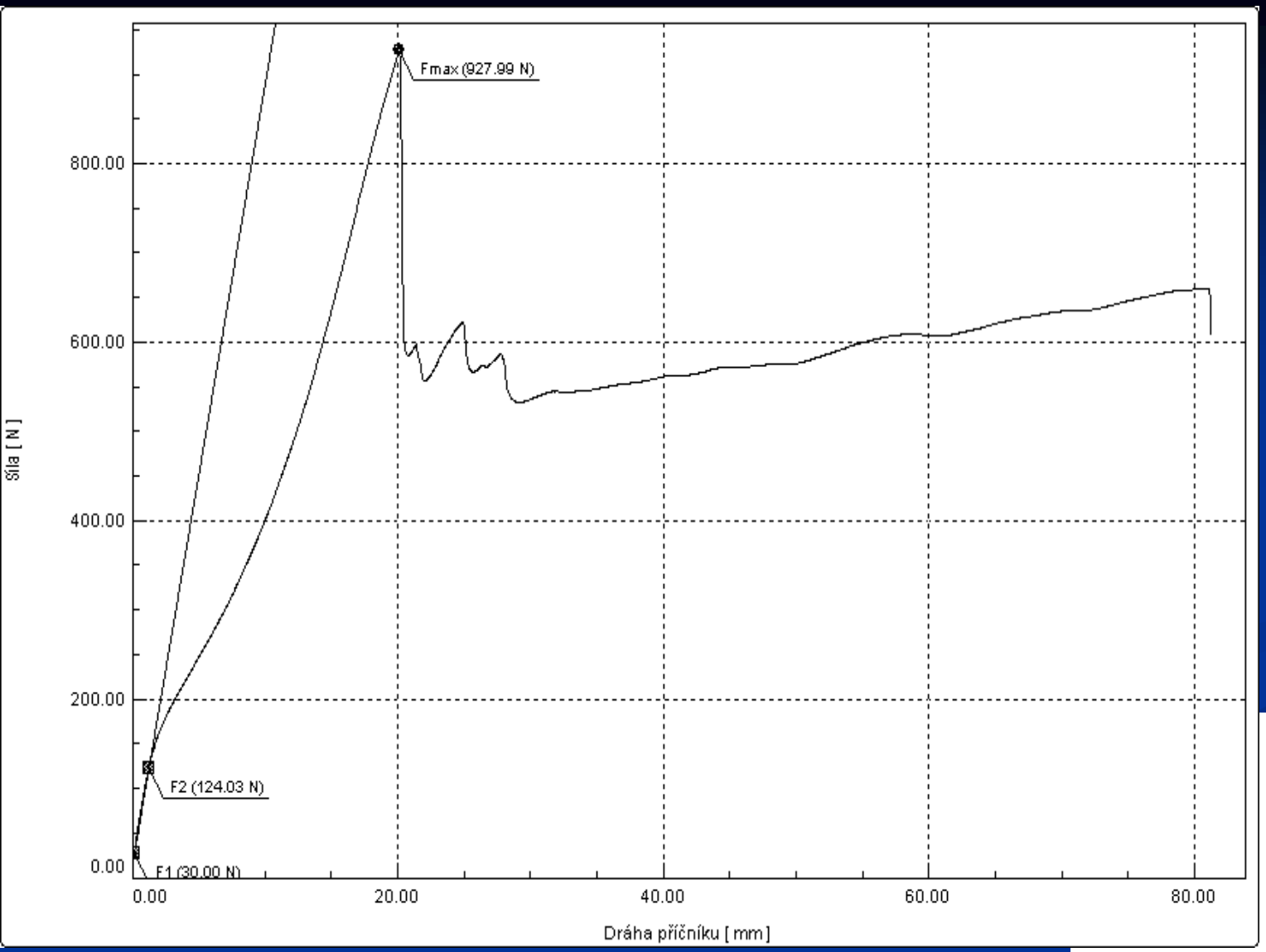
Bad static dimensioning, the absence of spreading wedges allows deformation of structures and therefore changes in slope ratios.
It is also dangerous to add weight when changing the function of the roof.

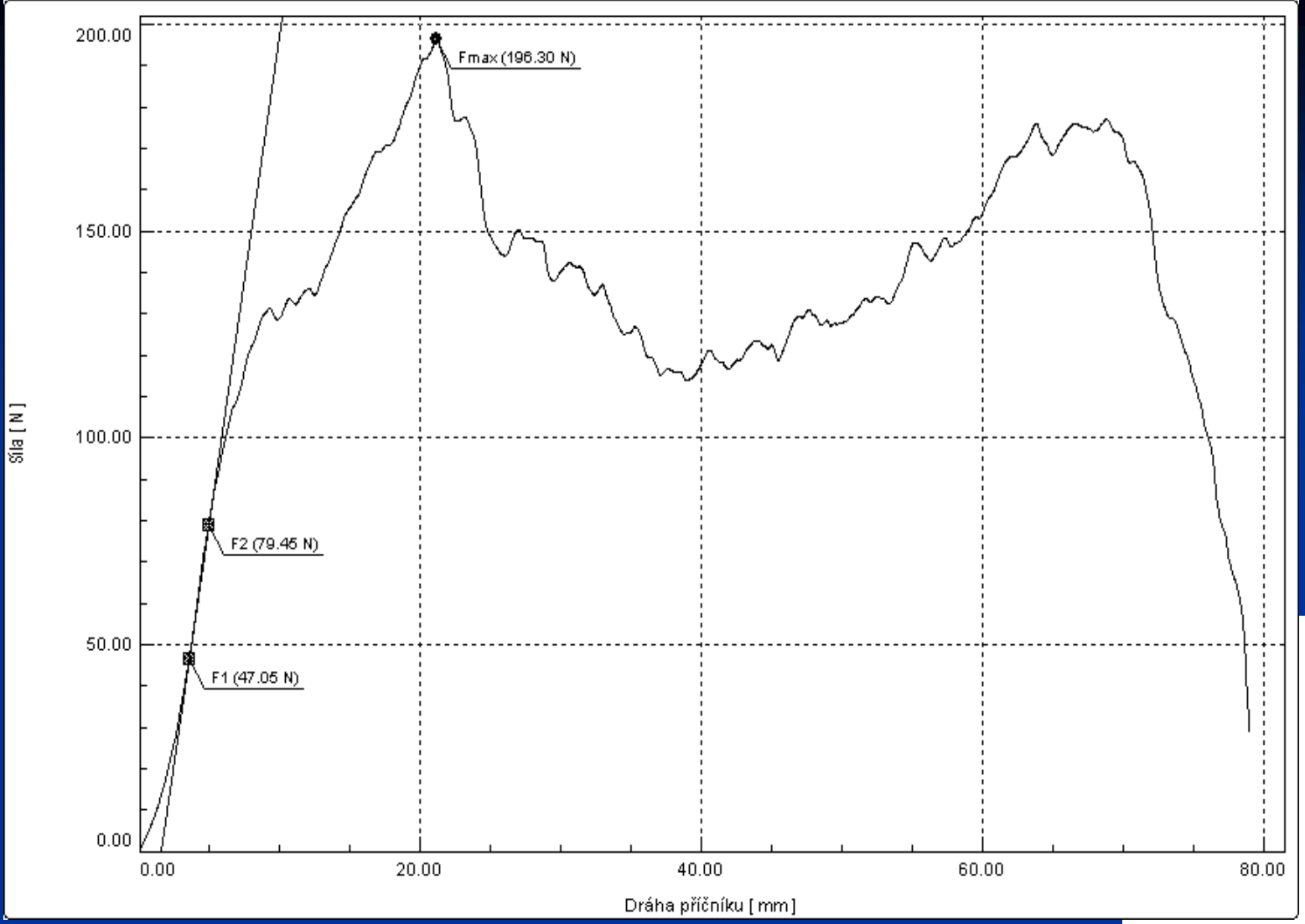
Extreme climatic conditions

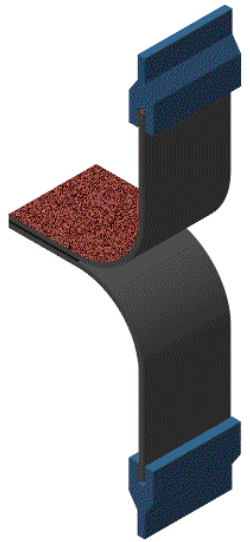
Extremely poor workmanship

Scratched, corroded mechanical fasteners


Zwick / Roell
79,42
57,477
34,86
STOP


Fmax (927.99 N)
F2 (124.03 N)
F1 (30.00 N)
800.00
600.00
400.00
200.00
0.00
Síla [N]
0.00
20.00
40.00
60.00
80.00
Dráha příčníku [mm]


Fmax (196.30 N)
F2 (79.45 N)
F1 (47.05 N)
200.00
150.00
100.00
50.00
0.00
0.00
20.00
40.00
60.00
80.00
Síla [N]
Dráha příčníku [mm]



An example of the extreme effect of hail on asphalt waterproofing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0 1 2 3 4 5 6 7 8

An example of the extreme effect of hail on transparent skylights


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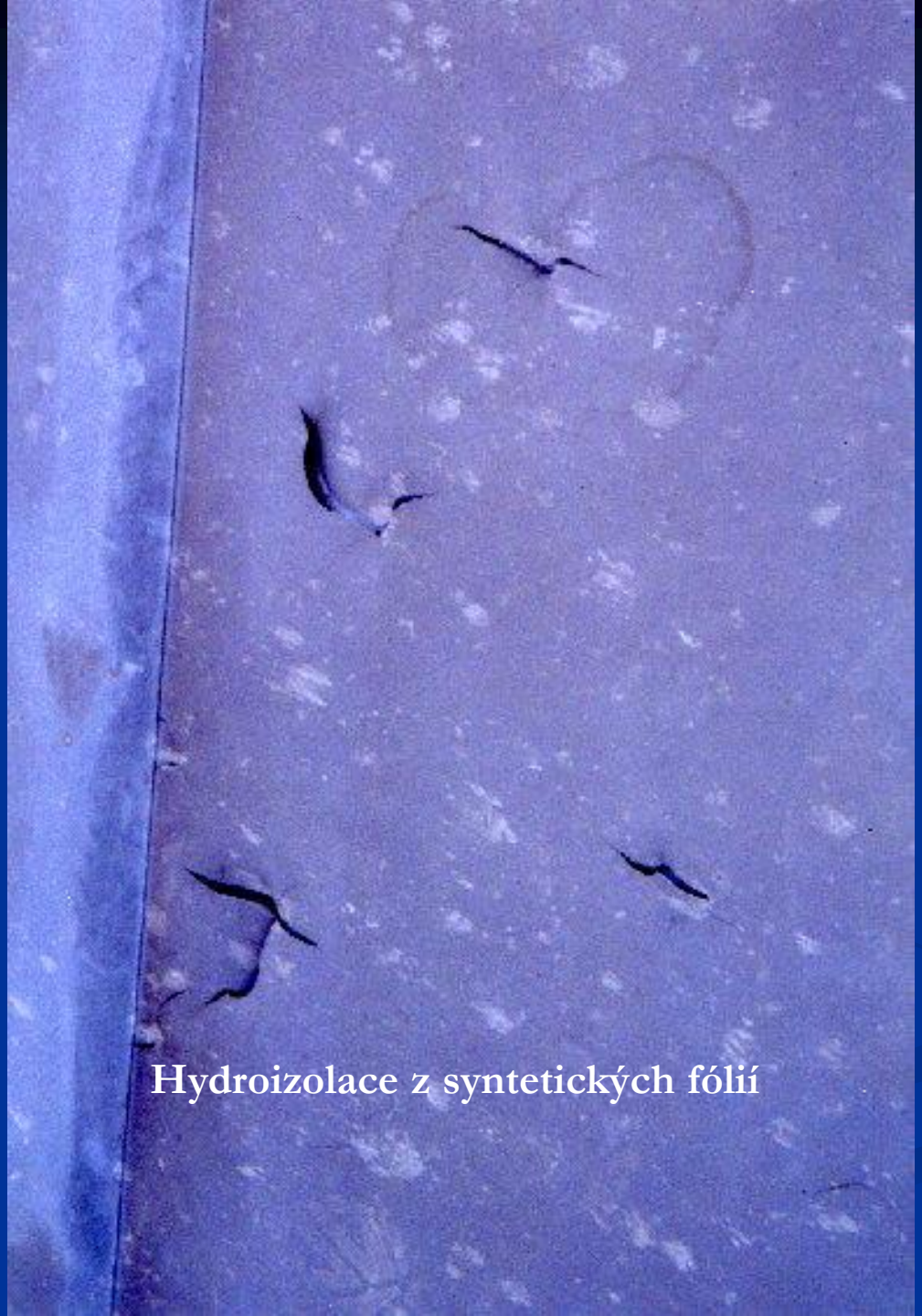
An example of the effect of hail on foil waterproofing - general view

An example of the effect of hail on foil waterproofing - detail

Plumbing damaged by hail



Hydroizolace z syntetických fólií

Improvised repair using wrapping film

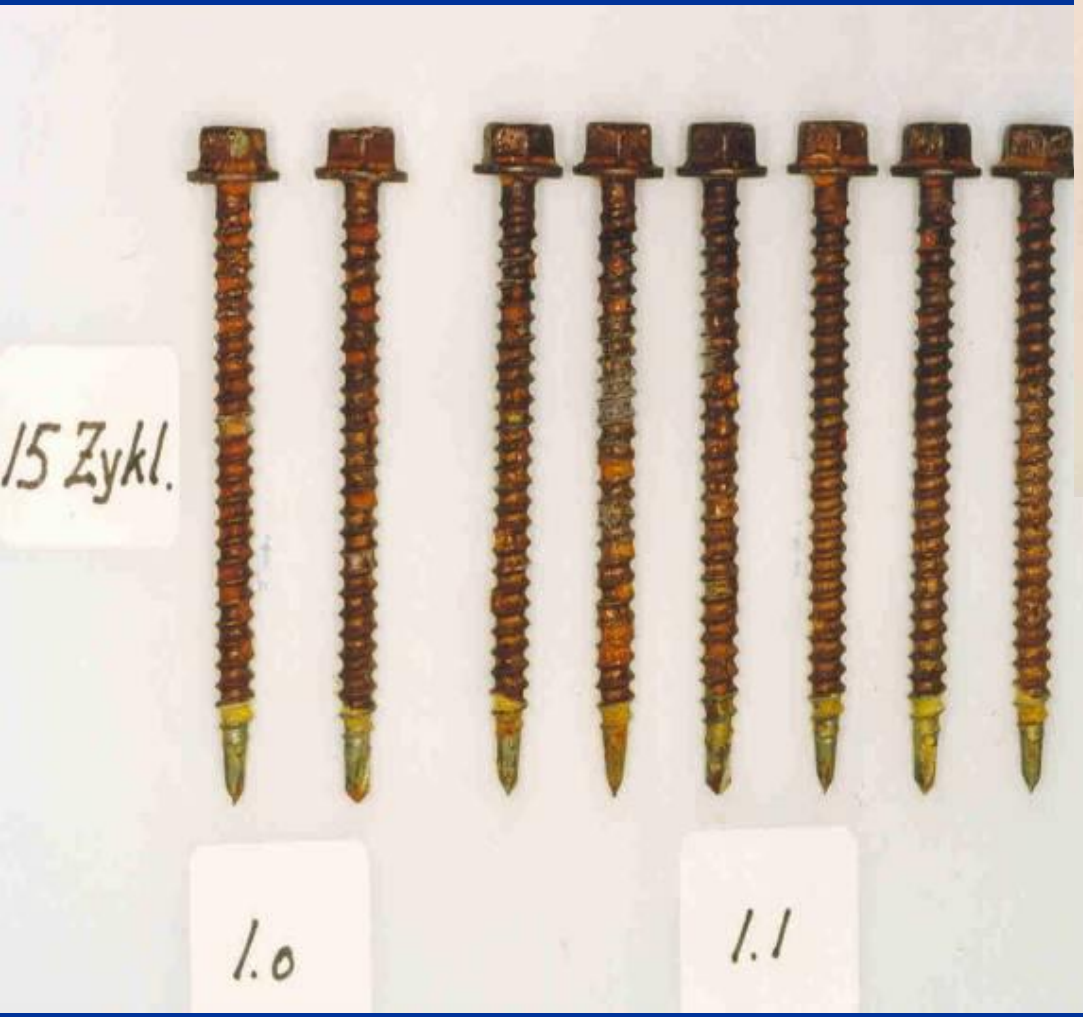
Corrosion of supporting building structures and other construkction

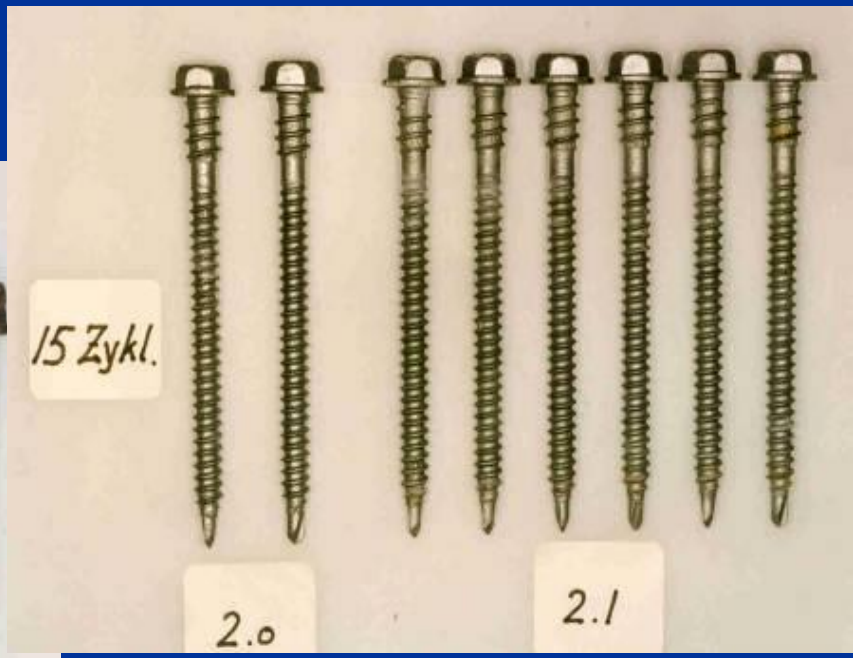
- Long-term leakage causes corrosion of metal elements (reinforcements, profiled sheets), but also of all other materials
- By using building materials that have a corrosive effect on metal elements, especially perlite, slag, expanded clay, etc.
- Frost corrosion of all building materials occurs due to long-term exposure to flowing water

Heavy Corrosion of fastening elements

Kesternich test – cyclic loading of an element in an aggressive sulfur oxide atmosphere, a quality element must pass min. 12 cycles with no signs of corrosion

Test results





Defects from the point of view of building physics in the area, or in detail (examples)

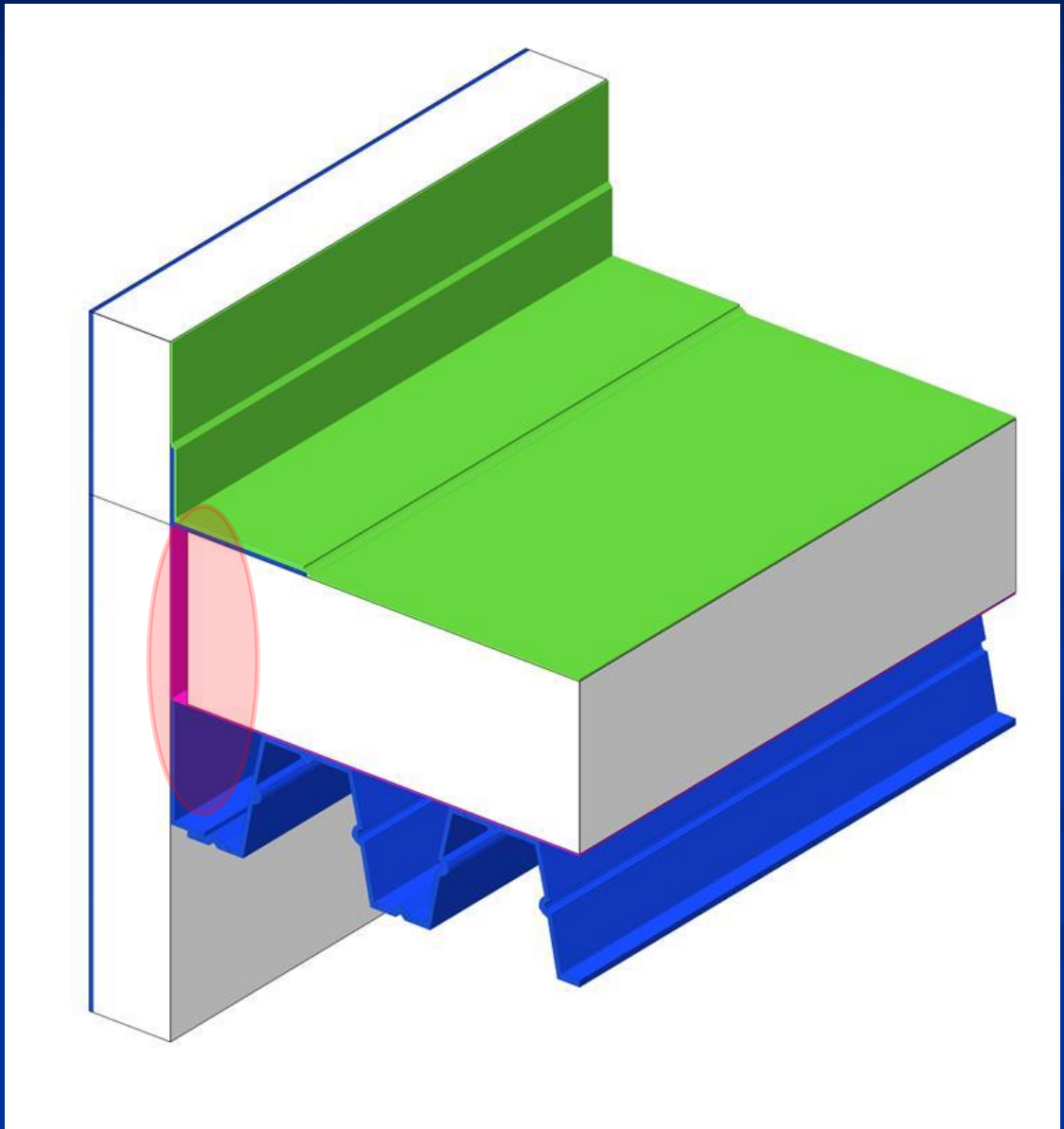
Passive balance of condensed and evaporated water vapor

Condensation in the air space inside of roof

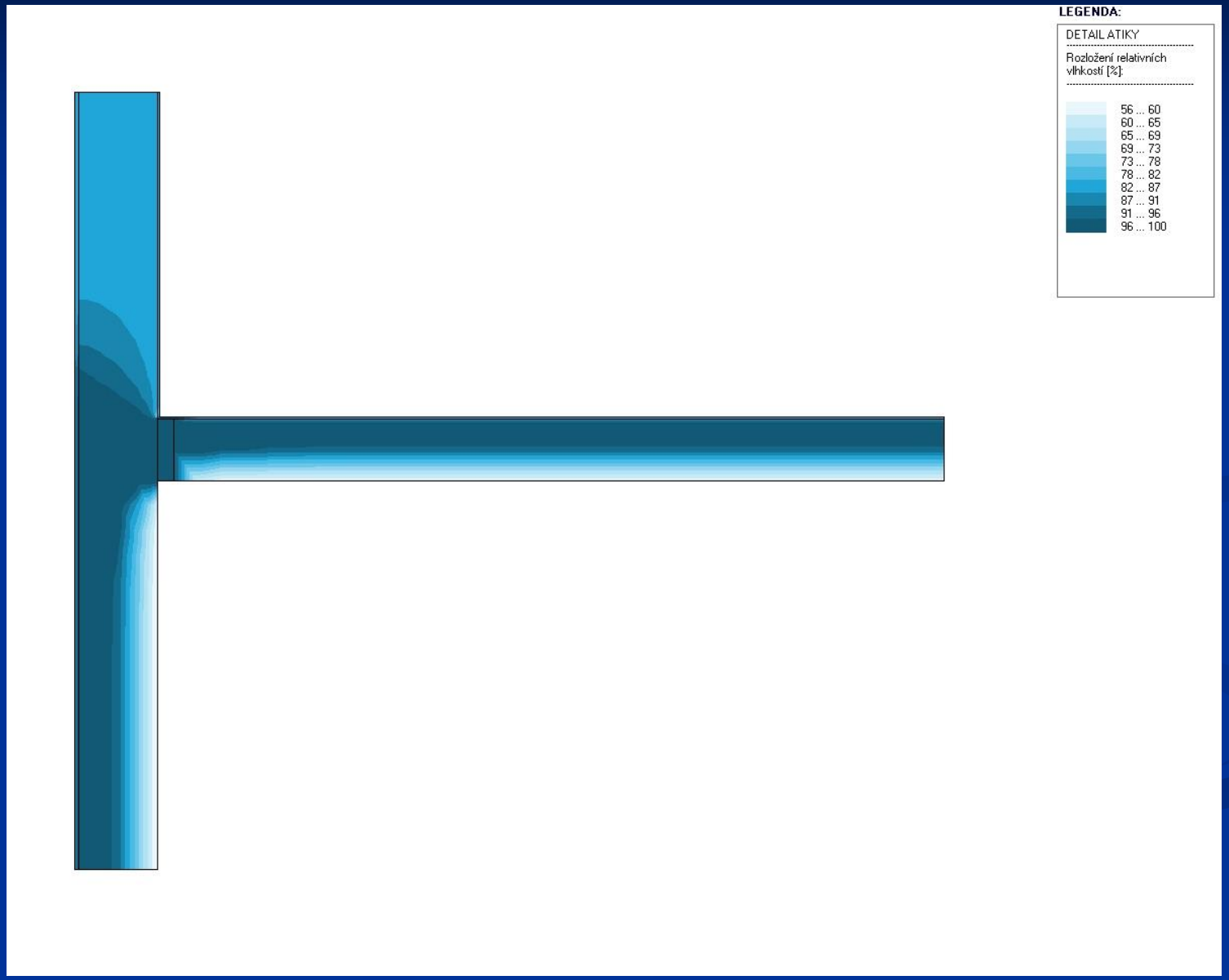
Condensation on a cold surface inside an air gap

Thermal bridge in construction detail

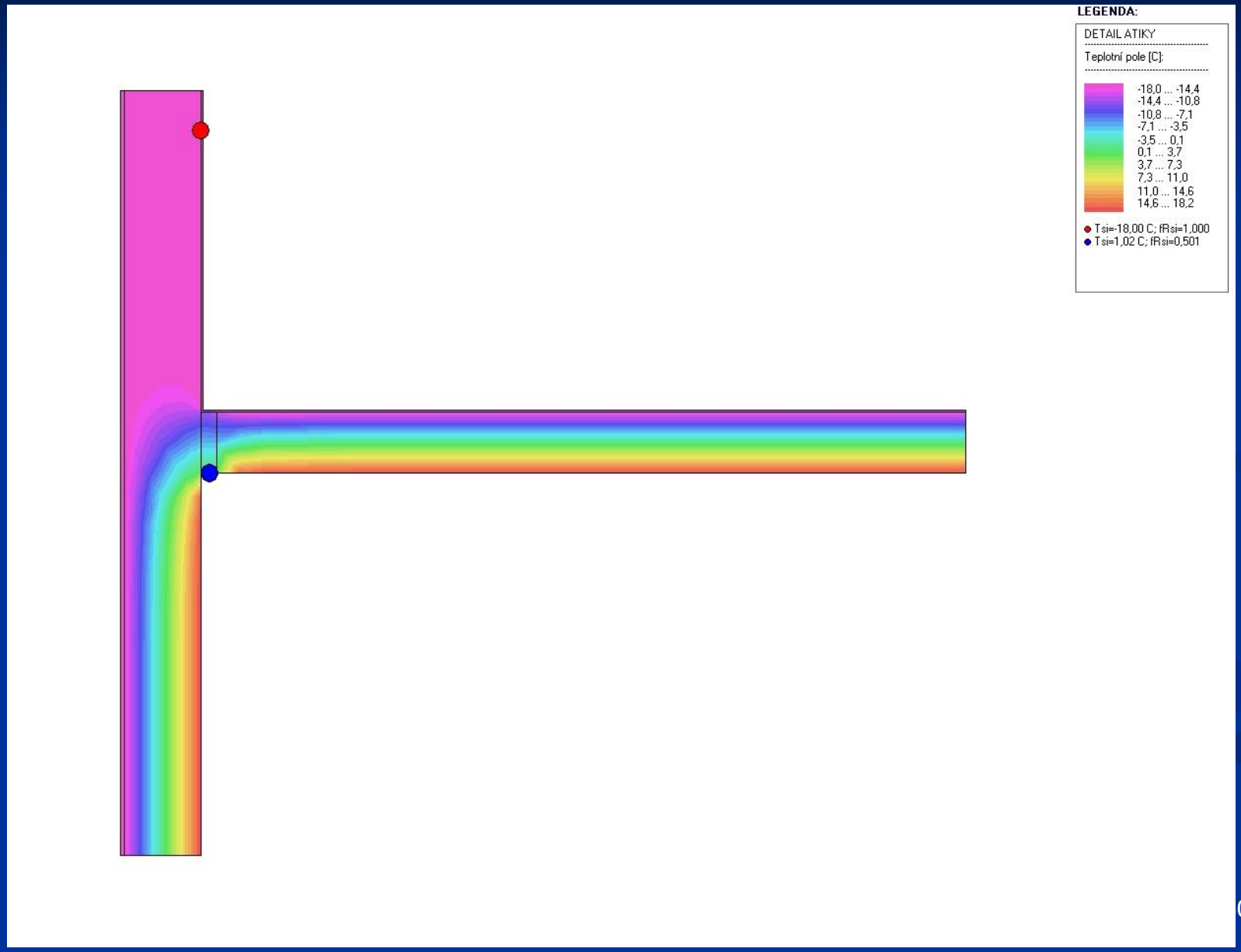
Thermal bridge in construction detail - shrinking polystyrene foam



Moisture parameters of the detail



Temperature parameters of the detail



Treatment of waterproofing during implementation and during the service life

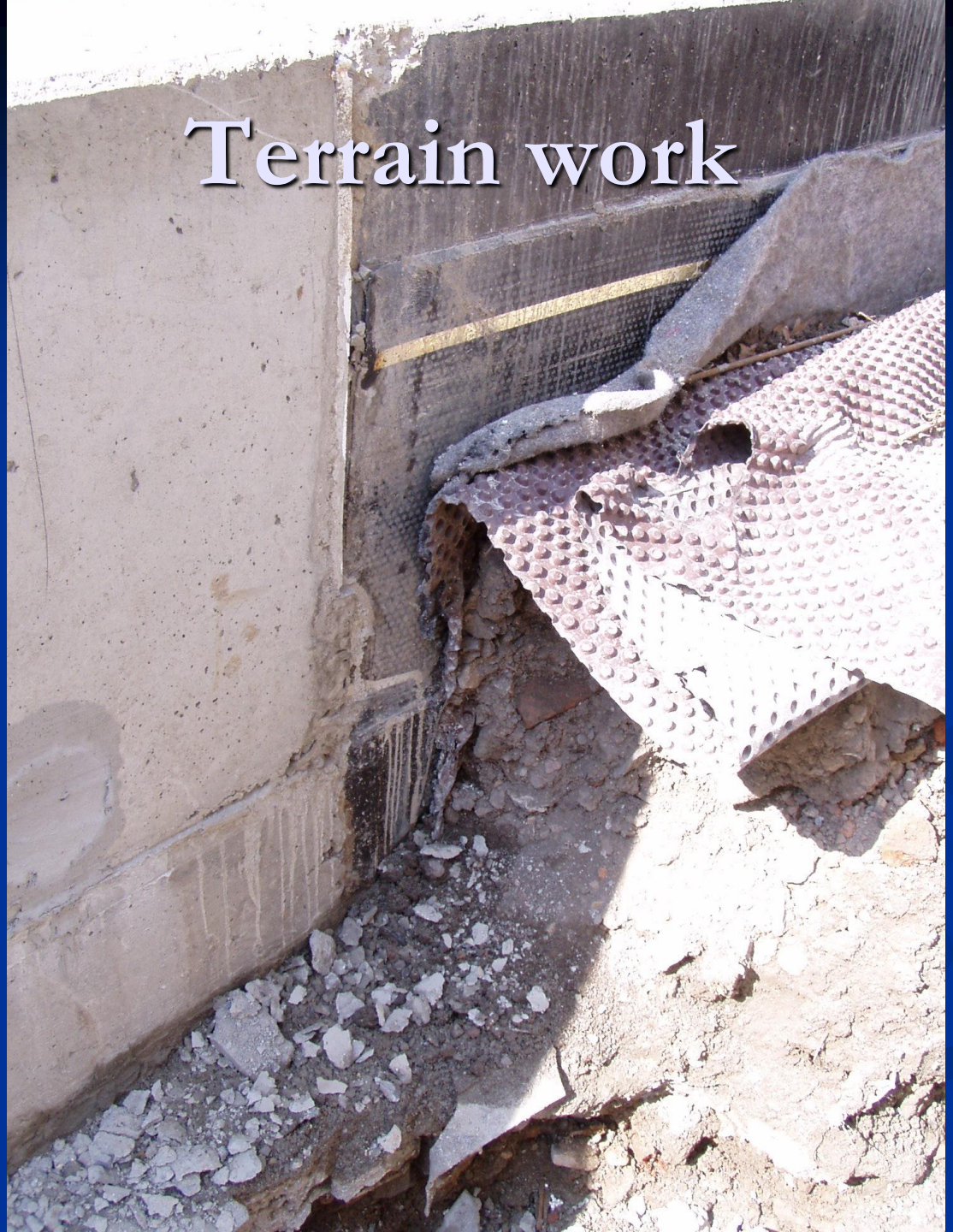
Enemies of roofs and waterproofing

Logistics and transport


17.08.2004 13:30

Core drilling - additional

Terrain work



Grinding, cutting of steel elements

03/09/2004 17:15

Geodetic work

Geodesic nail

High heels


STAPO
02 / 652 33 33
652 44 44
02 / 652 41 43

Warehouse at construction site

Irrigation fastening through waterproofing

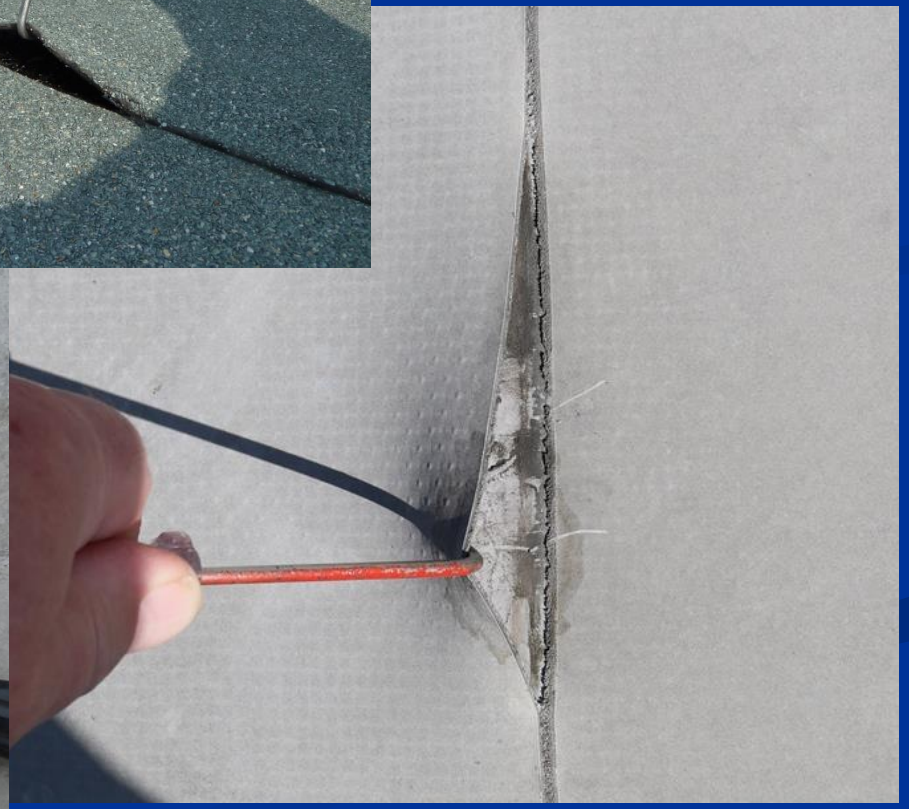
Intensive vegetation roof, but due to insufficient maintenance

Intensive vegetation roof, but due to insufficient maintenance

Blocked outlet due to bad maintenance

Defects of waterproofing coatings (including basic identification)

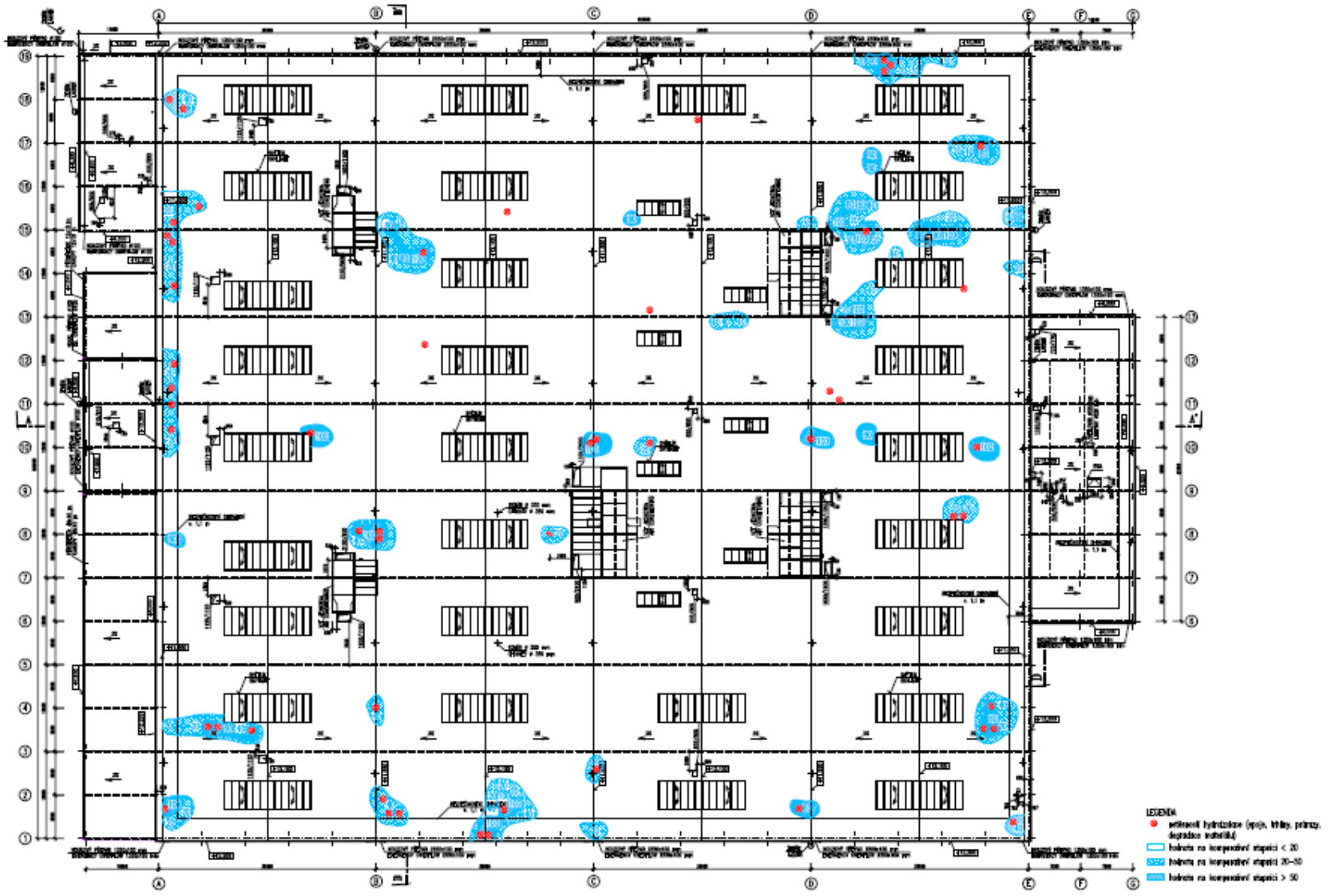
Needle test



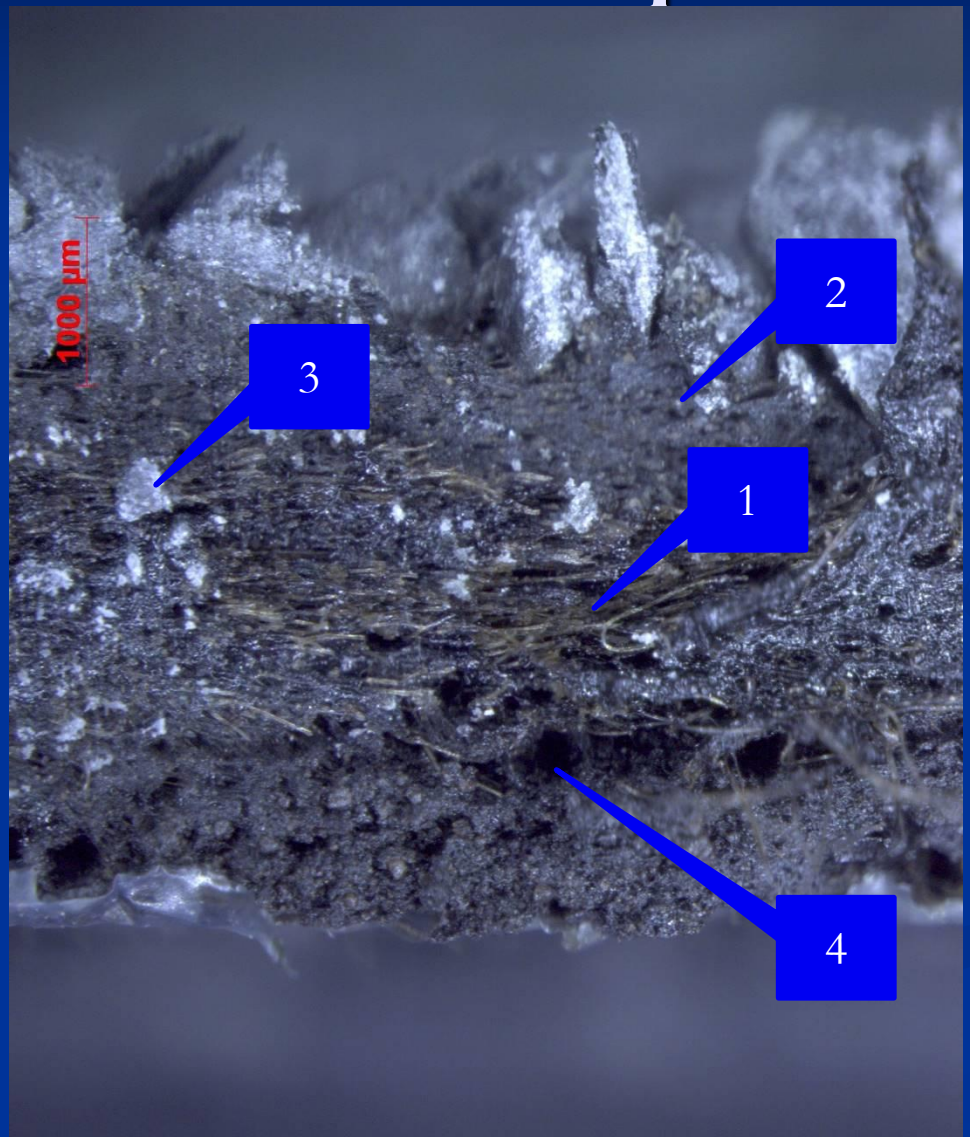
Impedance defectoscopy


Relative Scale
0
20
40
60
80
100
BATTERY
LOW MOISTURE
TRAMEX

Humidity map

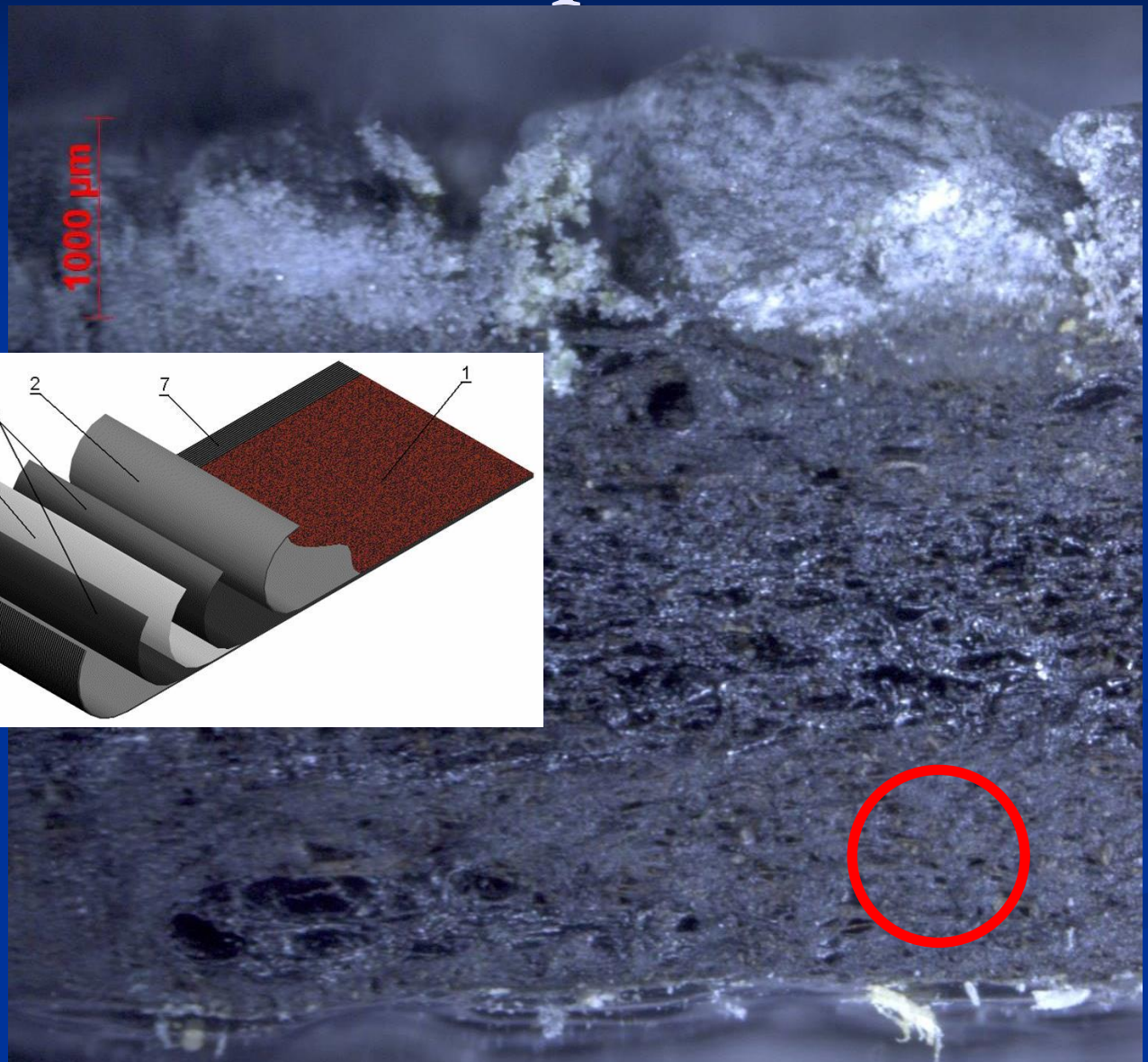


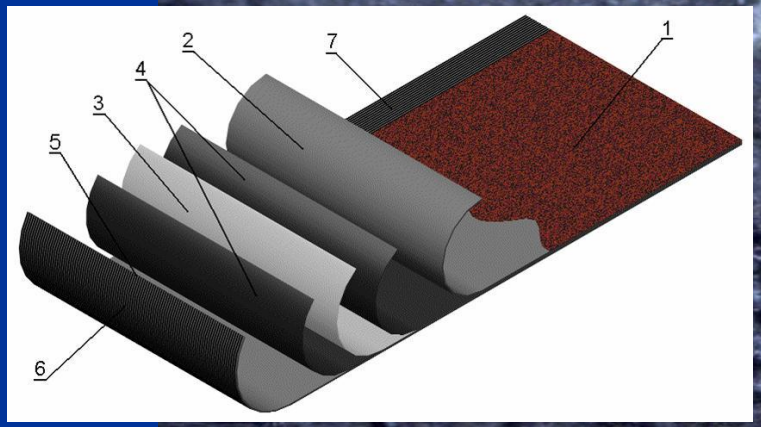
Microscopic photograph of asphalt belt



1./ Very heavy reinforcing insert – polyester mat, not completely compressed and saturated with asphalt,
2./ The shale sprinkle showing significantly different granulometry is pushed very deep into the mass, practically up to the reinforcing insert.
3./Light spots are mineral filler, there is a lot of it and it is unevenly mixed
4./"Holes" in the insulating asphalt mass. These are a consequence of the manufacturing technology

Microscopic photograph of asphalt belt

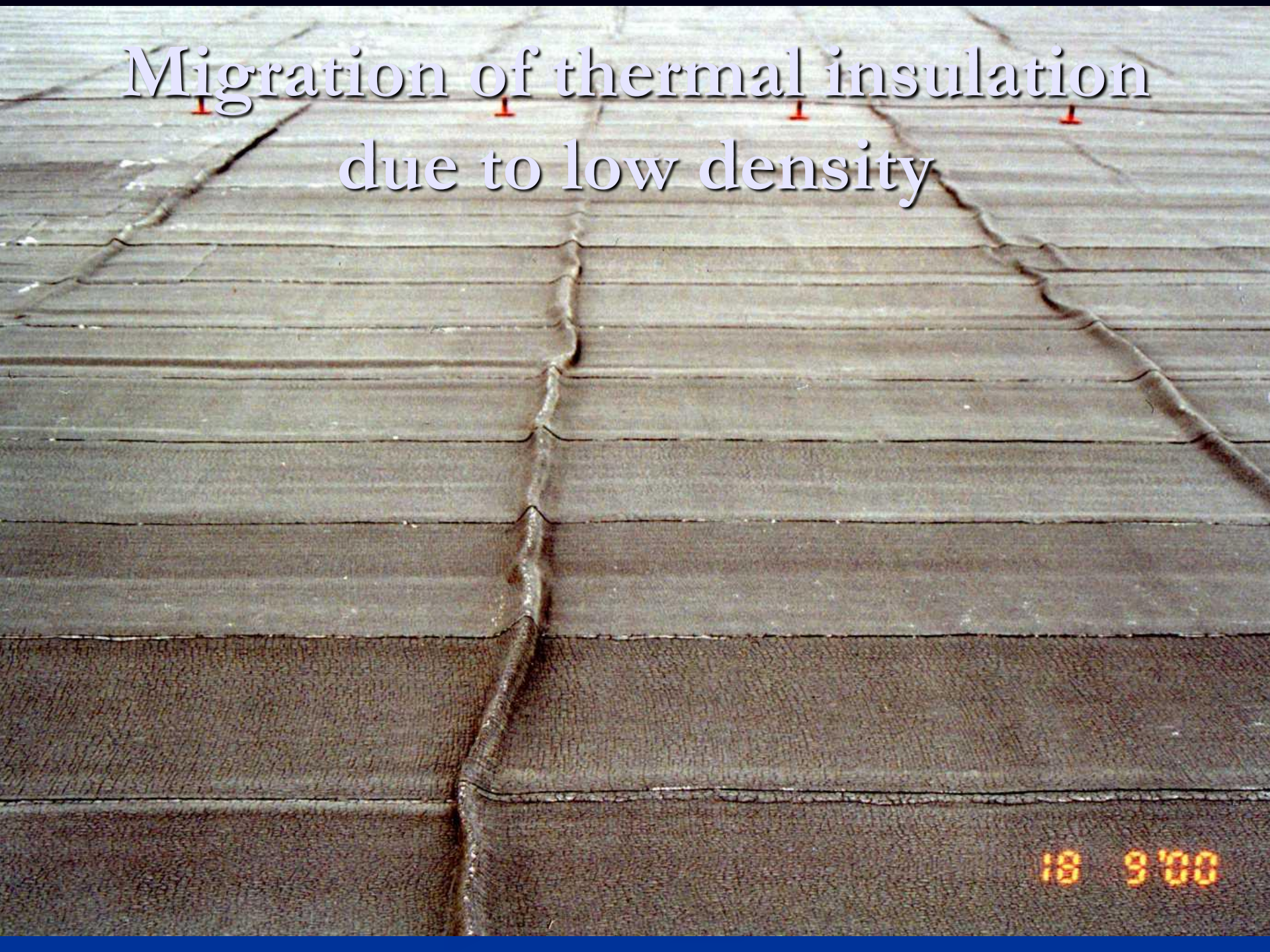




Part v
red circle
is an example
as it should
asphalt
he had a belt
to look like.

Defects in the base under waterproofing

Migration of thermal insulation due to low density

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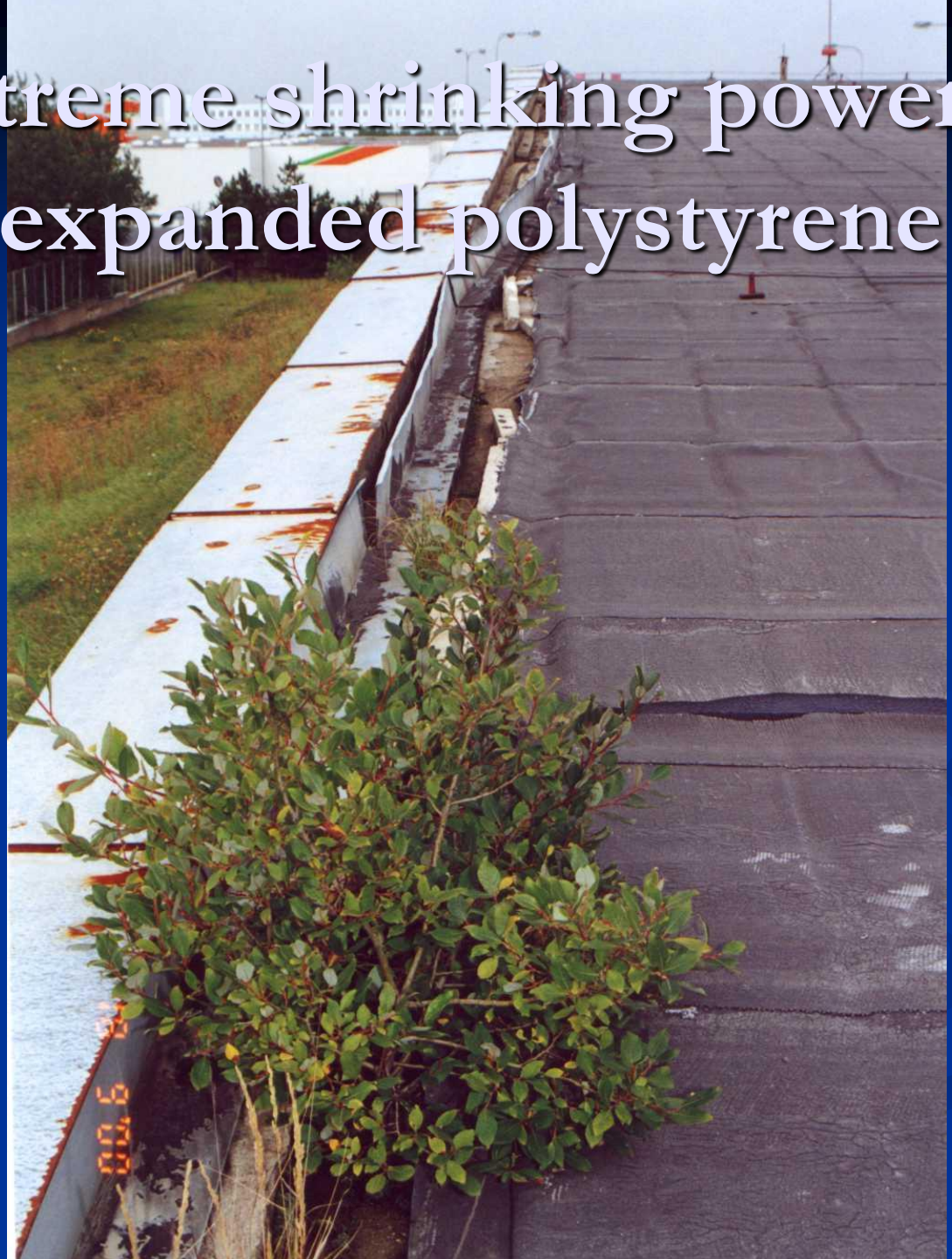
Extreme shrinking power of expanded polystyrene



Defects (shrinking) of thermal insulations, their insufficient thermal resistance

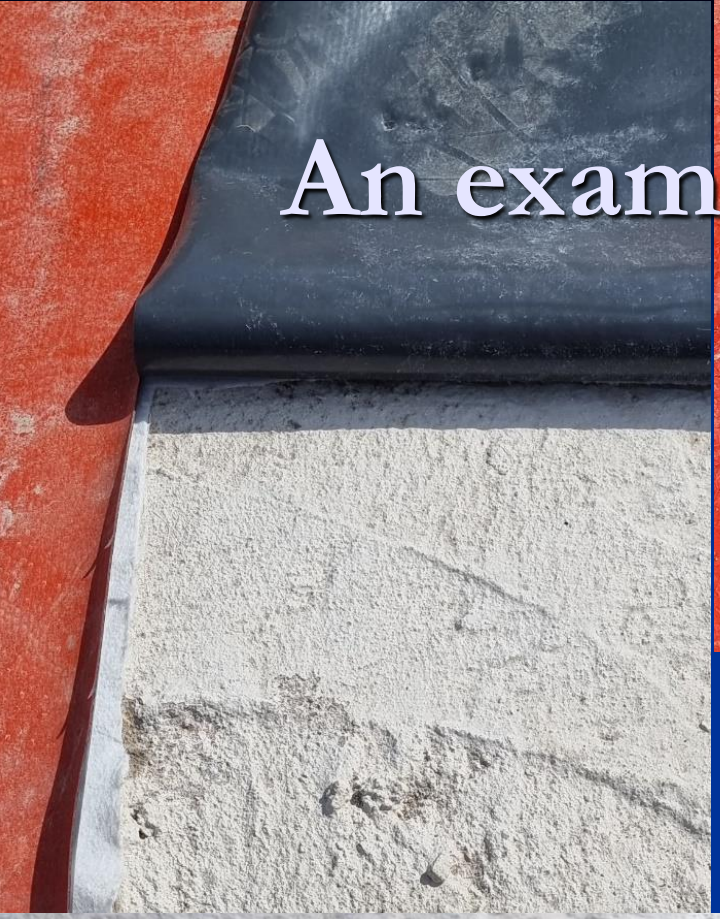
Migration of thermal insulation under high temperature

Degradation of the strength of mineral fiber thermal insulation due to heavy traffic


BOSCH

In general, there must not be a problem with the substrate, especially with its flatness and roughness, but also strength

An example of bad practice



Defects of waterproofing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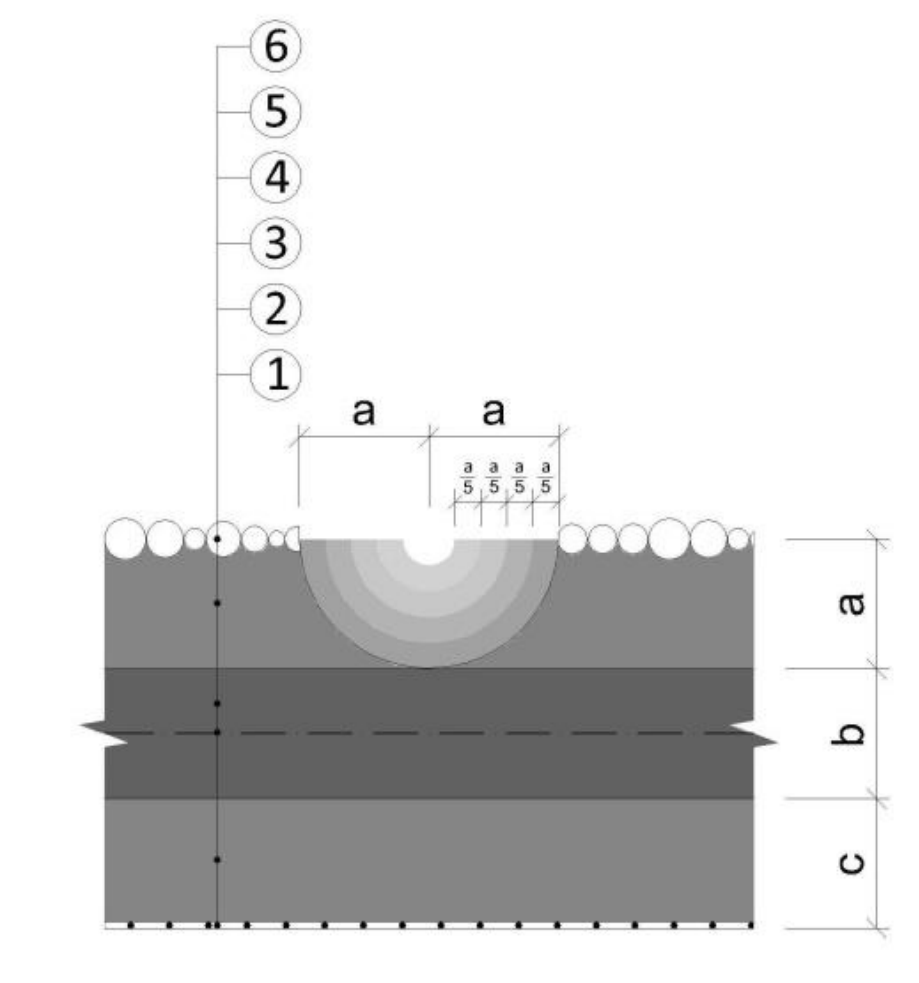
Cut of asphalt waterproofing with alligatorring

The principle of alligatoring



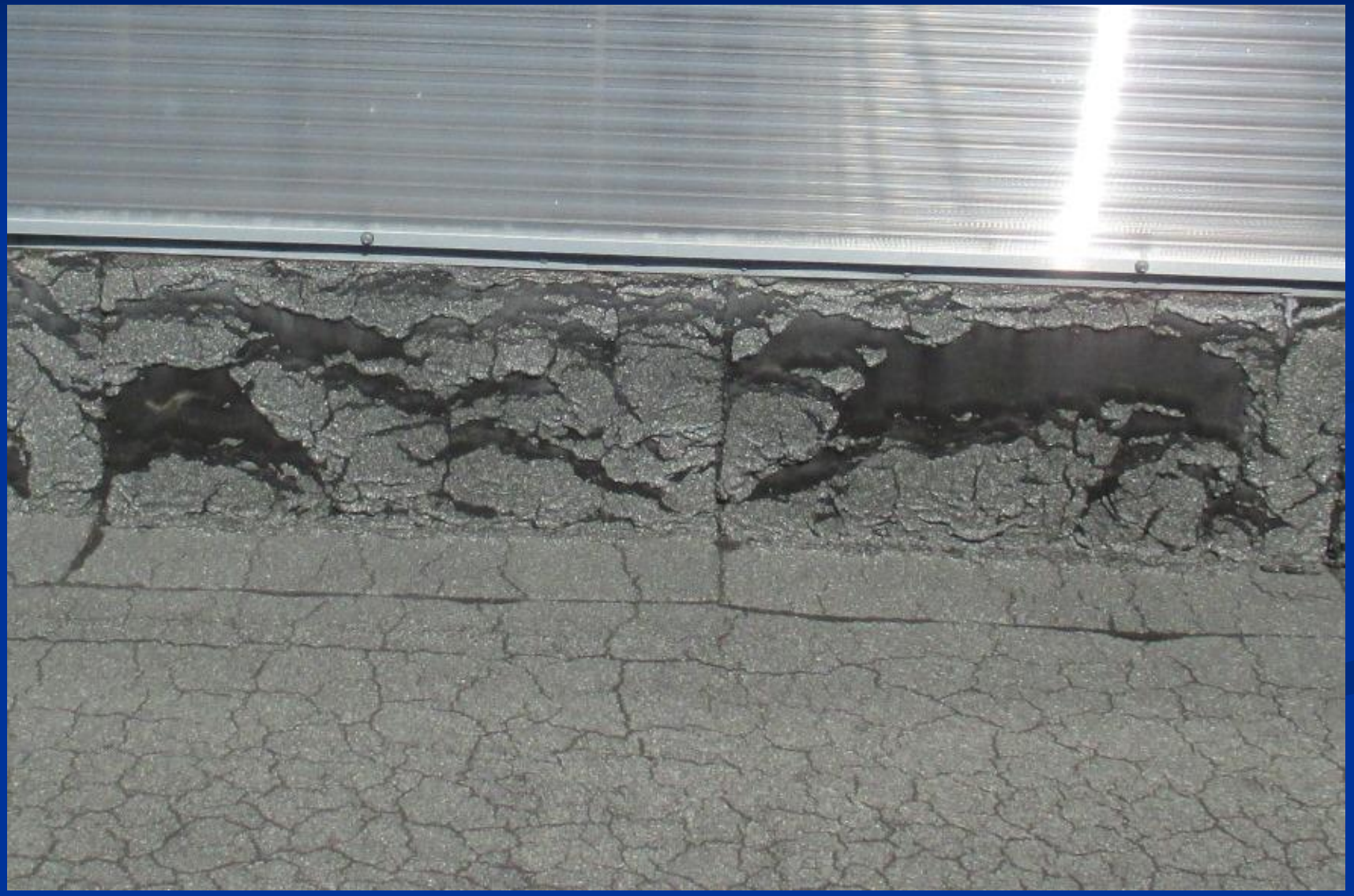
Alligatoring scheme with step-by-step se increasing damage waterproofing belt.

Explanations:

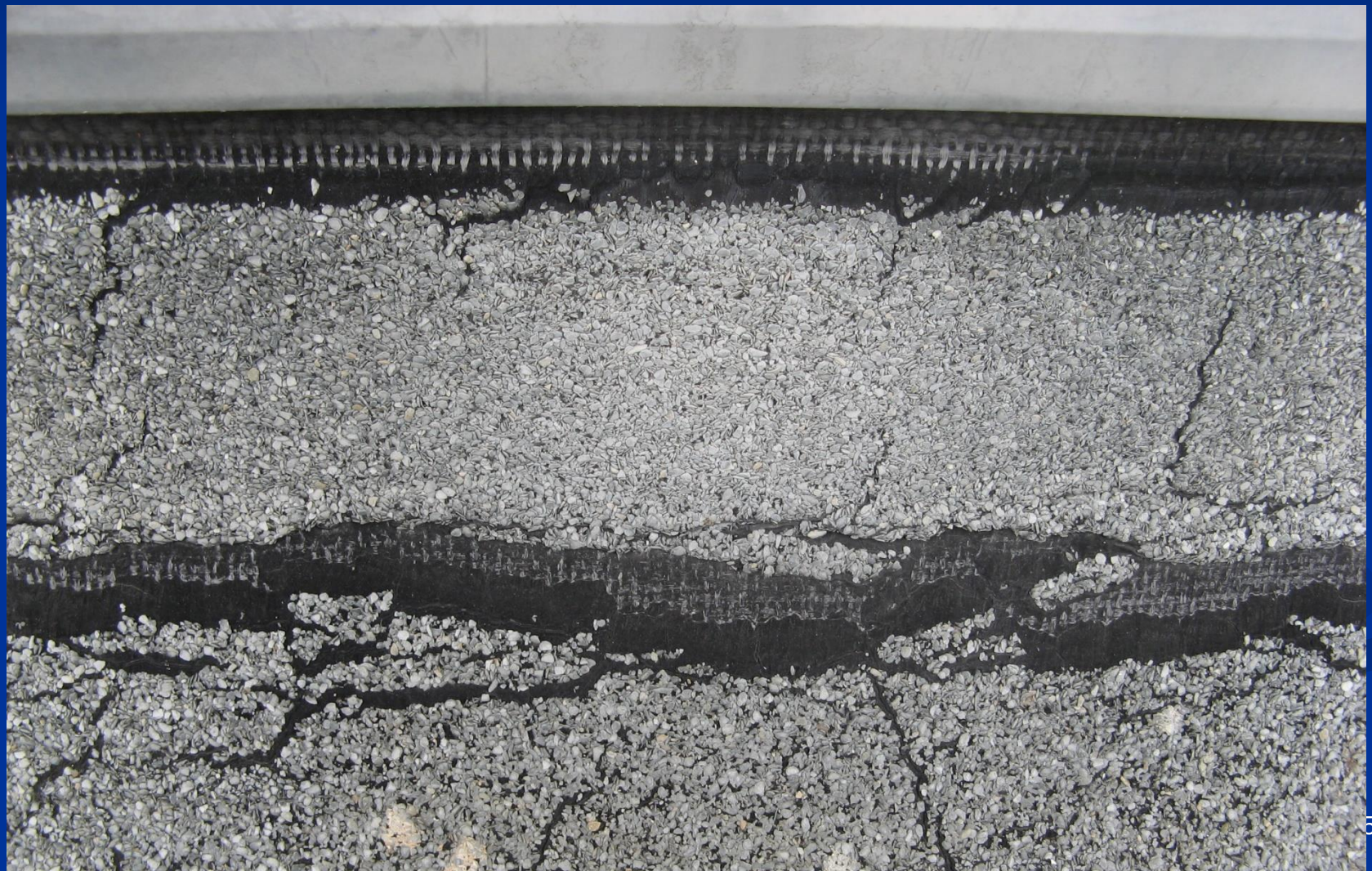
1 – bottom layer,
2 – lower asphalt layer,
3 – reinforcing insert,
4 – primary asphalt layer,
5 – upper asphalt layer,
6 – top surface treatment.

Runoff of asphalt belt – general view

Runoff of asphalt belt – detail view

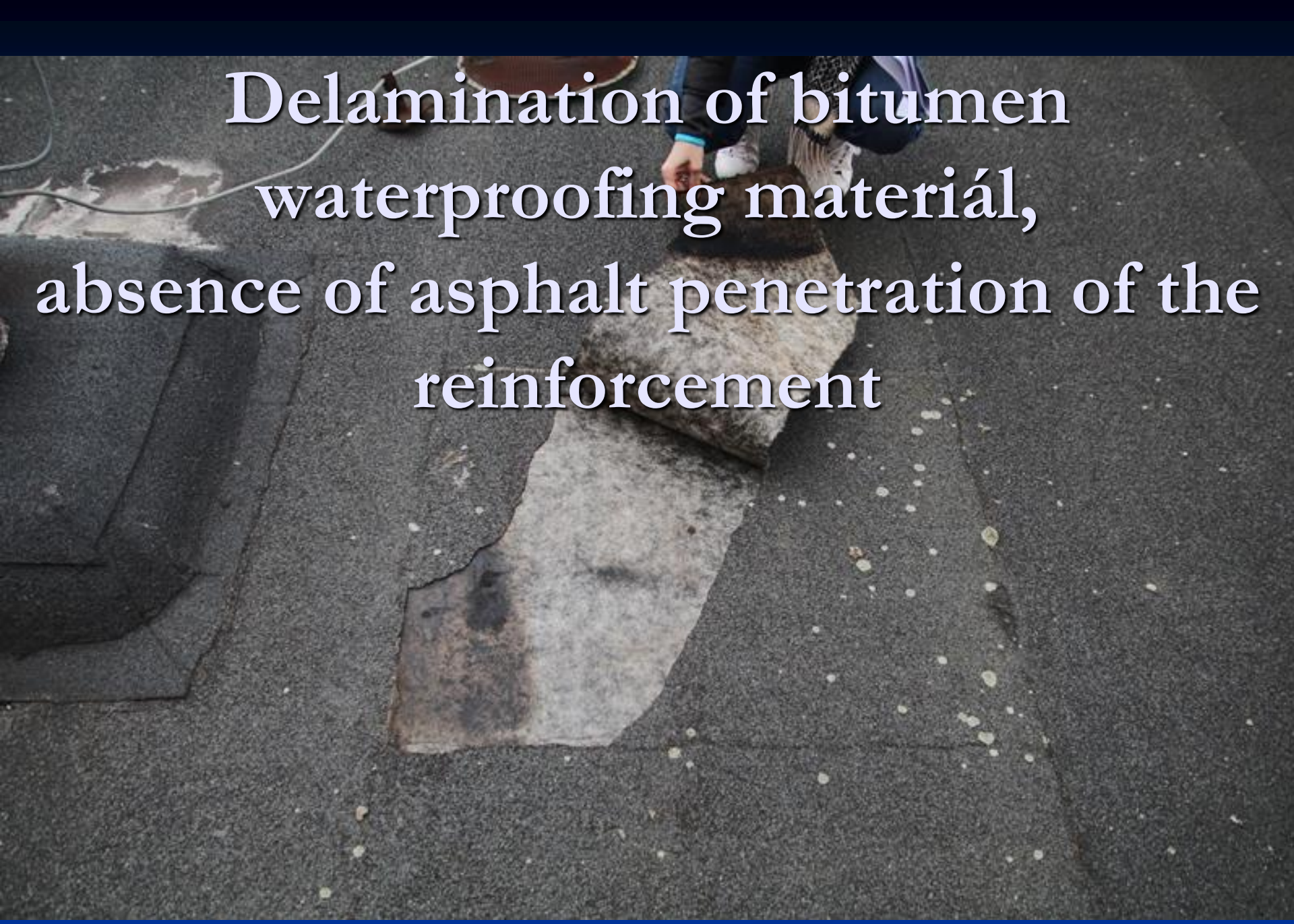


Asphalt runoff leading to the exposure of the reinforcement



Principle of hydrophobization

Delamination of bitumen waterproofing material

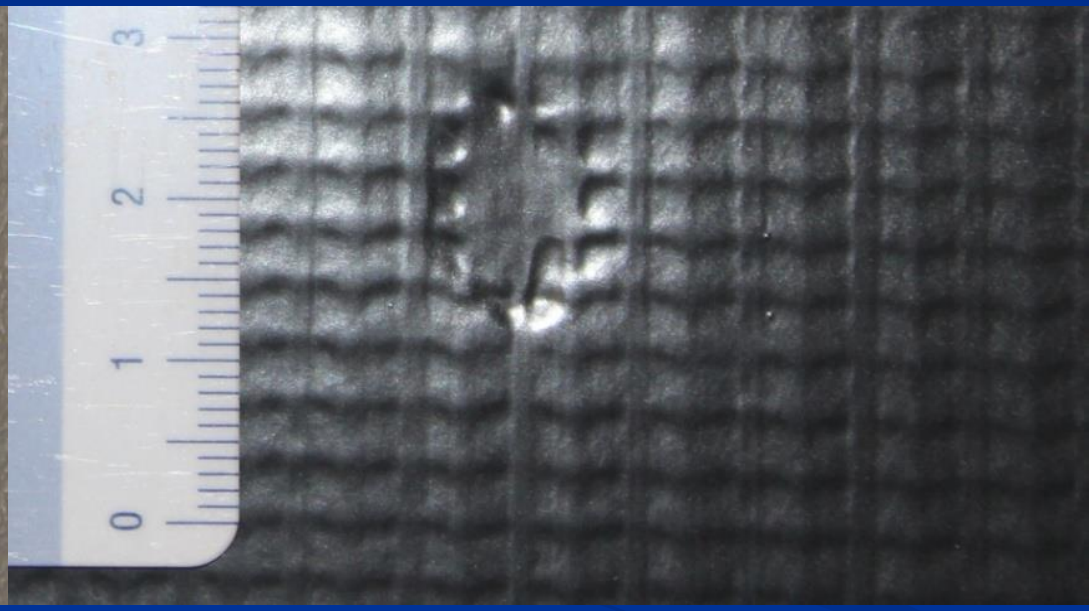

Delamination of bitumen waterproofing materiál, absence of asphalt penetration of the reinforcement

Delamination of single plywaterproofing material

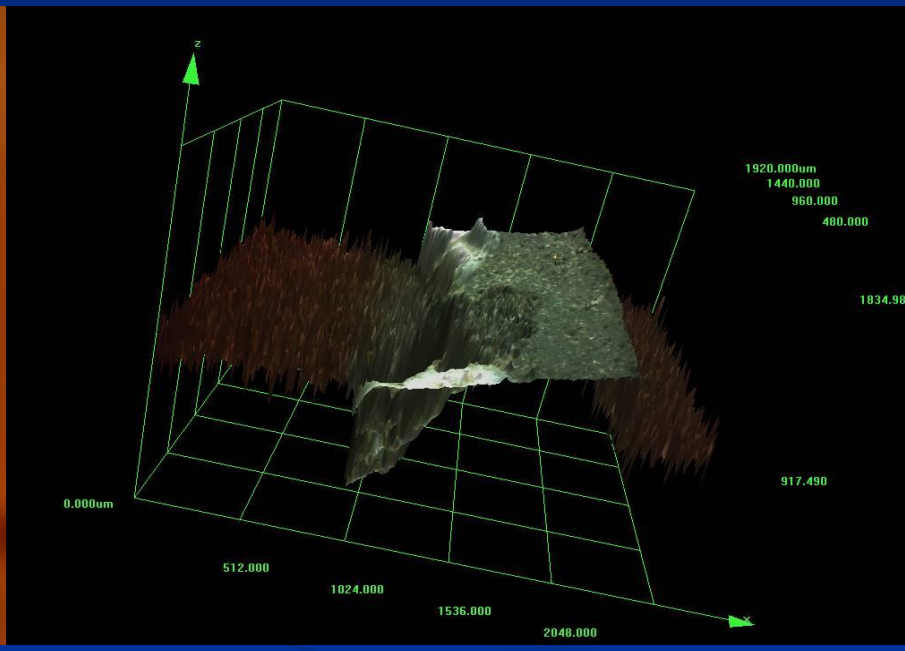
Cracks that are the result of migration of plasticizers

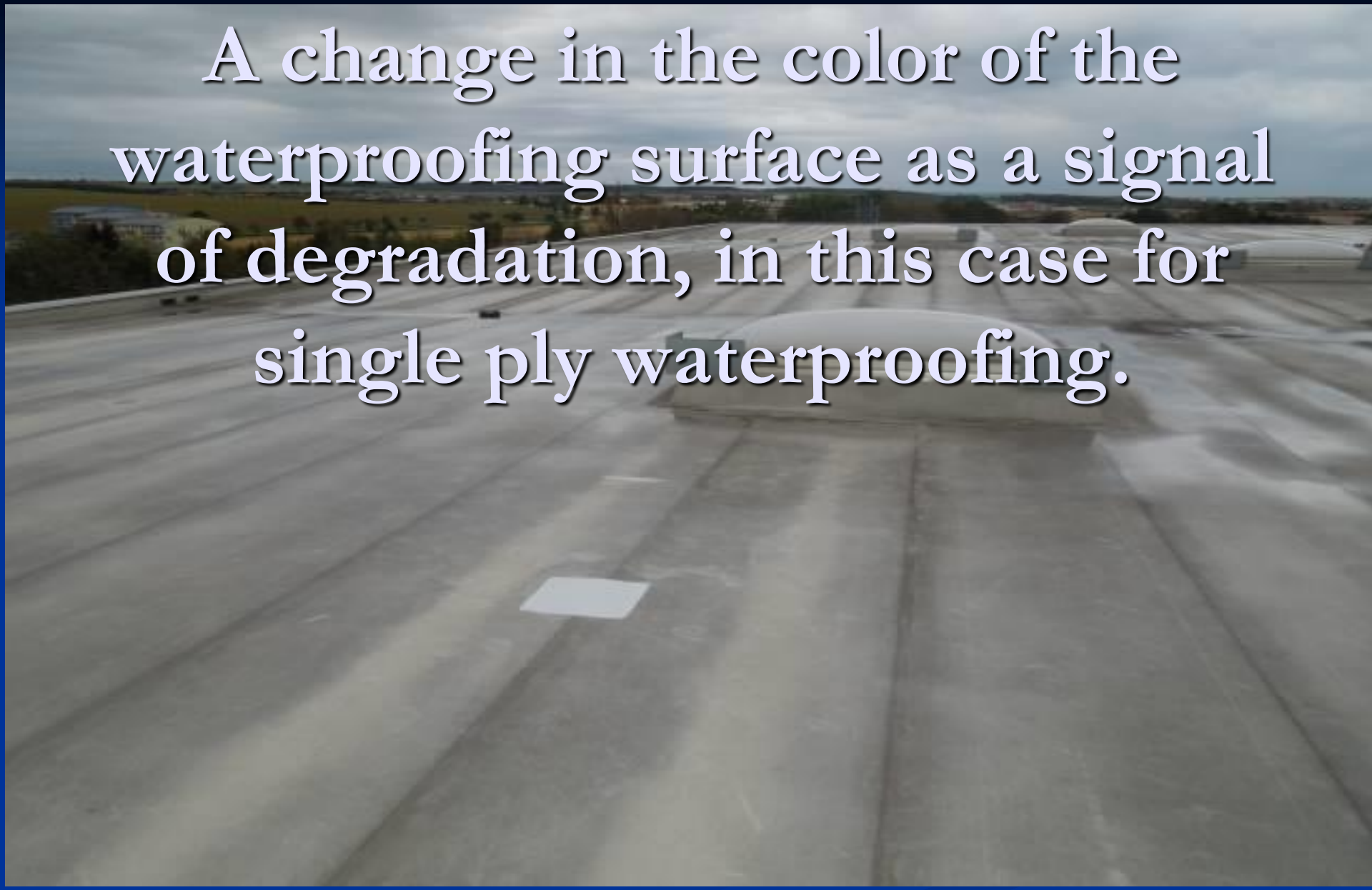
Cracks that are the result of the migration of plasticizers and the high content of mineral fillers

Mikrofotografie fólie mPVC – vrchní a spodní plocha



Mikrofotografie fólie mPVC- řez a 3D modelace

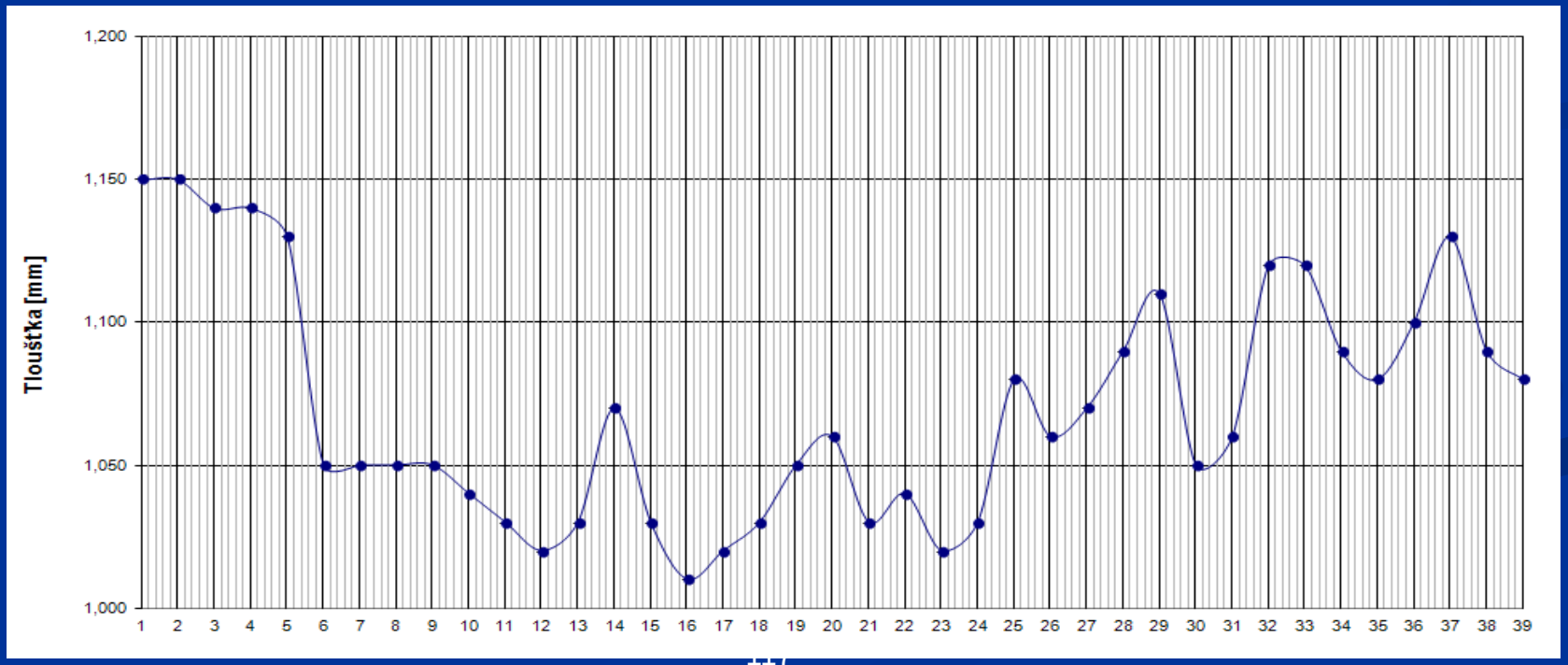


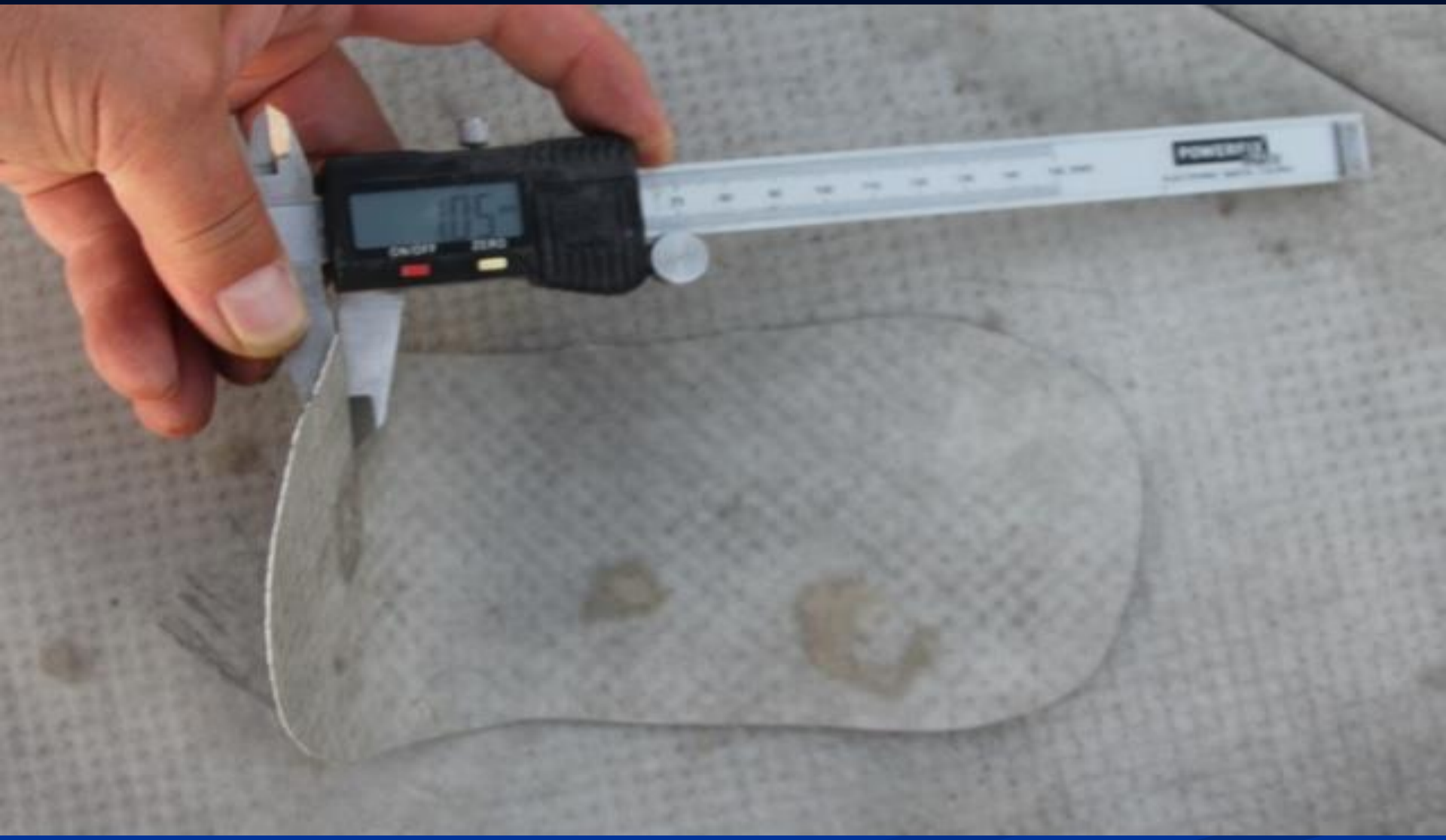


A change in the color of the waterproofing surface as a signal of degradation, in this case for single ply waterproofing.

A change in thickness is another signal of degradation for single ply waterproofing

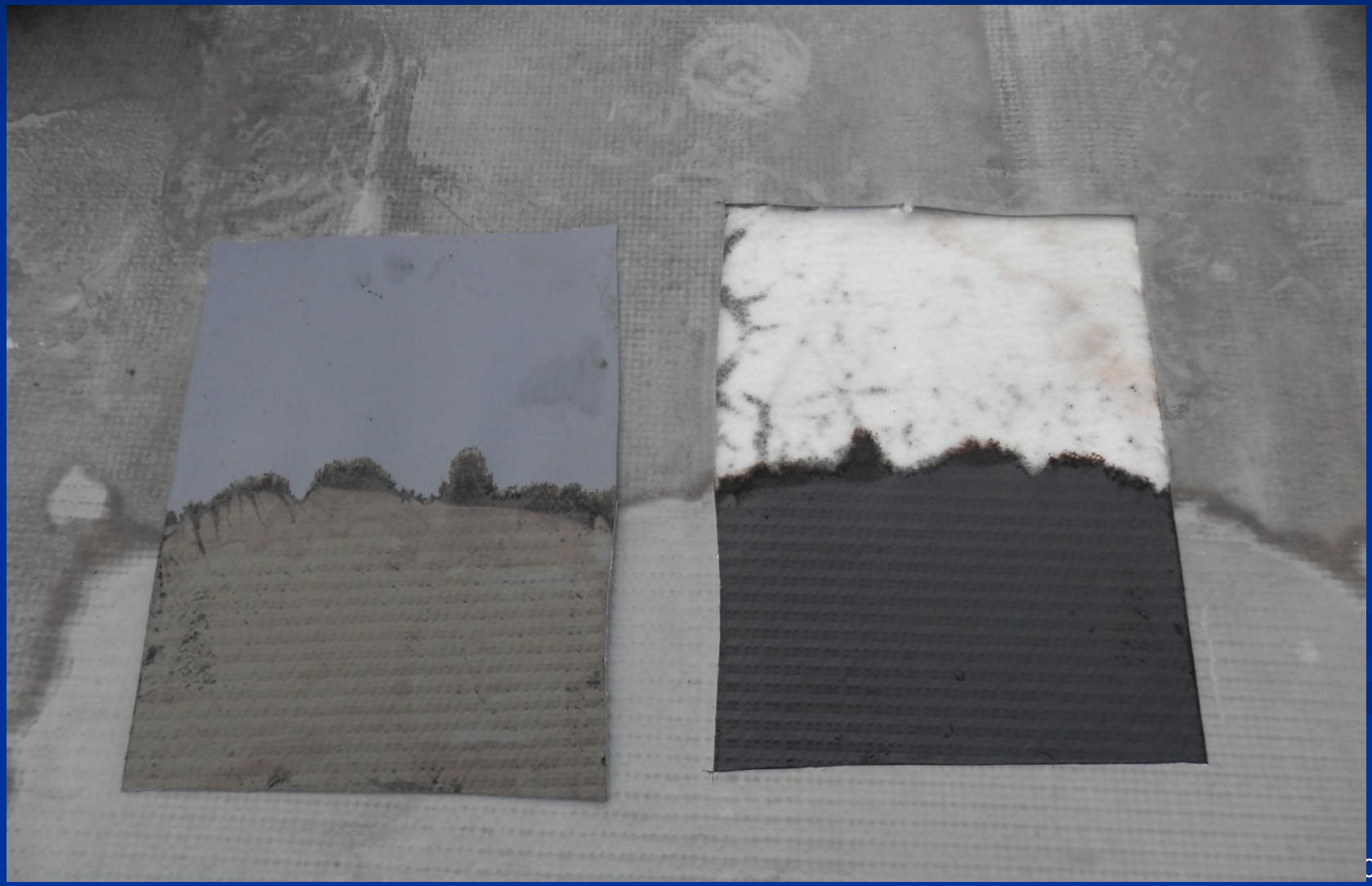
Tloušťka	[mm]	1	2	3	4	5	6	7	8	9	10
		1,150	1,150	1,140	1,140	1,130	1,050	1,050	1,050	1,050	1,040
Tloušťka	[mm]	11	12	13	14	15	16	17	18	19	20
		1,030	1,020	1,030	1,070	1,030	1,010	1,020	1,030	1,050	1,060
tloušťka	[mm]	21	22	23	24	25	26	27	28	29	30
		1,030	1,040	1,020	1,030	1,080	1,060	1,070	1,090	1,110	1,050
tloušťka	[mm]	31	32	33	34	35	36	37	38	39	
		1,060	1,120	1,120	1,090	1,080	1,100	1,130	1,090	1,080	
Ø tloušťka	[mm]	1,070									





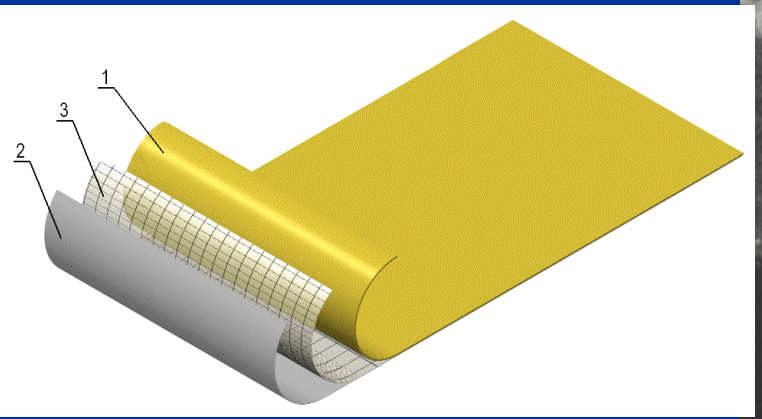
Asphalts and foam thermal insulation are not compatible with single ply waterproofing

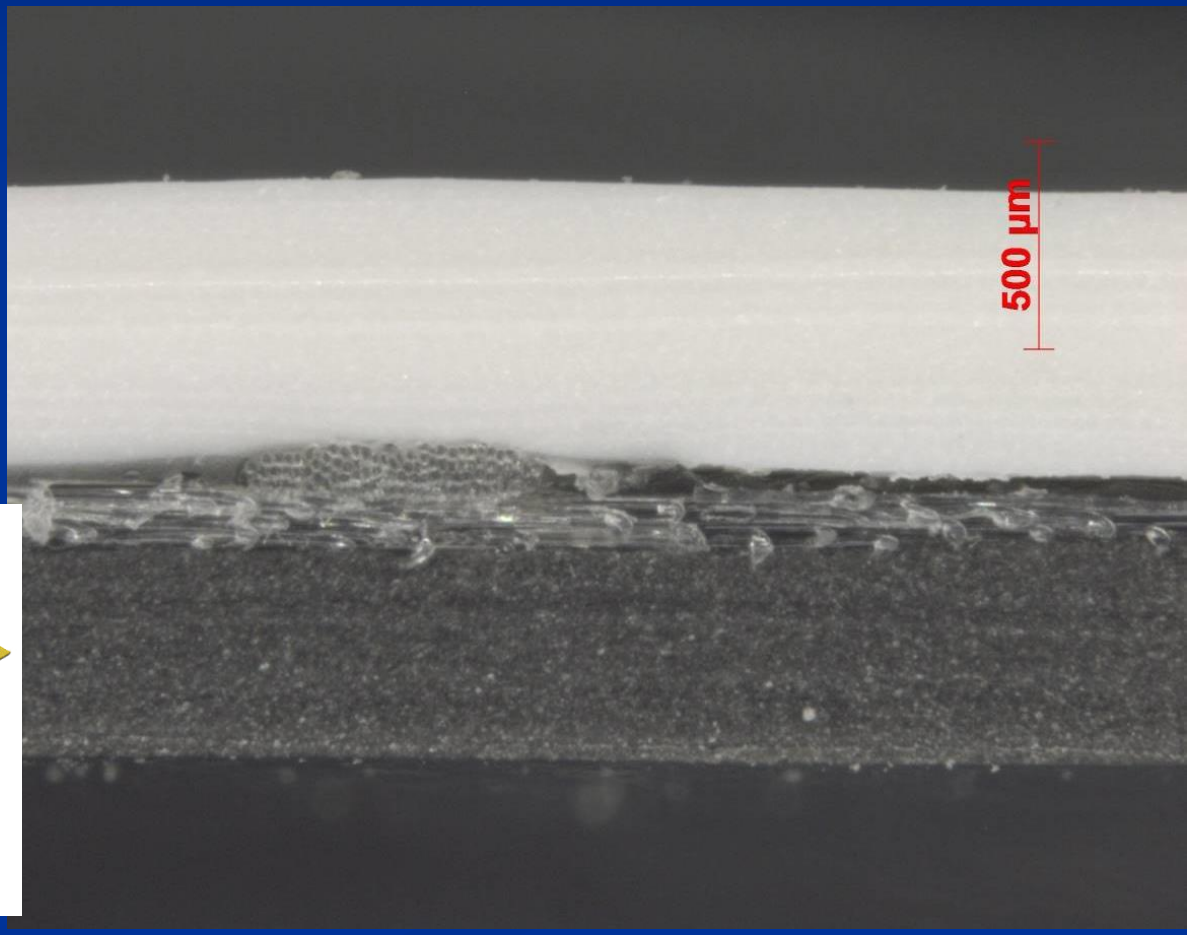
Single ply waterproofing in long-term contact with mPVC single ply



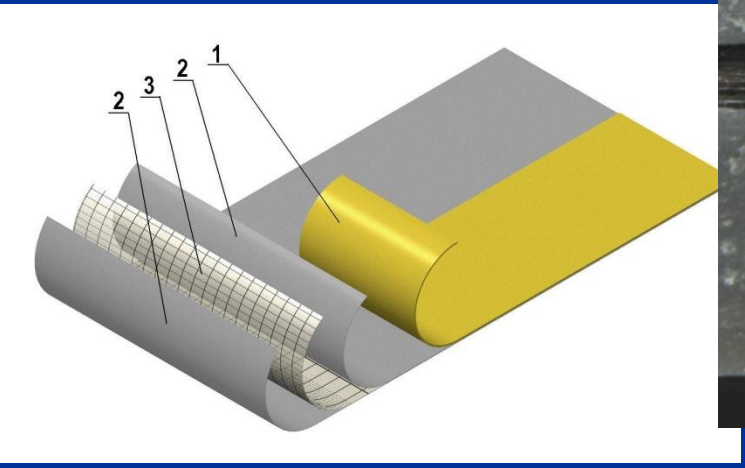
Single ply waterproofing in long-term contact with polystyrene foam foil

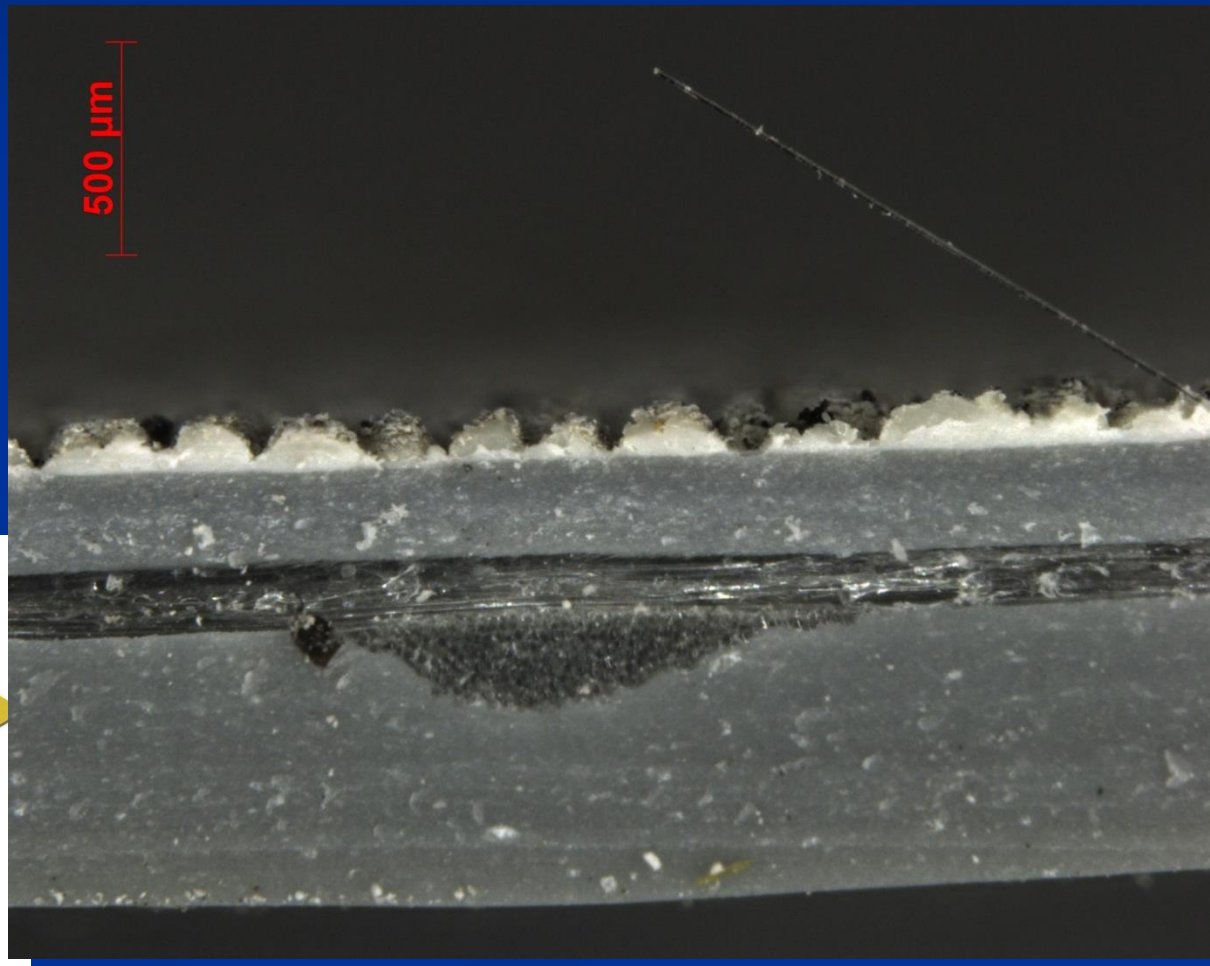
Microscopic photo of mPVC single ply (1/2 thickness is UV stabilized)



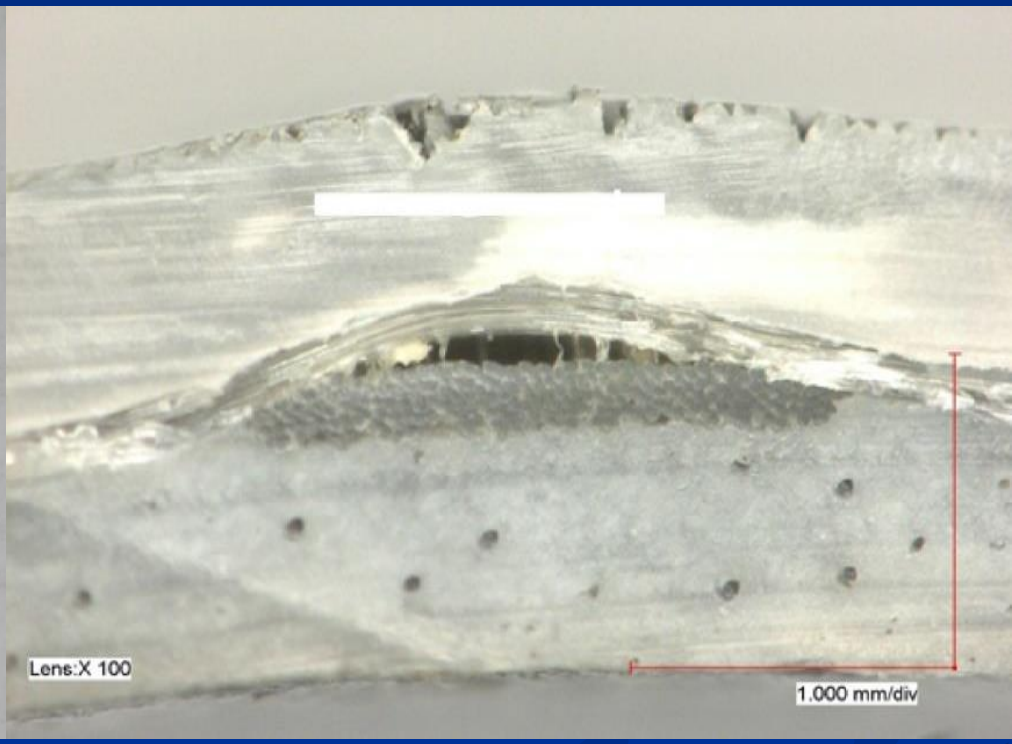


Microscopic photo of mPVC single ply (only the thin layer on the surface is UV stabilized)

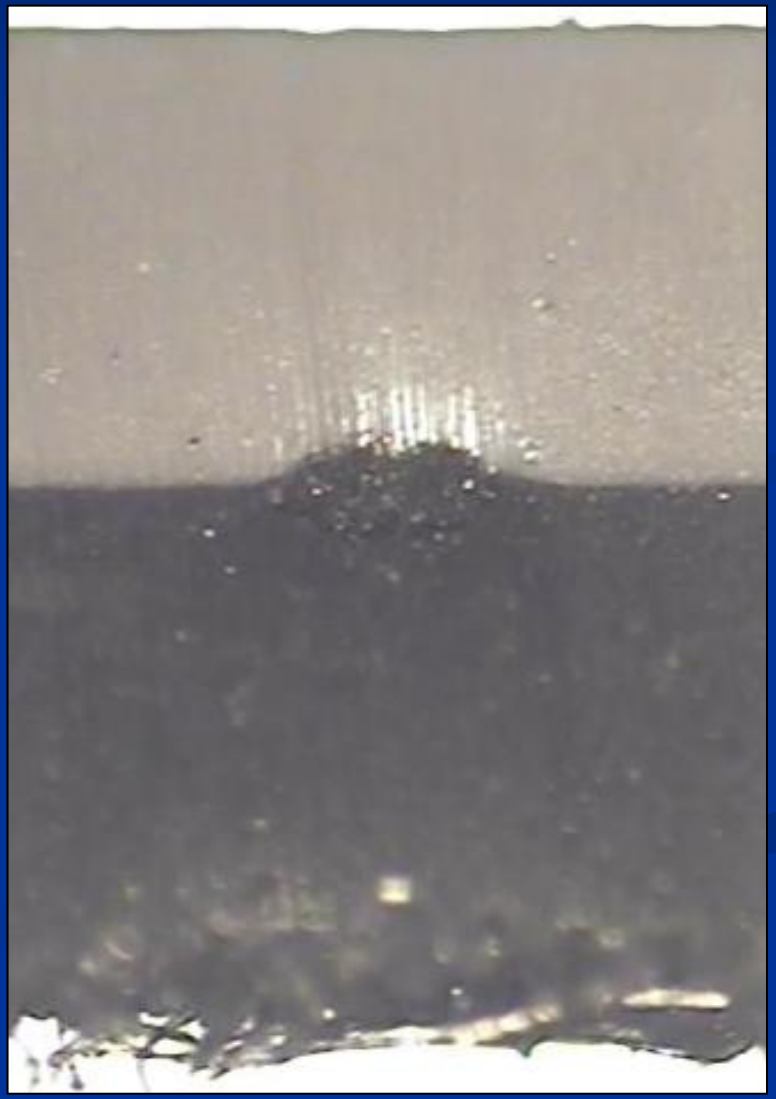




Microscopic photo of mPVC single ply – cut of a defect (blistr)

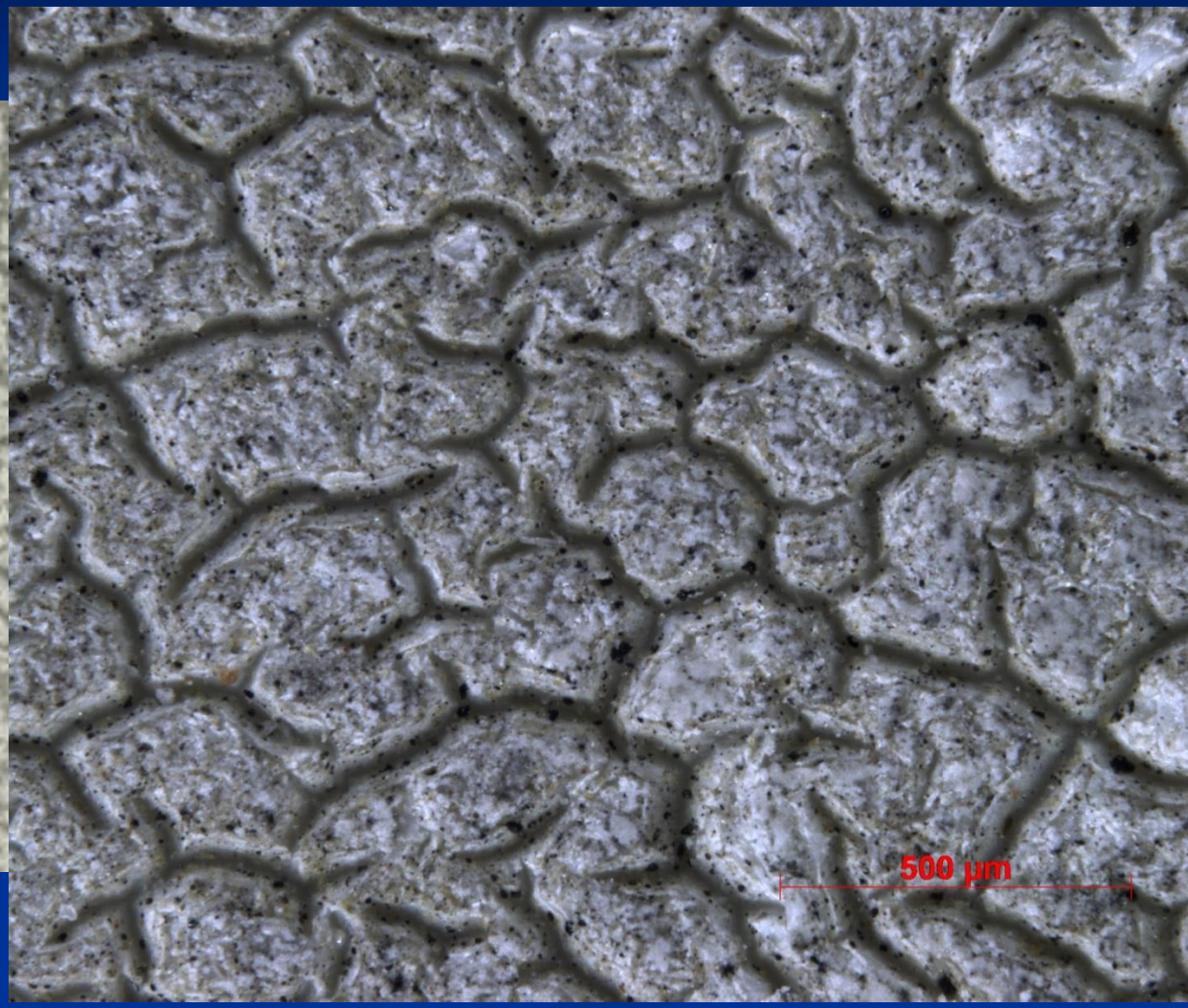


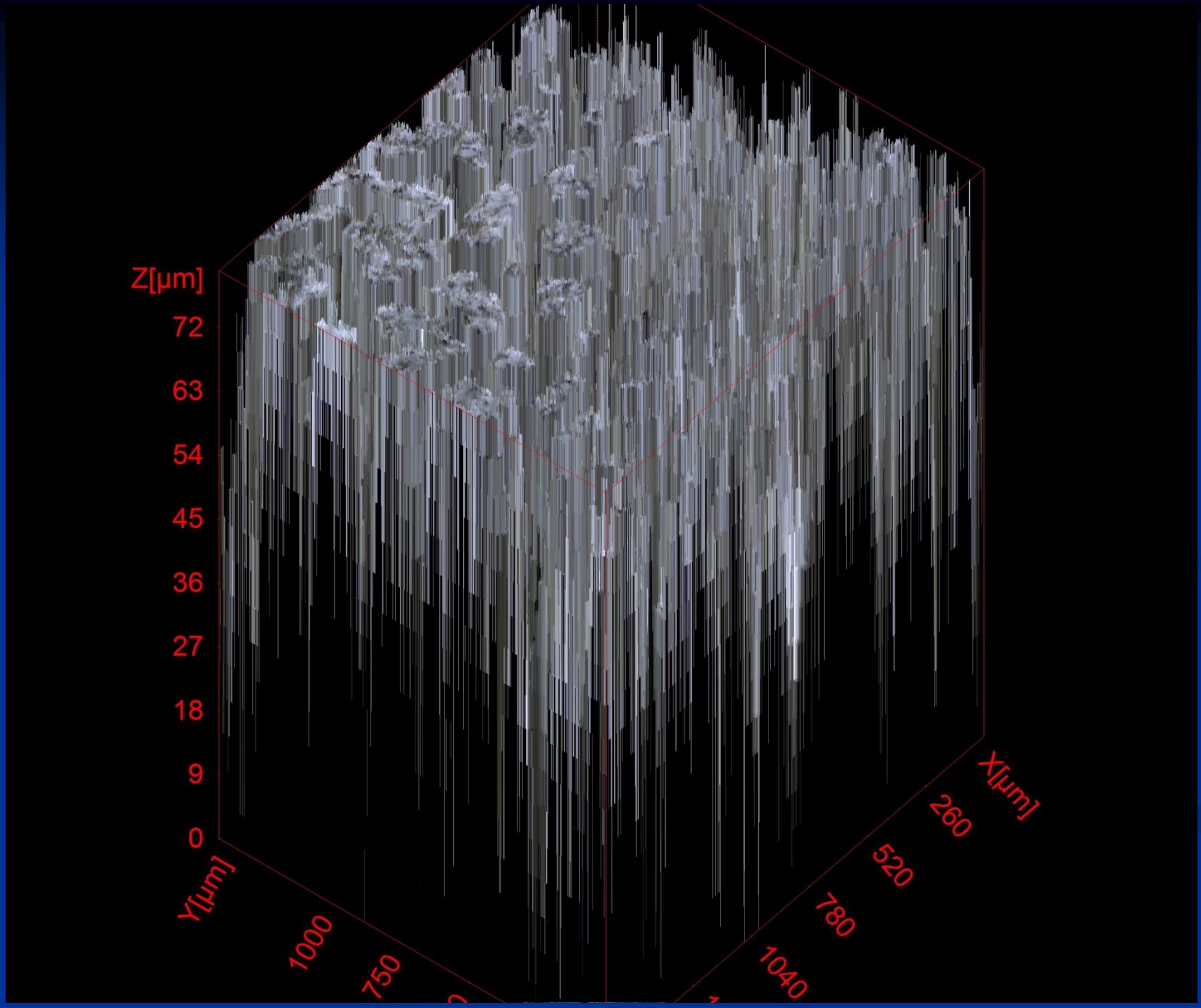
Eccentrically placed reinforcemen



Consequence

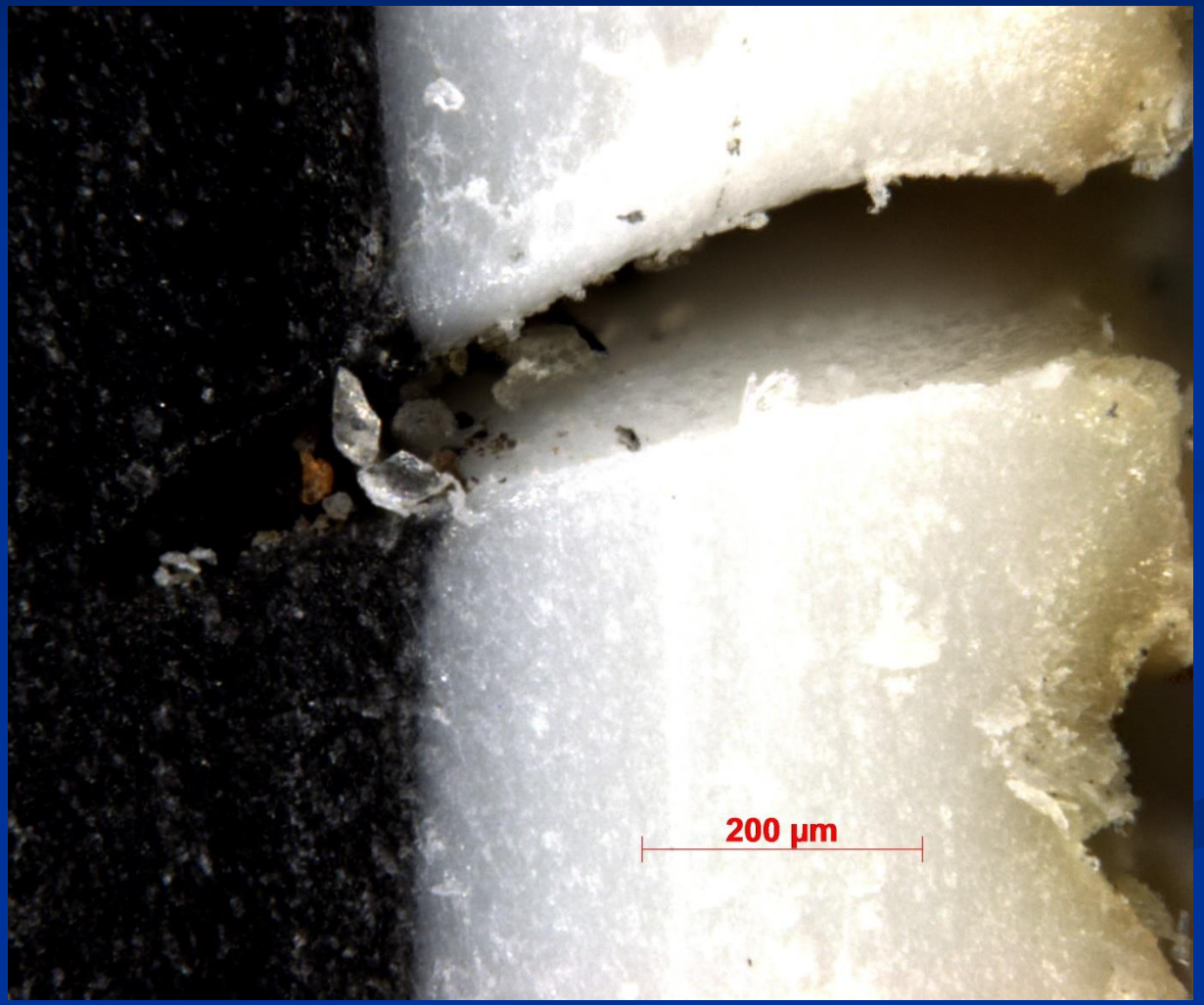
Microscopic photo of mPVC single pyl - top surface




Z[µm]
72
63
54
45
36
27
18
9
0
Y[µm]
1000
750
X[µm]
260
520
780
1040

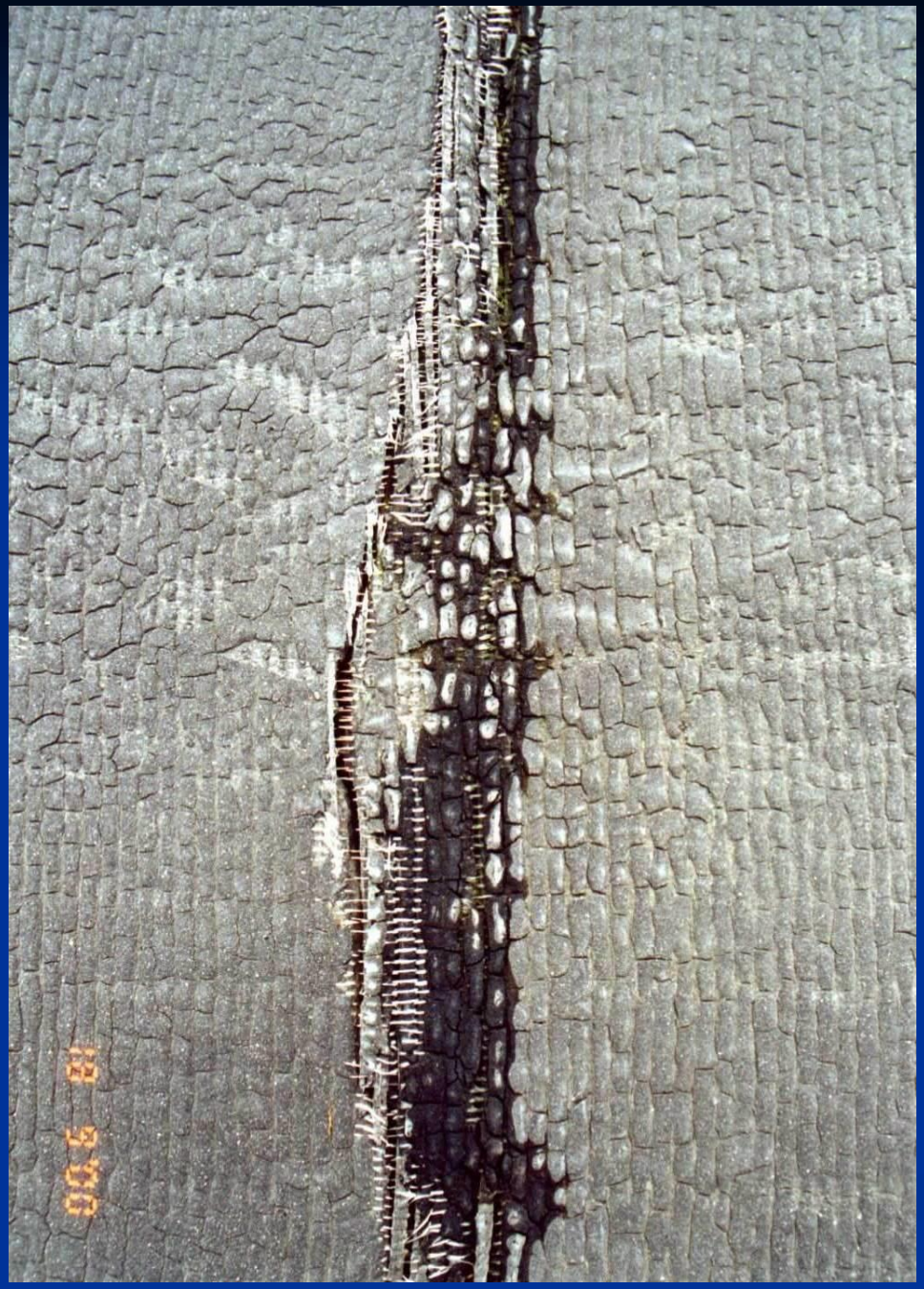
Microscopic photo of mPVC foil - cut

Microscopic photo of mPVC foil - cut



Hydrophobization of single ply

Volumetric changes of single ply waterproofing

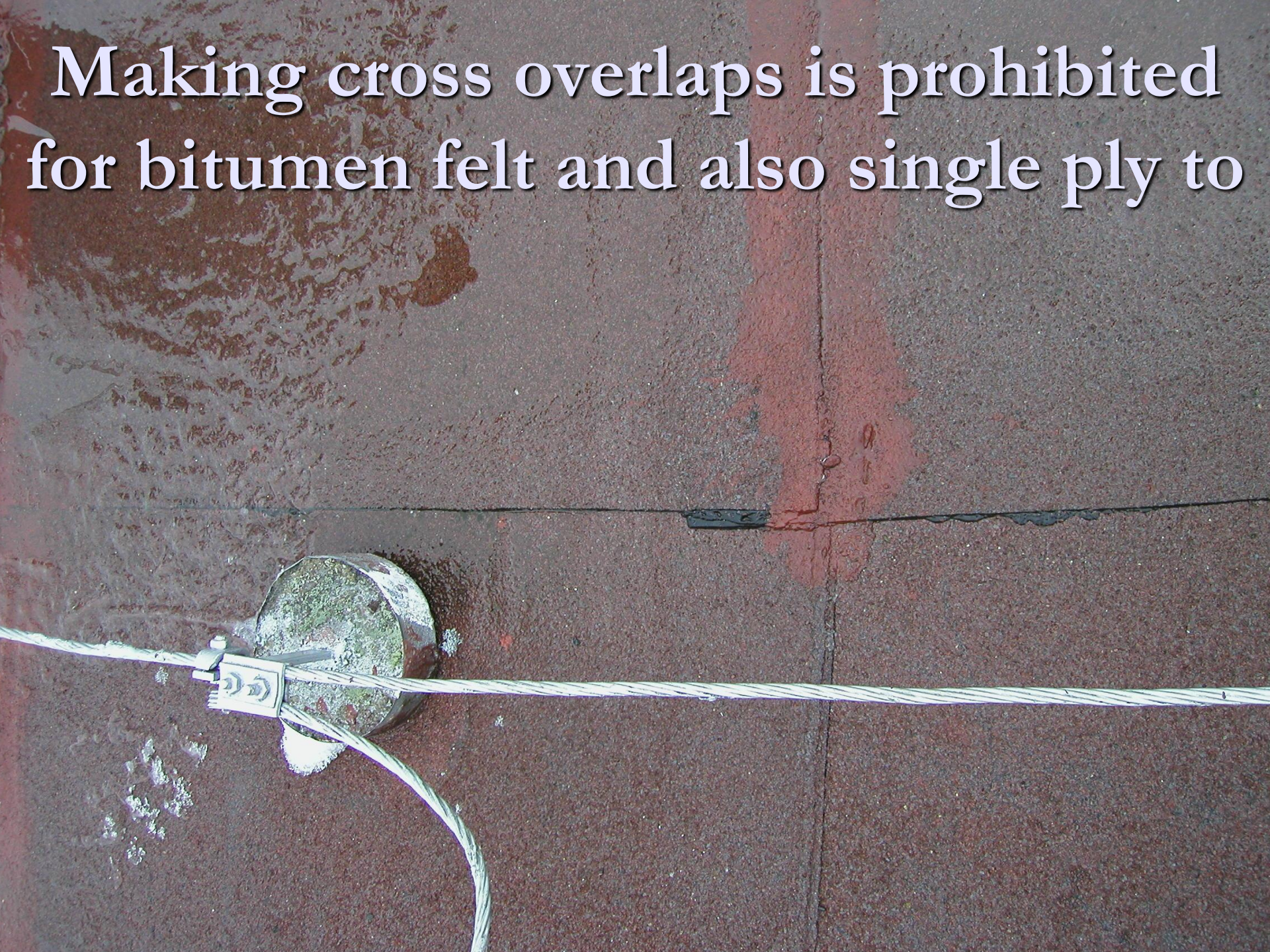


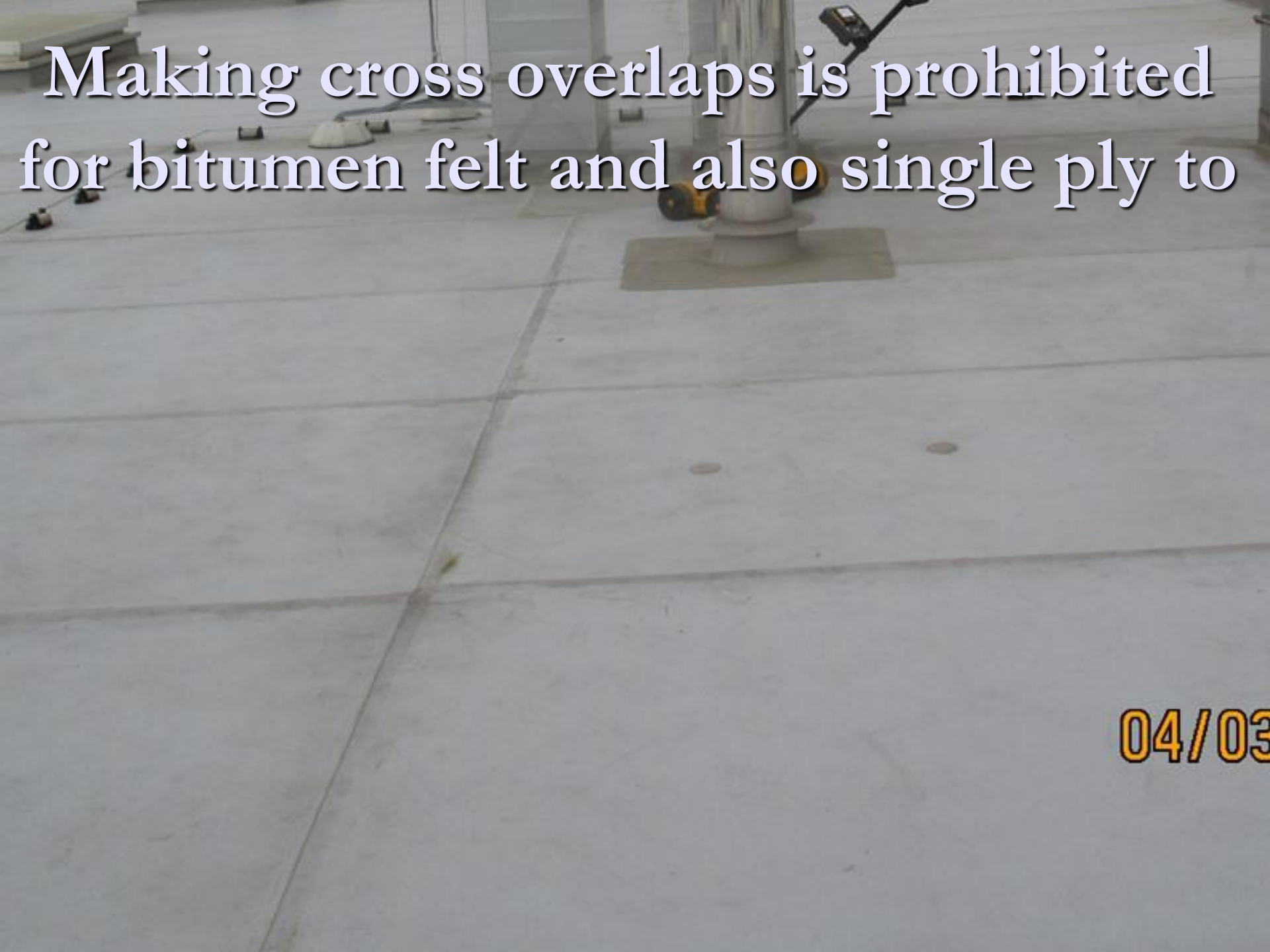
Crack of waterproofing

Insufficient strength waterproofing material, or its insufficiency ductility are defects already very rare, reinforcing inserts already have such properties that waterproofing they usually don't crack anymore due to force stress.


Insufficient strength of asphalt waterproofing materials

Realization of waterproofing - in the area


Making cross overlaps is prohibited
for bitumen felt and also single ply to


Making cross overlaps is prohibited
for bitumen felt and also single ply to
04/03

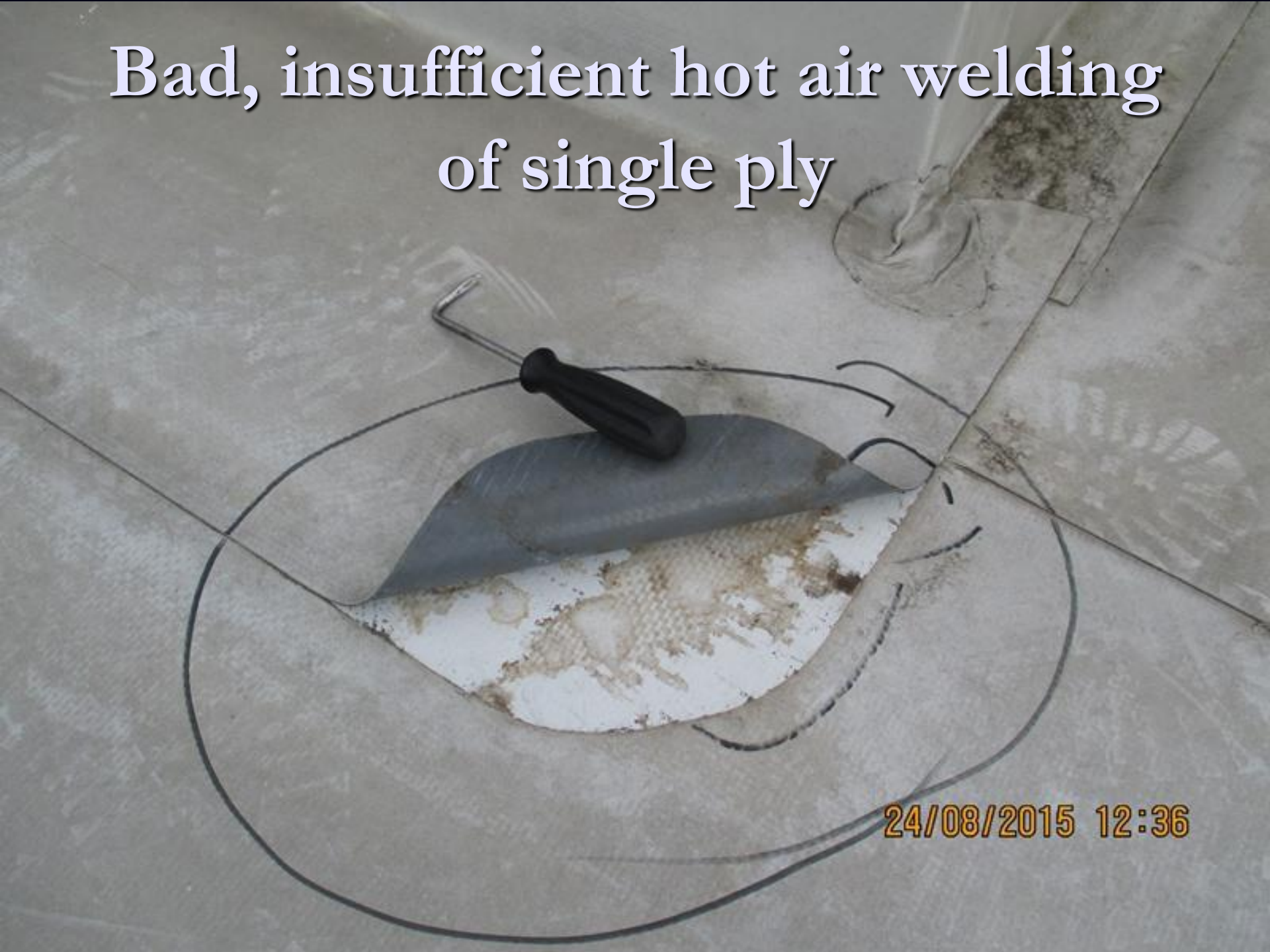
Tearing the single ply is prohibited

Unremoved sprinkling from the overlap

Unburned burning film, including packing tape

Locally insufficient welding - "mouth"

Bad, insufficient hot air welding of single ply

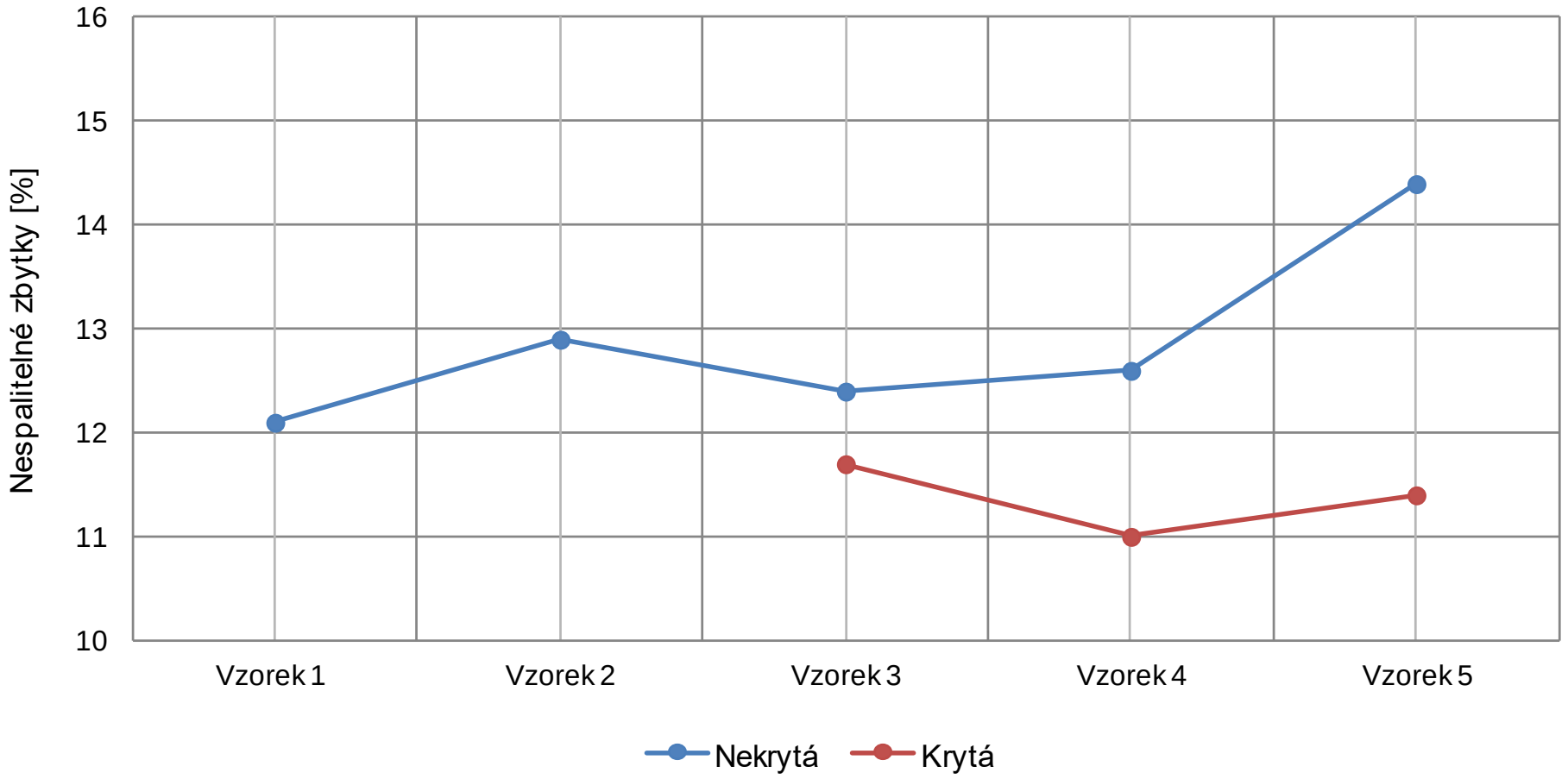


Locally insufficient welding - "mouth"

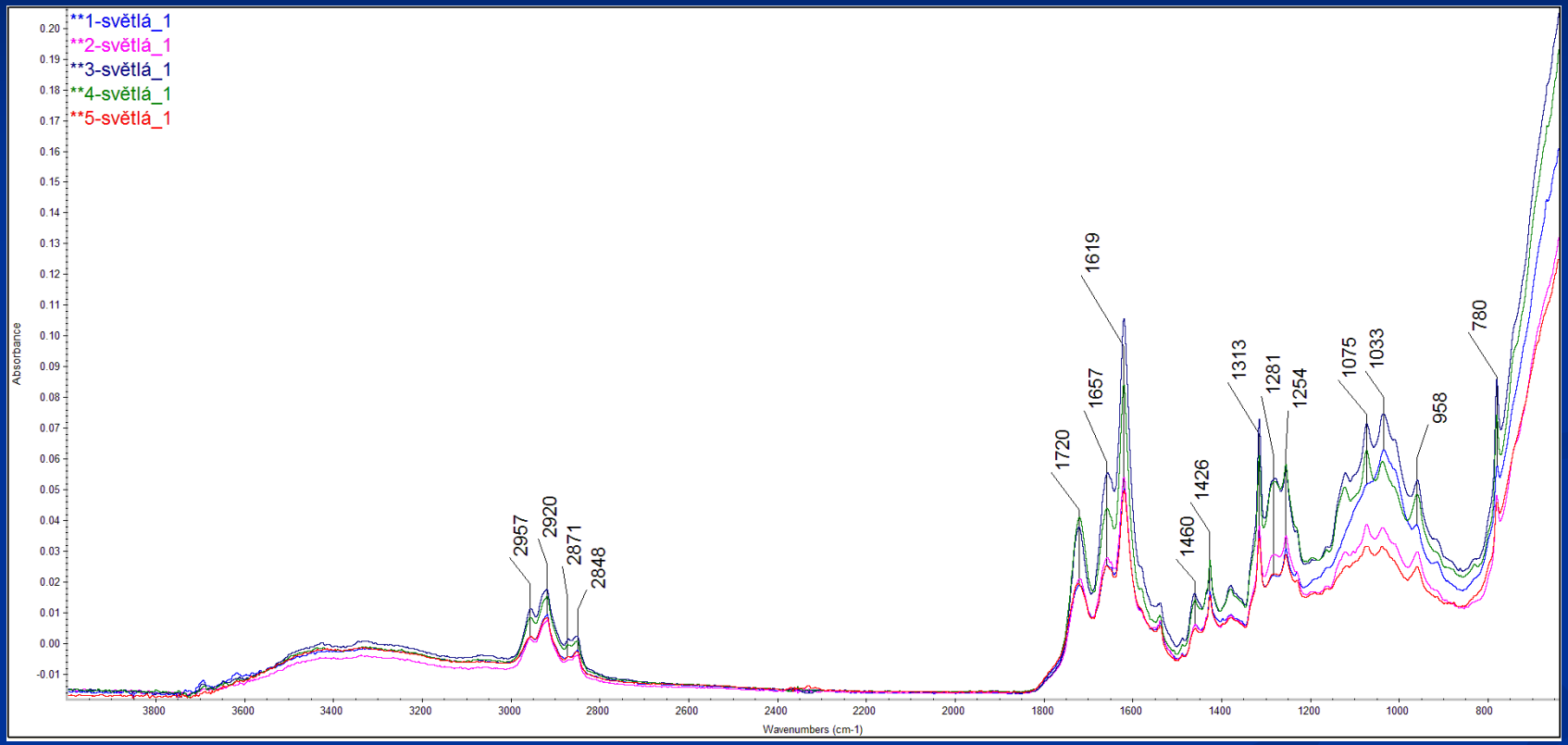
Bad, uneven hot air welding

Defektoskopie

Unburnable residues

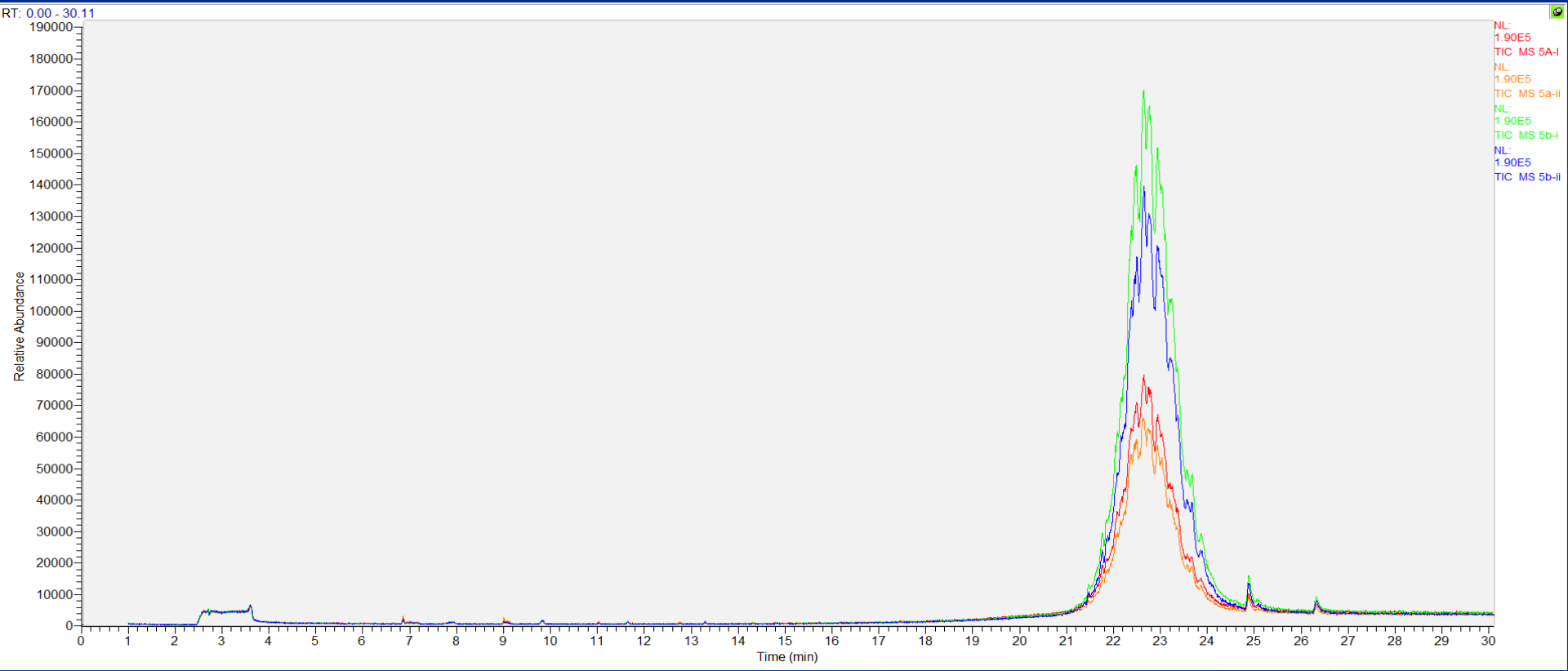


IR analysis



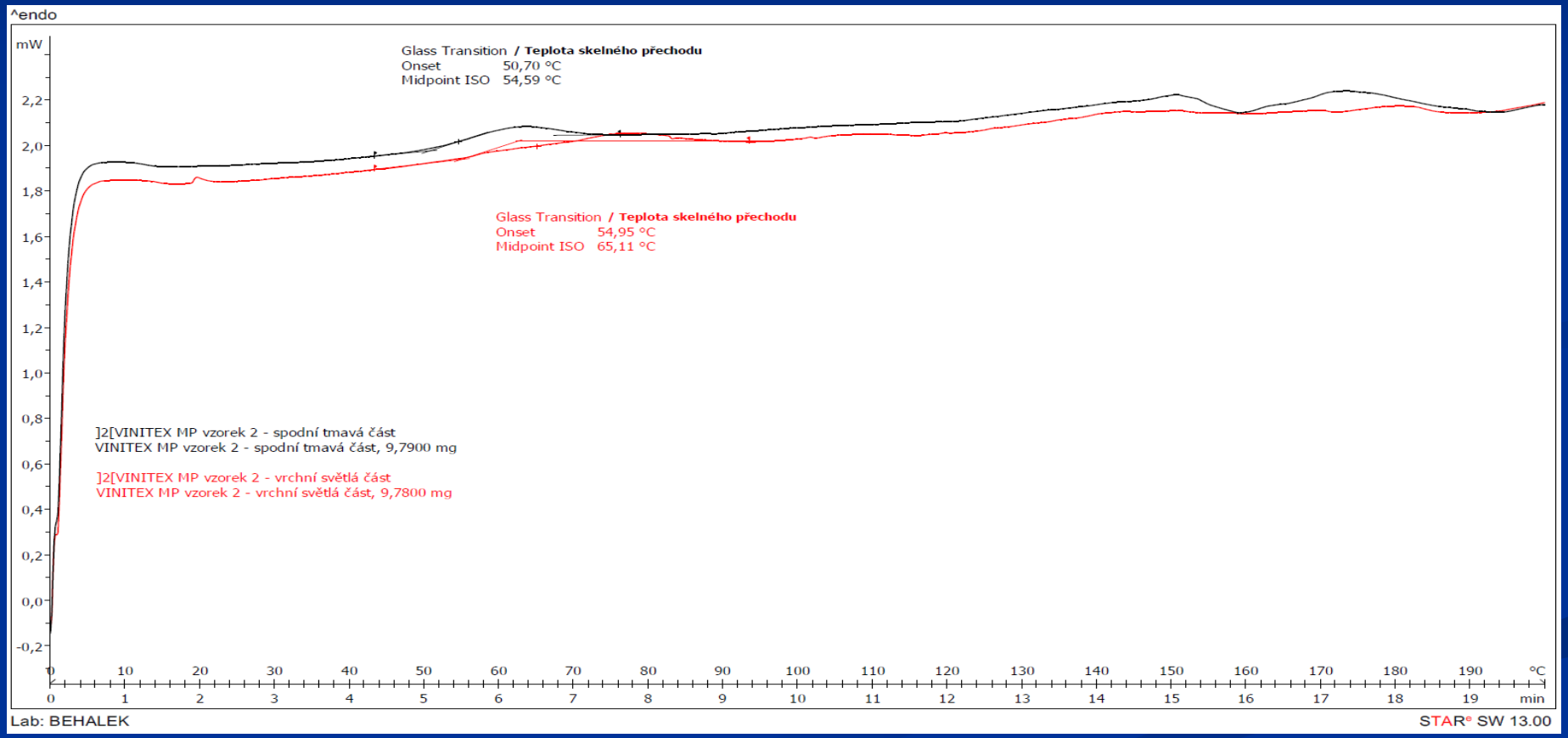
Comparison of degraded and non-degraded mPVC single ply waterproofing

Gas chromatography

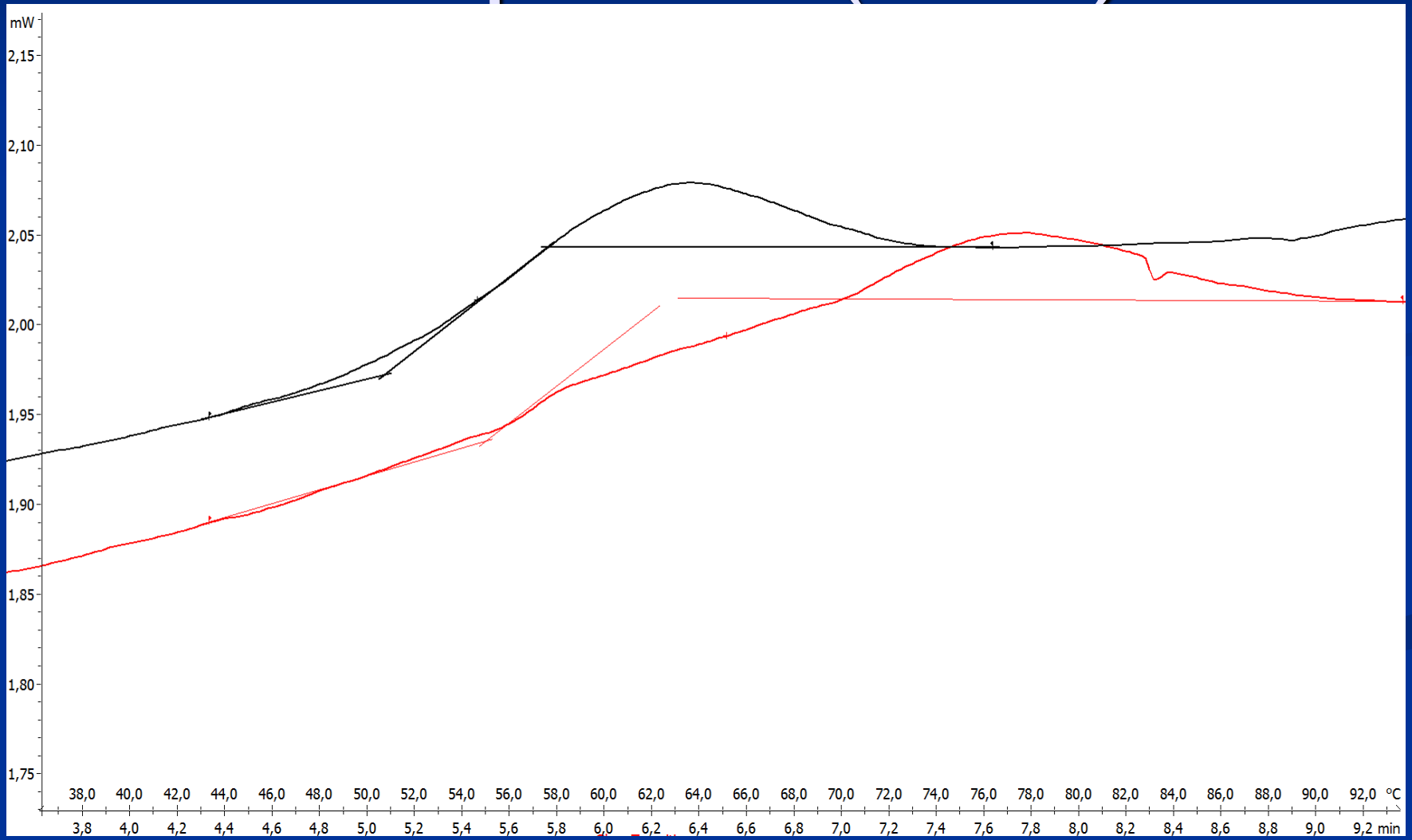


Comparison of plasticizer degradation (evaporation)

Measuring the glass transition temperature



Measuring the glass transition temperature (detail)



Realization of waterproofing - in the detail

Never combinate asphalt and single ply

Bad ending on roof parapet

Bad ending on roof parapet

Bad ending on roof parapet

Bad ending on roof sky lights

A poorly executed corner

Corroded outlet

Corroded outlet

Absence of mechanical fastening of the outlet

Outlet not for roofs, but for showers

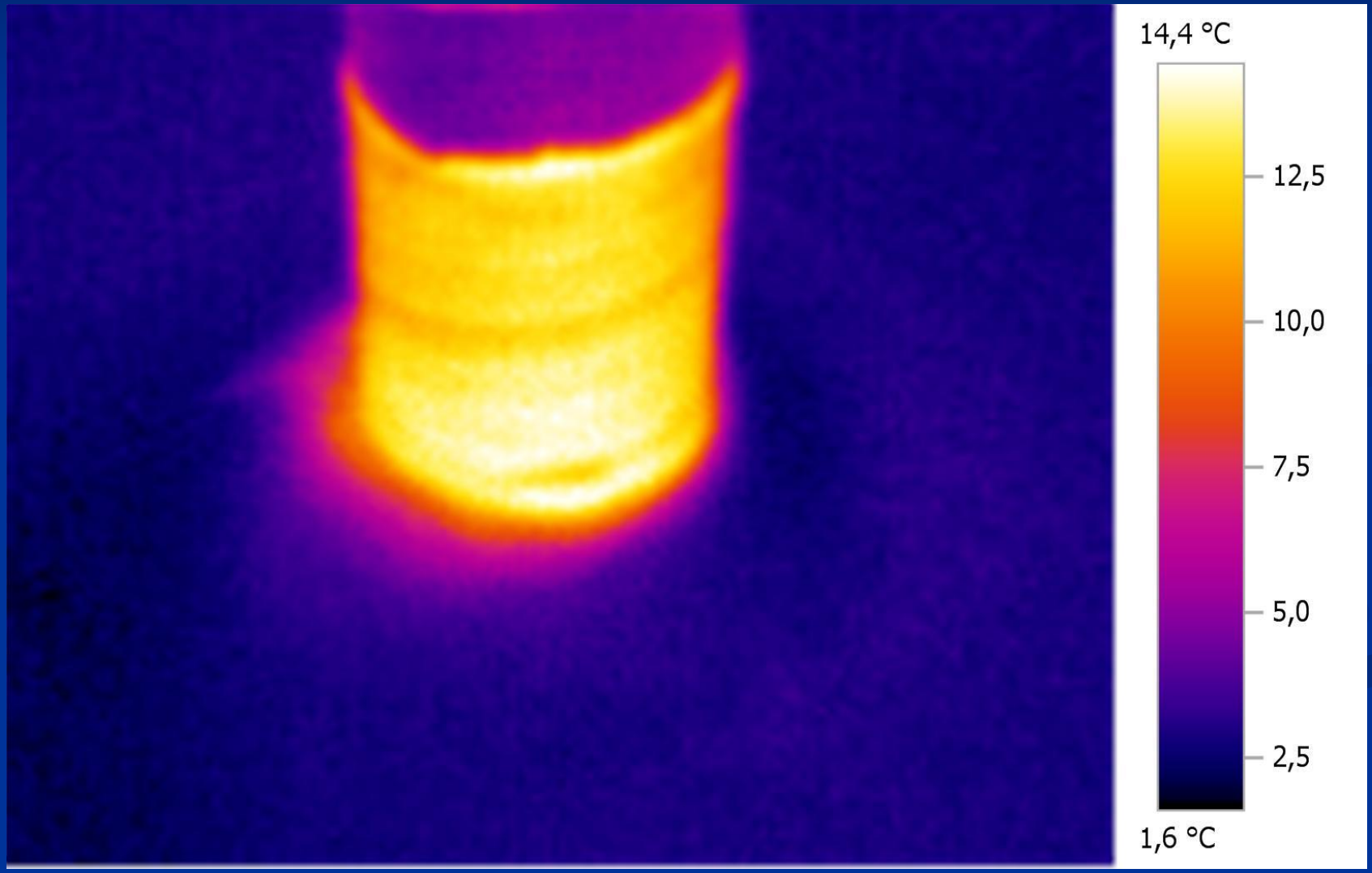
The penetration of a circular profile


05/12/2

Squaring the circle

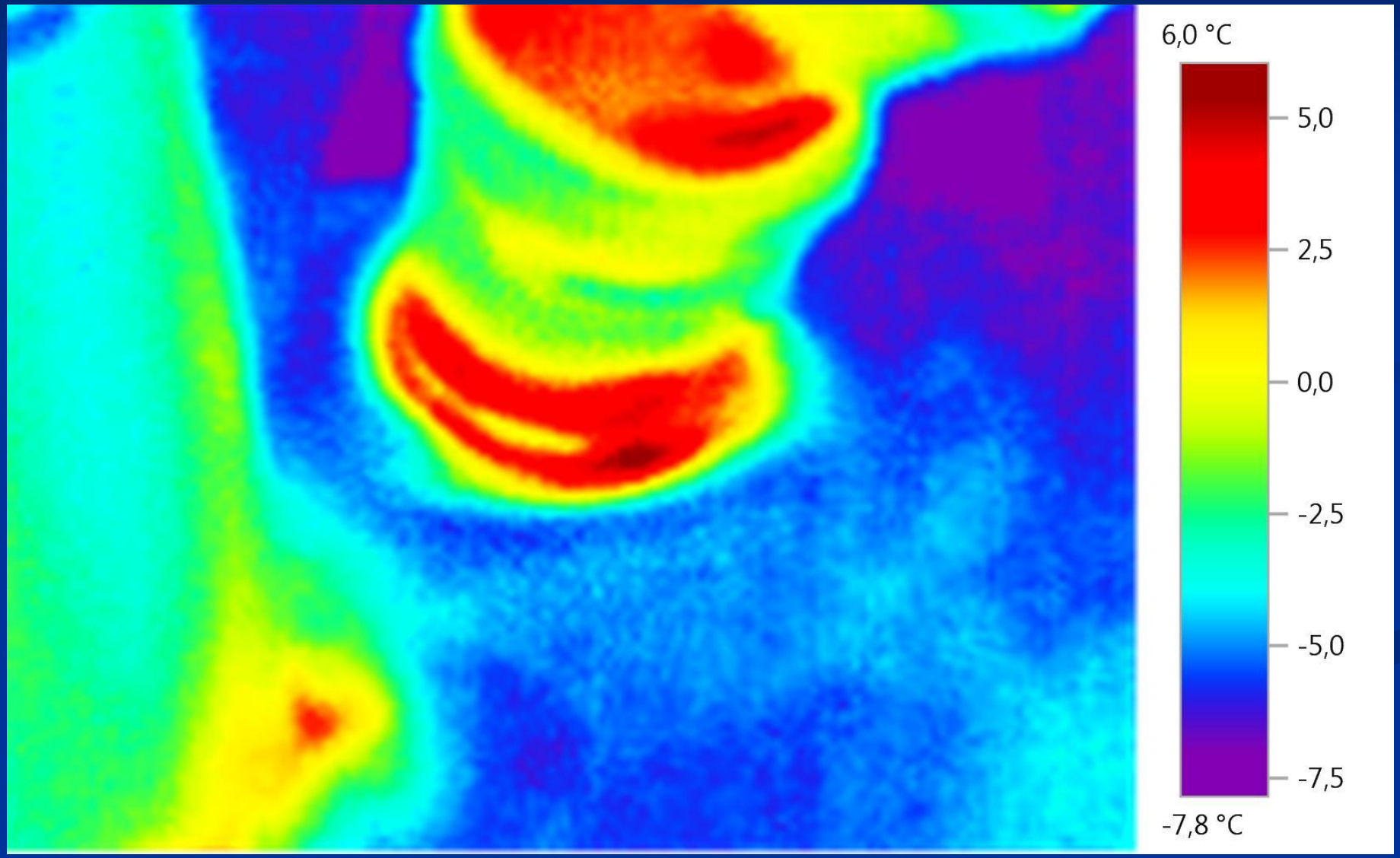
Vapor (defected) barrier and penetration

Thermal imaging



Non-processable mass penetration

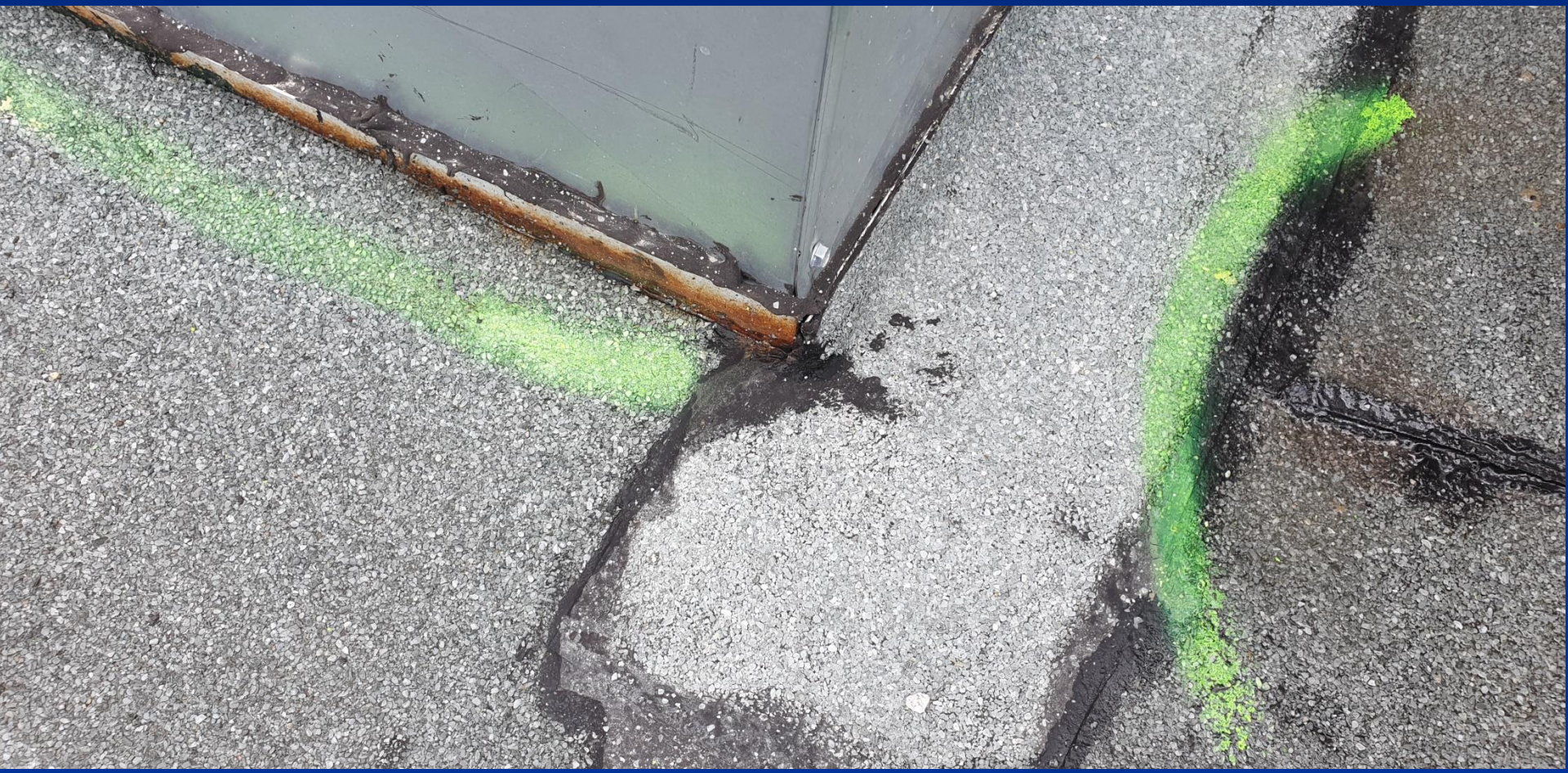
Thermal imaging



Non-processable mass penetration

Non-processable mass penetration

Right-angled penetration



Right-angled penetration and waterproofing is slipping down

Very complicated details that can only be solved with liquid-applied waterproofing, e.g. PMMA


07.04.2016 14:13

Bizardní detaily

Ultra šikmý prostup

Prostup s opěrou

Olepený I prostup

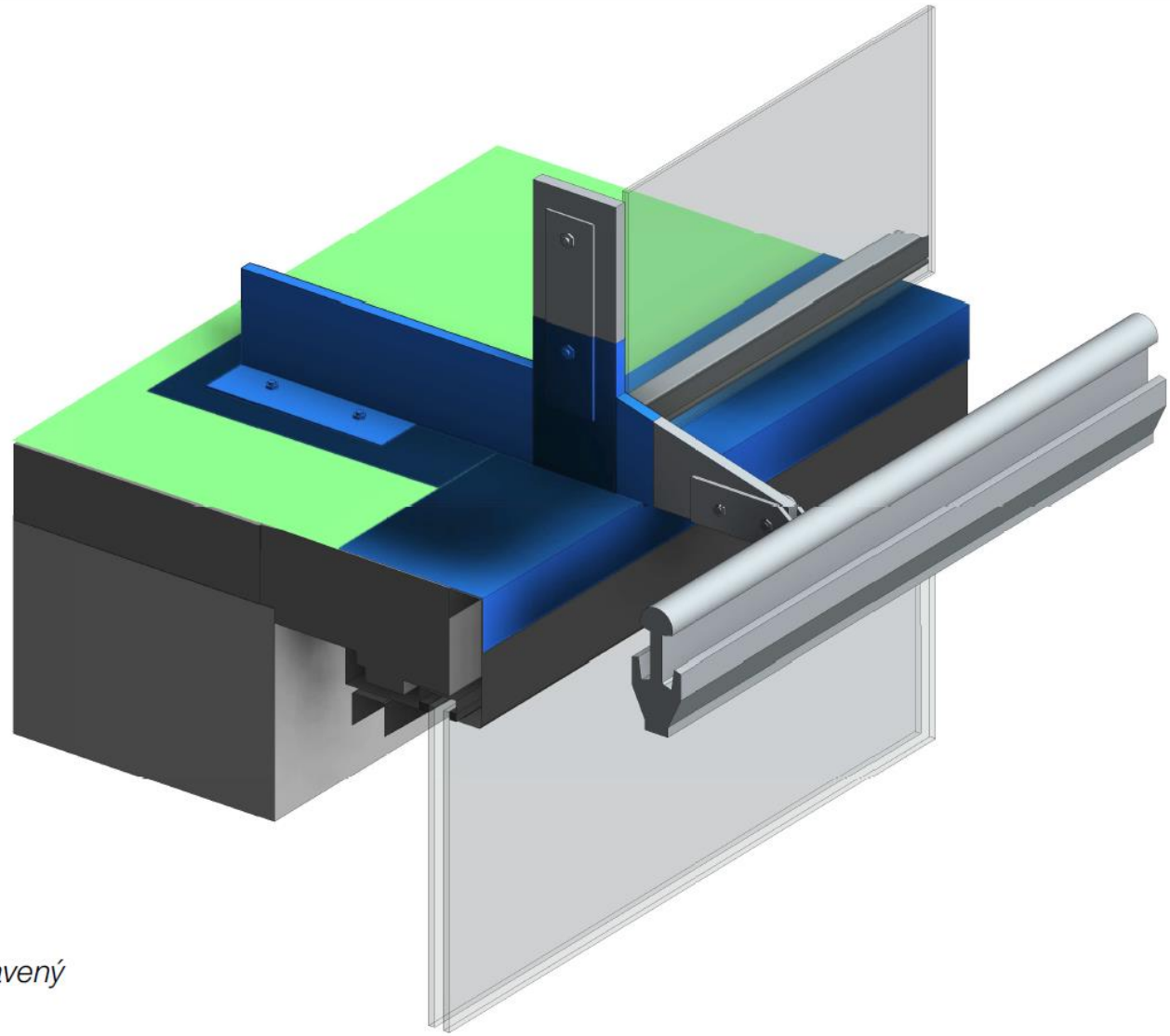
Těžce opracovatelný detail

Detail těžce opracovatelného detailu

Ukotvení fasády

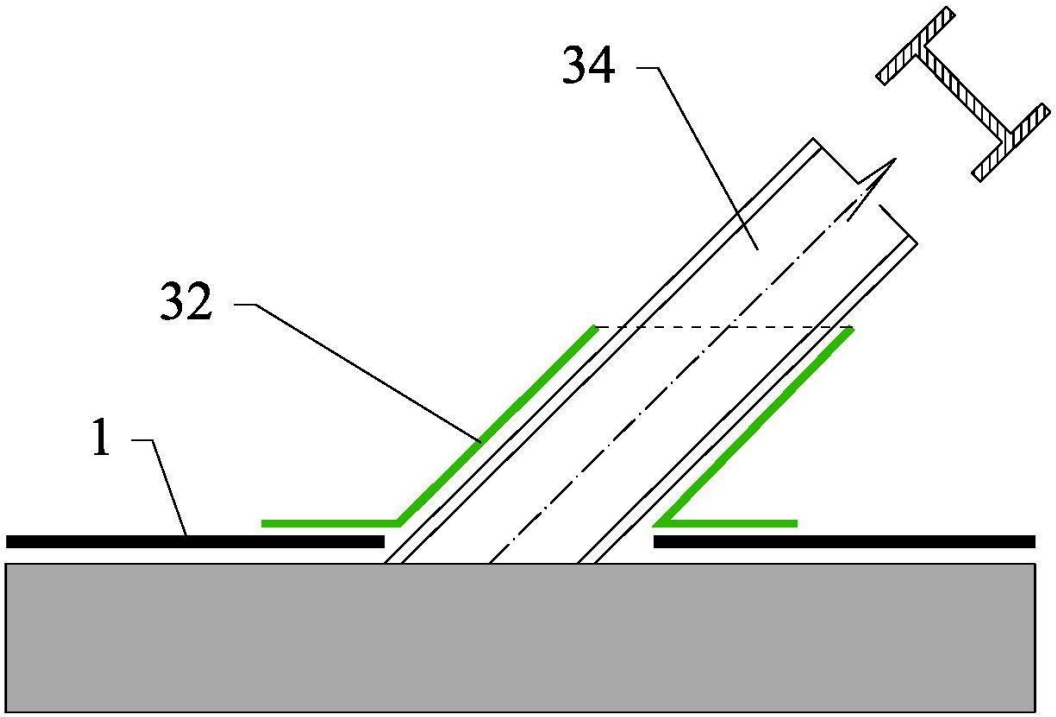
Ukotvení fasády rekonstruované stěrkou PMMA (Triflex)

3D detail řešení (BIM)



3.3 - stav opravený
3D pohled b

Složitý detail opracovaný Triflexem

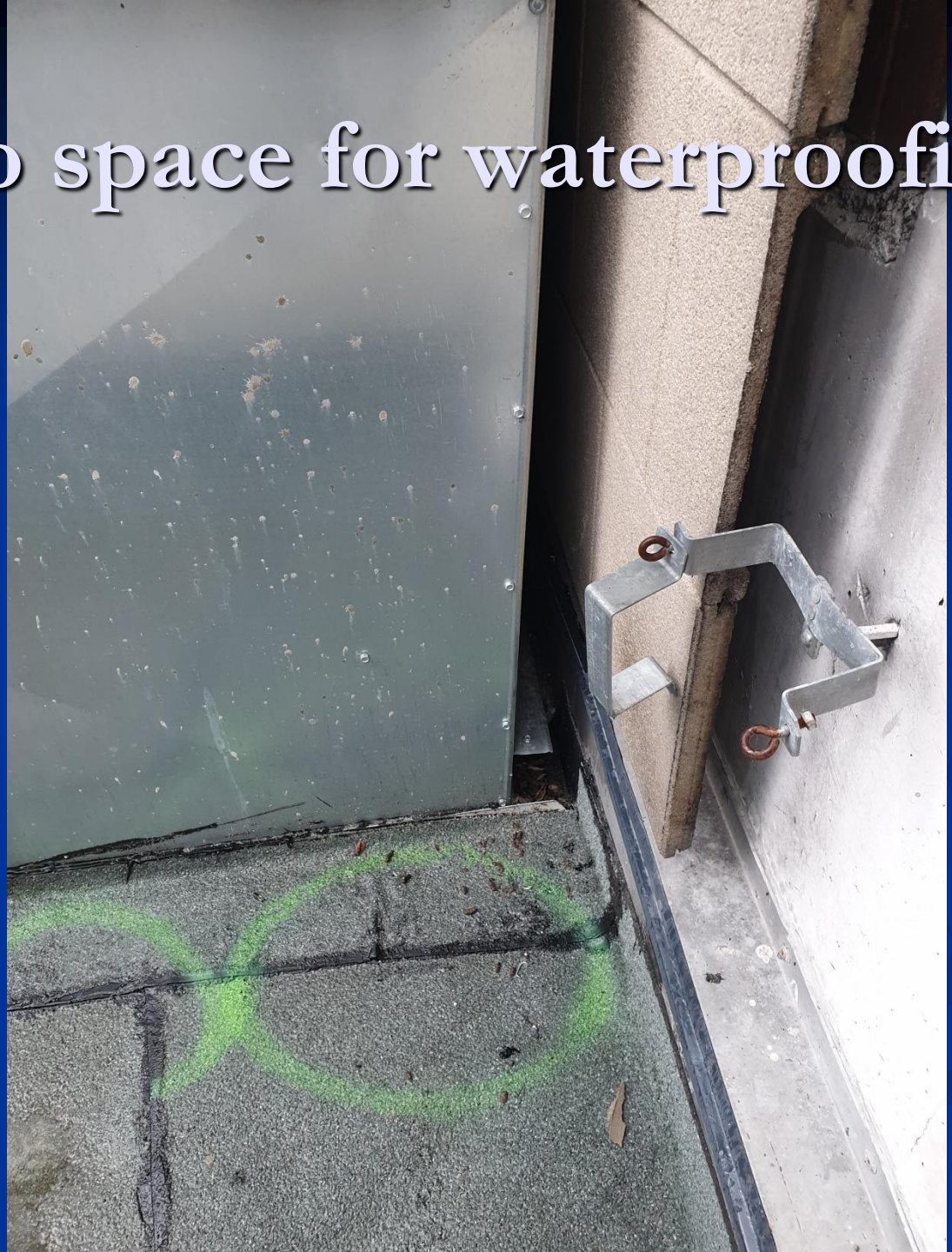


Složitý detail opracovaný Triflexem

No space for waterproofing

No space for waterproofing

No space for waterproofing



End of the waterproofing on the door frame

End of the waterproofing on the door frame – with bitumen felt

Solution with PMMA liquid applied waterproofing

End of waterproof insulation on the facade


End of waterproof insulation on the facade

End of waterproof insulation on the facade


End of waterproof insulation on the facade

End of waterproof insulation on the facade


End of waterproof insulation
on the facade withPMMA
liquid applied waterproofing

Defects liquid applied waterproofing

Defects liquid applied waterproofing

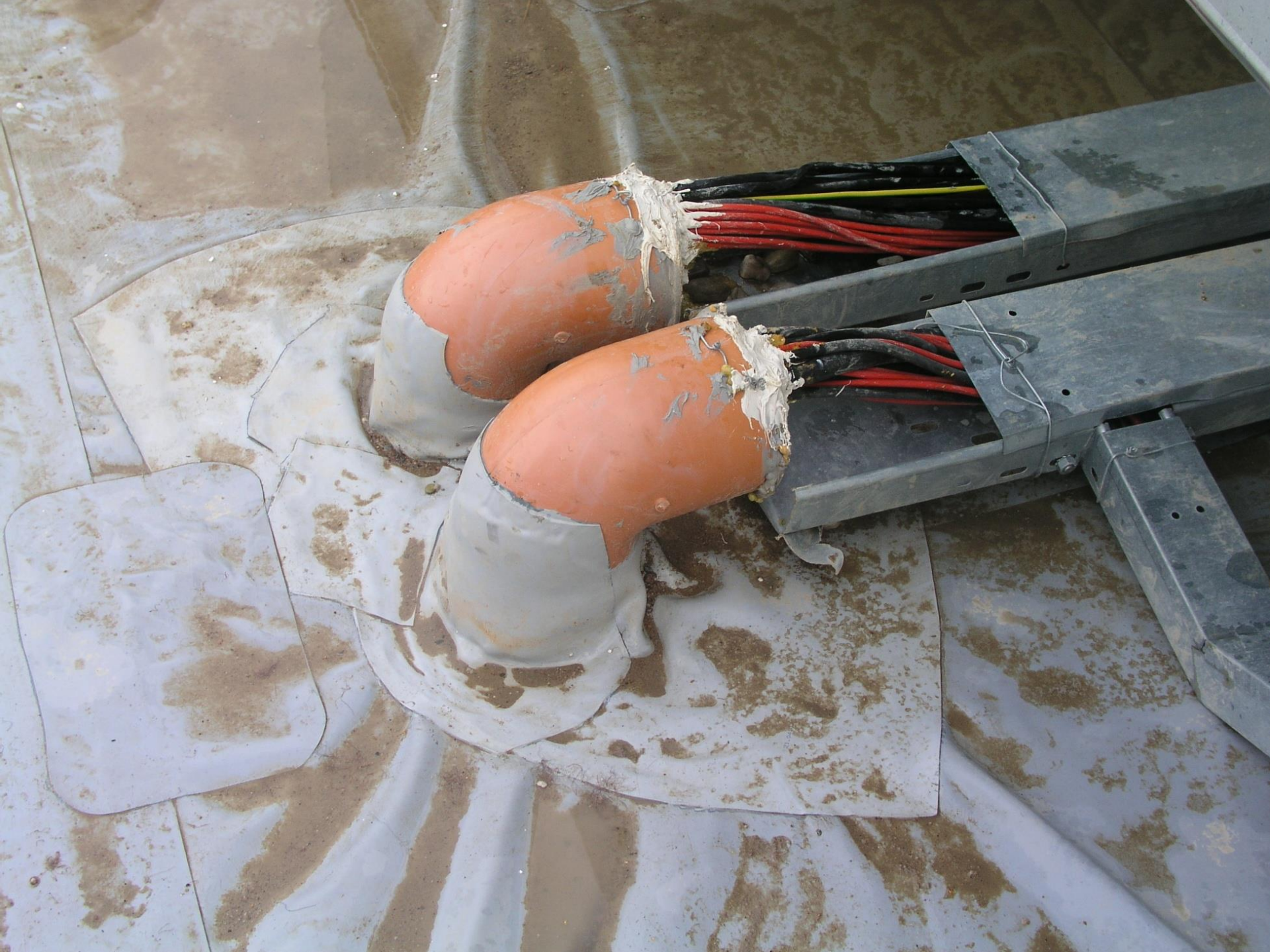
Defects liquid applied waterproofing

Walk window

Walk window

Walk window with PMMA waterproofing

Cable penetration – ending of waterproofing



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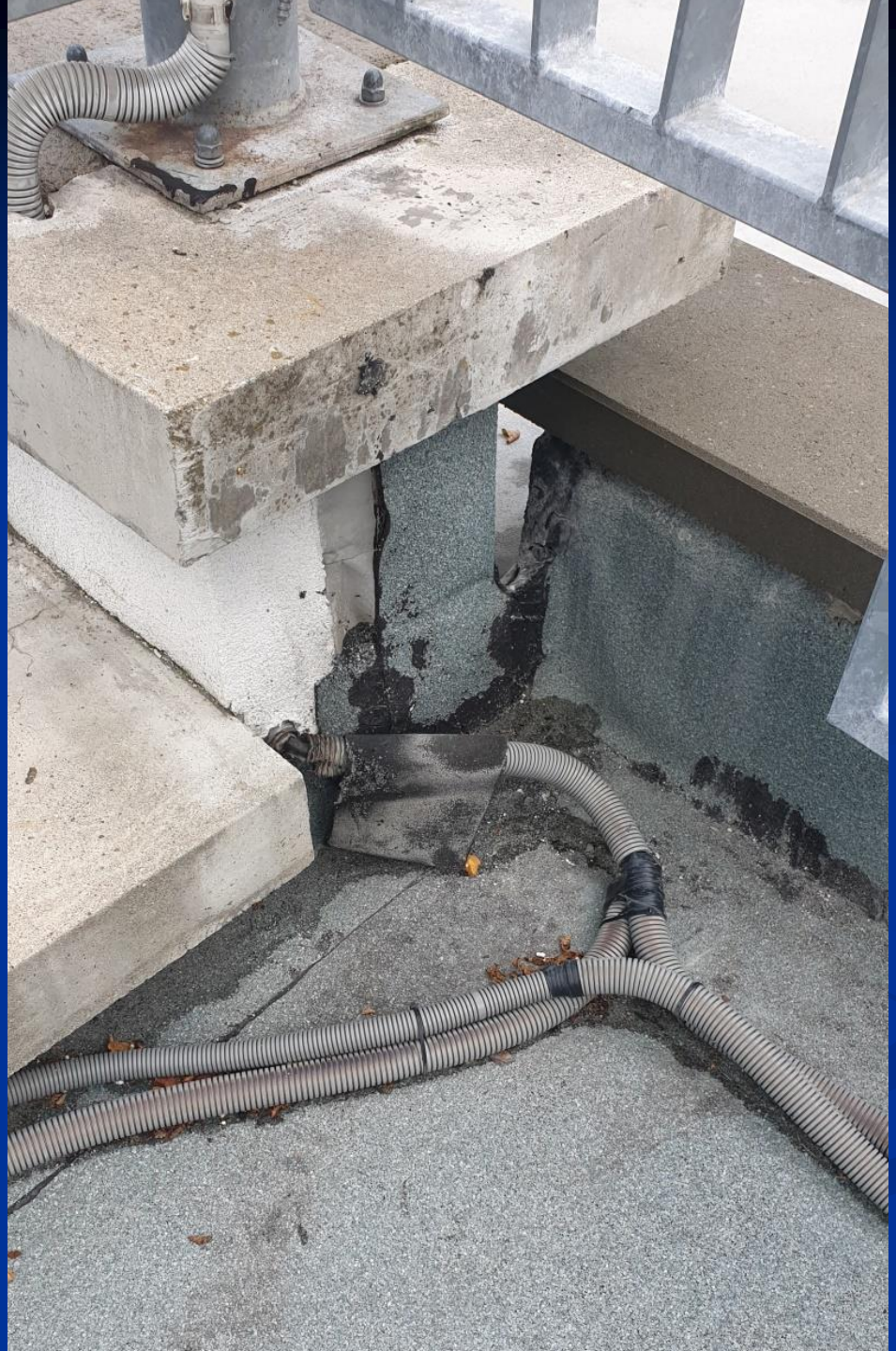

The penetrationof a small circular profile– lightning rod

Supports of roof equipment

Dilation waterproofing


18 9'00

The End