

Deterioration of thatched roofs – moisture and temperature monitoring in a cold roof museum

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Outline

- Background
 - Thatched roofs
 - Premature failure
- Monitoring project
 - Measuring system
 - Sorption isotherms
 - Results
- Conclusions & Outlook

Thatching

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1004

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Premature failure

Desired/Expected service life = 30-40 years

Here: severe rot after 6 years



Premature failure



Potential reasons

- Increased amount of imported reed (low quality)
- Newly introduced pests
- Disadvantageous conditions of harvest and storage
- Increased number of warm roofs (insulated attics)
- Emissions from cattle-breeding farms



→ most likely a complex!

Monitoring object

- Cold roof museum – built in 1639



Monitoring object

- Latest restoration started in 2006



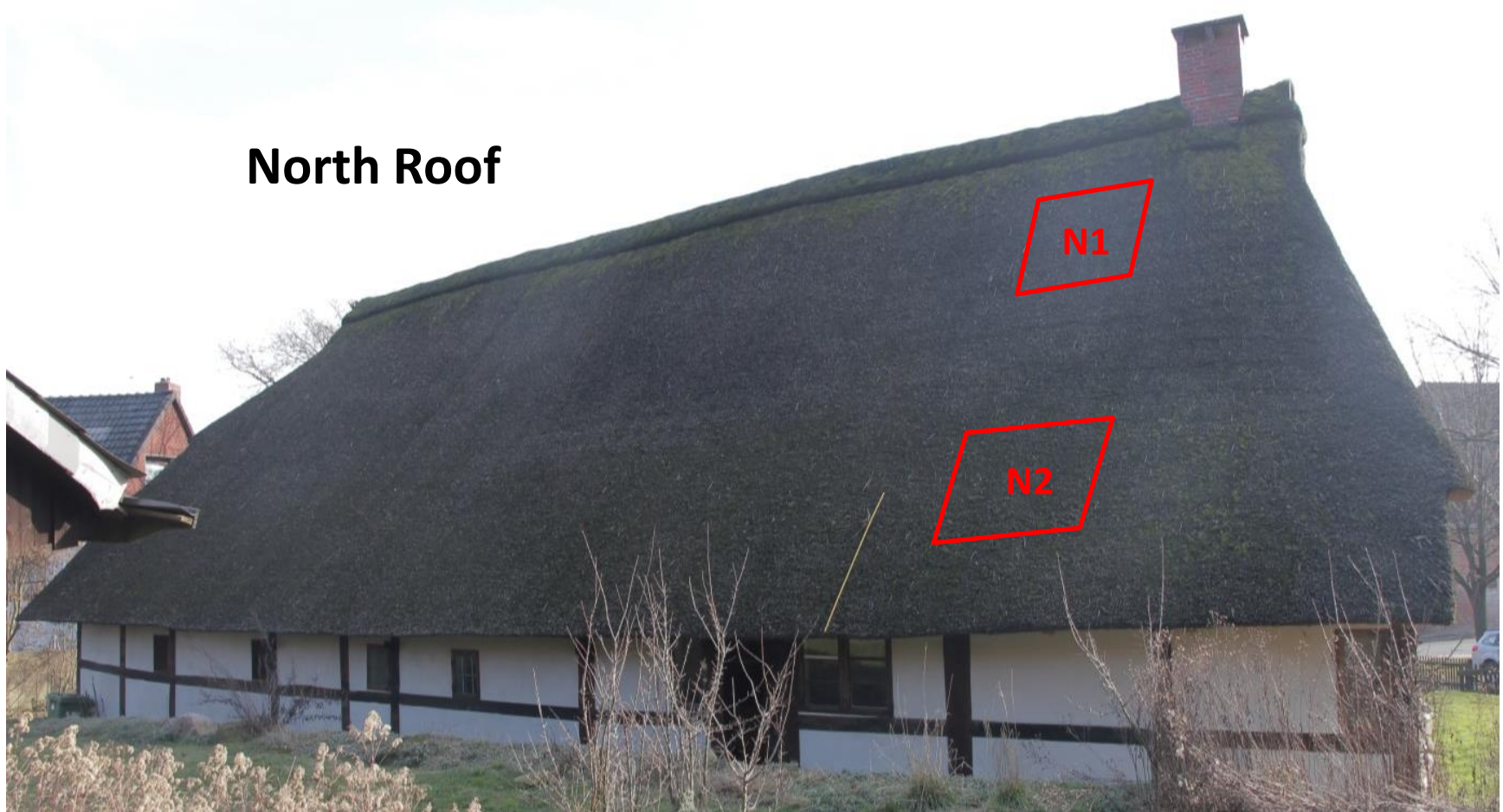
Monitoring object

- Reed layer: 290 mm thickness
- Moisture monitoring at different depths
 - 35, 70, 105, 140, 175, 210 mm



Monitoring object

North Roof

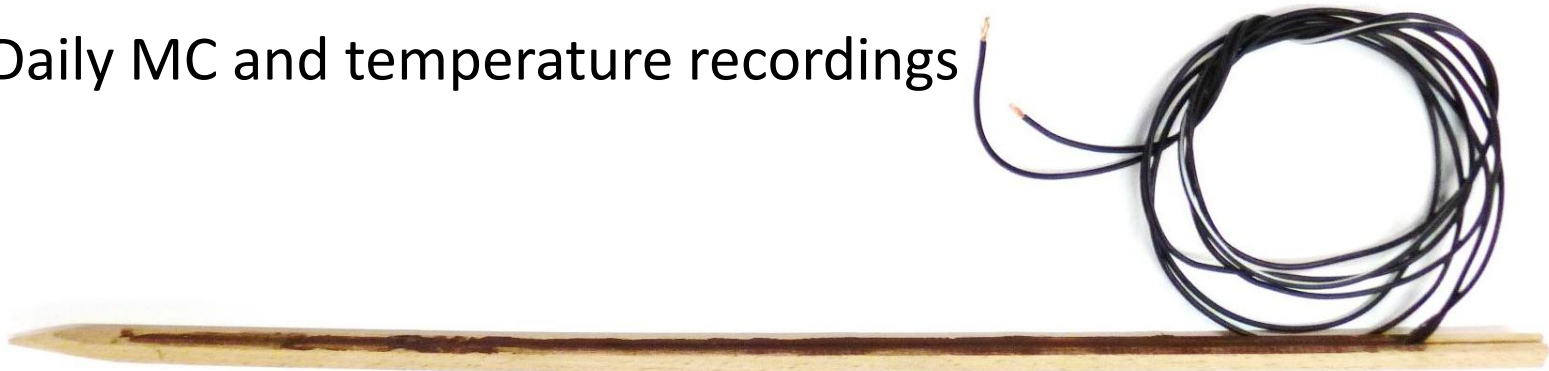


Monitoring object



Monitoring object

- Reed layer: 290 mm thickness
- Moisture monitoring at different depths
 - 35, 70, 105, 140, 175, 210 mm
- Measurement technique:
 - Substitute dowels (beech wood)
 - Electrical resistance measurements
 - Daily MC and temperature recordings



Installation of dowels

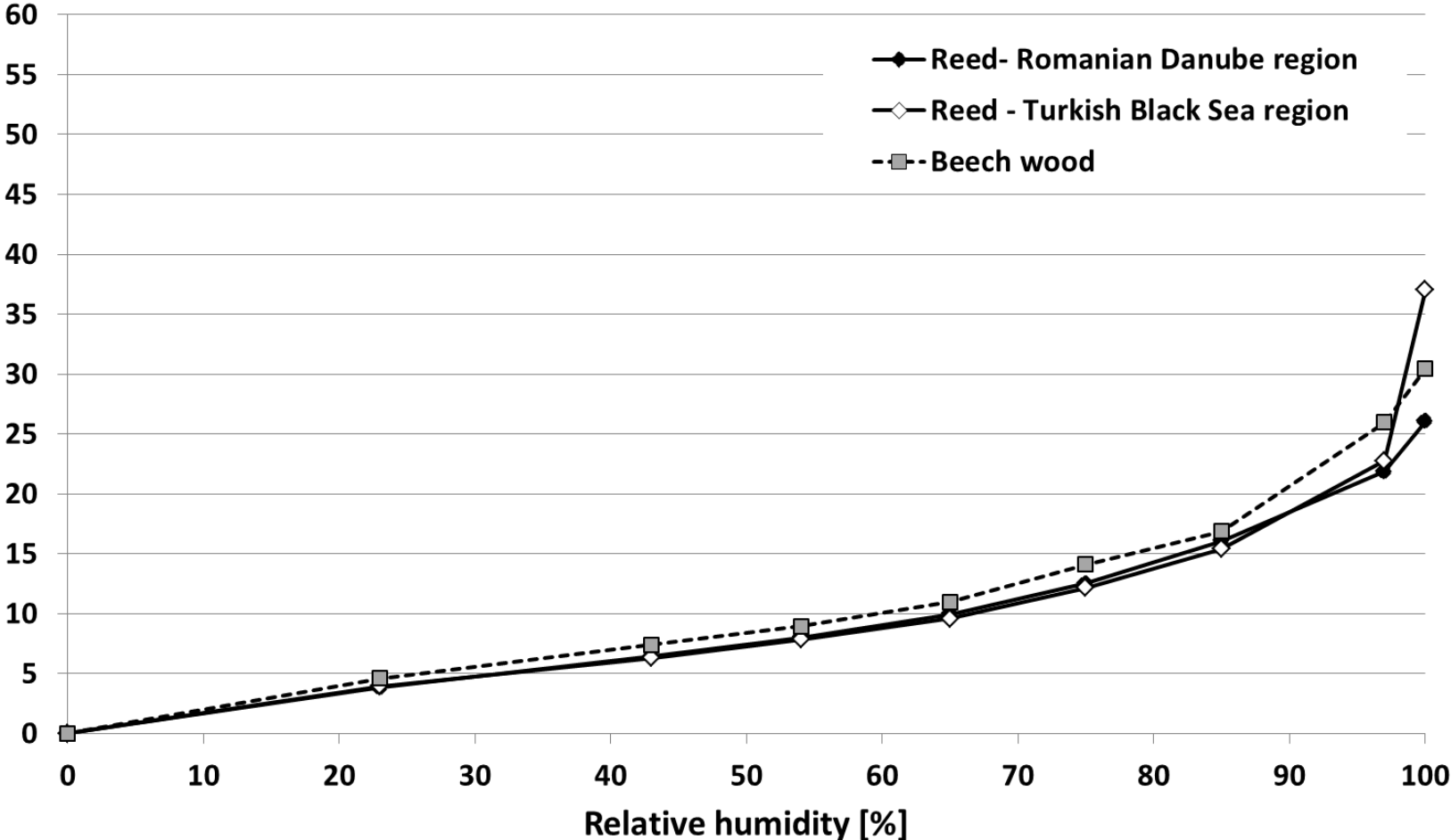
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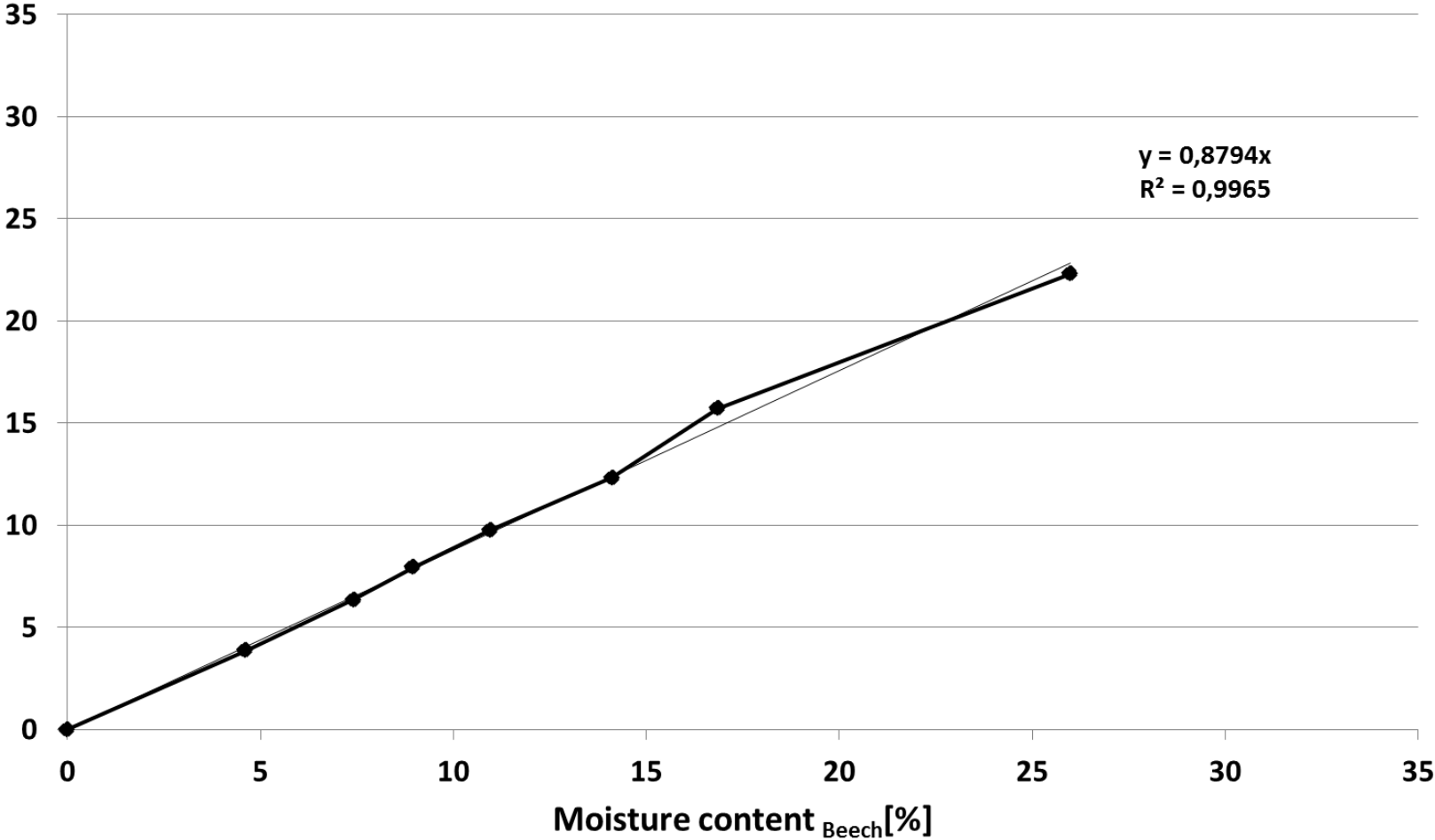
Sorption isotherms

Moisture content [%]

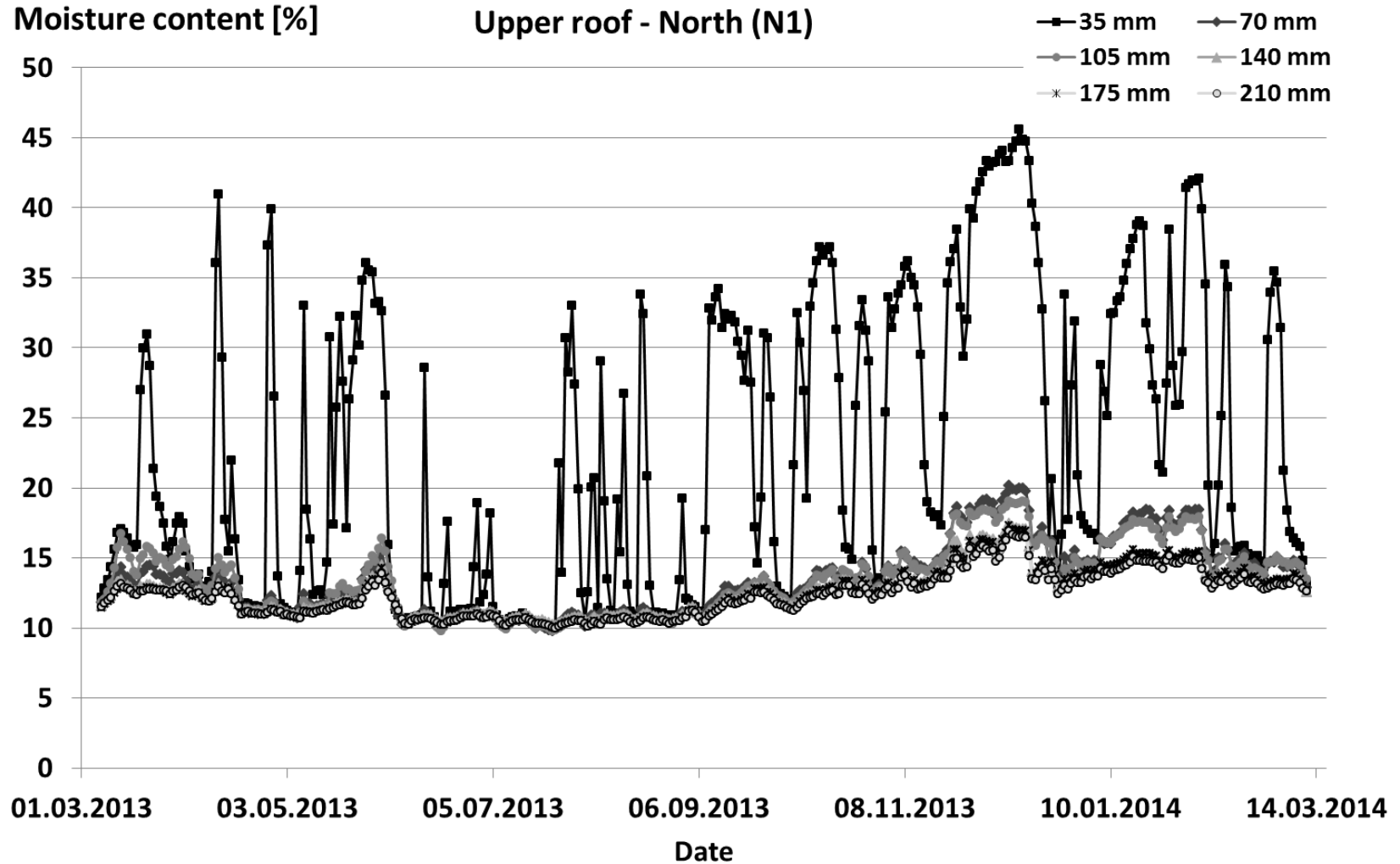


Moisture content

Moisture content Romania/Turkey [%]



Results – Moisture monitoring



Average moisture content [%]

Depth	Upper roof		Lower roof	
	North	South	North*	South
35 mm	22.6	13.1	12.9	21.3
70 mm	13.5	12.9		
105 mm	13.5	13.3	12.6	19.6
140 mm	12.7	13.9		
175 mm	12.5	12.7	13.7	16.8
210 mm	12.3	12.8		

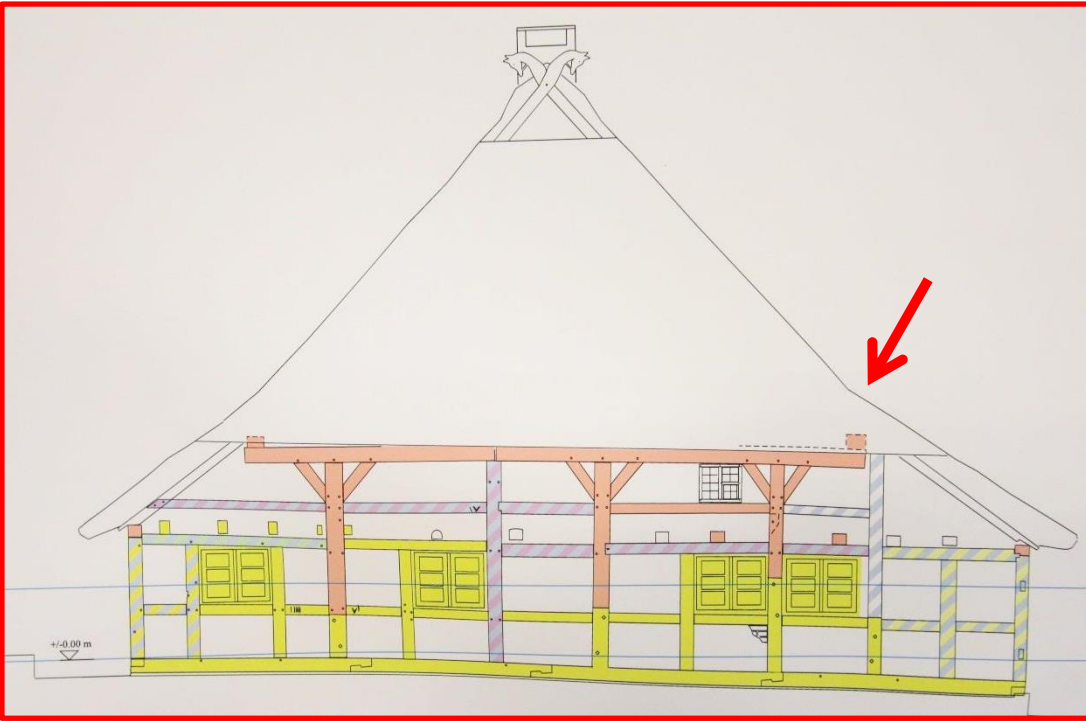
* 07.03.13 – 08.10.14

Average moisture content [%]

Depth	Upper roof		Lower roof	
	North	South	North*	South
35 mm	22.6	13.1	12.9	21.3
75 mm	13.5	13.2	12.9	21.3
105 mm	13.5	13.2	12.9	21.3
140 mm	12.7	13.2	12.9	21.3
175 mm	12.5	13.2	12.9	21.3
210 mm	12.3	13.2	12.9	21.3



Average moisture content [%]



		Lower roof		
		North*		South
	175 mm	12.5	12.7	13.7
	210 mm	12.3	12.8	
0.1		12.9		21.3
0.9				
0.3		12.6		19.6
0.9				
				16.8

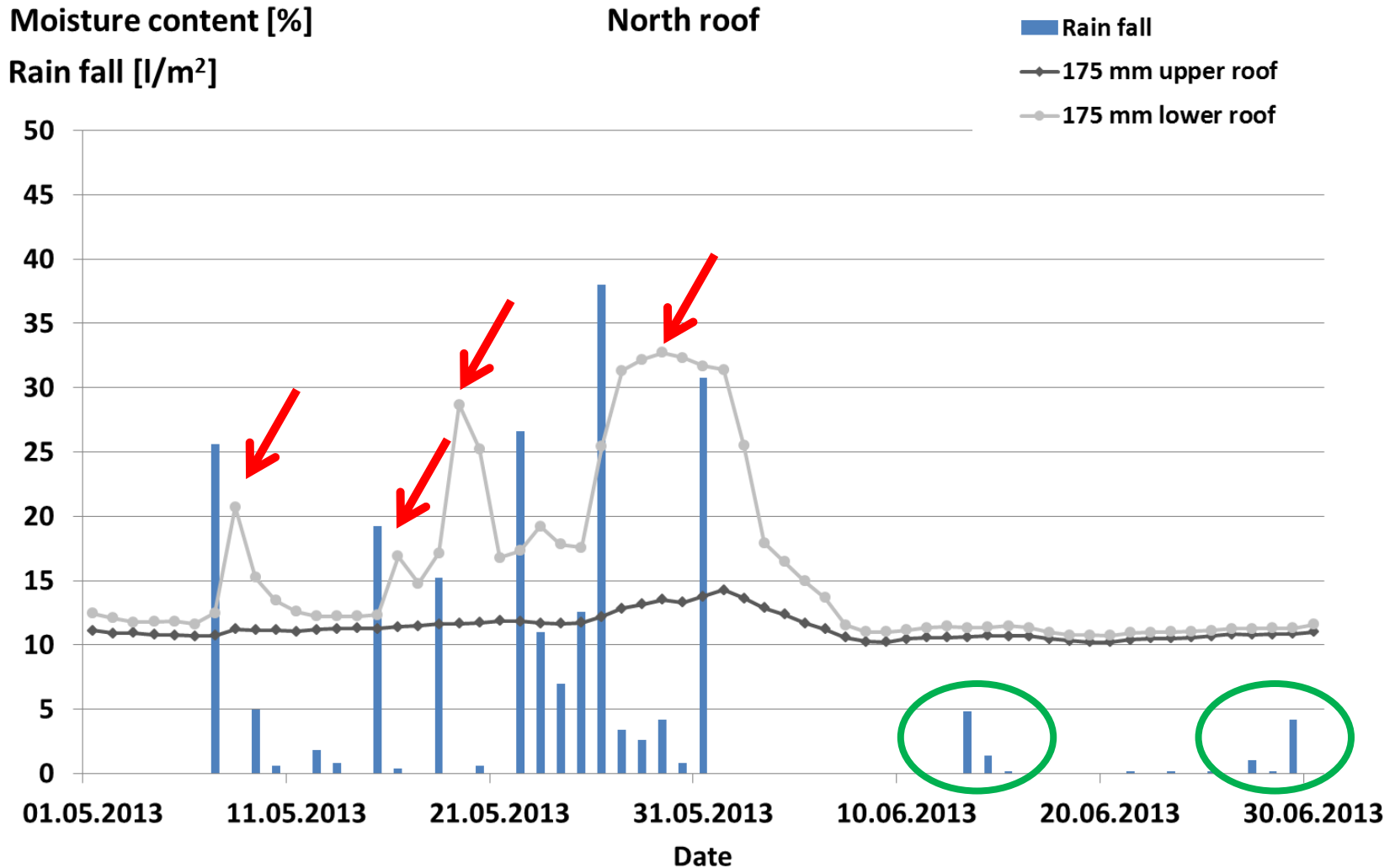
* 07.03.13 – 08.10.14

Number of wet days (> 25% MC)

Depth	Upper roof		Lower roof	
	North	South	North*	South
35 mm	157	7	0	141
70 mm	0	7		
105 mm	0	0	0	112
140 mm	0	6		
175 mm	0	0	10	74
210 mm	0	0		

* 07.03.13 – 08.10.14

Effect of heavy rain events



Conclusions and outlook

- Highest moisture loads on outer layers of North roof
 - plus severe rot, and superficial growth
- Algae and mosses:
 - Cause or consequence of high MC?
- High MC where roof pitch turned from steep to flat
- Reason for premature failure not clearly identified
 - Further analysis needed!
 - Initial reed quality?
 - Storage conditions?
 - Pests? Preinfection?



Thanks for listening!

