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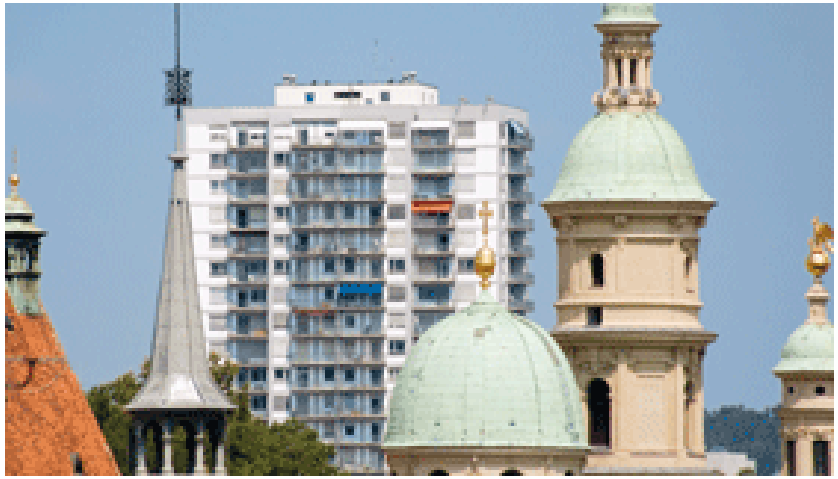
Challenging ETICS



supported by:

Science Park Graz

FFG

aws erp-fonds

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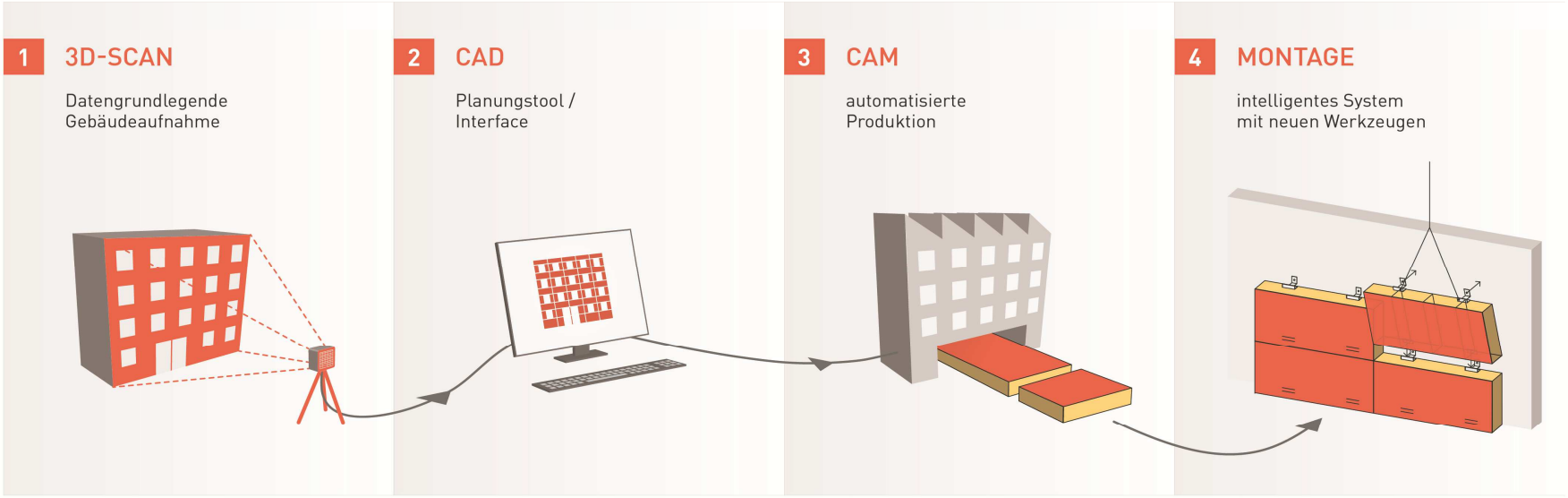
AIM

Prefabrication of ETIC Elements



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ETIC Elements

Components:

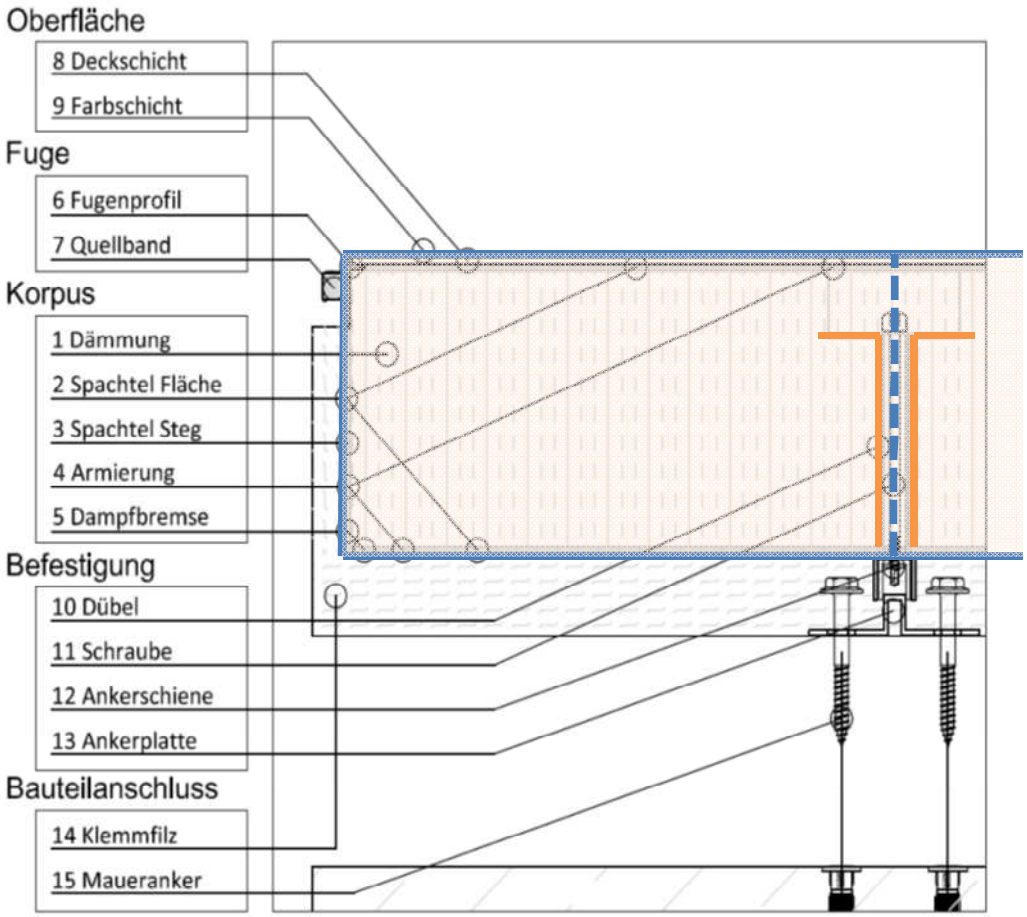
Insulation: MW | (WFB) | EPS

Thickness: 120mm | 200mm
of insulation body

Adhesive: Cement | Dispersion
on glass fiber reinforcement

Bars: with | without
Connecting front and back Adhesive Layer

Fixing: Dowels | Threaded Rod



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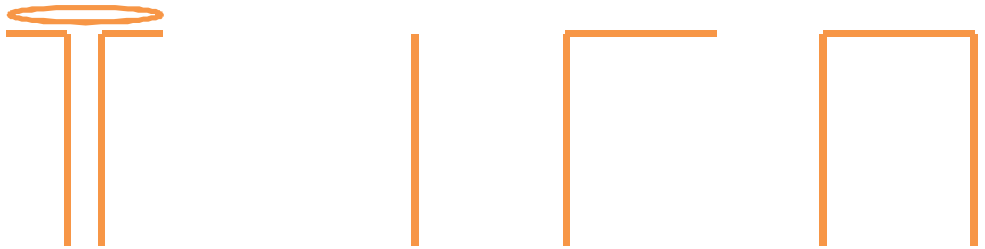
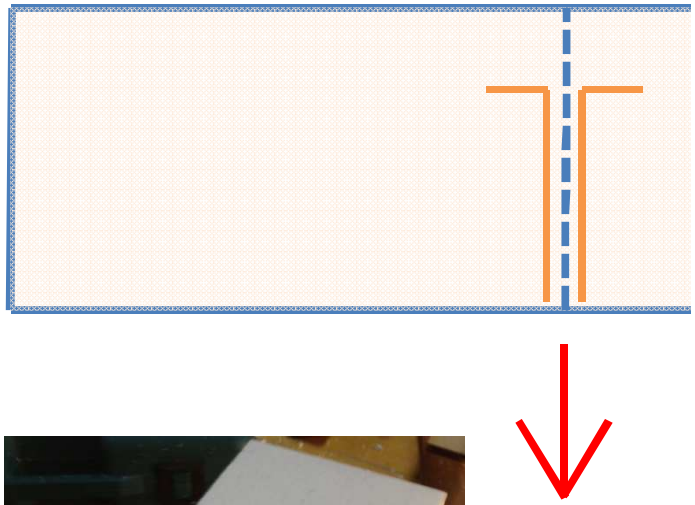
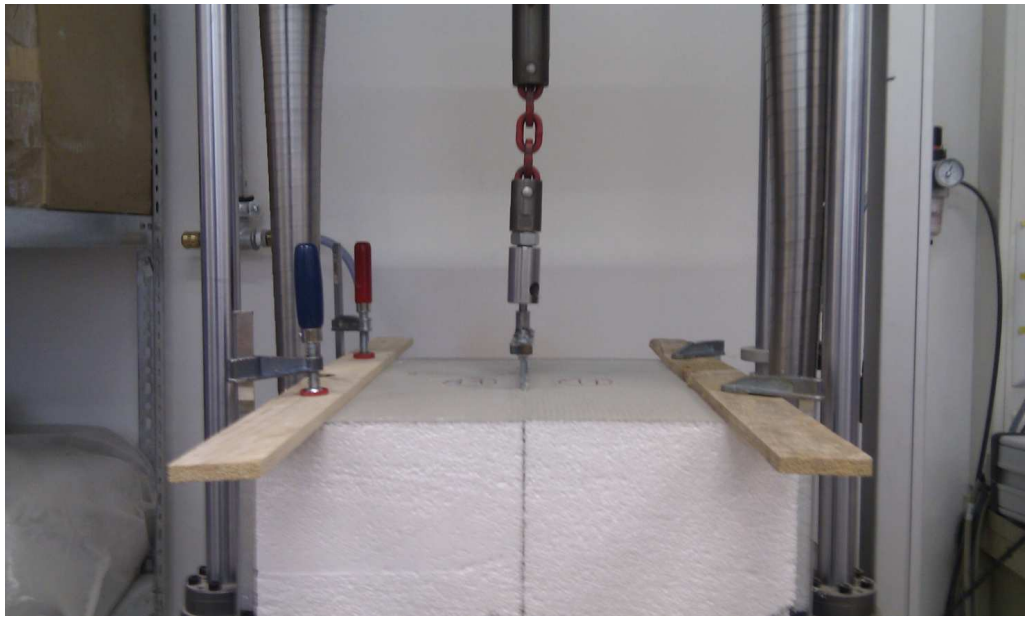
Pull Out Tests

Fixing: pull out tests of Dowels | Threaded Rod







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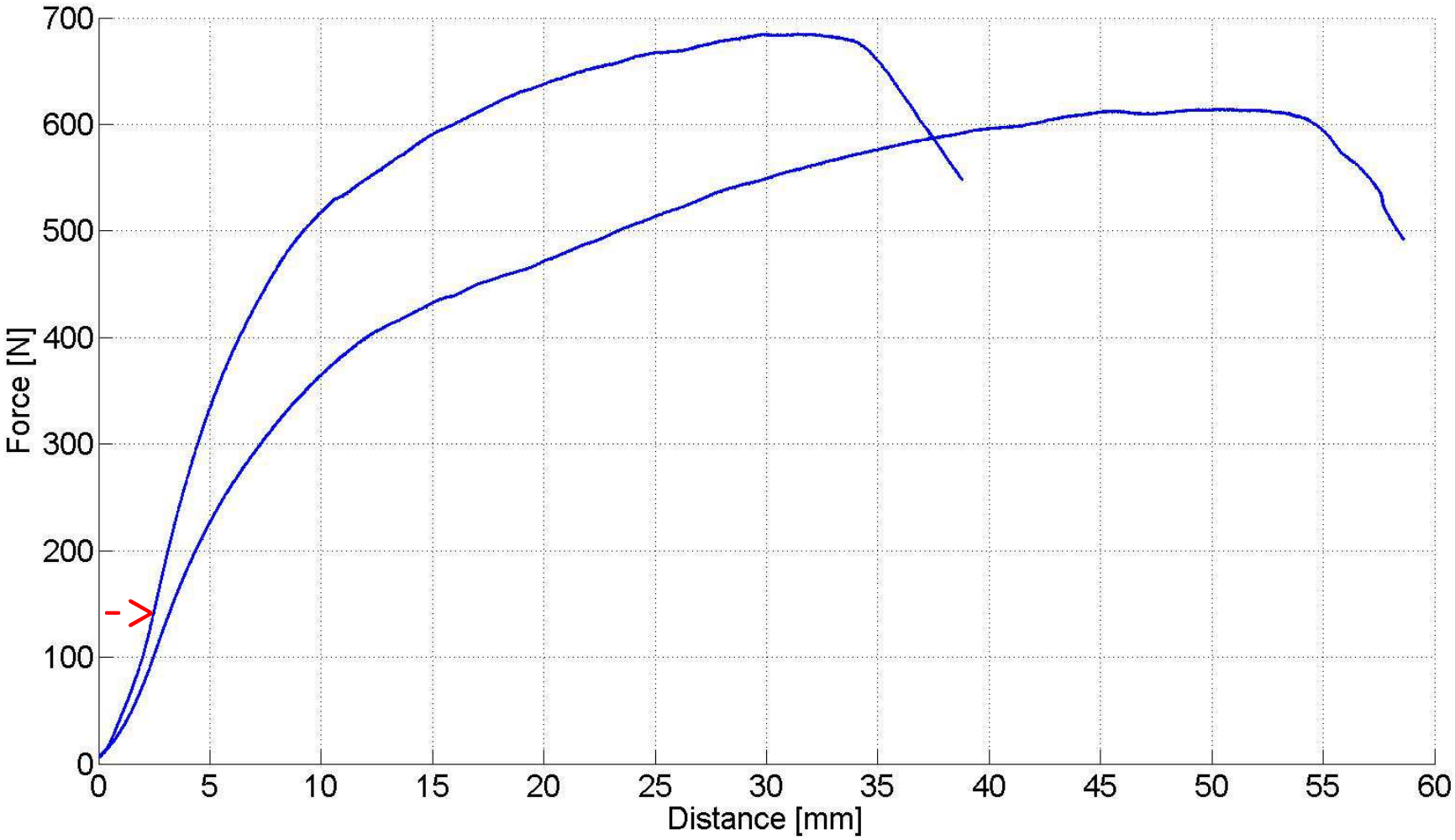
Pull Out Tests

force distance curve dowels



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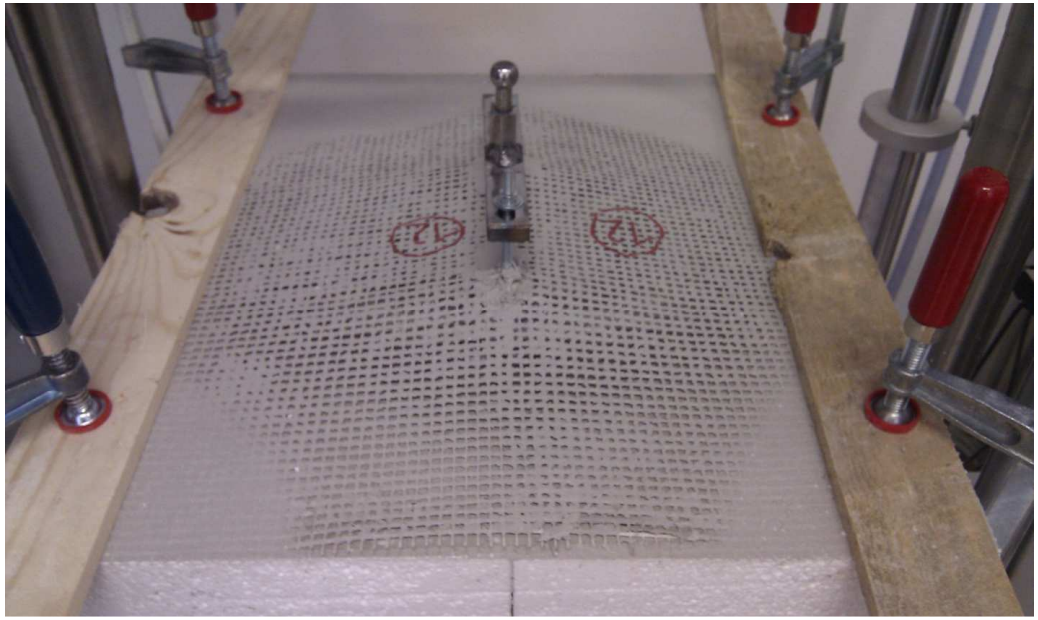
Pull Out Tests

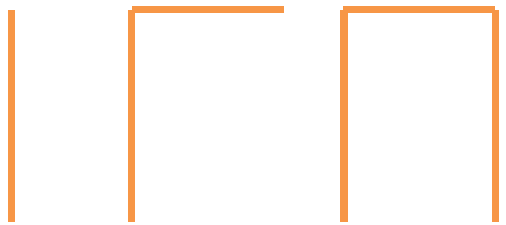
Results:

Fixing in insulation -> distance to go before bearing load

Fixing in bond with adhesive layer show better results

Further improvement by simple alternatives to dowels when in bond with adhesive layer





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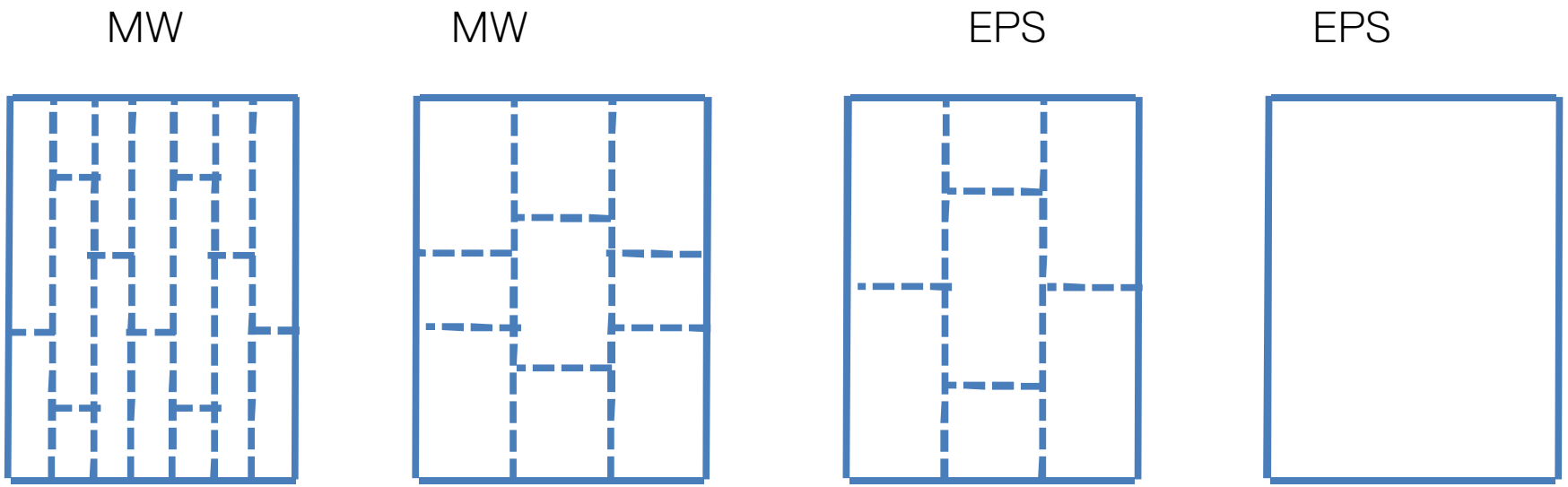
Testing Deflection

Layout for building MW and EPS elements 1500/2000mm (120/200mm thick)



Adhesive layer on glass fiber reinforcement coating the elements

Bars connecting adhesive layer coating from front to back

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Testing Deflection

Results of testing the Elements:

						max Load	max Deflection	Deflecion at load X in mm					
Type	No	Adhesive	Bars	Thickne	Material	N/m²	mm	1000 N/	1500 N/	2000 N/	2500 N/	3000 N/	3500 N/
1	A	Dispersion	with bars	120 mm	EPS-Board	1000	17,5	17,5					
1	B	Dispersion	with bars	120 mm	EPS-Board	1000	24,3	24,3					
2	A	Dispersion	without bars	120 mm	EPS-Board	1000	31,1	31,1					
2	B	Dispersion	without bars	120 mm	EPS-Board	1000	38,8	38,8					
3	A	Dispersion	with bars	200 mm	EPS-Board	2500	34,4	13,2	19,9	26,9	34,4		
3	B	Dispersion	with bars	200 mm	EPS-Board	3000	34,1	7,0	12,1	18,6	25,3	34,1	
4	A	Dispersion	without bars	200 mm	EPS-Board	2500	35,8	9,8	17,2	26,6	35,8		
4	B	Dispersion	without bars	200 mm	EPS-Board	3000	43,8	8,2	14,8	23,0	32,9	43,8	
5	A	Cement	with bars	120 mm	EPS-Board	2500	15,3	1,9	4,4	10,2	15,3		
5	B	Cement	with bars	120 mm	EPS-Board	3500	25,8	1,8	3,8	9,8	15,3	20,3	25,8
5a	A	Cement	with bars	120 mm	MW-Board	2500	14,3	1,1	3,0	7,2	14,3		
5a	B	Cement	with bars	120 mm	MW-Board	2000	5,9	1,0	1,6	5,9			
5b	A	Cement	with bars	120 mm	MW-Plate	2500	16,8	1,3	3,1	8,7	16,8		
5b	B	Cement	with bars	120 mm	MW-Plate	3000	19,4	0,9	3,0	7,4	13,1	19,4	
6	A	Cement	without bars	120 mm	EPS-Board	2000	16,5	3,4	9,8	16,5			
6	B	Cement	without bars	120 mm	EPS-Board	2500	22,8	5,2	10,9	16,8	22,8		
7	A	Cement	with bars	200 mm	EPS-Board	3000	5,4	1,0	1,5	2,1	3,3	5,4	
7	B	Cement	with bars	200 mm	EPS-Board	3000	6,2	1,0	1,6	2,3	3,9	6,2	
8	A	Cement	without bars	200 mm	EPS-Board	3000	8,5	0,5	1,2	2,9	5,4	8,5	
8	B	Cement	without bars	200 mm	EPS-Board	3000	8,4	1,4	2,2	3,5	6,1	8,4	

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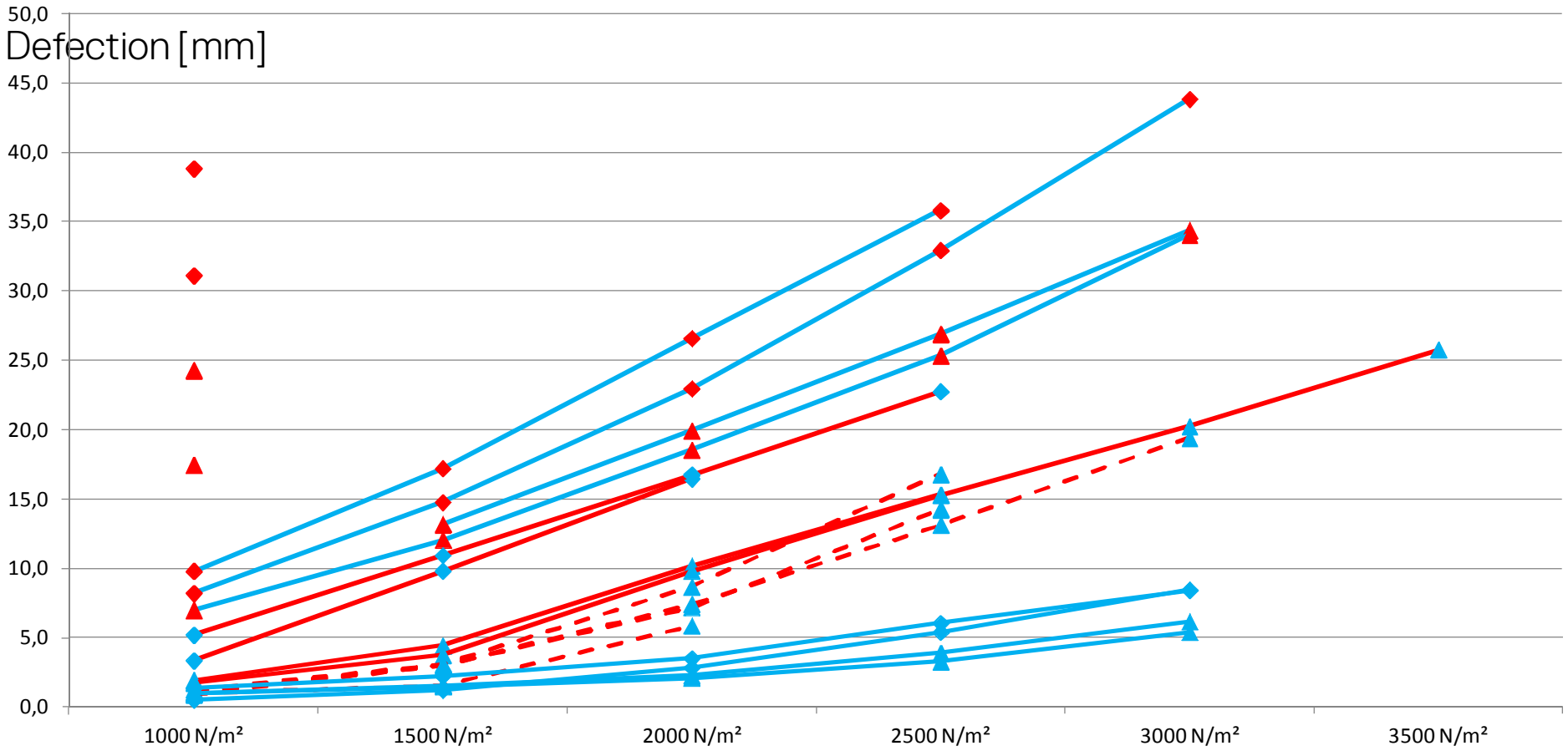
Testing Deflection



	red	blue	V 1	V 2
Marker	Dispersion	Cement	Triangle -> with bars	Diamond -> without bars
Line	120mm	200mm	Dashed -> Mineralwool	Solid -> EPS

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Computational Models

two different computational models were compared with the results of testing the deflection:

- Total cross-section method (TCS)
- Composite method (Comp.)

						Load	1000	[N/m²]	Load	1500	[N/m²]	Load	2000	[N/m²]
Type	Bar	Length	Width	Thickness	Area	Measured	TCS	Comp.	Measured	TCS	Comp.	Measured	TCS	Comp.
		[mm]	[mm]	[mm]	[m²]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
5	A	1860	1000	130	1,86	1,9	5,5	10,3	4,4	8,2	15,4	10,2	10,9	20,5
5	B	1860	1000	130	1,86	1,8			3,8			9,8		
6	A	1860	1000	130	1,86	3,4	6,0	13,5	9,8	9,0	20,3	16,5	12,0	27,0
6	B	1860	1000	130	1,86	5,2			11,0			16,8		
7	A	1860	1000	210	1,86	1,0	2,9	2,8	1,5	4,4	4,2	2,1	5,9	5,5
7	B	1860	1000	210	1,86	1,0			1,6			2,3		
8	A	1860	1000	210	1,86	0,5	3,5	3,9	1,2	5,2	5,8	2,9	7,0	7,8
8	B	1860	1000	210	1,86	1,4			2,2			3,5		

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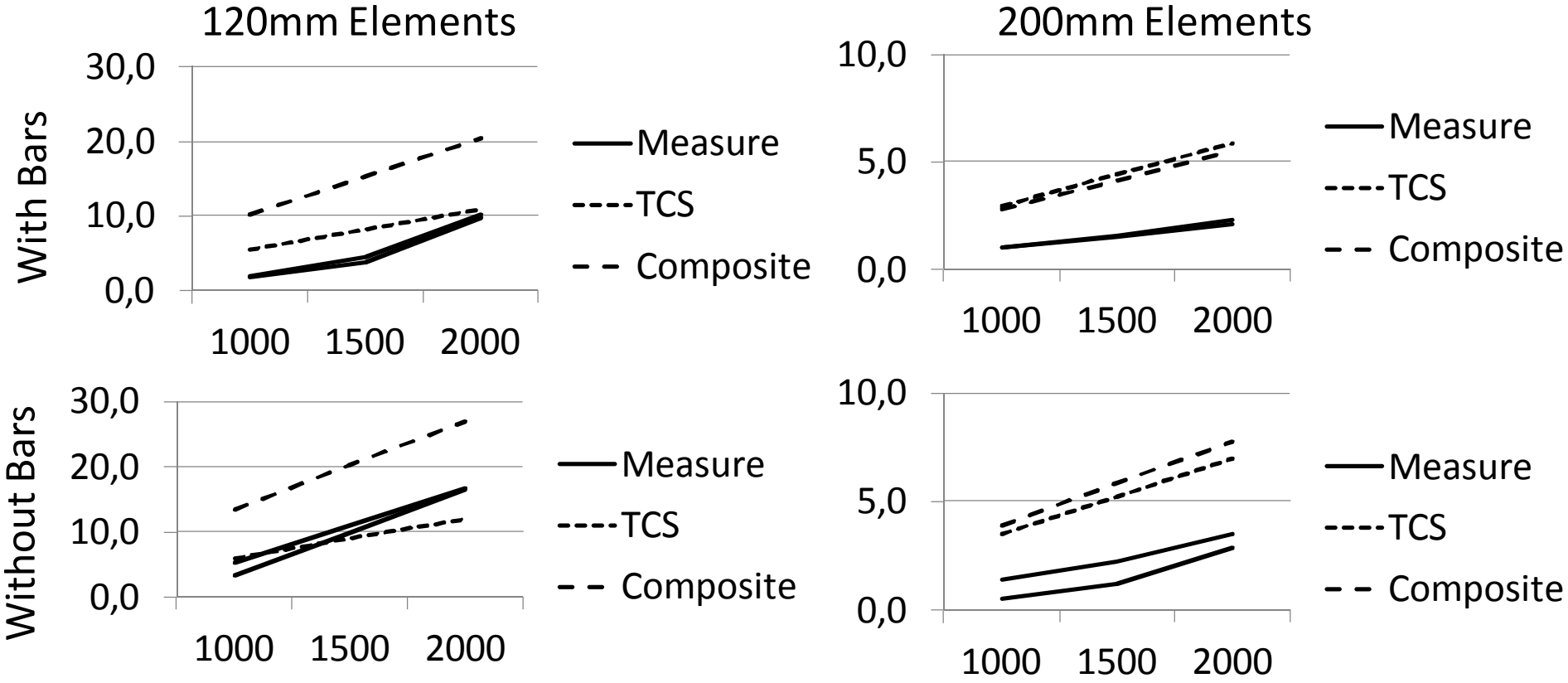
Computational Models



Both methods give similar results for the expected deformation for the relevant load 1,000 N/m²
For thinner elements (120 mm), the total cross-section method gives about half as large values as the composite method.
For thicker elements (200 mm) arise in both methods the similar values.

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Conclusion

Elements from components of the ETICS can be produced that

- have static properties that ensure functionality and usability even under extreme conditions.

- are suitable as the exterior wall insulation for thermal renovation and new construction.

- can be fixed without being glued to the wall, thus disassembled they also meet the new requirement for construction works No. 5, 6, and 7 of the Regulation (EU) No 305/2011

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Conclusion

With this evidence, the foundation for the development of individualized industrial series production of EIFS cladding elements has been established.

From use of computer-based technologies can be expected, that the economic and ecological optimization of all areas in the entire production process of external wall insulation for buildings will finally begin.