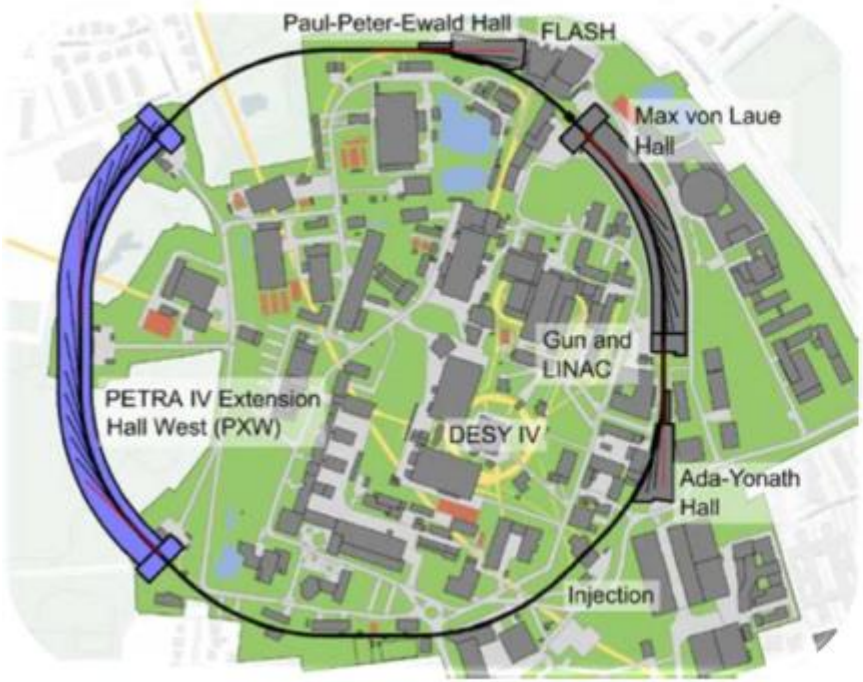
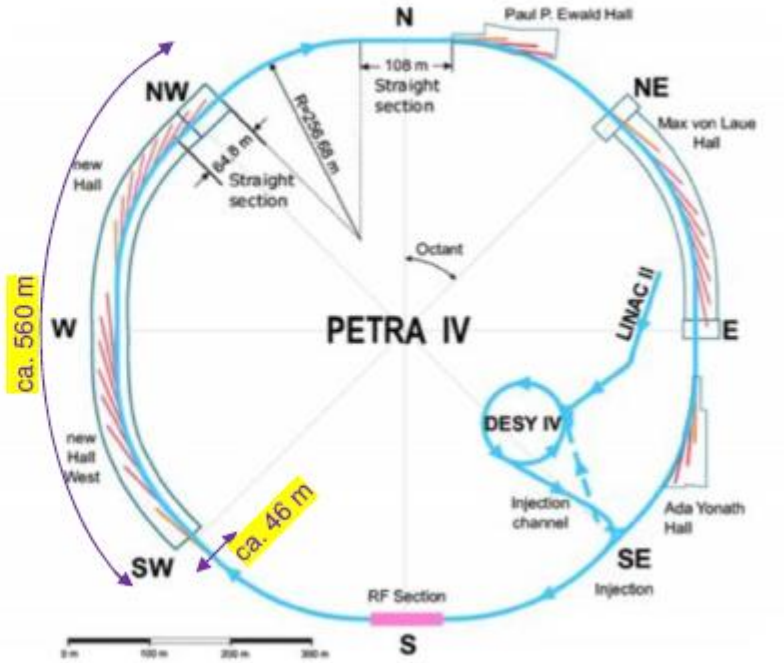
Zum dynamischen Verhalten des Bodenaufbaus PXW-Halle

ZM1 – Roland Platzer
AG: Kai Bagschik (FS-PETRA-BO)
Hamburg, 19.06.2025

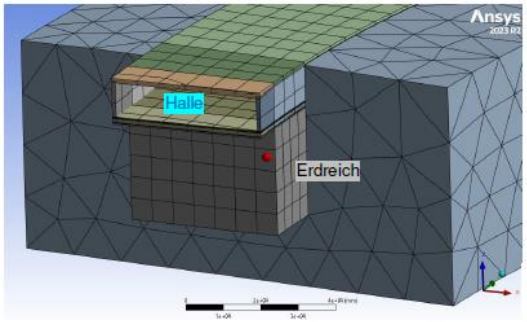
PETRA IV – neue Halle West (PXW)

Lage, Hauptabmessungen

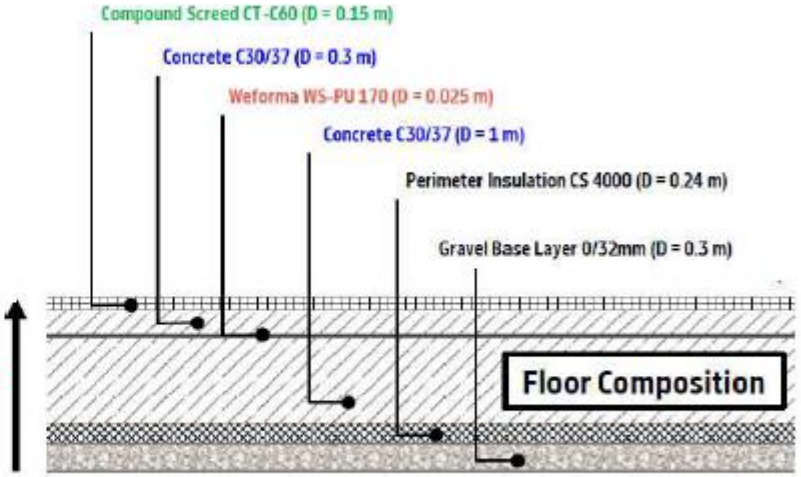




Untersuchungen 2024

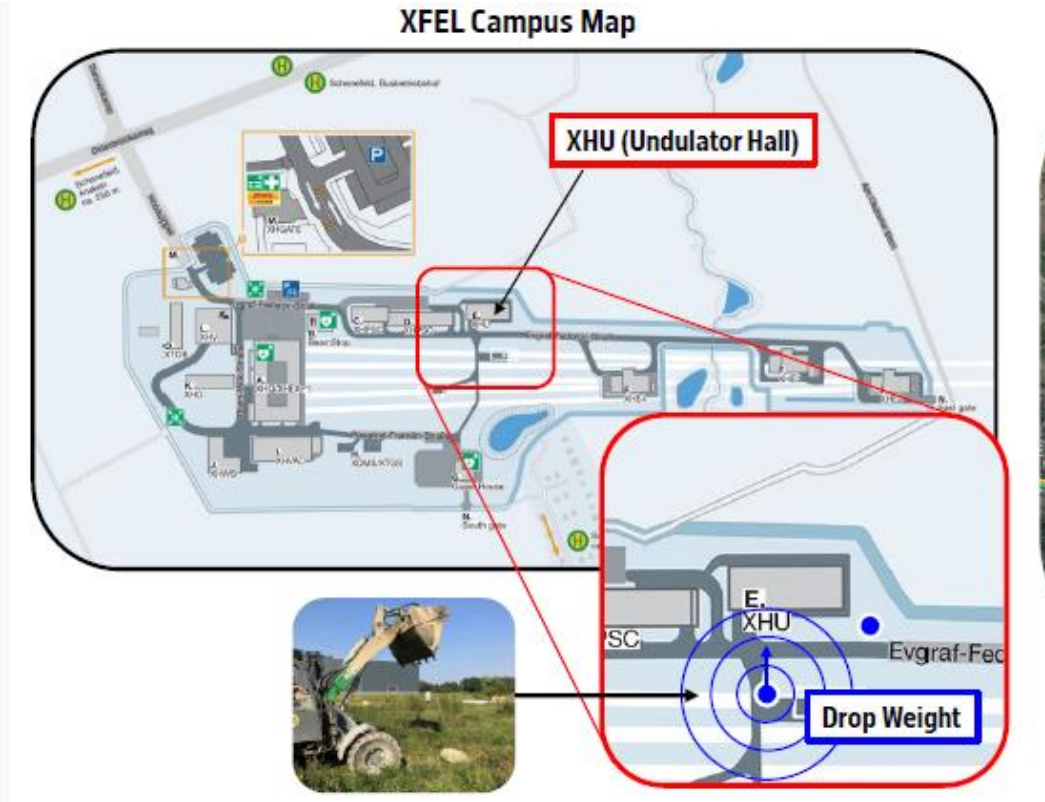


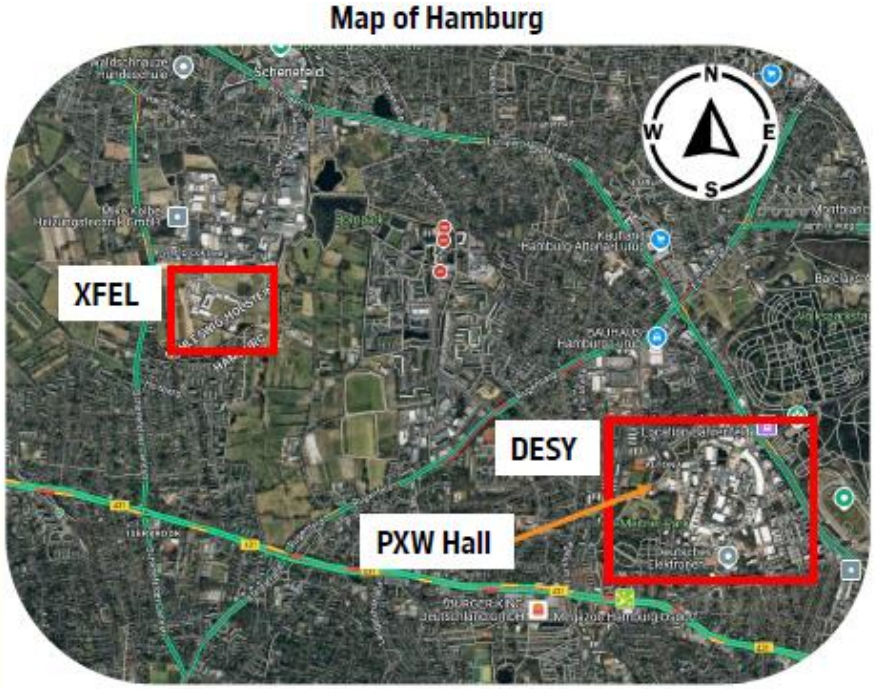
Material	E-Modulus [N/mm²]	Weight [kN/m³]	Source
Compound Screed CT-C60	37000	22.00	Estimate/Literature
Weforma WS-PU 170	2.27	0.45	Estimate/Literature
Concrete C30/37	31800	25.00	Norm/AG
Perimeter Insulation CS 4000	5	0.45	Estimate/Literature
Gravel Base Layer	180	18.0	Data sheet
Sandy Soil	120	18.0	Data sheet



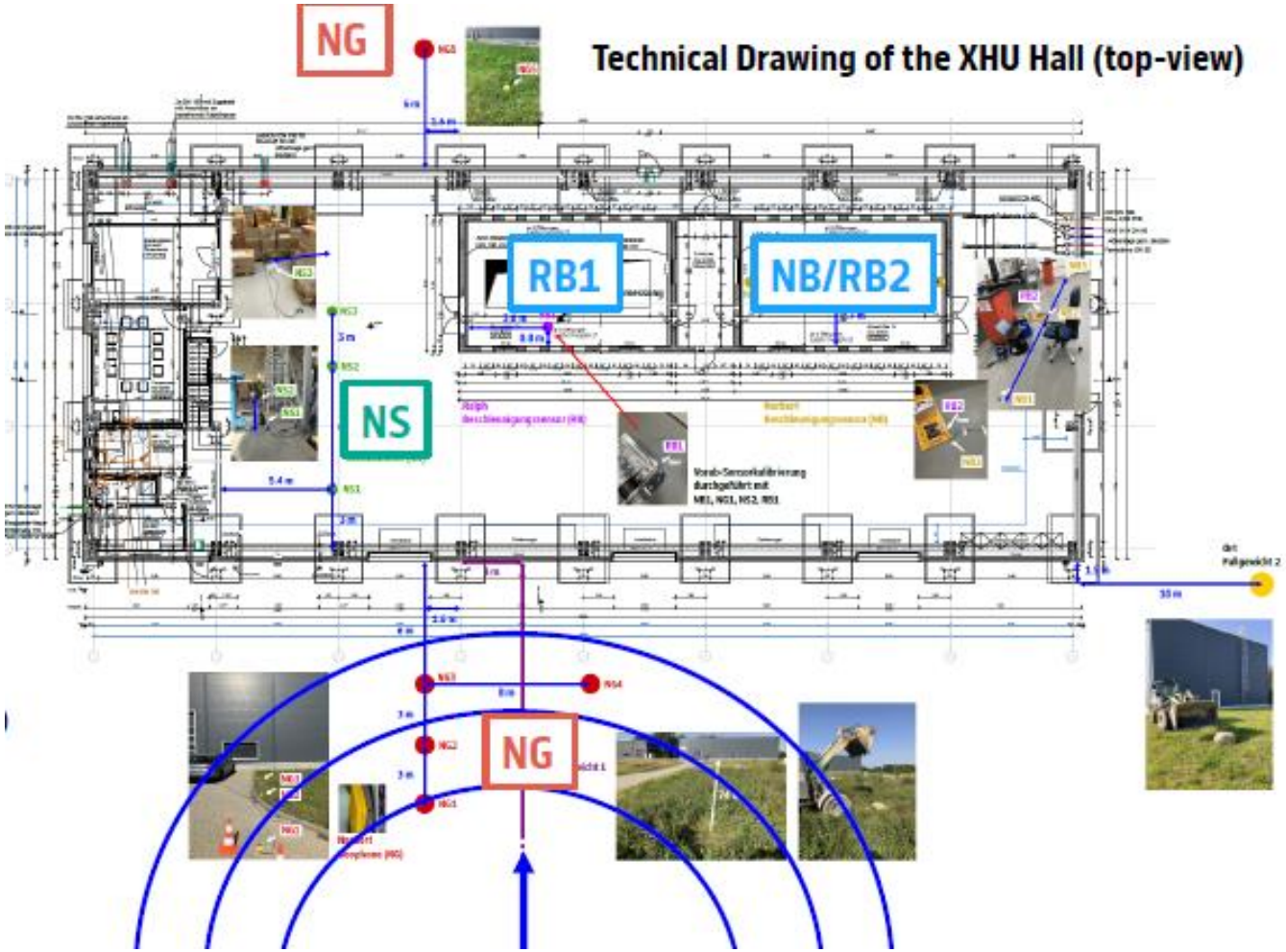
HRA	Description	Layers	1	2	3	4	5	6	Max reaction	Factor
		Sandy Soil	Gravel	Perimeter Insulation	Concrete (C30/37) base plate	Weforma	Concrete (C30/37) floor slab	Compund Screed (CT-C60)		
	E-Modulus [MPa]	120	180	5	31800	0.144	31800	37000		
	Density [g/cm³]	1.8	1.8	0.045	2.5	0.045	2.5	2.2		
			Thickness [mm]						[mm]	
12a	Standard structure		300	240	1000	25	300	150	0.0044562	**1.00**
	Walls not connected to floor slab		300	240	1000	25	300	150	0.0047351	**1.06**
	Stiffer base plate		300	240	1500	25	300	150	0.0041335	**0.93**
	Softer base plate		300	240	500	25	300	150	0.0049234	**1.10**
12e	Without perimeter insulation		300	x	1000	25	300	150	0.0035858	**0.80**
	Without Weforma		300	240	1000	x	300	150	0.0332280	**7.46**
12b	Without perimeter insulation and weforma		300	x	1000	x	300	150	0.0326460	**7.33**
	Without Weforma - perimeter insulation as interlayer (top)		300	x	1000	240 peri	300	150	0.0327530	**7.35**
	Perimeter insulation bottom and top		300	240	1000	240 peri	300	150	0.0308720	**6.93**
	Double Weforma layer			Weforma 25	1000	25	300	150	0.0047482	**1.07**
12	Standard structure with 22 m joints		300	120	1000	25	300	150	0.0068783	**1.54**
12d	Standard structure with 22 m joints without perimeter insulation		300	0	1000	25	300	150	0.0060022	**1.35**

Validierung, Messung XHU-Halle





Validierung, Messung XHU-Halle

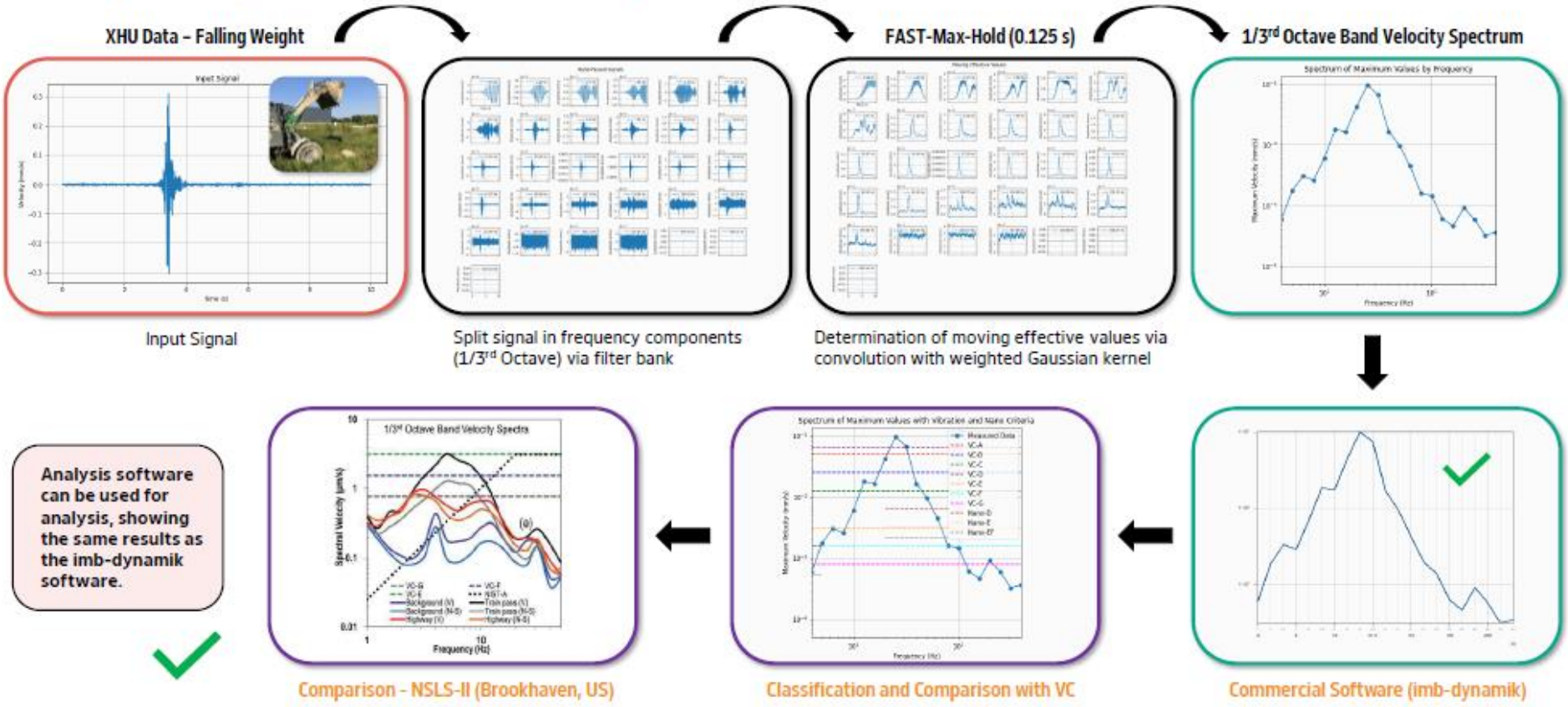


Validierung, Berechnung Terzspektren

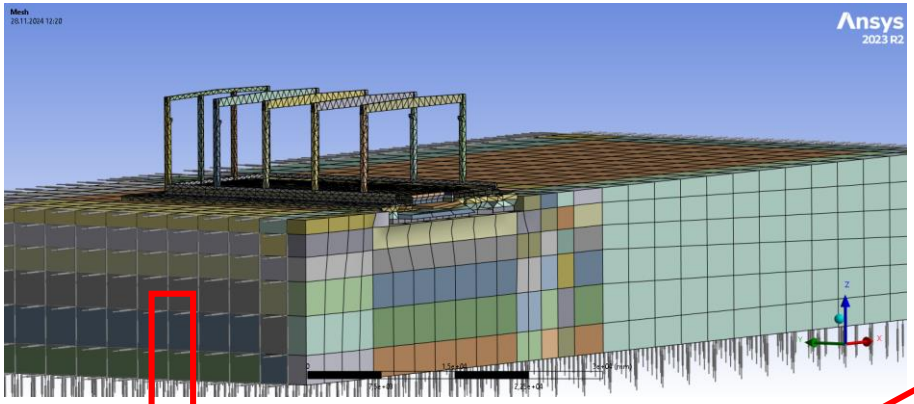
Calibration of the XHU FE-Model

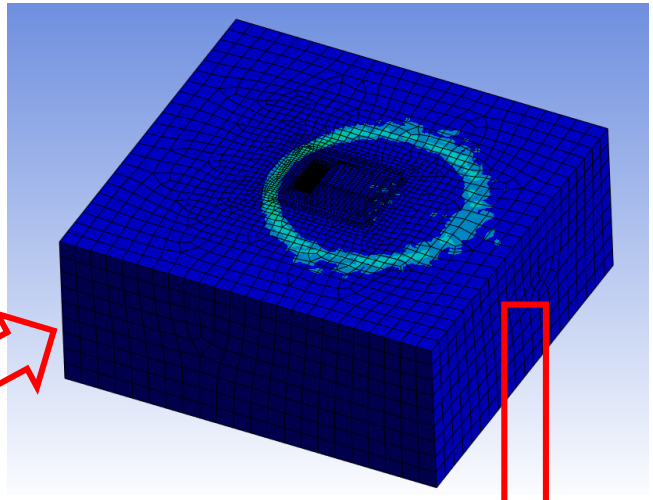
1st Step: Data Analysis Tools - 1/3rd Octave Band Spectra

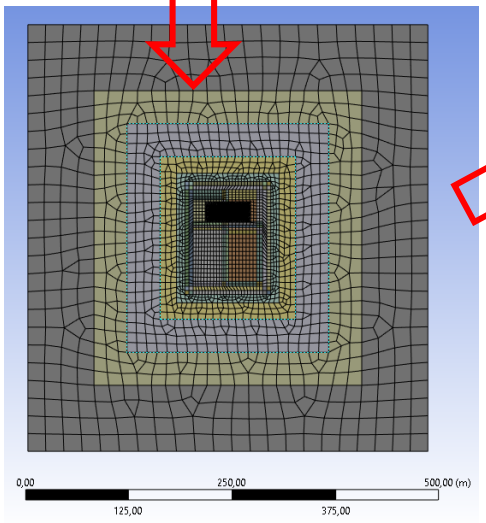
PETRA IV. NEW DIMENSIONS



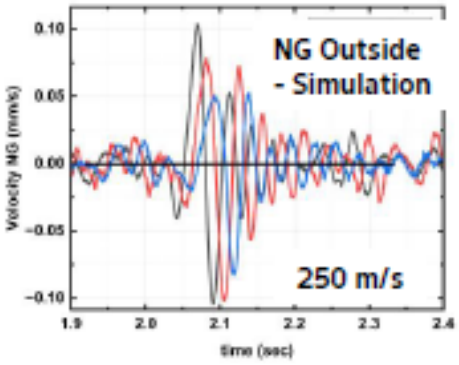
Validierung, Aufbau FE-Modell

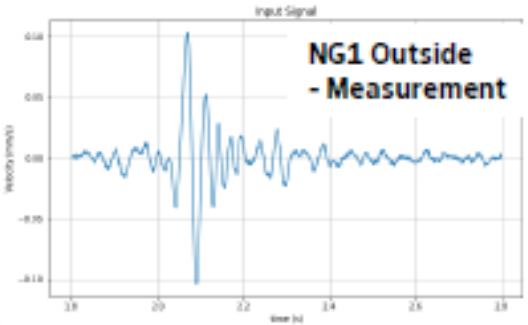




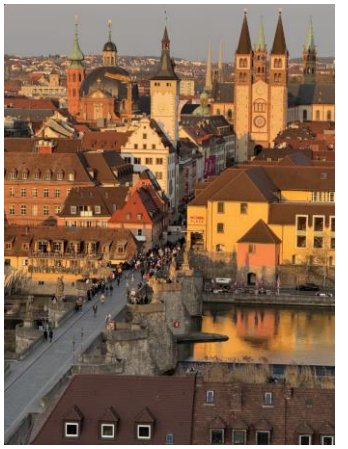


Shear-Wave Velocities and Excitation Pulse Shape





VDI Baudynamik Tagung 04/2025



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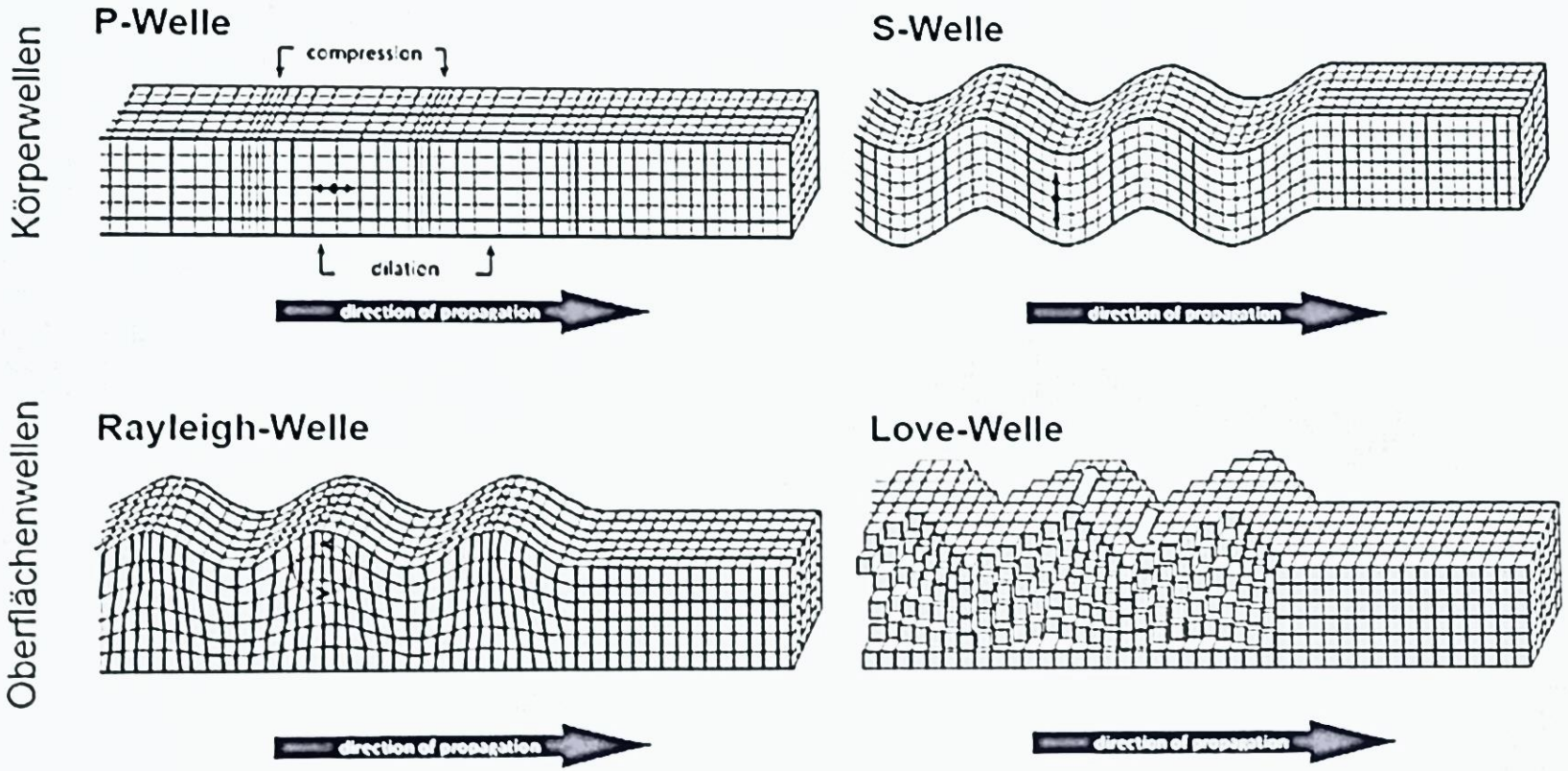

Modified after Bakić, Mario et al. "The Usefulness of Seismic Surveys for Geotechnical Engineering in Karst: Some Practical Examples." (2020)
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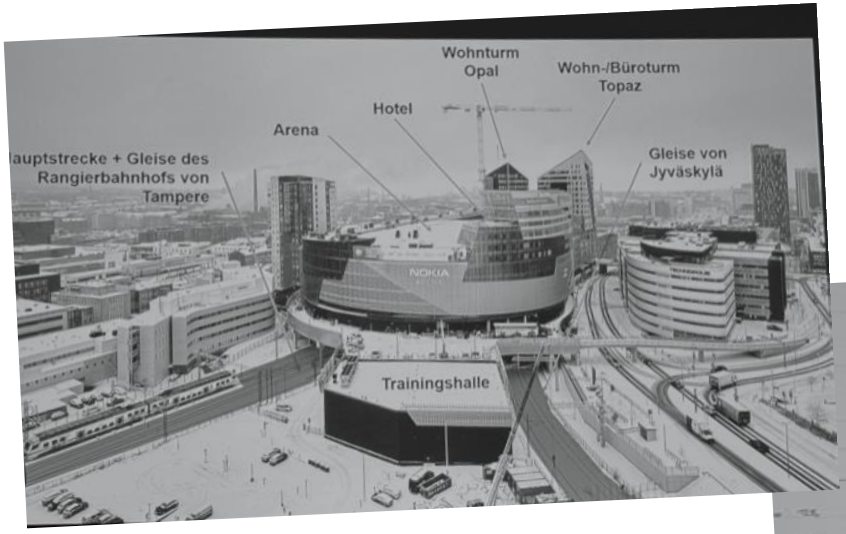
Wohnturm Nürnberg

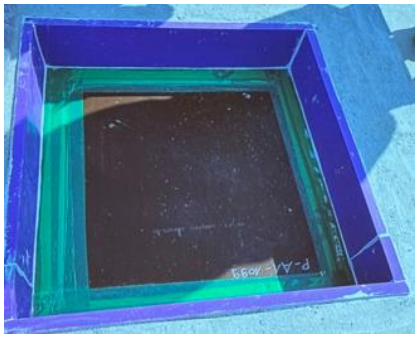
Arena Tampere, Finnland

Anforderungen

- Abstimmfrequenz Arena: < 15 Hz
- Abstimmfrequenz Tower. < 12 Hz

- Max. Verlustfaktor 0,1
- Funktionalität auch bei -30 C





Randbedingung, FE-Modell PXW

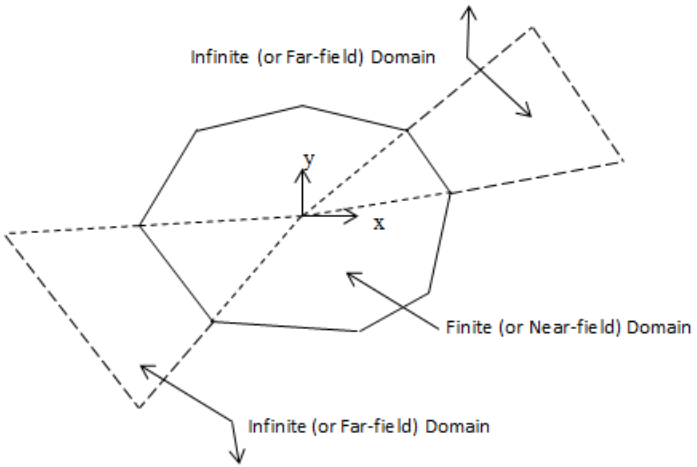
The **EINFIN** command generates structural infinite elements (INFIN257) directly from the selected face of valid base elements.

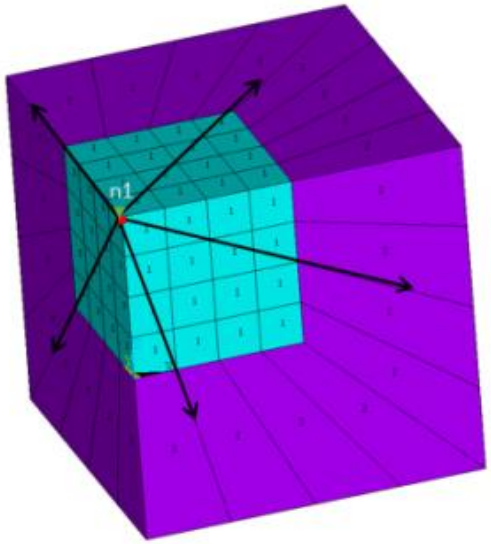
INFIN257 Element Description

Use INFIN257 with standard 2-D or 3-D solid elements (the *base elements*) to model infinite domain in a static analysis.

A single layer of elements represents an exterior subdomain of infinite domain; the layer models the effect of far-field decay in structural analyses. Use base elements to model the near-field domain that interacts with the solid structures or applied loads.

Figure 257.1: Near-field vs. Far-field



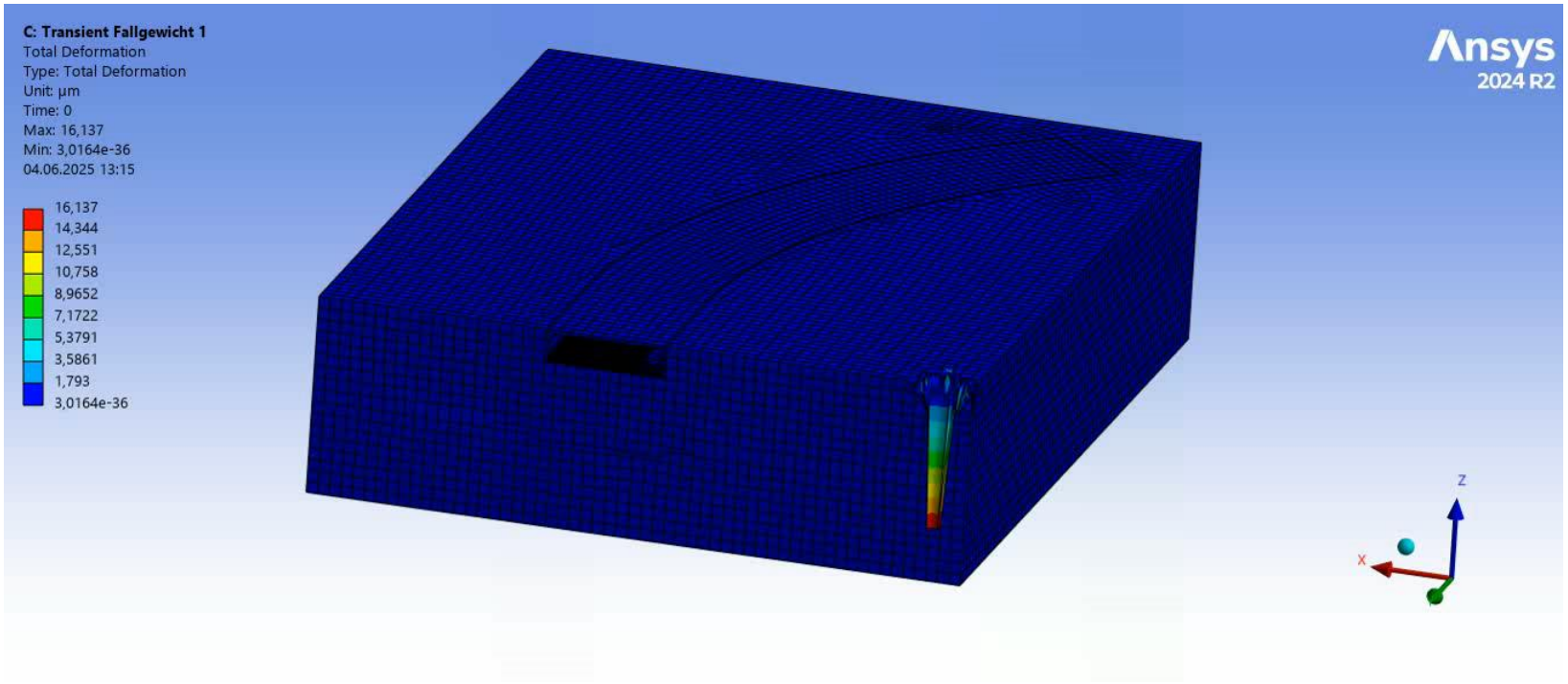


APDL -Command

```
 9   /PREP7
10
11   CMSEL,S,N1
12   *GET,N_1,NODE,,NUM,MIN
13   CMSEL,S,Lagerbedingungen,NODE
14
15
16   EINFIN,,N_1
17
18
19   ! Alles wieder aktivieren
20   ALLSEL
21   /SOLU
```

FE-Modell PXW, Lösung

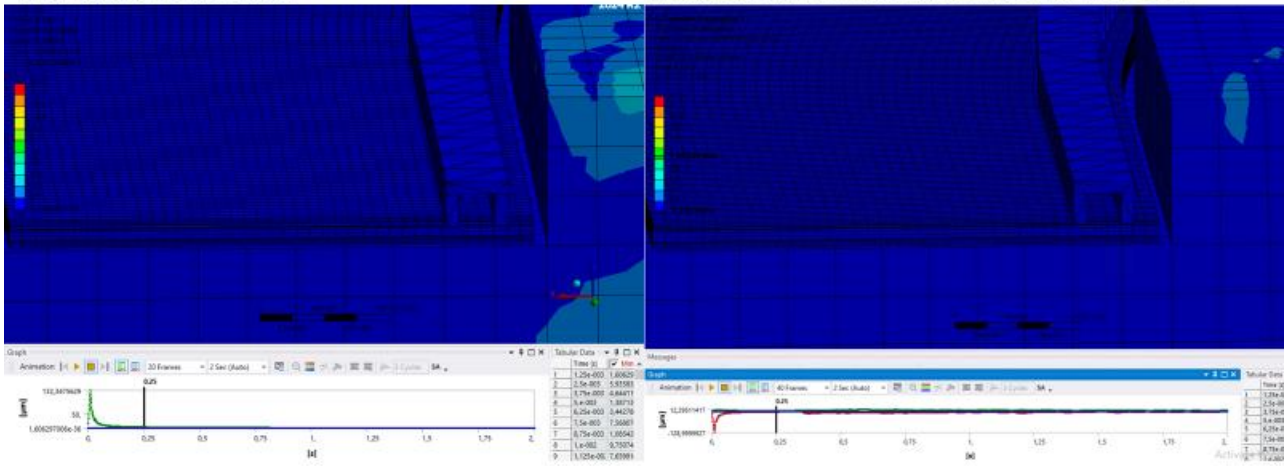
Raileigh-Welle



Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht

PXW mit 75 mm Elastomerschicht (Weforma WS PU-10)



Zeitverlauf zwischen 0,25 s und 0,5 s
Verformungen in µm, logarithmische Skala
Schnitt in der Mitte des Modells, PXW_Wände und Decke ausgeblendet

Bodenaufbau: Schottertragschicht 300 mm, Massebeton 1000 mm, ggf. Elastomer 75 mm, Fußboden 450 mm
dynamischer E-Modul Boden (inkl. Schotter): E = 408,26 Mpa ; Wichte 18 kN/m
Beton: E = 31.800 Mpa ; Wichte 25 kN/m
Elastomer: E = 0,144 Mpa ; Wichte 0,45 kN/m

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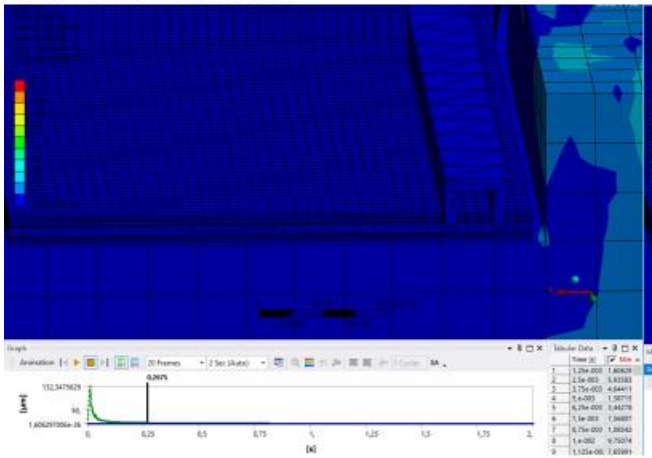

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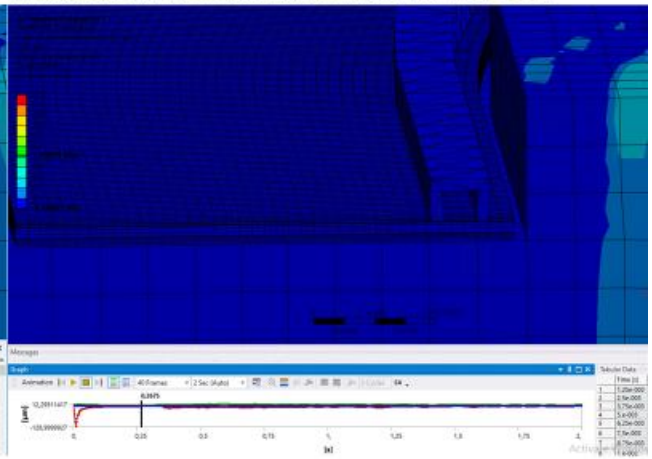

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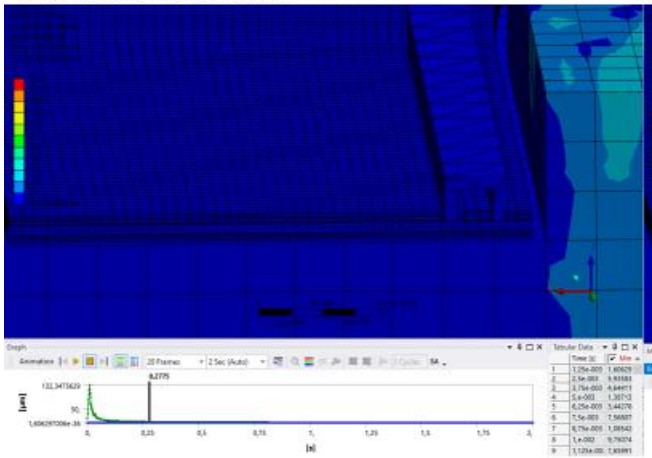

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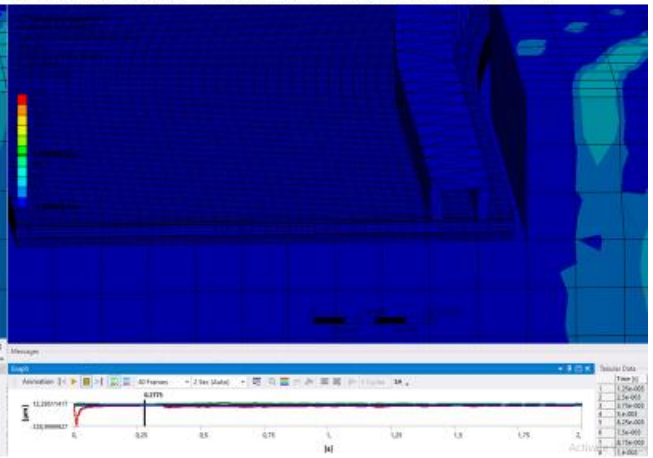

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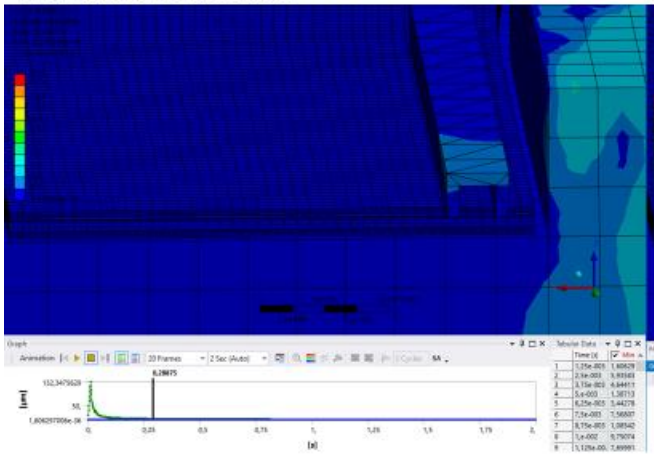

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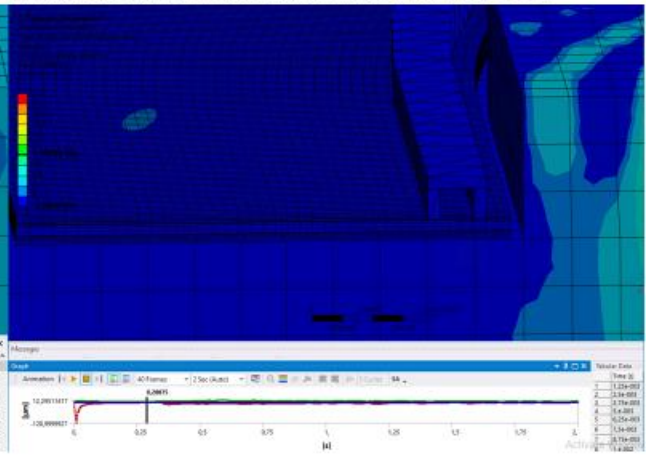

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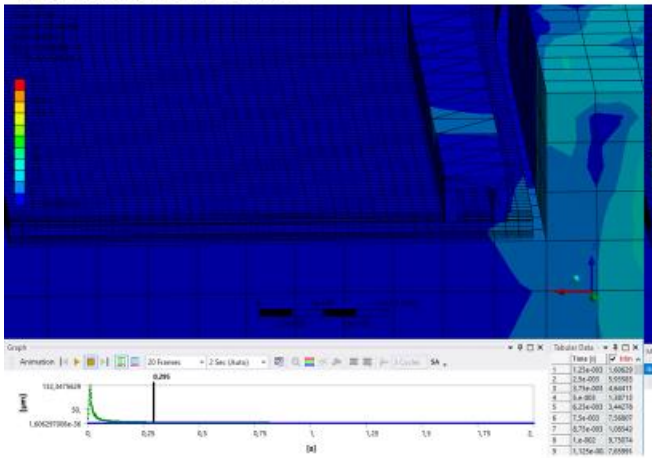

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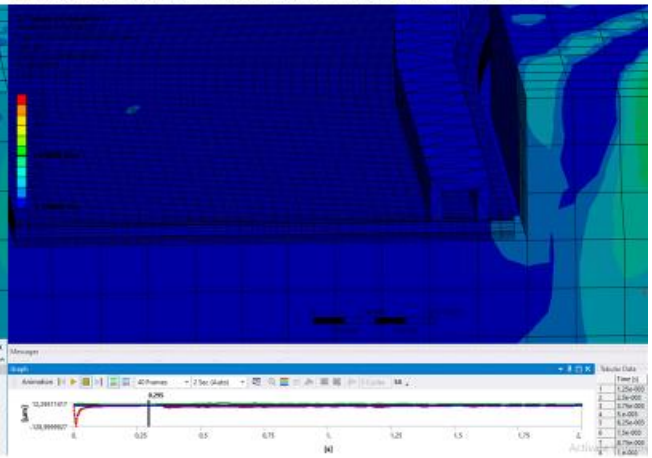

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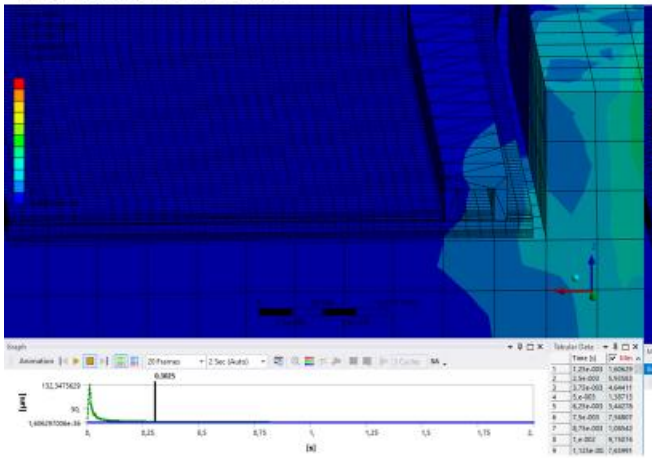

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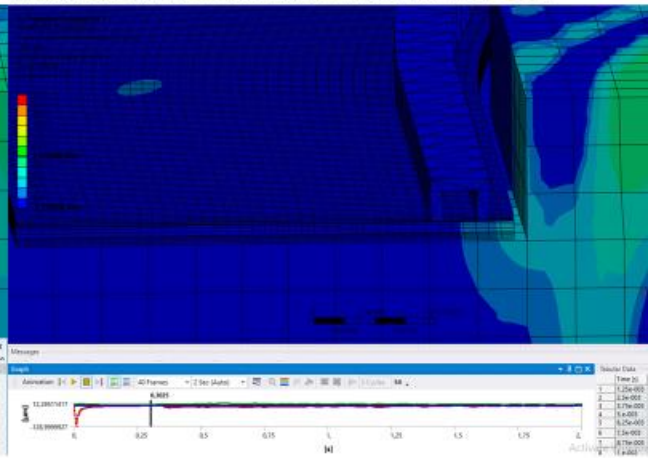

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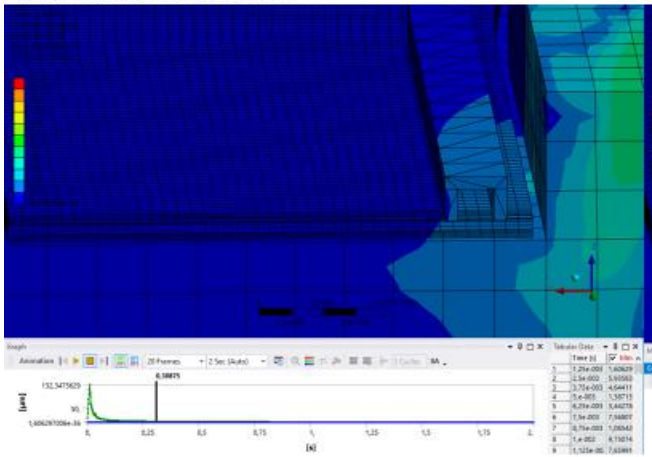

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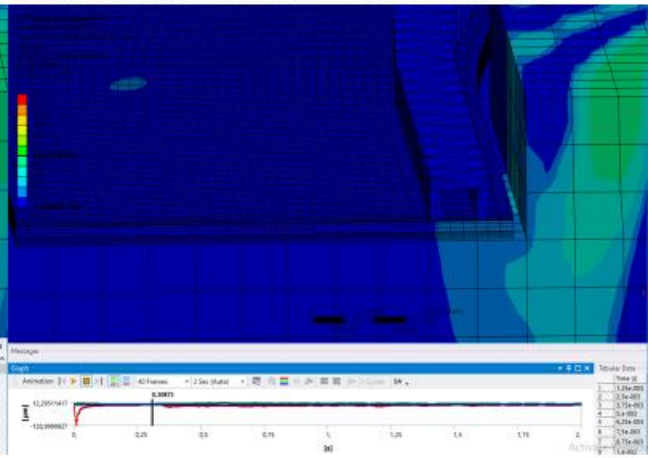

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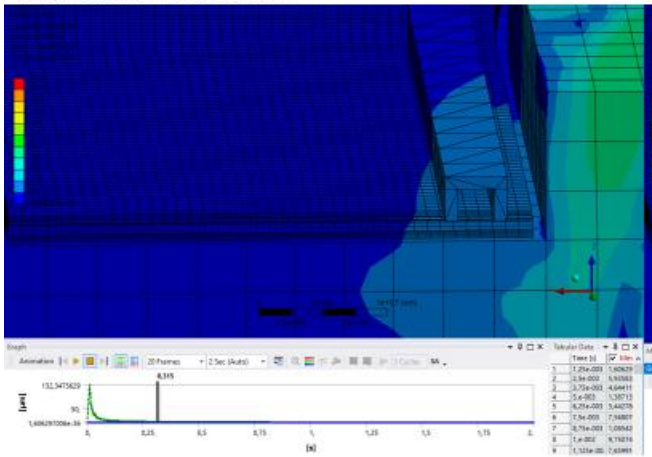

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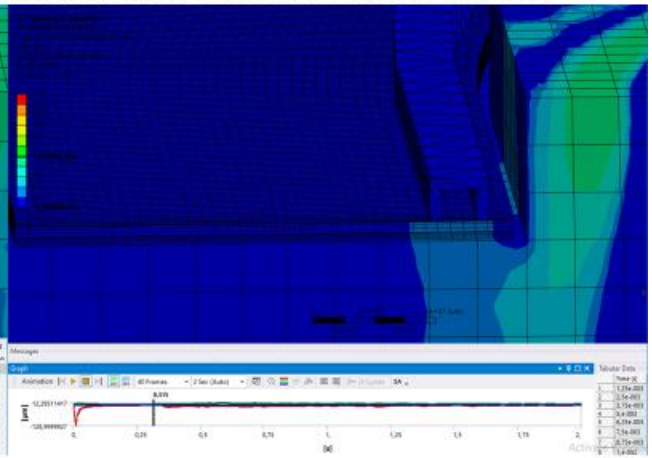

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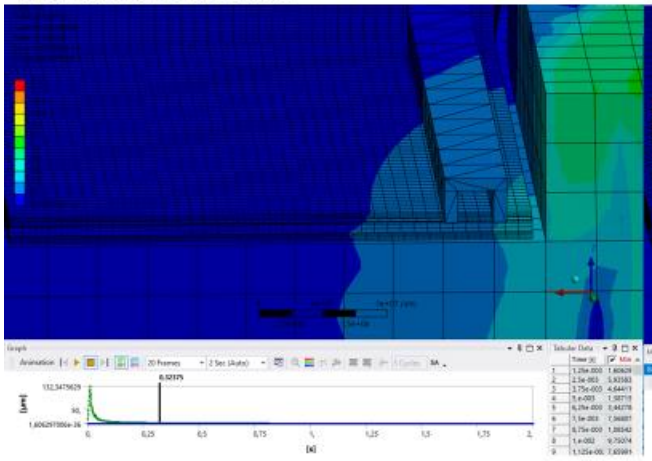

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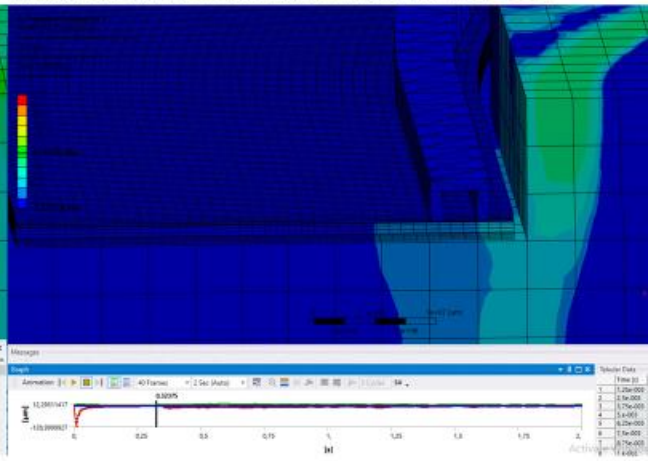

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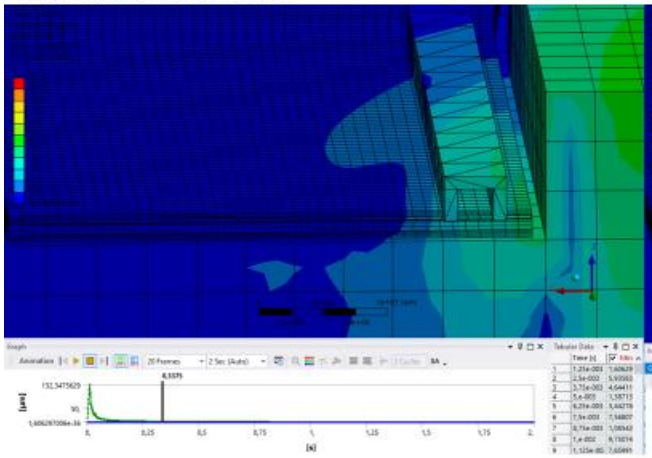

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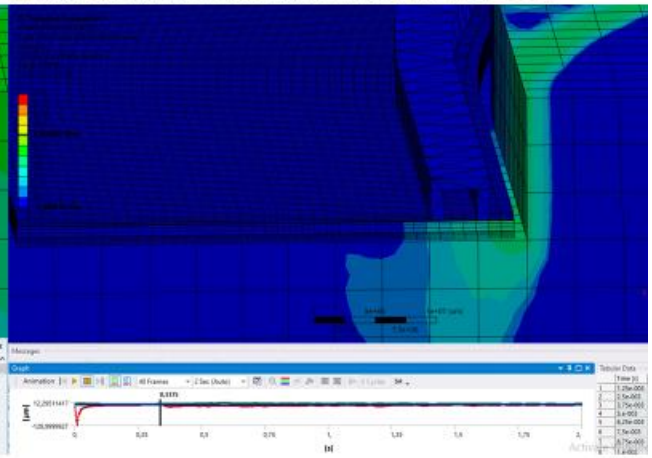
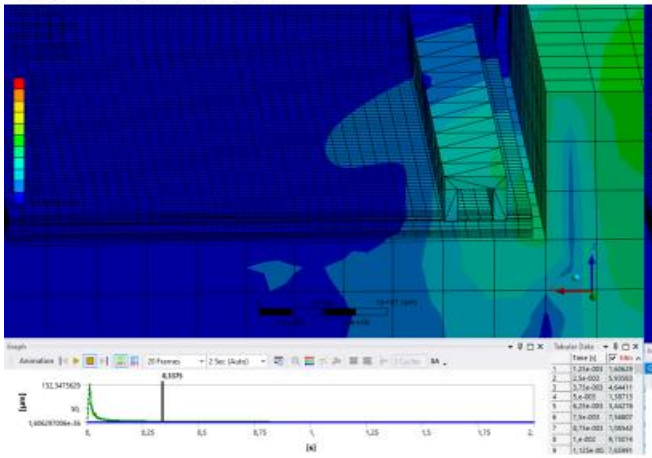


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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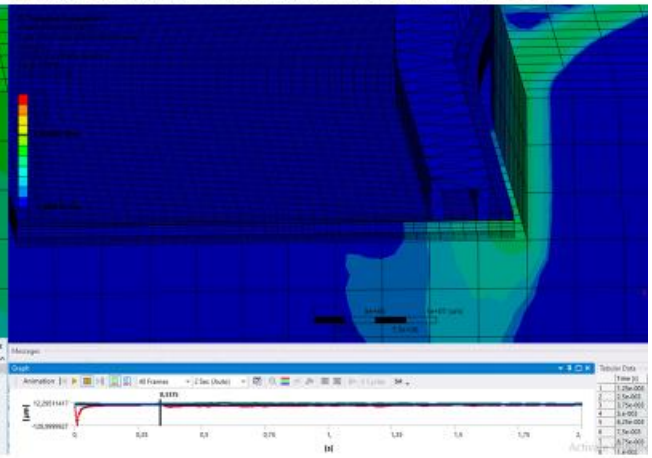

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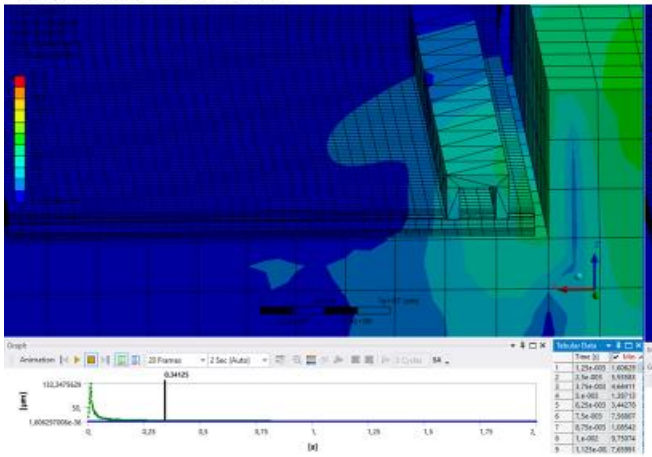

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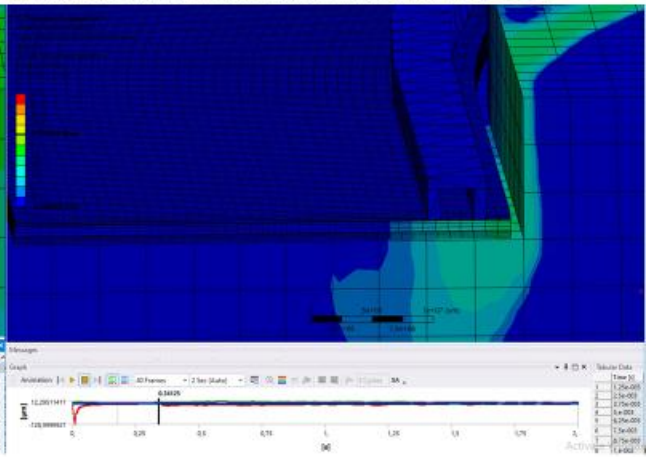

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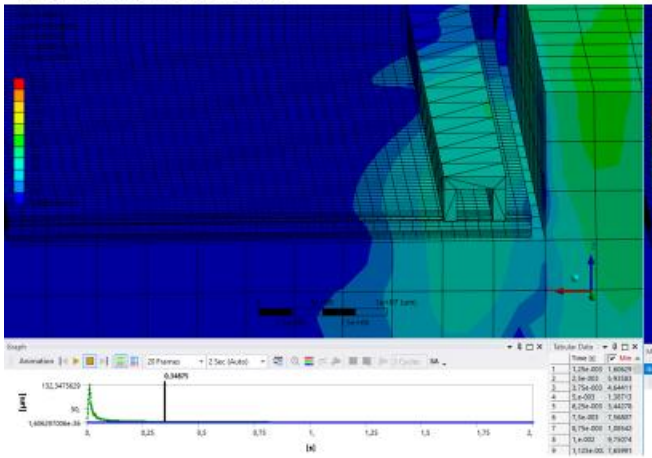

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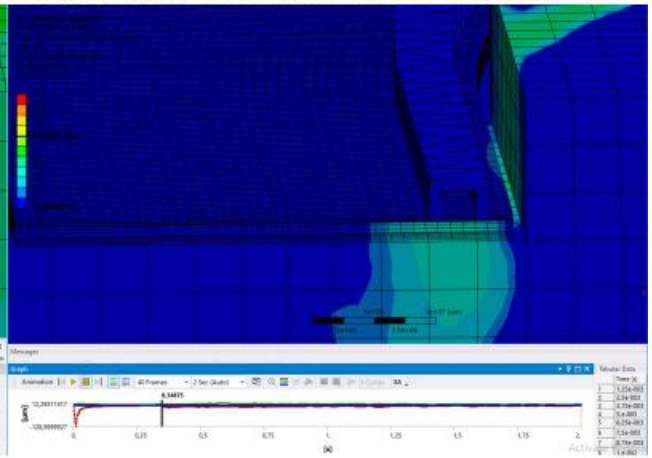

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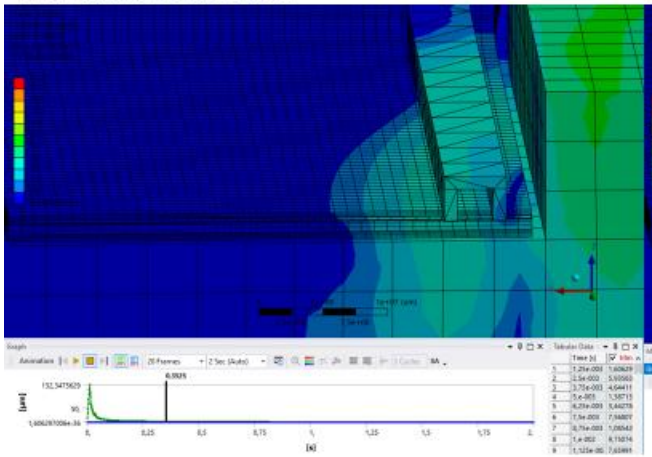

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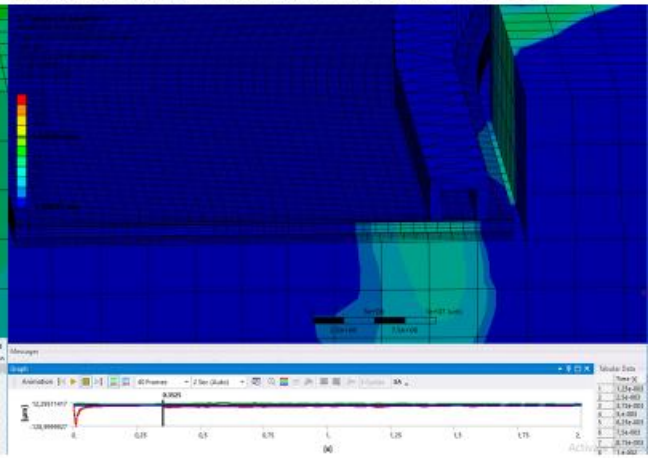
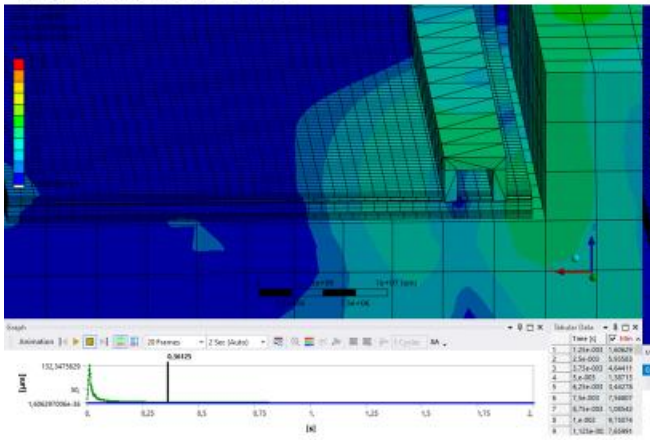
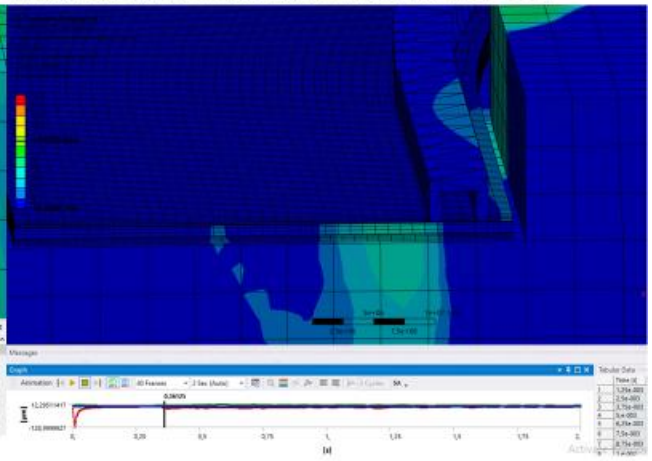


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht

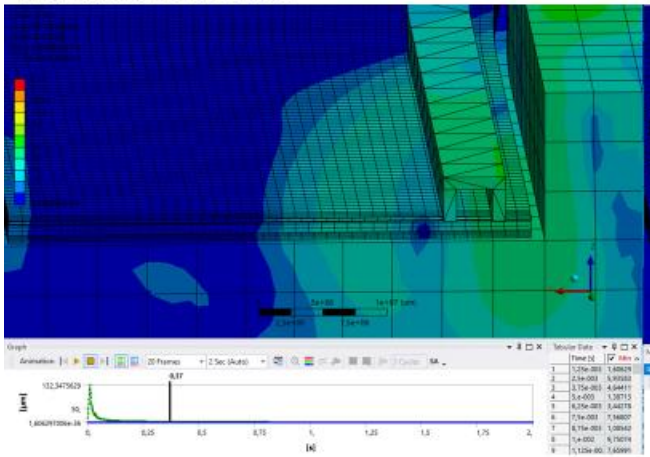


PXW mit 75 mm Elastomerschicht (Weforma WS PU-10)



Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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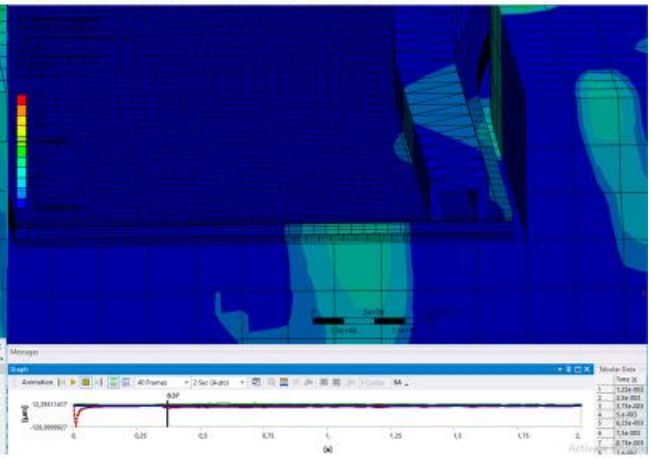

Vergleich Varianten Bodenaufbau PXW

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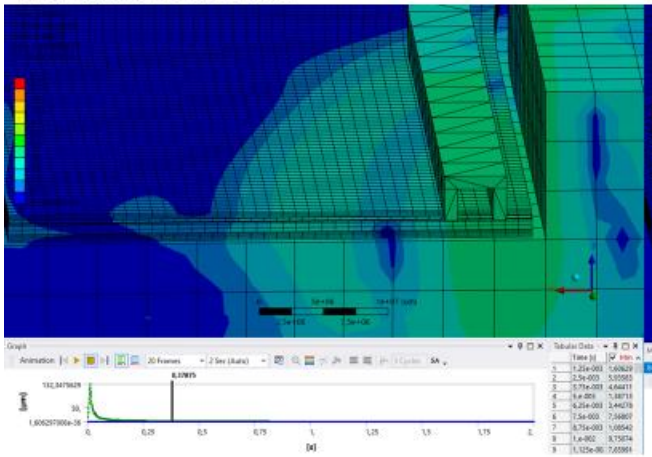

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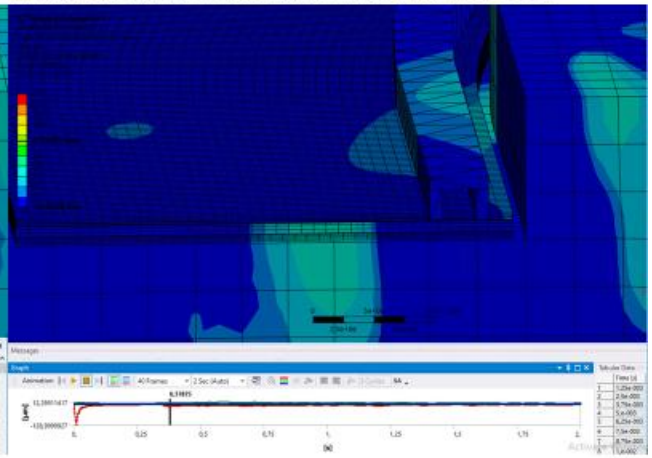
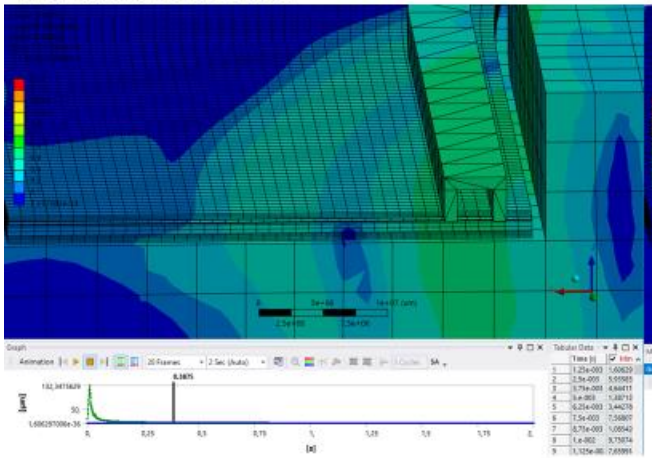
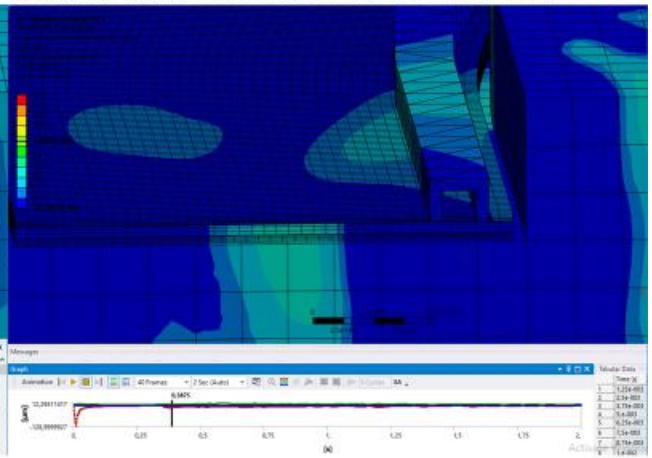


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



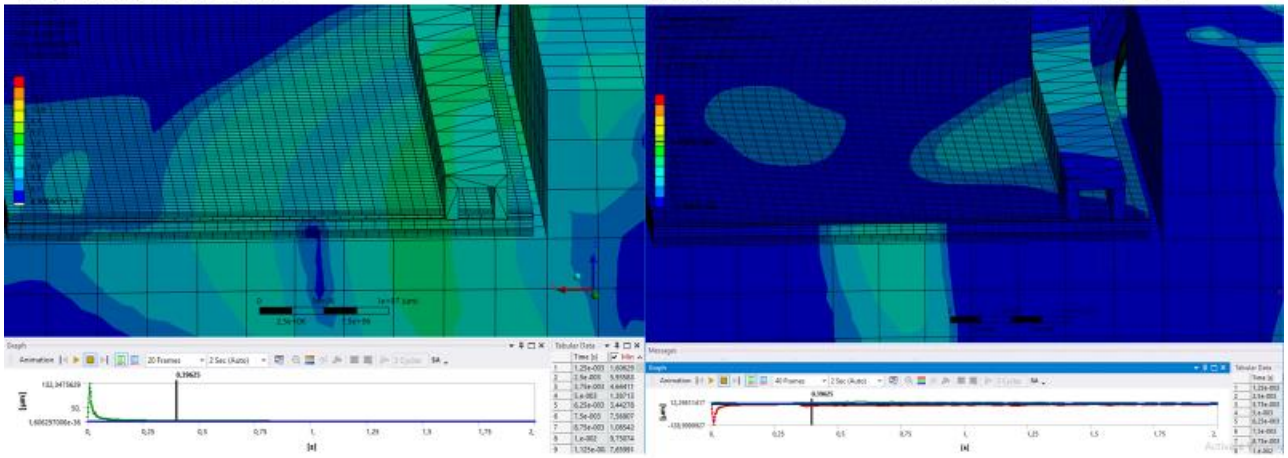
PXW mit 75 mm Elastomerschicht (Weforma WS PU-10)



Vergleich Varianten Bodenaufbau PXW

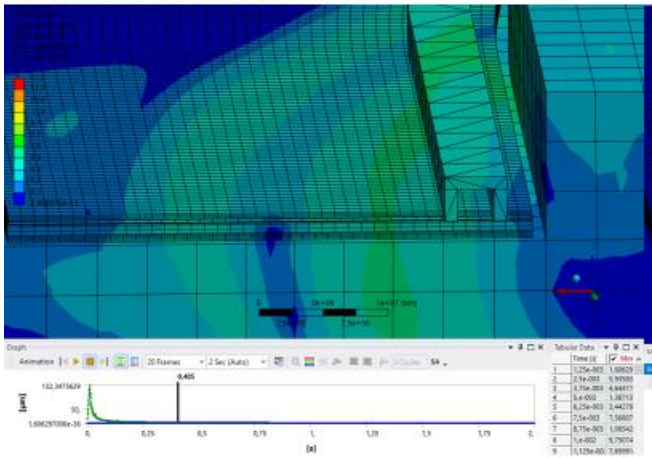
PXW ohne Elastomerschicht

PXW mit 75 mm Elastomerschicht (Weforma WS PU-10)



Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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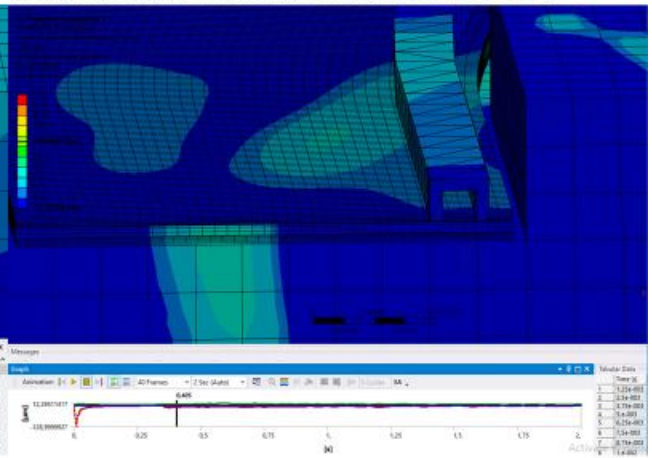

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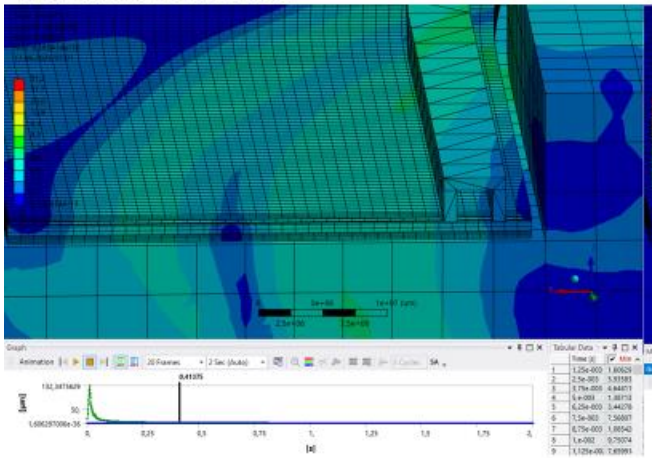
PXW ohne Elastomerschicht



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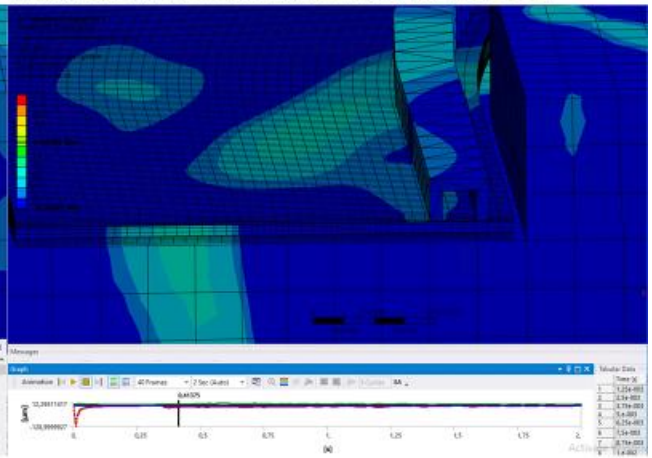

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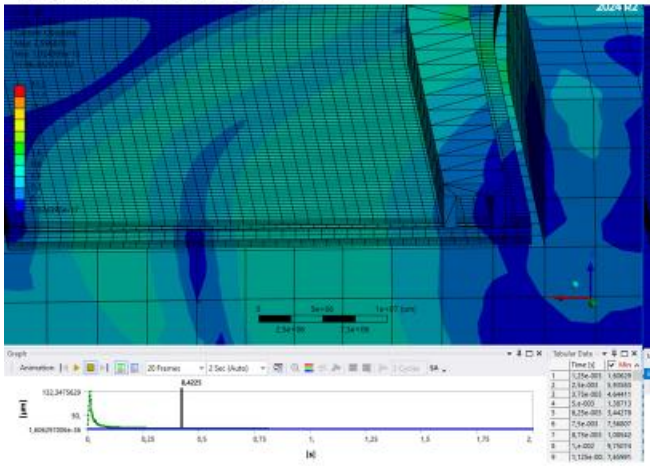

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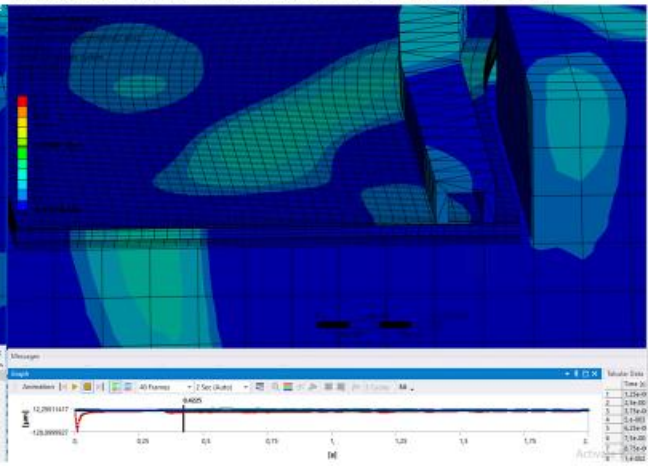
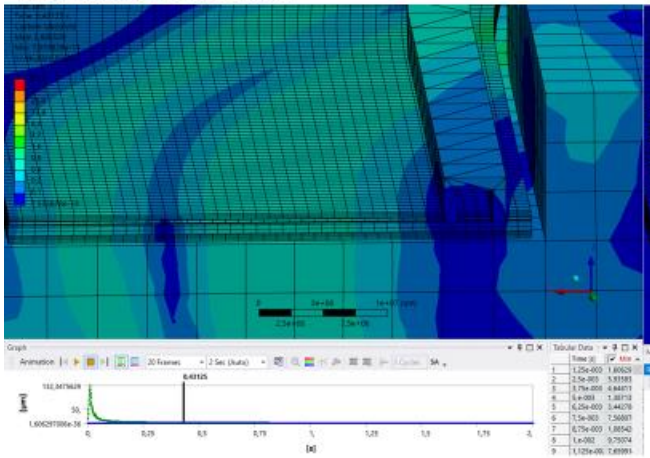


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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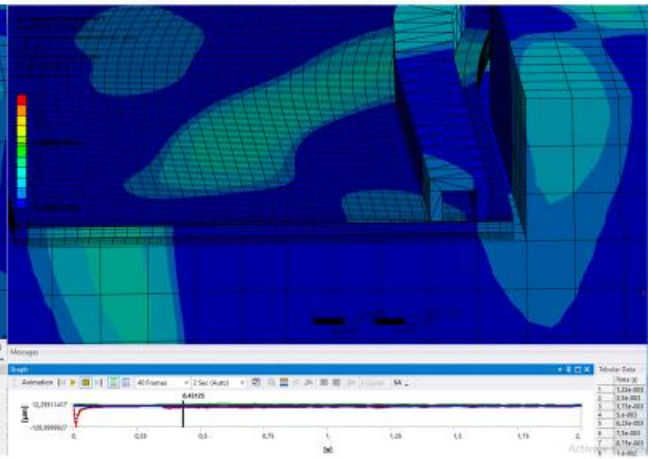
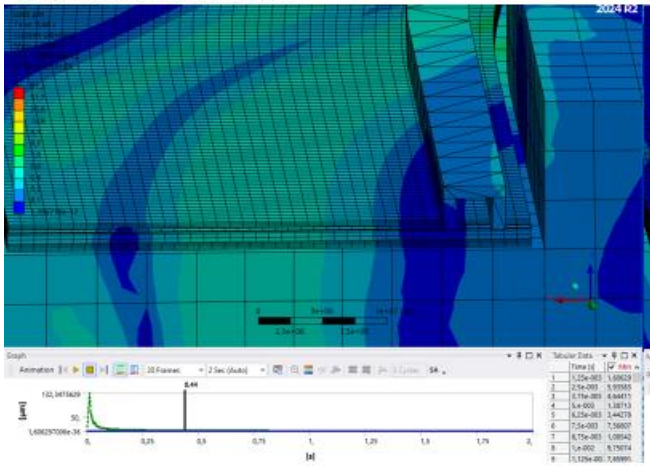


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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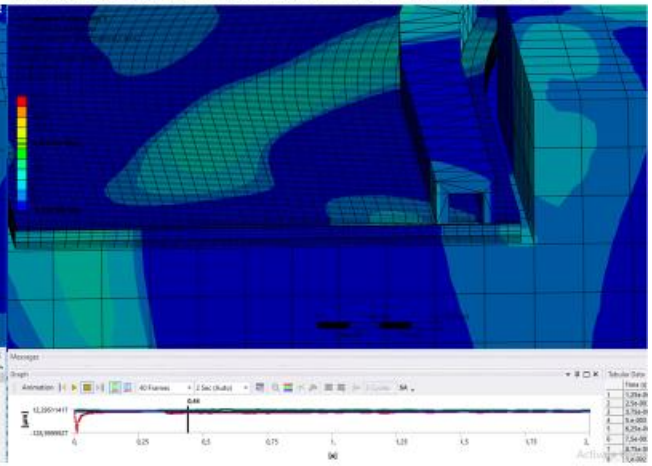
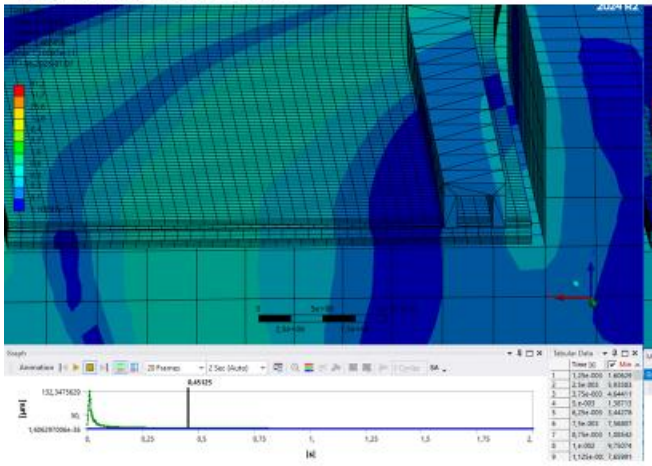


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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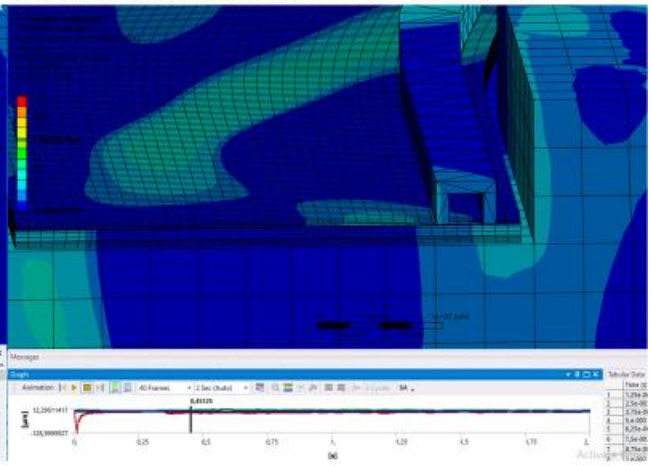
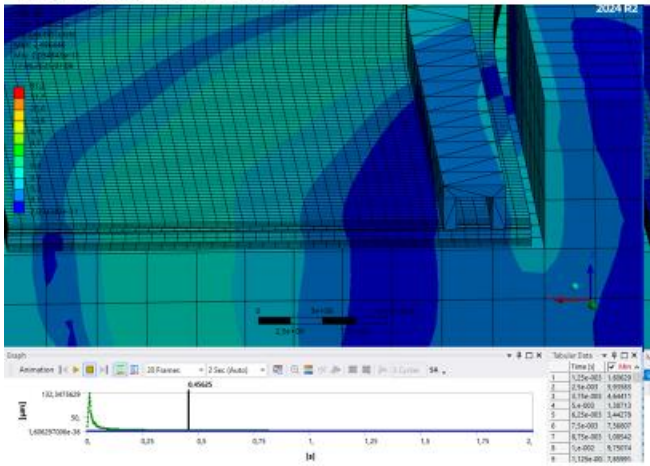


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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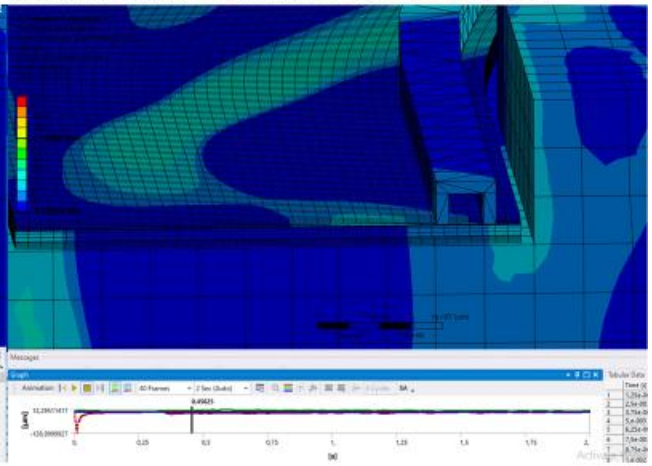

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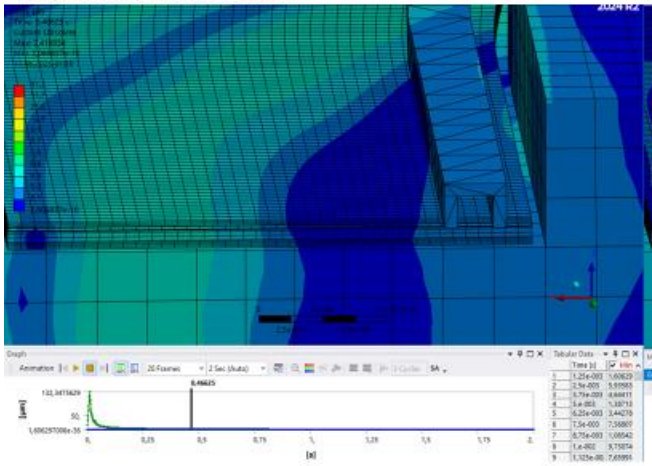
PXW ohne Elastomerschicht



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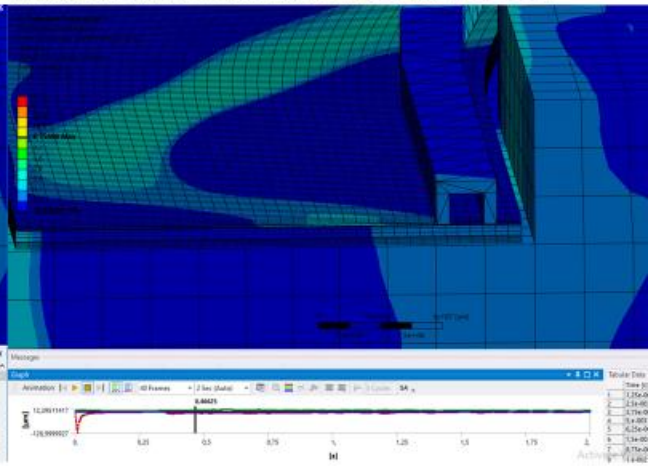
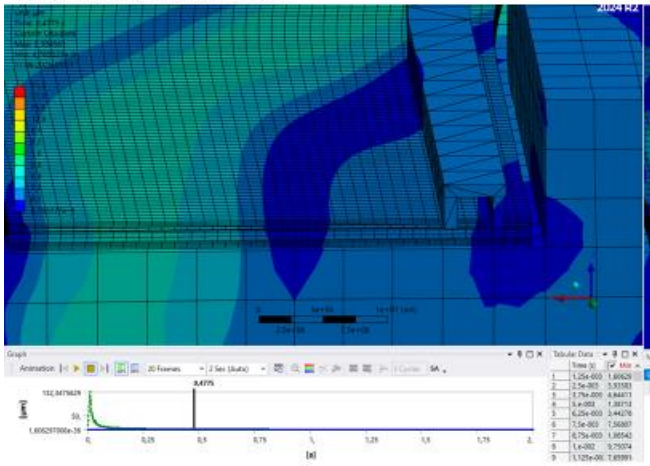


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht



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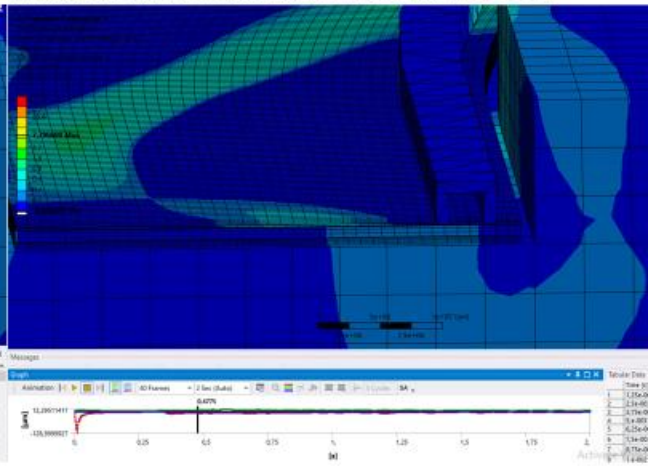

Vergleich Varianten Bodenaufbau PXW

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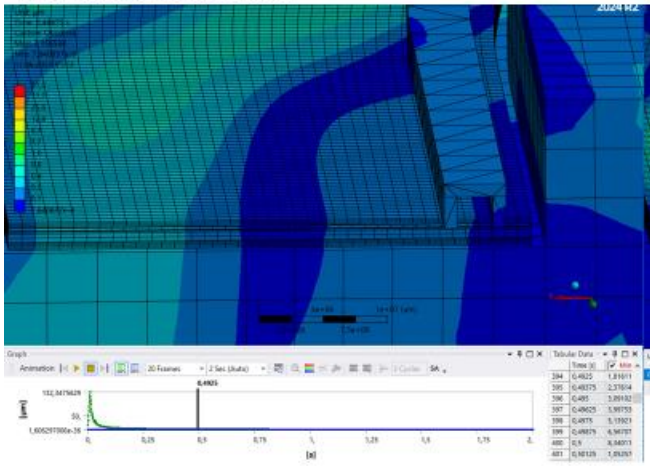

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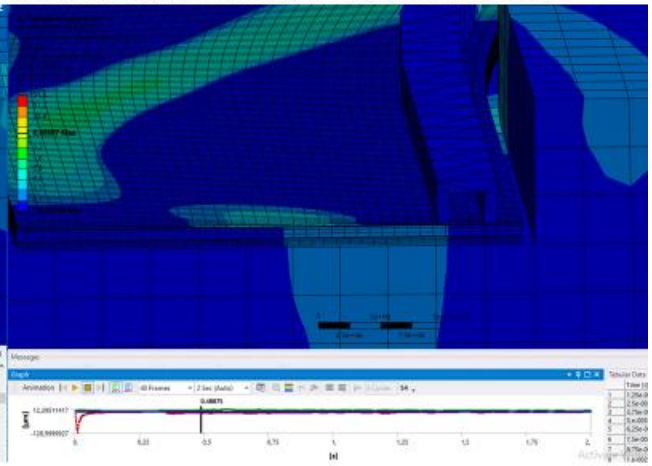
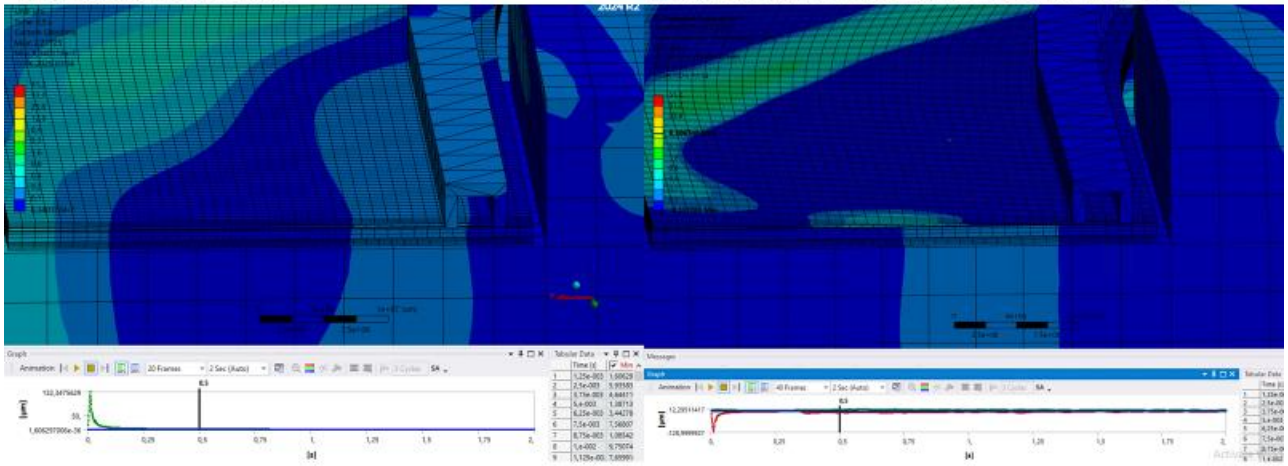


Vergleich Varianten Bodenaufbau PXW

PXW ohne Elastomerschicht

PXW mit 75 mm Elastomerschicht (Weforma WS PU-10)



Kontakt

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