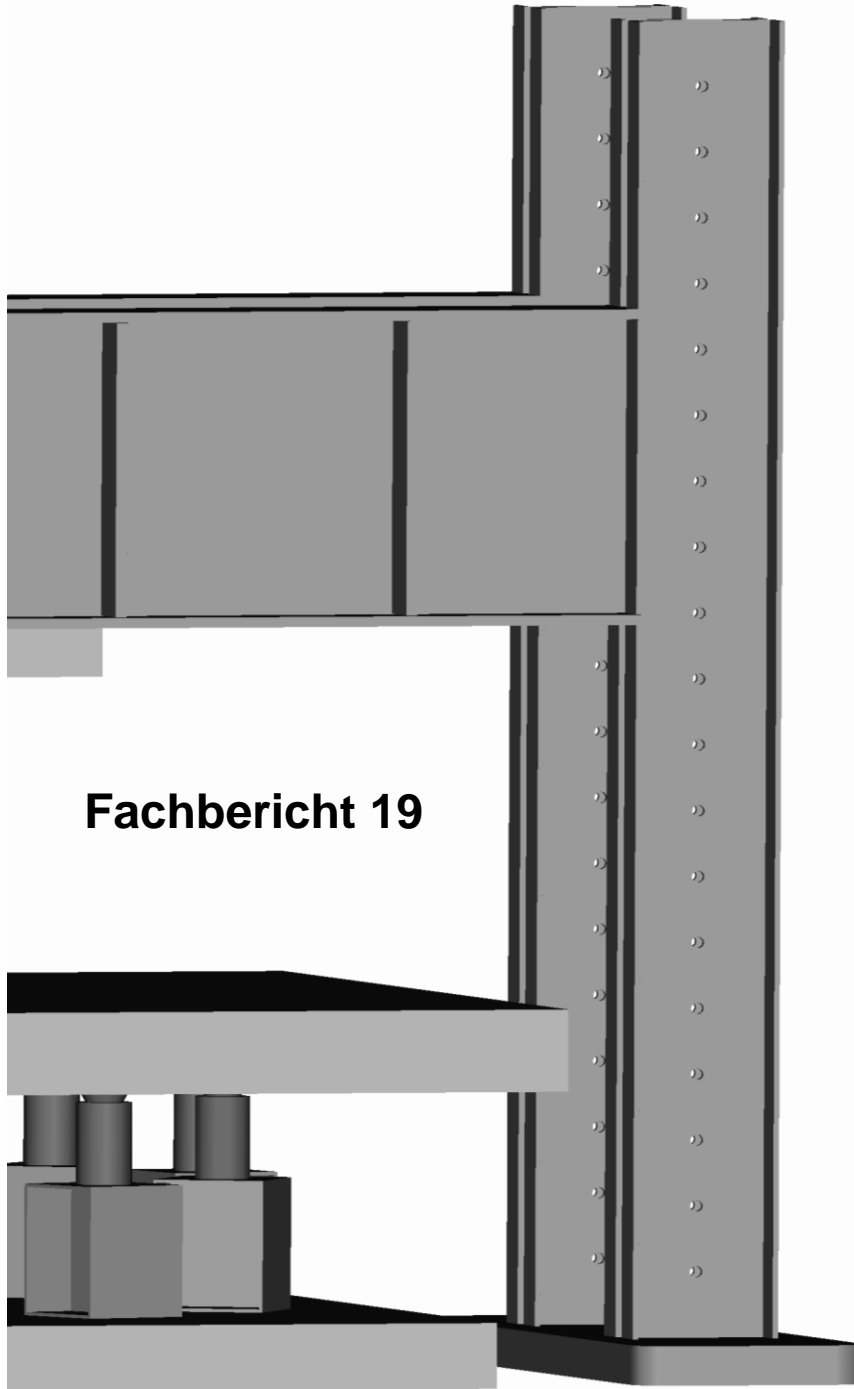




THM

TECHNISCHE HOCHSCHULE MITTELHESSEN



Fachbericht 19

Tragfähigkeit von Installationsdecken mit L- Blechen als Querkraftbewehrung

Untersuchungs-Parameter:

Tragfähigkeitssteigerung von
Installationsdecken infolge von L-
Blechen als Querkraftbewehrung

Einfluss der Anordnung und der
Anzahl der L-Bleche auf die
Tragfähigkeit

Einfluss der Lage der Öffnung auf
die Tragfähigkeit

Falko Koch (B.eng.)

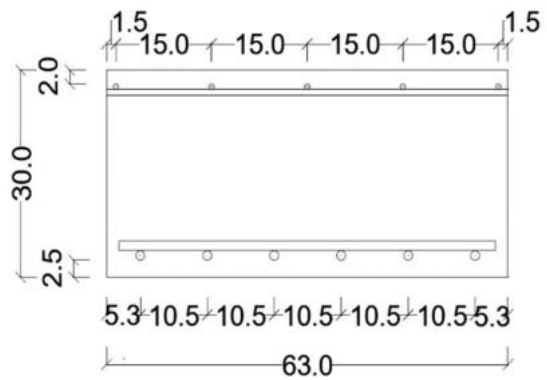
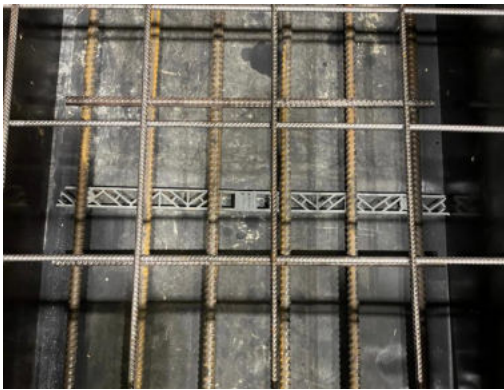
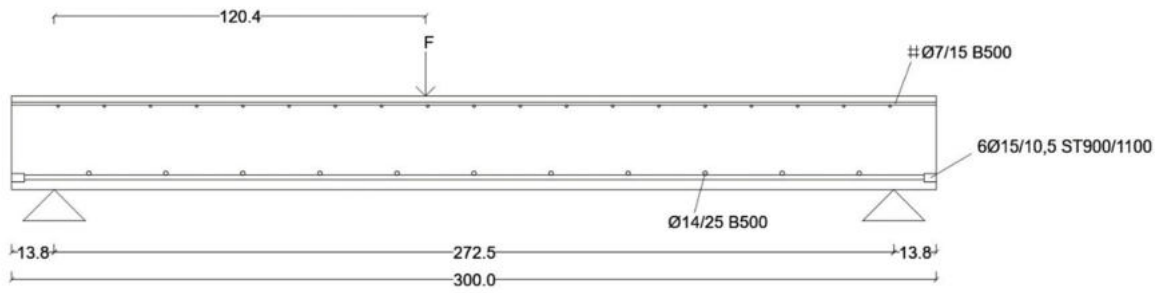
Zusammstellung und Vergleich der experimentellen Untersuchungen

Körper	Bleche: Last zuge- wandte Seite	Bleche: Last abge- wandte Seite	Bügel- Anzahl Ø6 mm je L- Blech	Abstand UK _{Beton} - UK _{L-Blech}	Abstand OK _{Beton} - OK _{Rohr}	$f_{cm,cube}$	$f_{ck} =$ $f_{cm,cube} *$ 0,83 - 4	$V_{Rk,c} *$ 1,15 (5% Fraktile)	Bruch- last V_{test}	Quer- kraft im Bruch- zustand V_{Ek}	$V_{Ek} /$ $V_{Rk,c}$	Anmerkungen
	[-]	[-]	[-]	[cm]	[cm]	[N/mm ²]	[N/mm ²]	[kN]	[kN]	[kN]	[-]	[-]
A0-1	-	-	-	-	-	32,7	23,1	133	290	162	1,22	keine Öffnung
A0W-1	-	-	-	-	-	36,2	26,0	138	311	174	1,26	keine Öffnung
AR-1	-	-	-	-	8,3	32,7	23,1	133	146	81	0,61	keine Bleche
ARW-1	-	-	-	-	8,3	38,4	27,9	141	167	93	0,66	keine Bleche
ARW-3	2	-	2	2,00	8,3	38,4	27,9	141	285	159	1,13	-
ARW-4	3	-	2	2,00	8,3	38,4	27,9	141	311	174	1,23	-
ARW-5	2	2	2	2,00	8,3	38,4	27,9	141	329	184	1,30	-
AR-6	3	3	2	2,00	8,2	32,7	23,1	133	312	174	1,31	-
ARW-6	3	3	2	2,00	8,3	40,6	29,7	144	350	195	1,36	-
ARW-7	2	2	2	4,90	8,3	41,1	30,1	145	270	151	1,04	Linien- elemente liegen auf der Biegebewehrung
ARW-8	3	3	2	4,90	8,3	41,1	30,1	145	310	173	1,20	
AR-3	2	-	2	2,00	5,5	32,7	23,1	133	191	107	0,80	Schwerachse der Öffnung liegt oberhalb der Mittellinie des Betonquerschnitts
AR-5	2	2	2	2,00	5	32,7	23,1	133	250	140	1,05	
AR-7	2	2	2	4,90	4,5	32,7	23,1	133	210	117	0,88	
AR-4	3	-	2	2,00	3,5	32,7	23,1	133	214	119	0,90	
AR-2	2	-	1	2,00	3,3	32,7	23,1	133	150	84	0,63	

$V_{Rk,c} = 0,15 k (100 \rho_l * f_{ck})^{1/3} (b * d)$ mit: statische Höhe $d = 26,8$ cm, Breite $b = 63$ cm, Bewehrung $\rho_l = 0,0063$, Beiwert $k = 1,864$

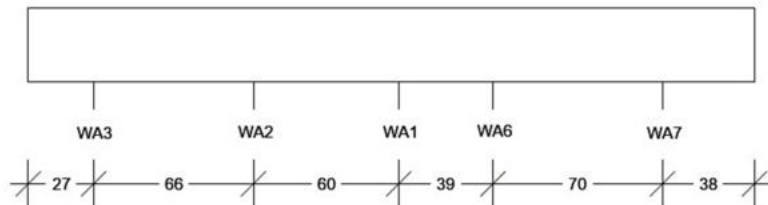
Datenblatt Prüfkörper AO-1

Referenzkörper - keine Öffnung - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 290,4 \text{ kN}$

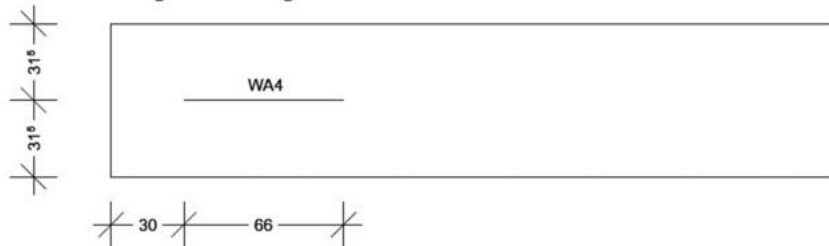


Anordnung der Wegaufnehmer

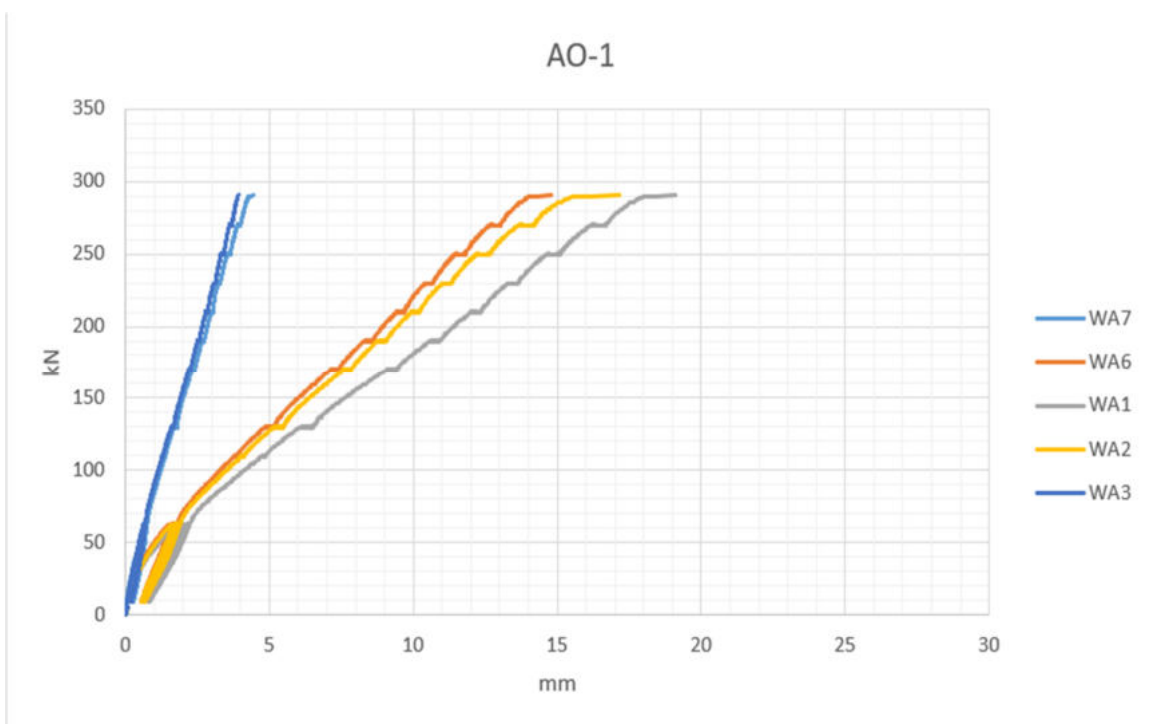
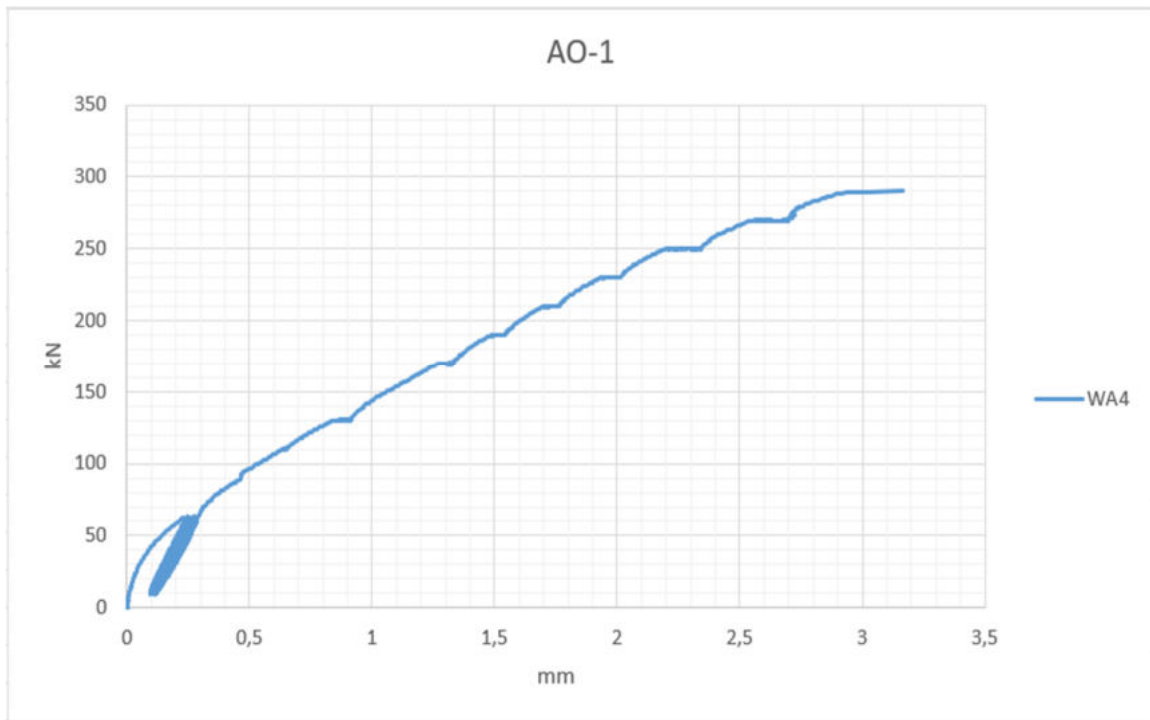
Durchbiegungsmessung unten

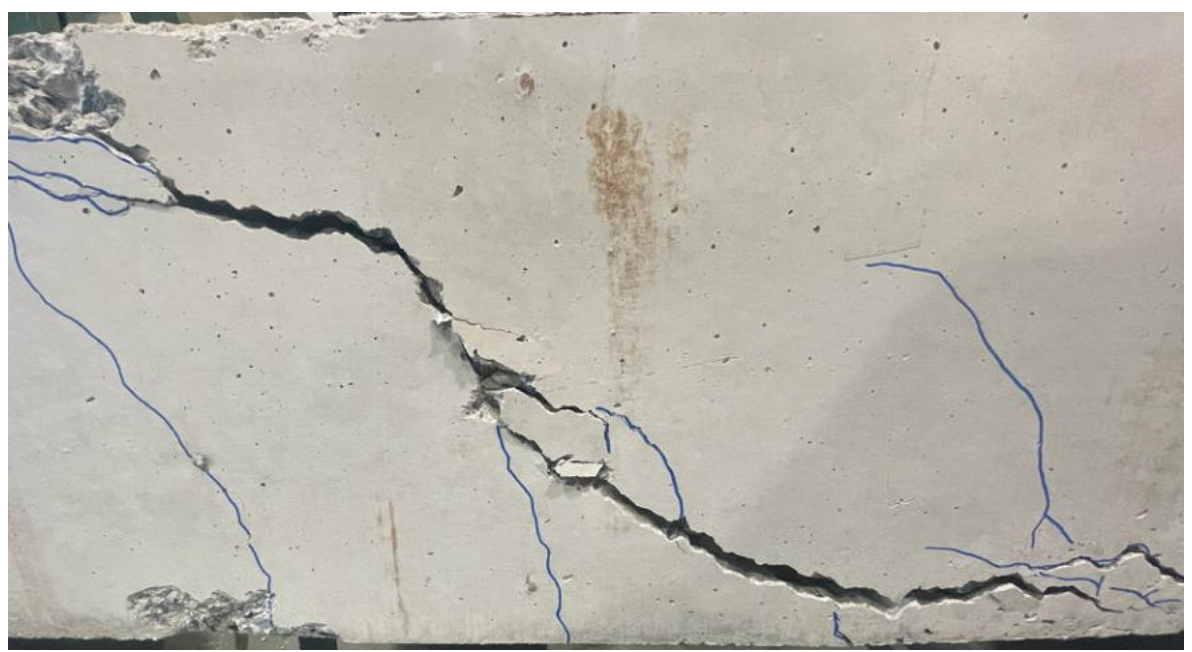


Längenmessung unten



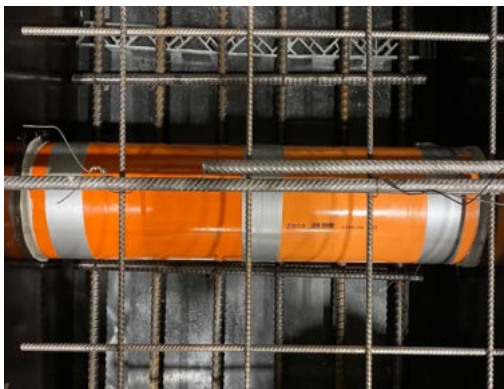
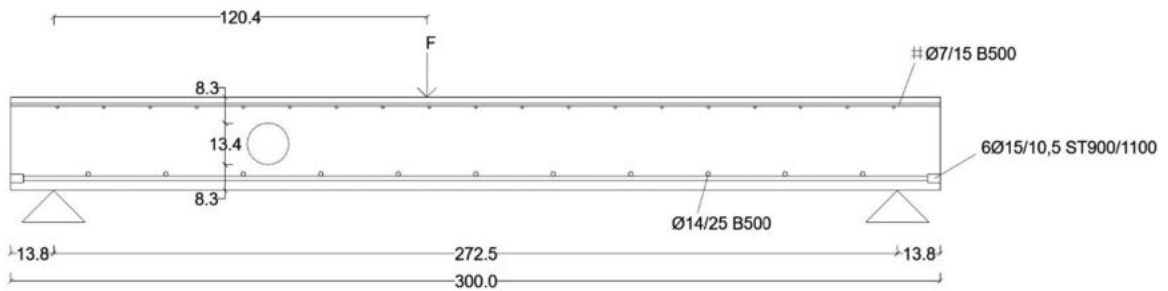
Last-Verformungs-Kurven



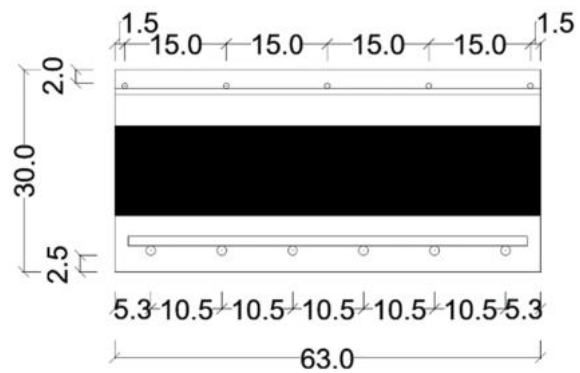


Datenblatt Prüfkörper AR-1

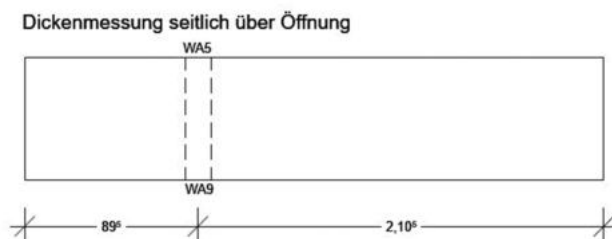
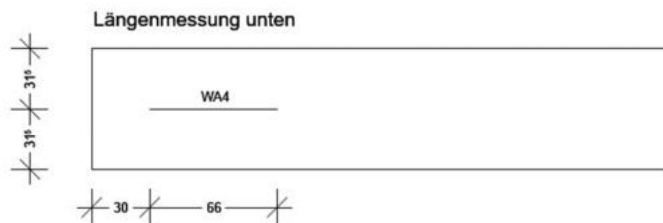
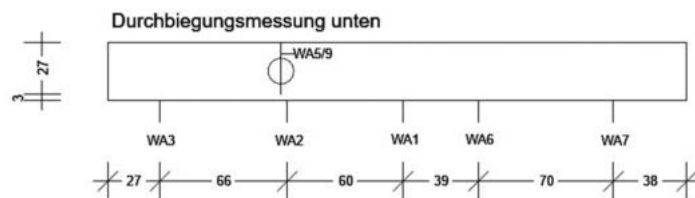
Referenzkörper - keine Bleche - Öffnung rund - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 146,0 \text{ kN}$



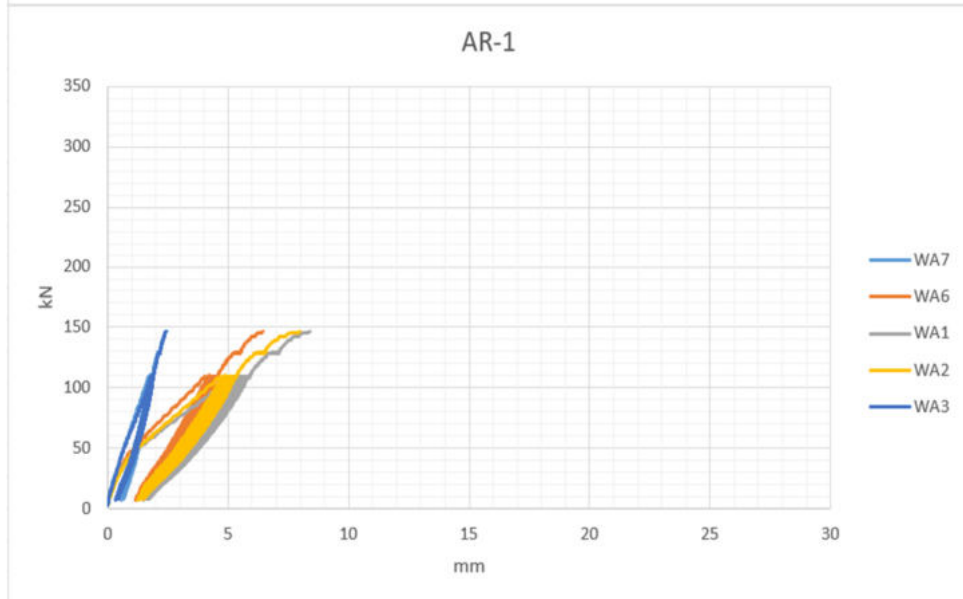
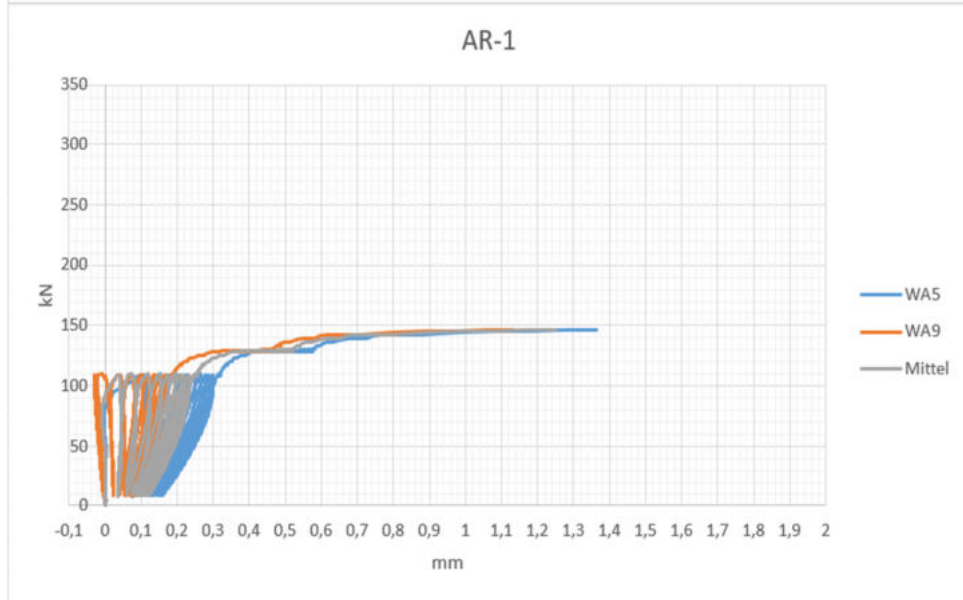
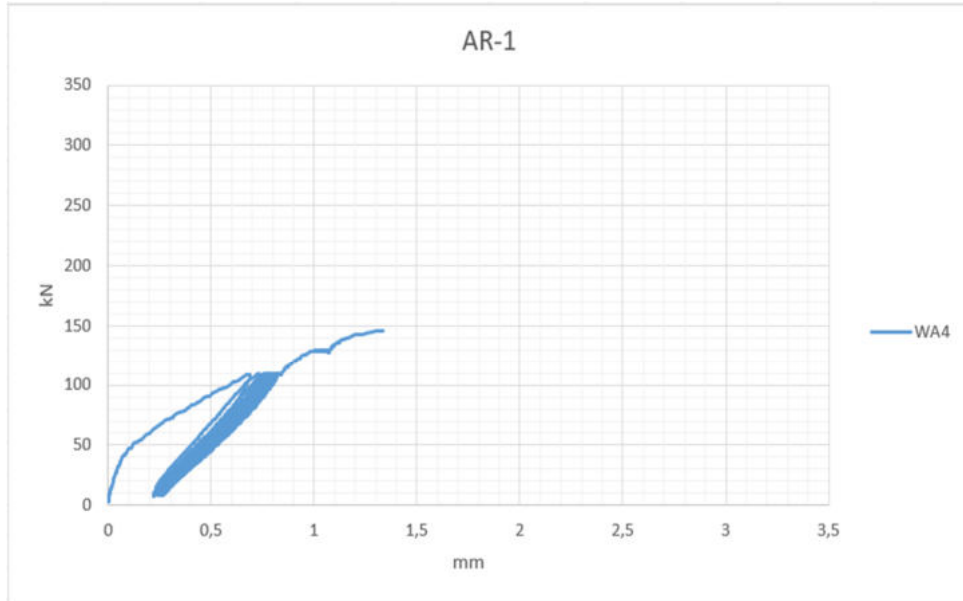
Fixierung der oberen Bewehrung mit Ø12 auf der Schalung.
Entfernung nach dem Betonieren.



Anordnung der Wegaufnehmer



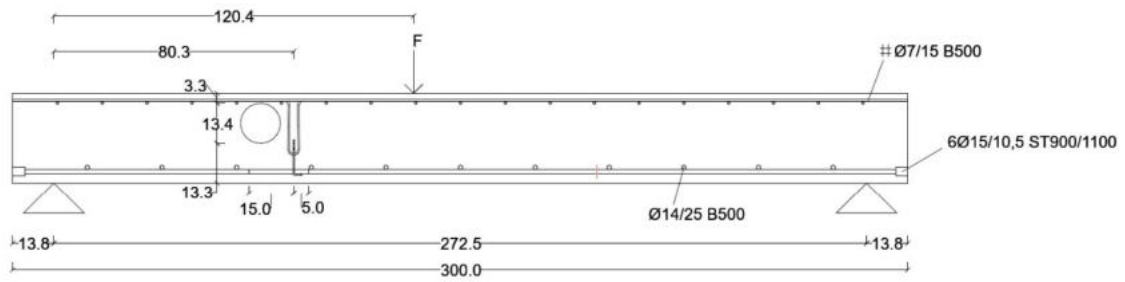
Last-Verformungs-Kurven



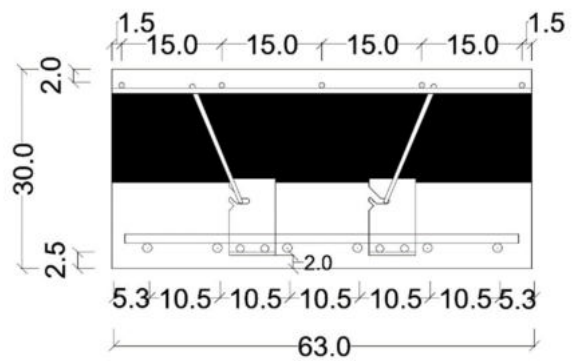


Datenblatt Prüfkörper AR-2

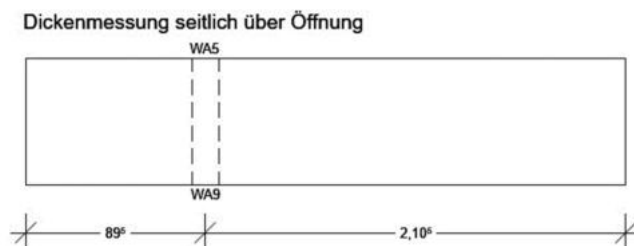
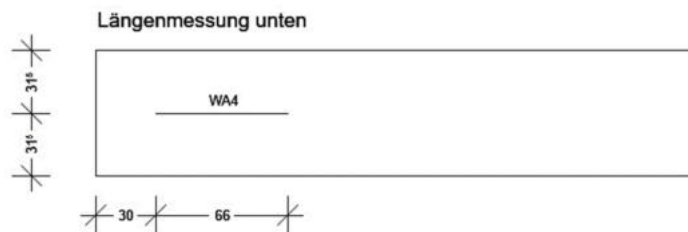
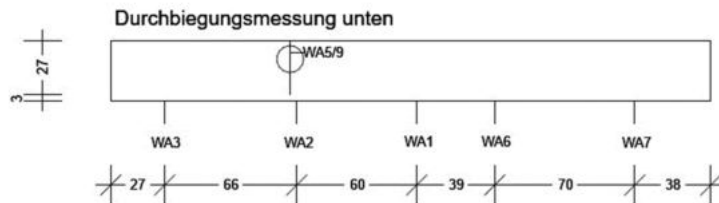
1Ø6 Bügel - 2 Bleche - Öffnung rund - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 150,1 \text{ kN}$



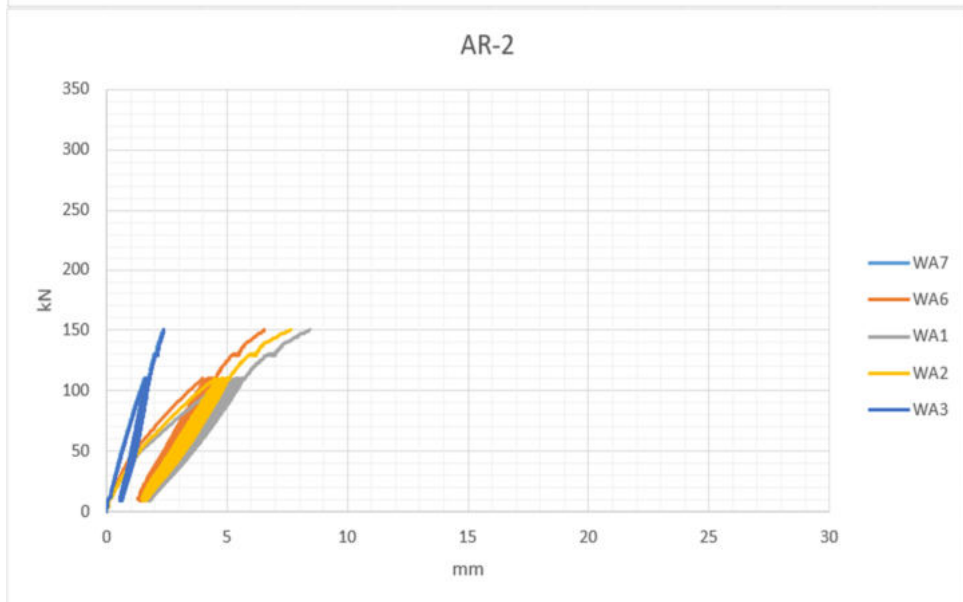
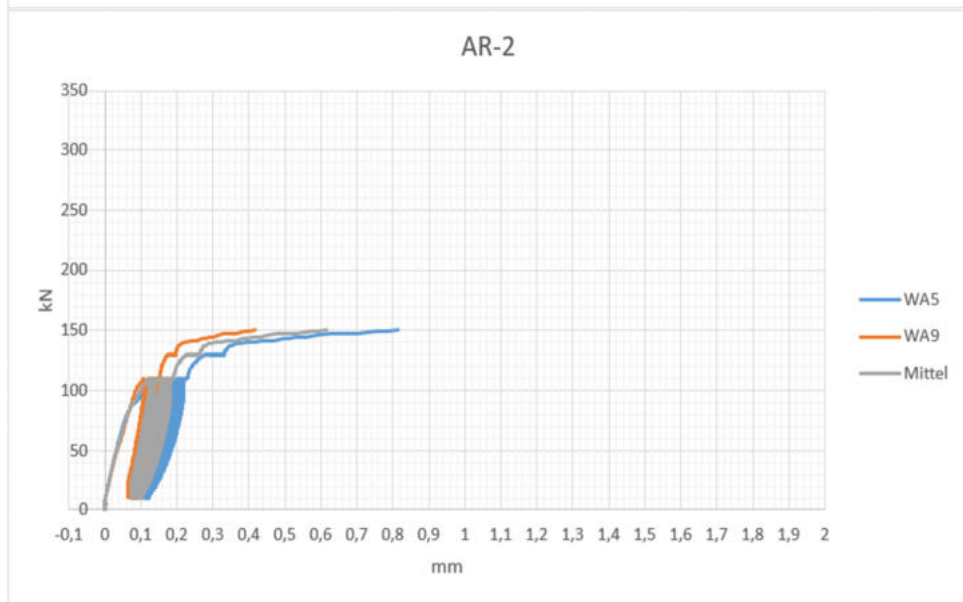
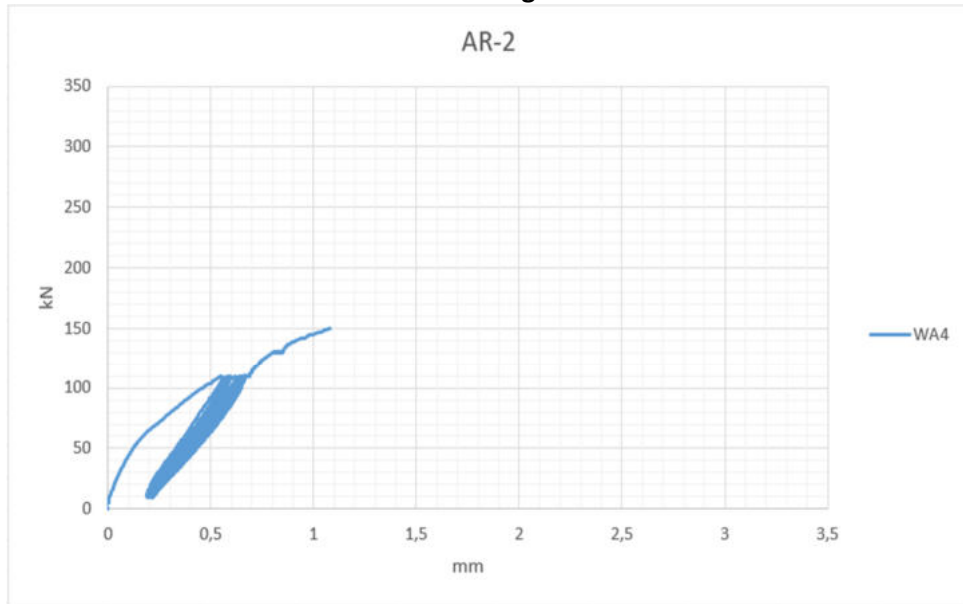
Fixierung der oberen Bewehrung mit Ø12 auf der Schalung.
Entfernung nach dem Betonieren.



Anordnung der Wegaufnehmer



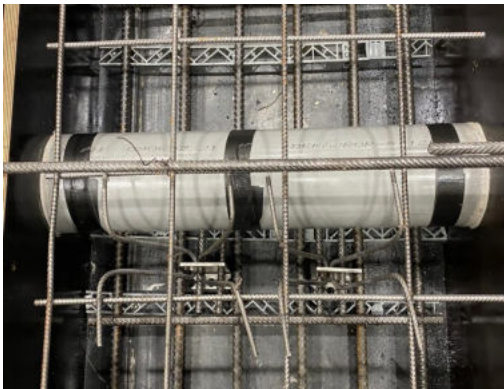
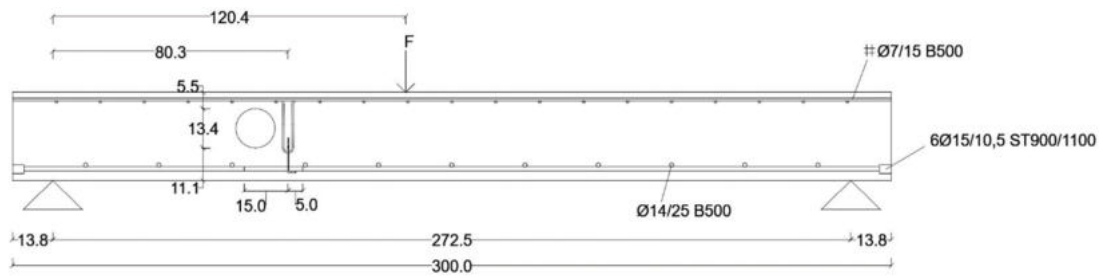
Last-Verformungs-Kurven



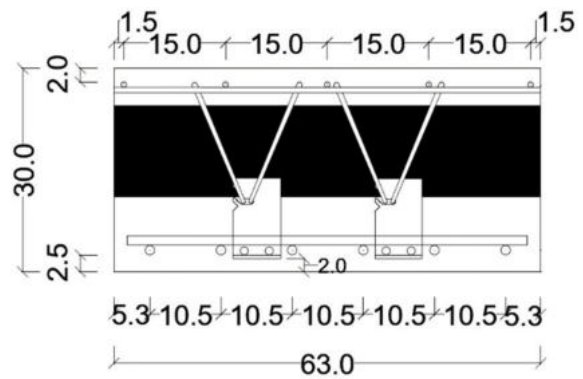


Datenblatt Prüfkörper AR-3

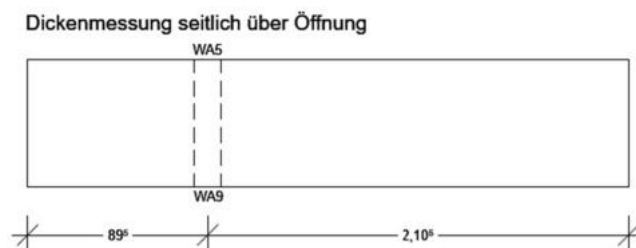
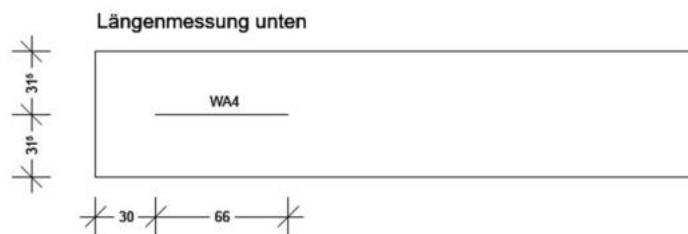
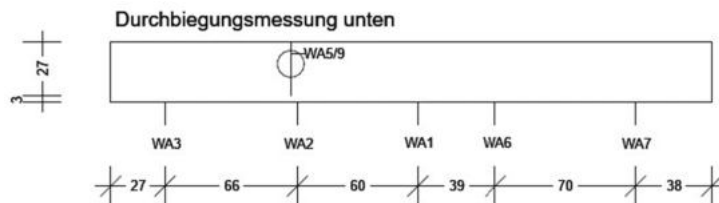
2Ø6 Bügel - 2 Bleche - Öffnung rund - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 190,6 \text{ kN}$



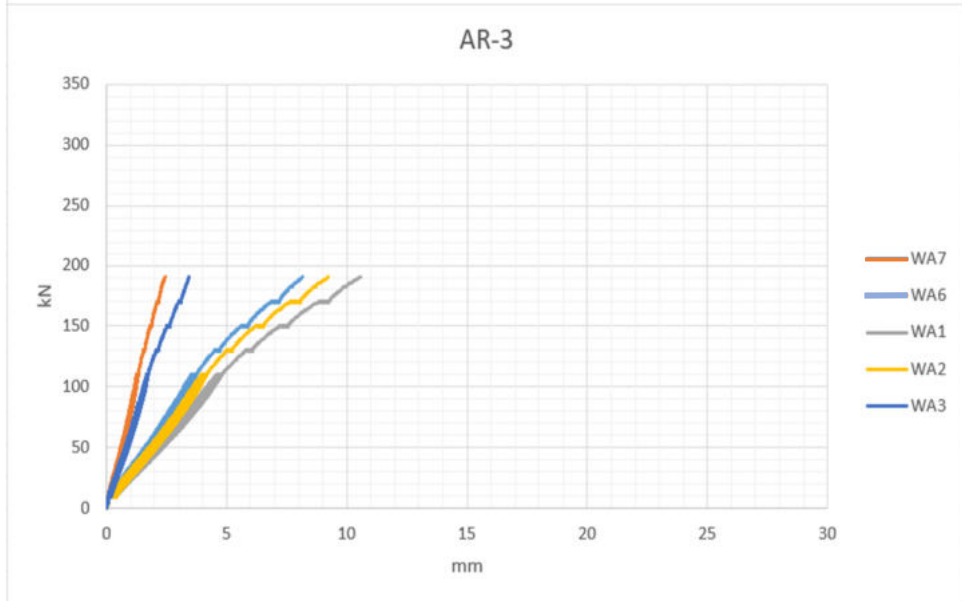
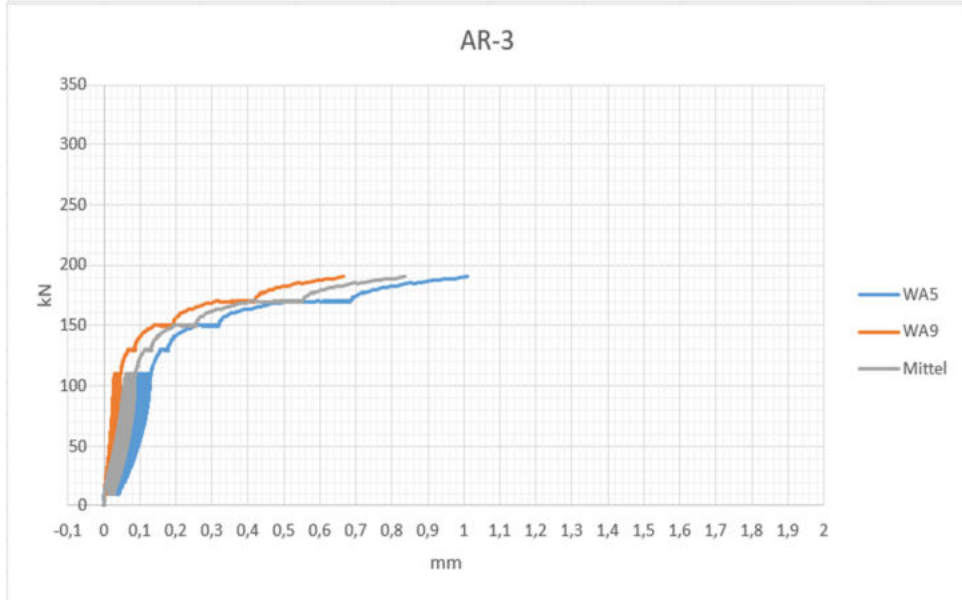
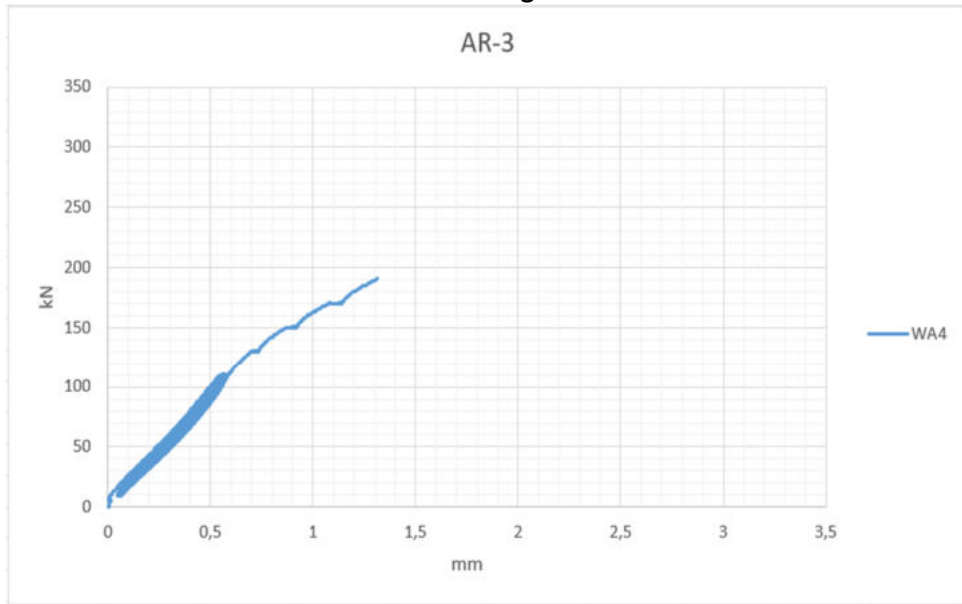
Fixierung der oberen Bewehrung mit Ø12 auf der Schalung.
Entfernung nach dem Betonieren.



Anordnung der Wegaufnehmer



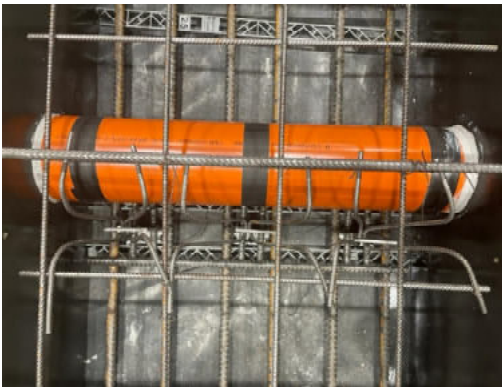
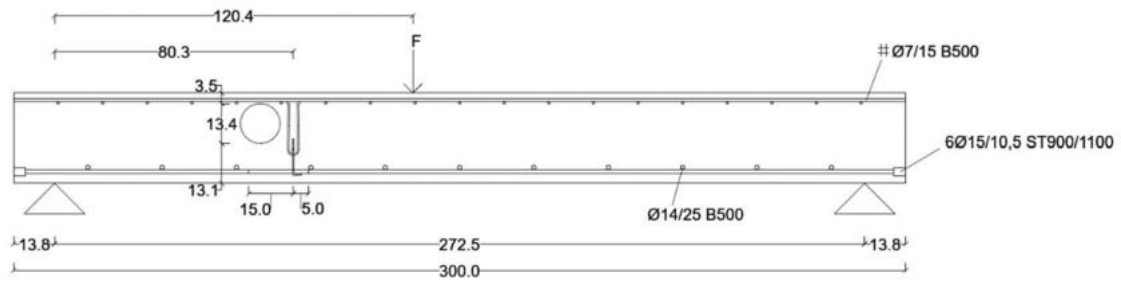
Last-Verformungs-Kurven



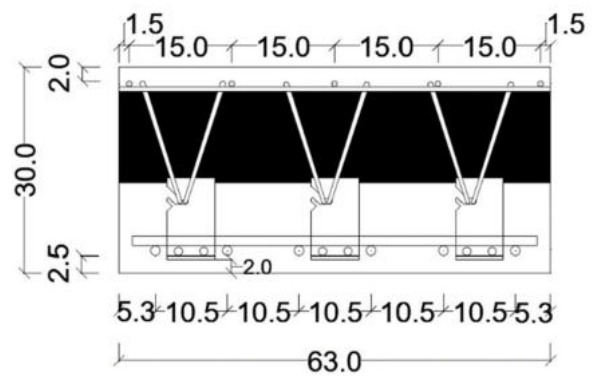


Datenblatt Prüfkörper AR-4

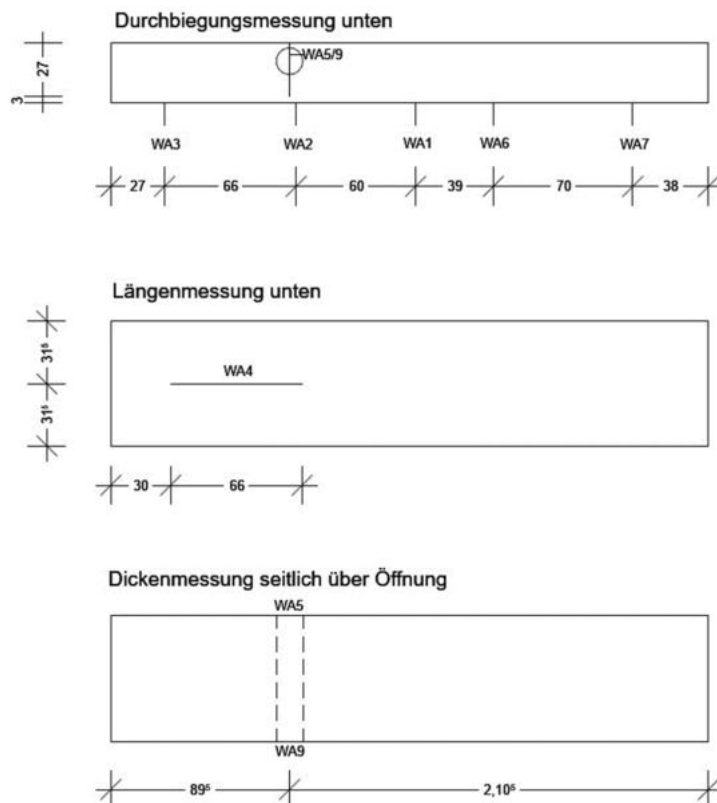
2Ø6 Bügel - 3 Bleche - Öffnung rund - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 213,5 \text{ kN}$



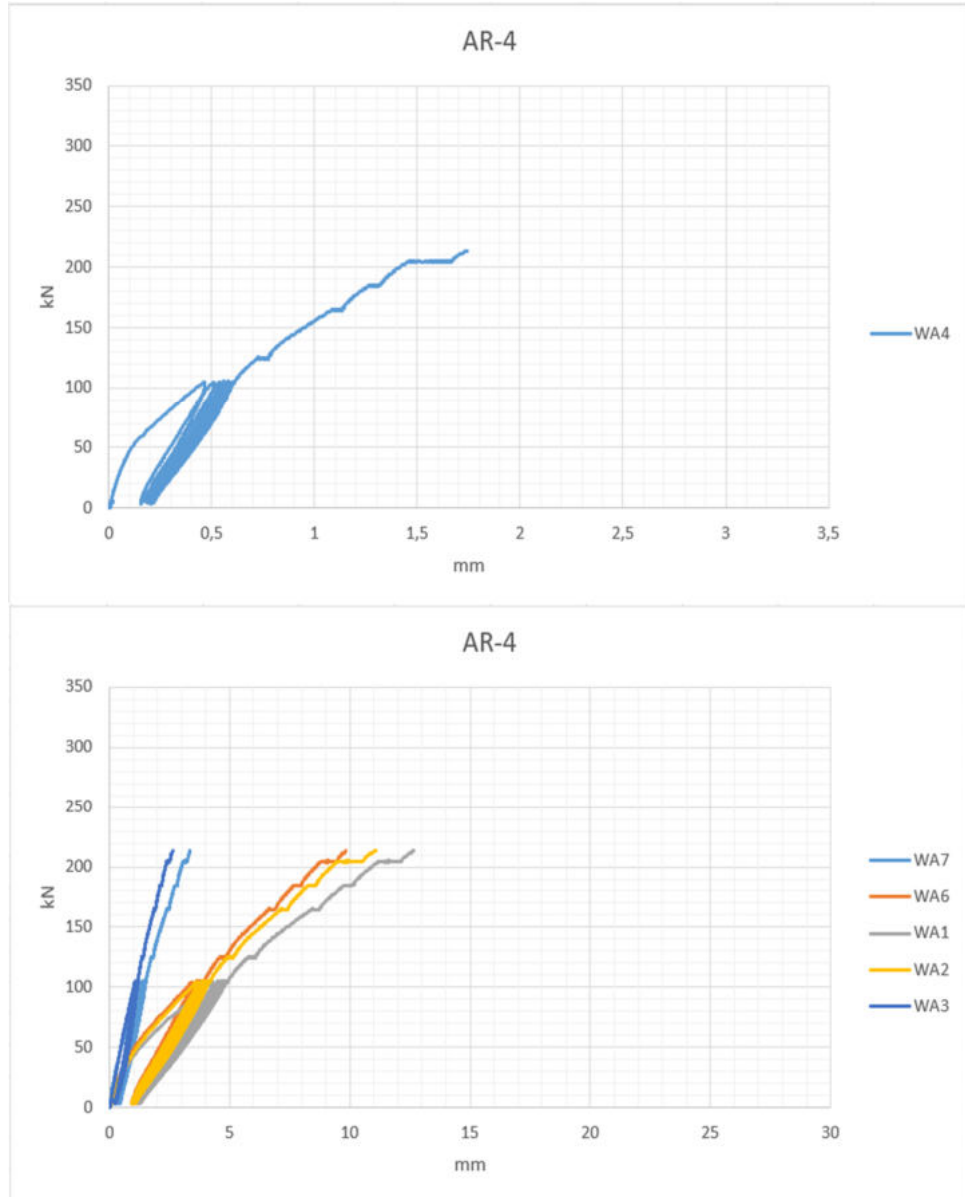
Fixierung der oberen Bewehrung mit Ø12 auf der Schalung.
Entfernung nach dem Betonieren.

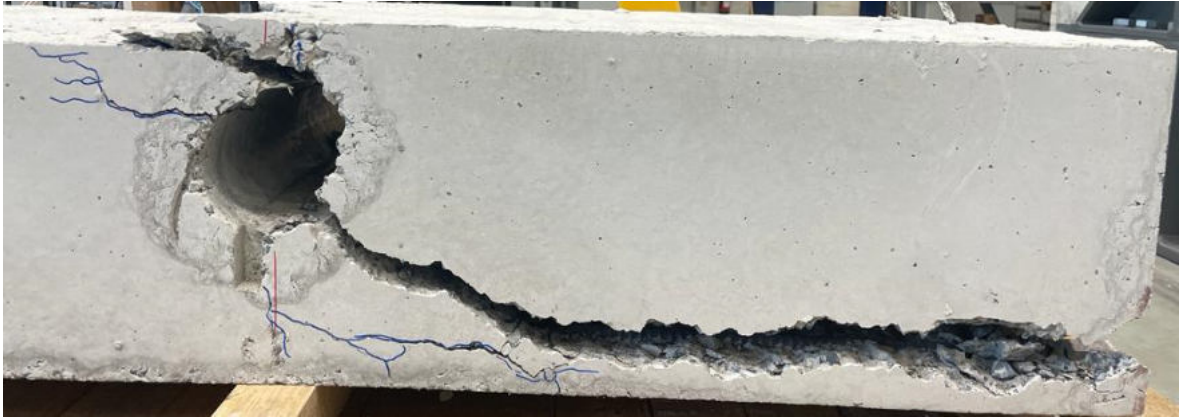


Anordnung der Wegaufnehmer



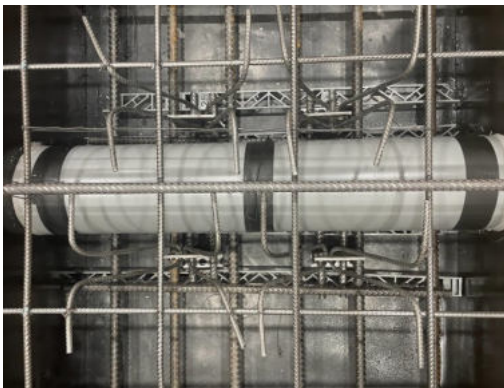
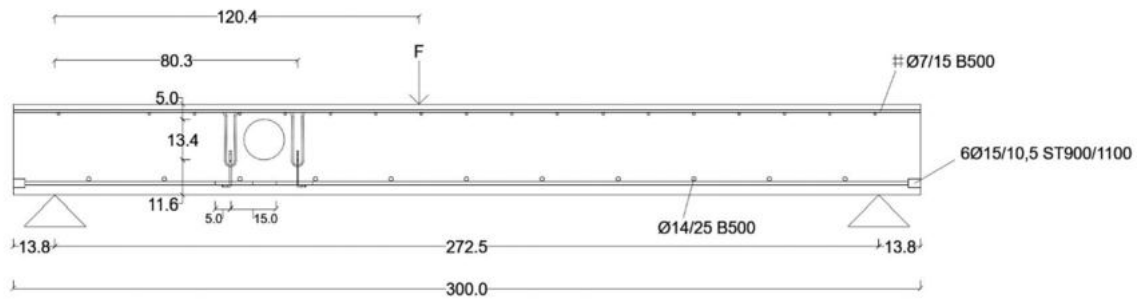
Last-Verformungs-Kurven



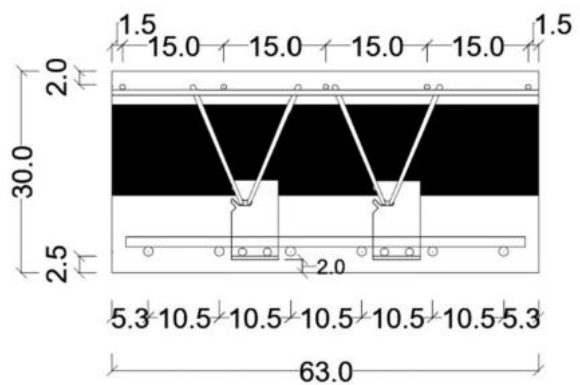


Datenblatt Prüfkörper AR-5

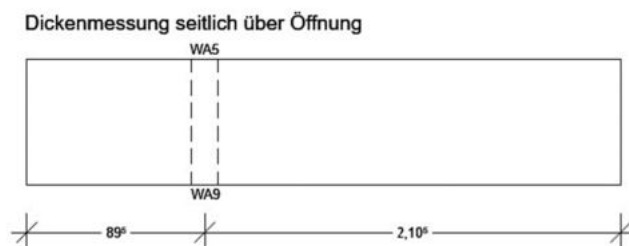
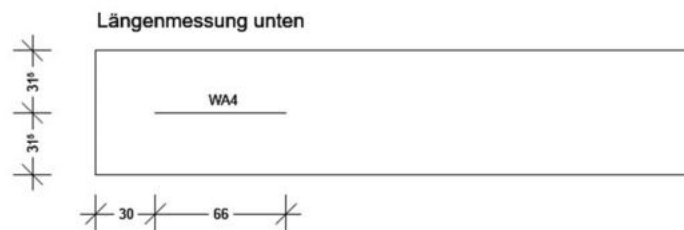
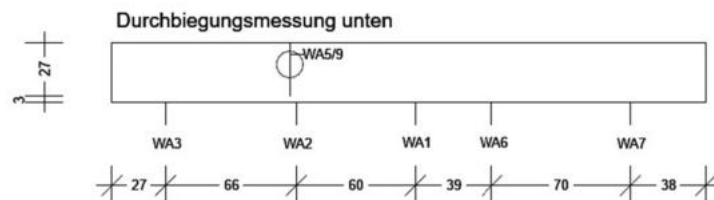
2Ø6 Bügel - 4 Bleche - Öffnung rund - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 250,0 \text{ kN}$



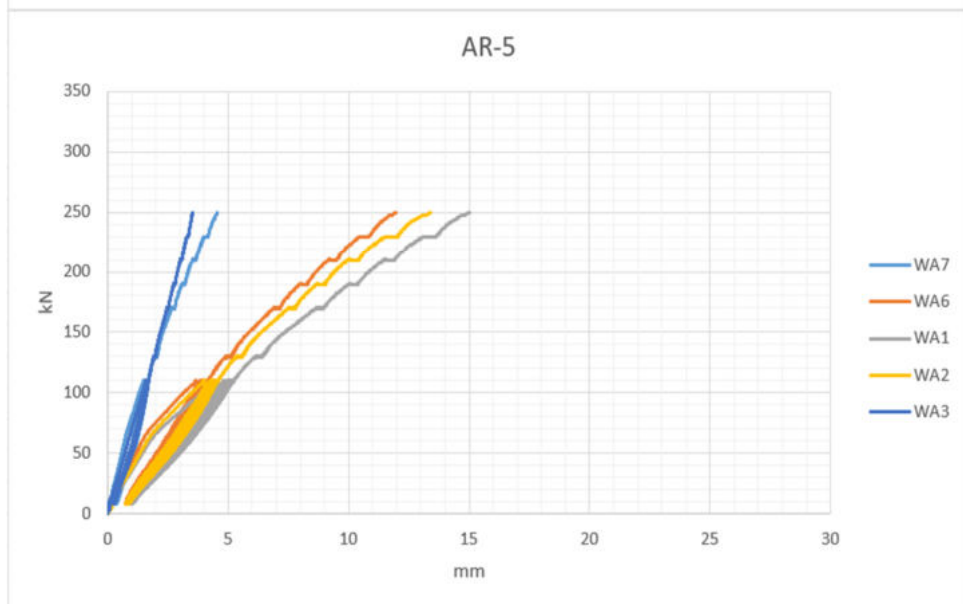
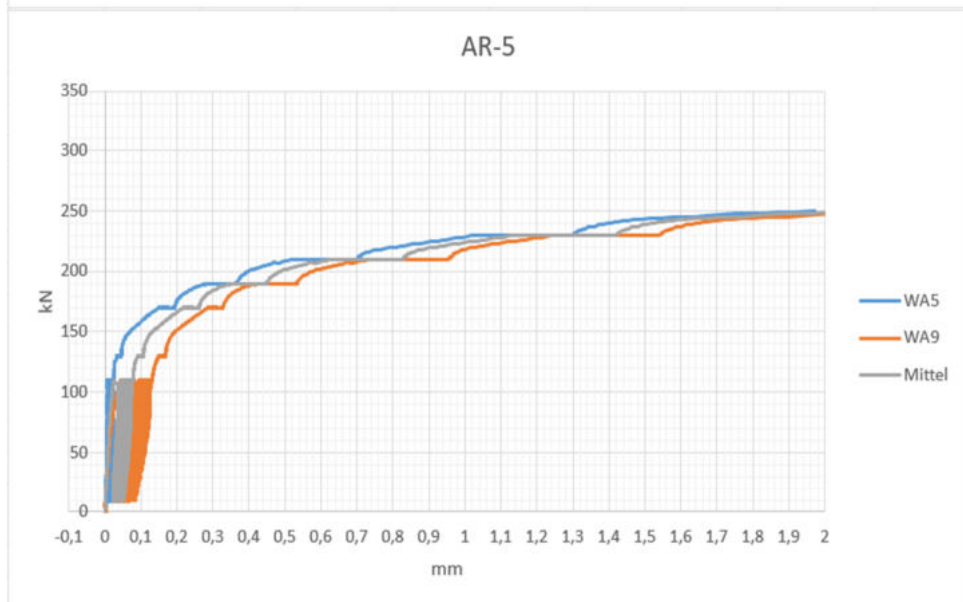
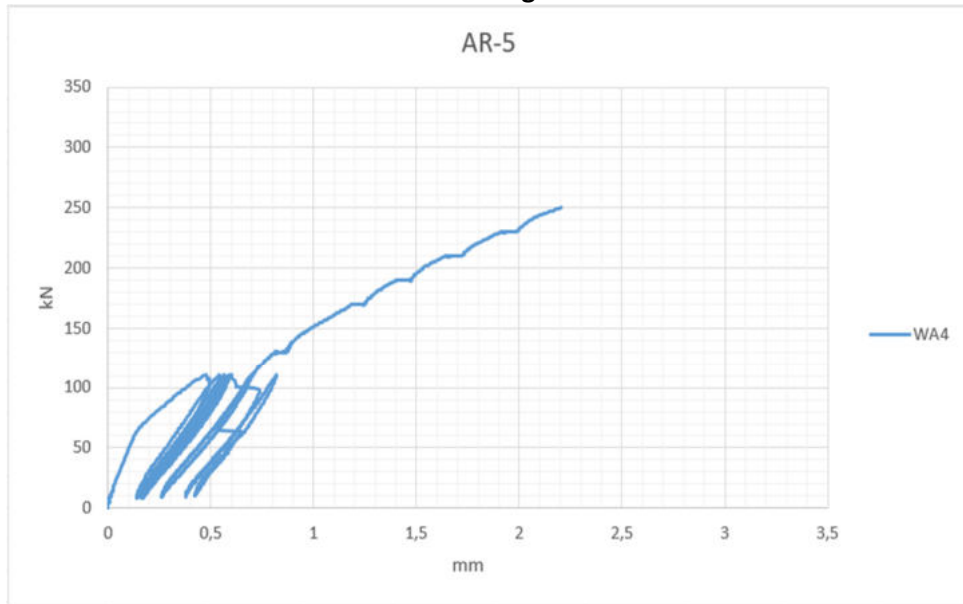
Fixierung der oberen Bewehrung mit Ø12 auf der Schalung.
Entfernung nach dem Betonieren.



Anordnung der Wegaufnehmer



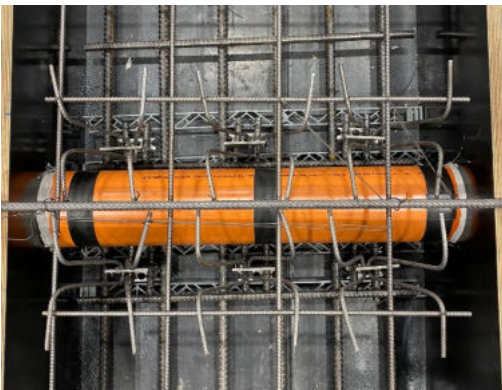
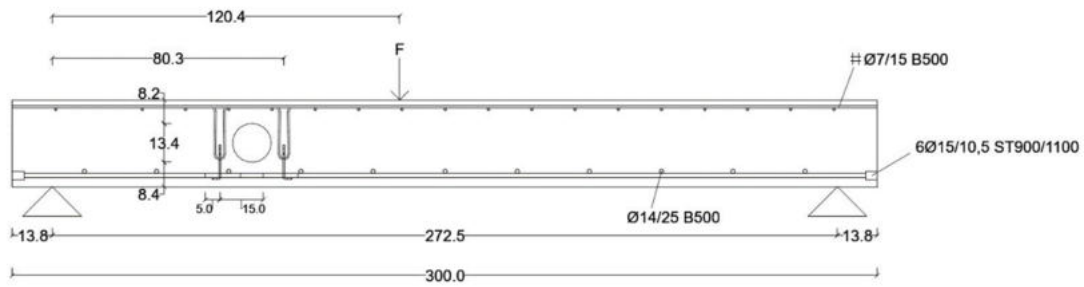
Last-Verformungs-Kurven



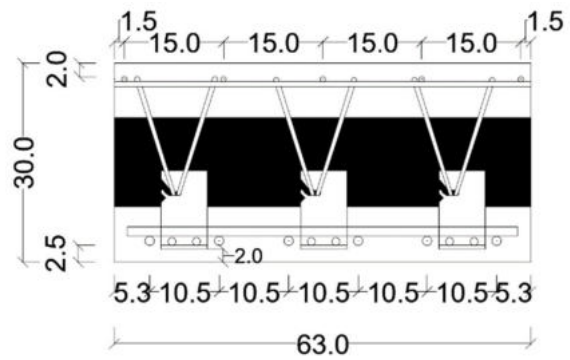


Datenblatt Prüfkörper AR-6

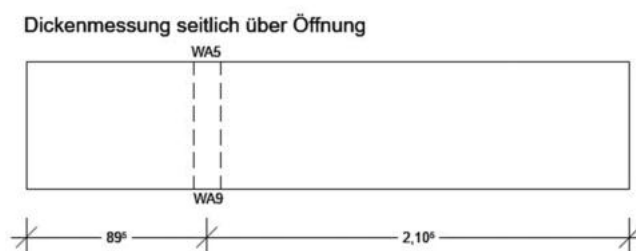
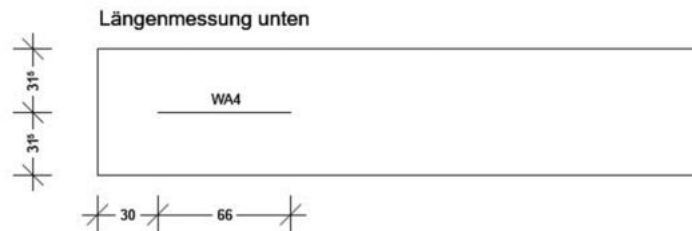
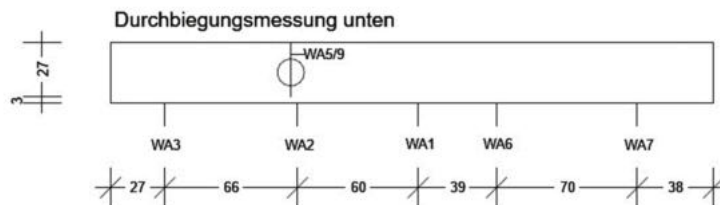
2Ø6 Bügel - 6 Bleche - Öffnung rund - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 321,4 \text{ kN}$



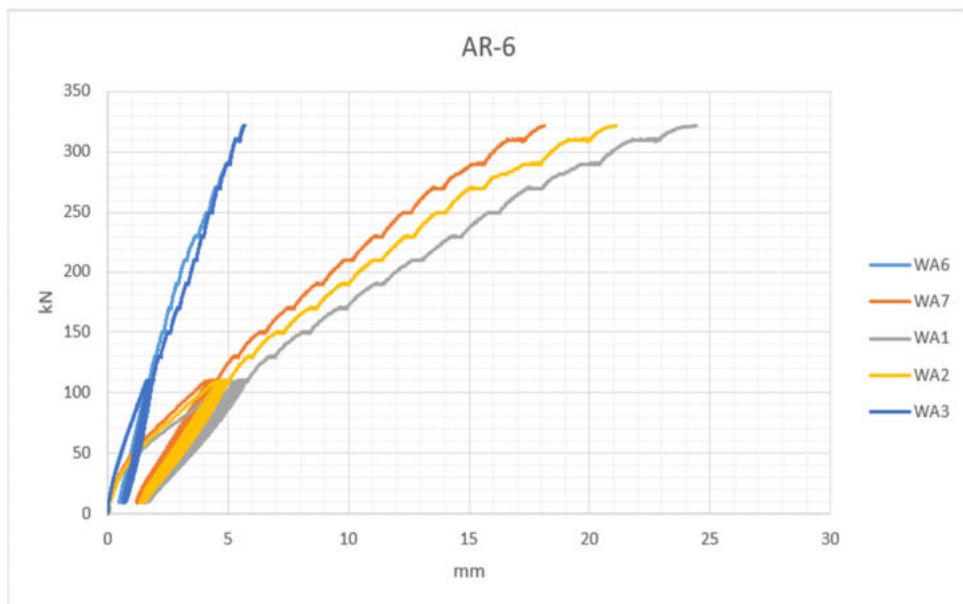
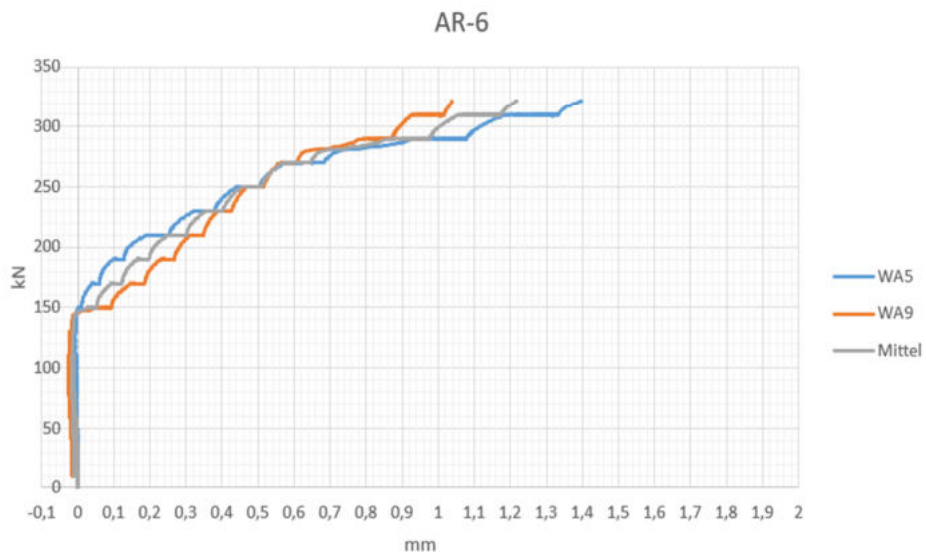
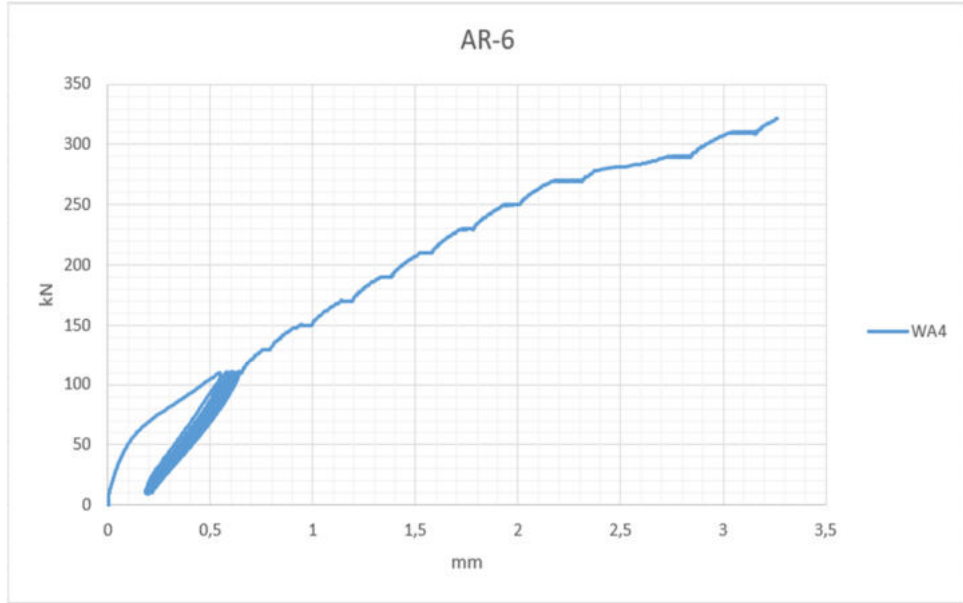
Fixierung der oberen Bewehrung mit Ø12 auf der Schalung.
Entfernung nach dem Betonieren.



Anordnung der Wegaufnehmer



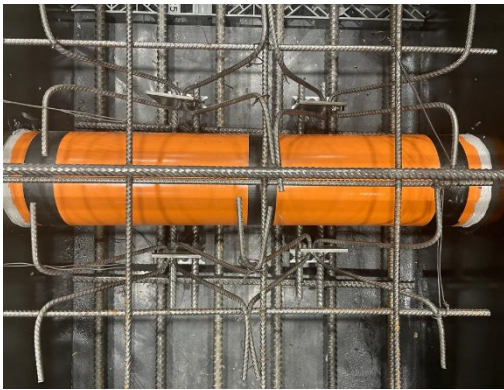
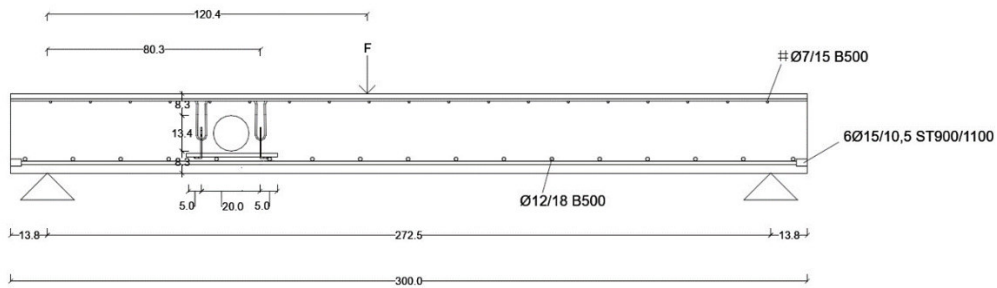
Last-Verformungs-Kurven



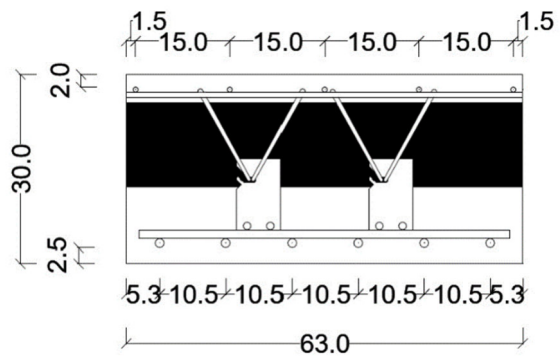


Datenblatt Prüfkörper AR-7

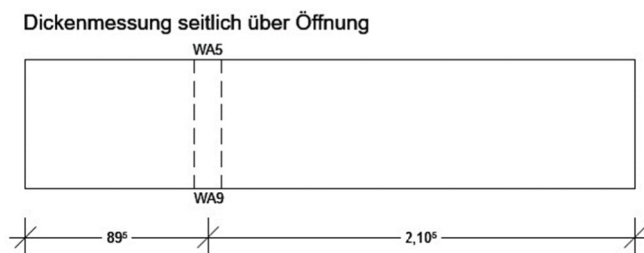
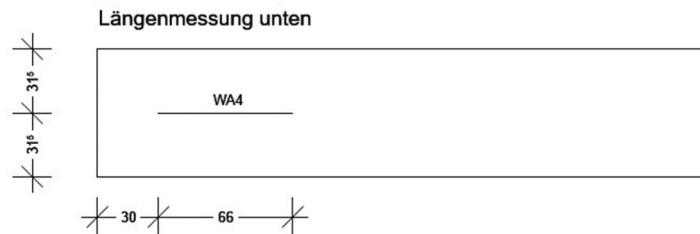
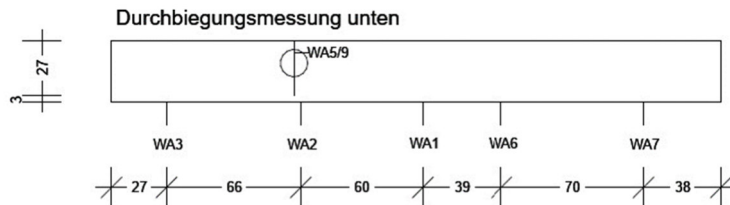
2Ø6 Bügel - 4 Bleche - Öffnung rund - aufgelegt - $f_{cm,cube} = 32,7 \text{ N/mm}^2$ - $V_{Test} = 210,1 \text{ kN}$



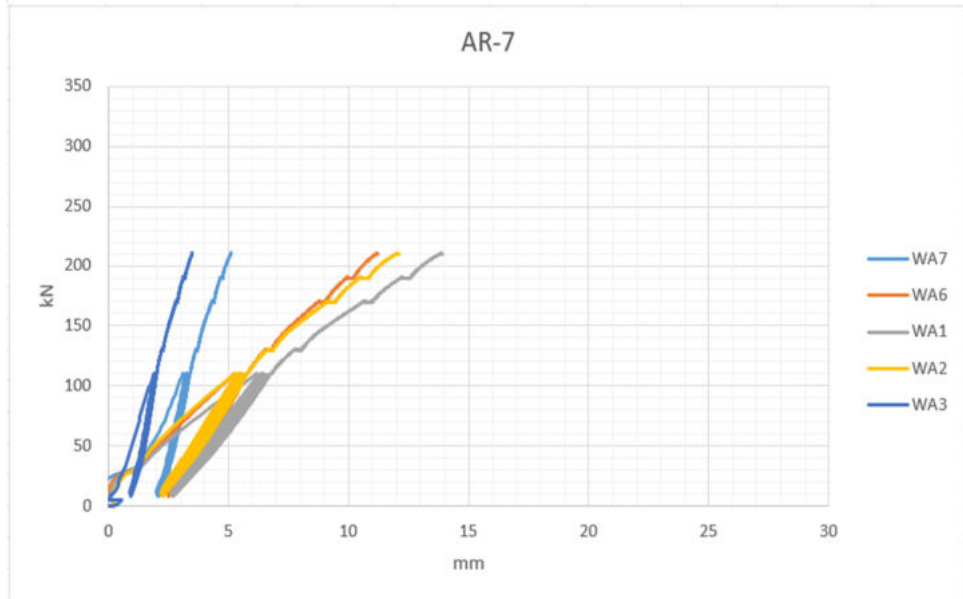
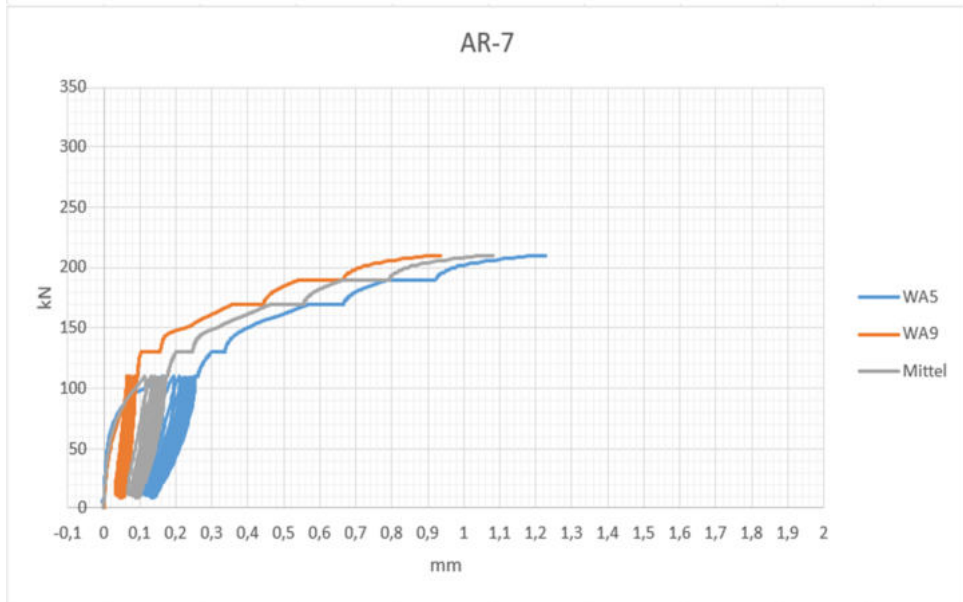
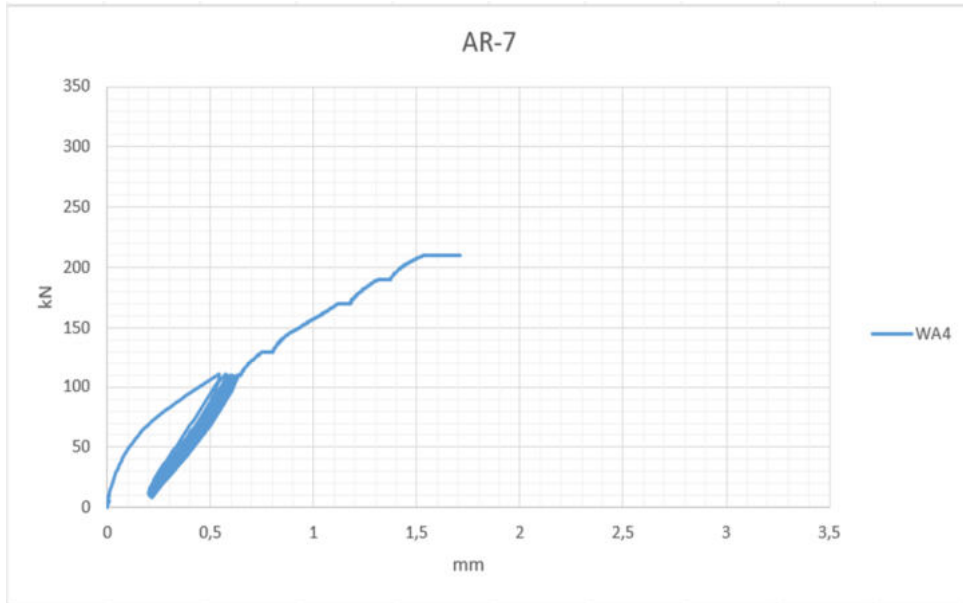
Fixierung der oberen Bewehrung mit Ø12 auf der Schalung.
Entfernung nach dem Betonieren.

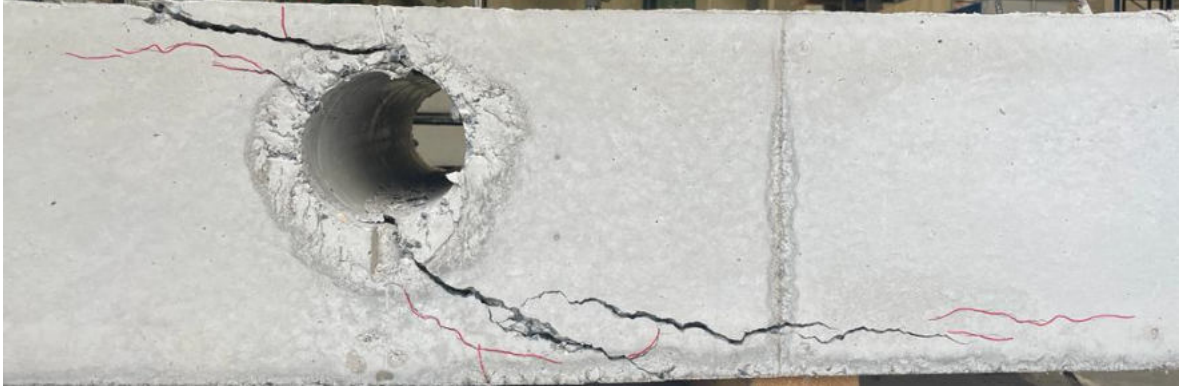


Anordnung der Wegaufnehmer



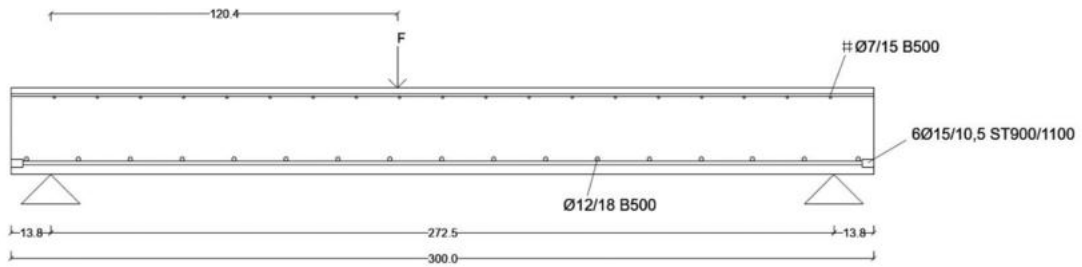
Last-Verformung-Kurven



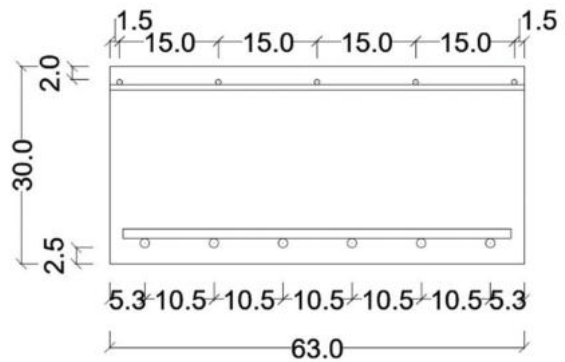


Datenblatt Prüfkörper AOW-1

Referenzkörper - keine Öffnung - $f_{cm,cube} = 36,2 \text{ N/mm}^2$ - $V_{Test} = 310,7 \text{ kN}$

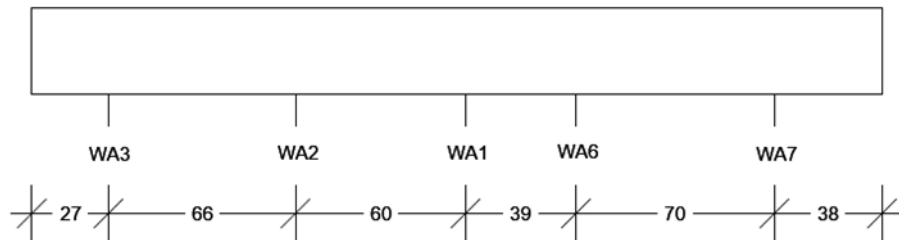


Die Øbere Bewehrung wurde in 2cm tiefe Schlitze in der Schalung eingelegt.

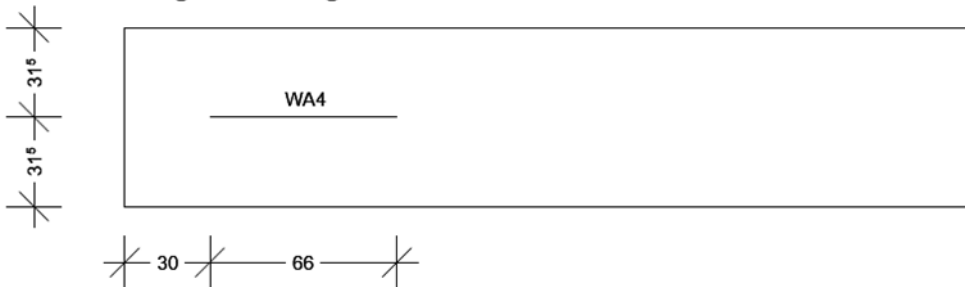


Anordnung der Wegaufnehmer

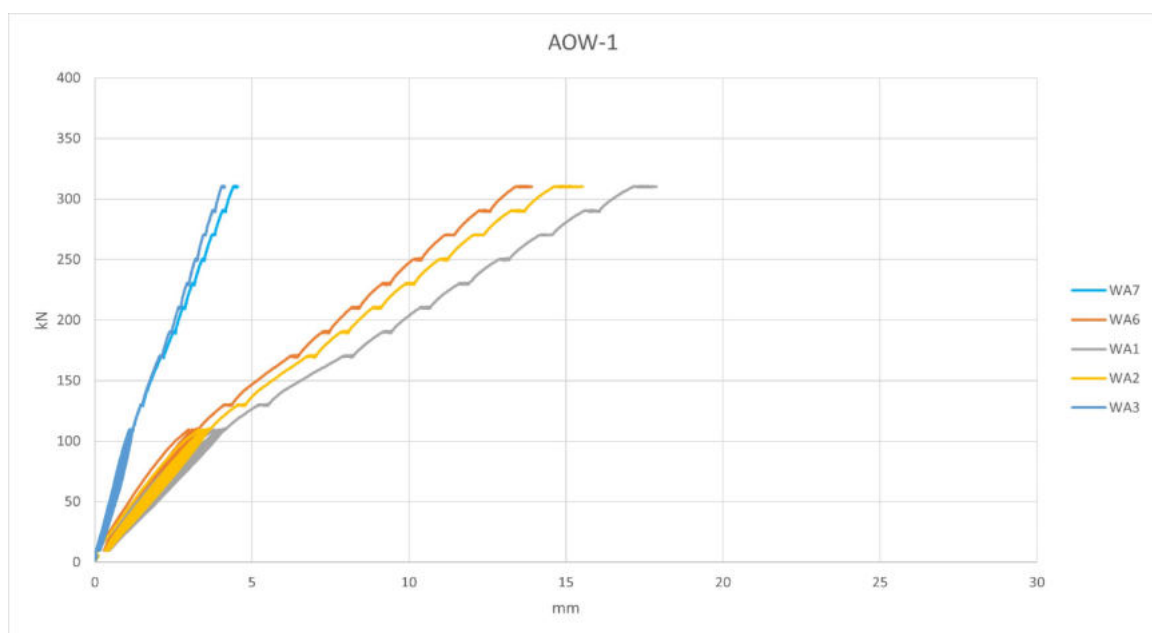
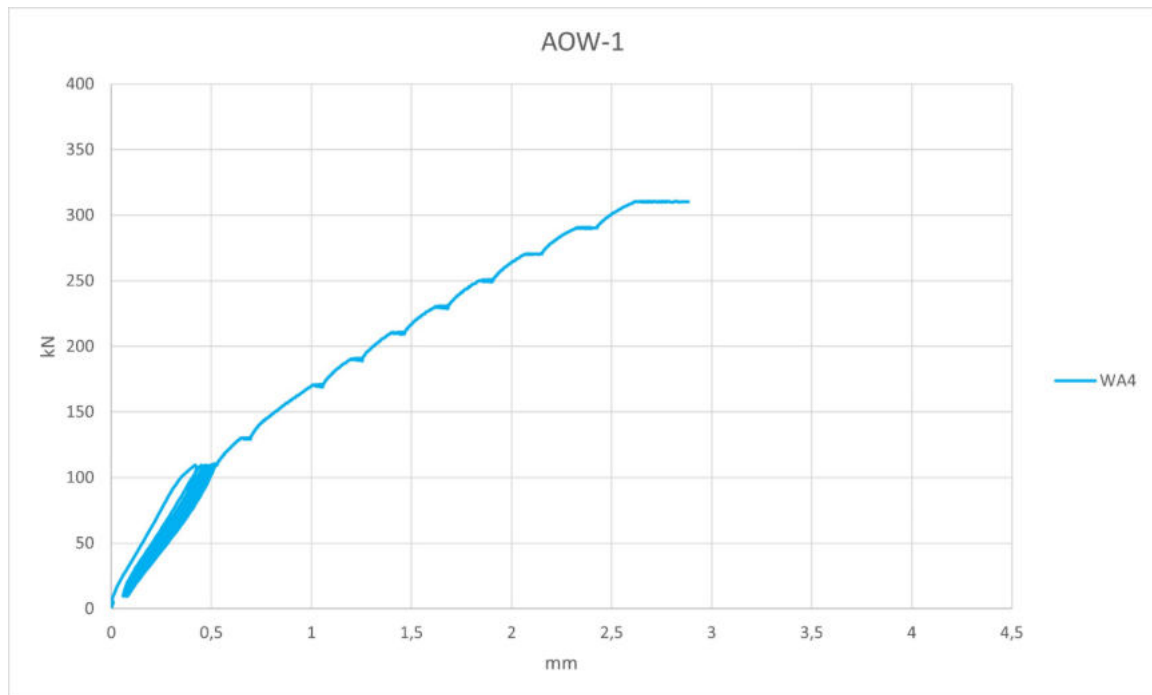
Durchbiegungsmessung unten



Längenmessung unten



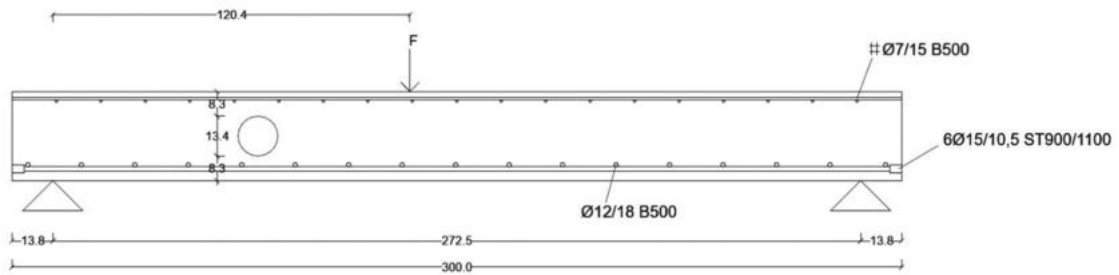
Last-Verformungs-Kurven



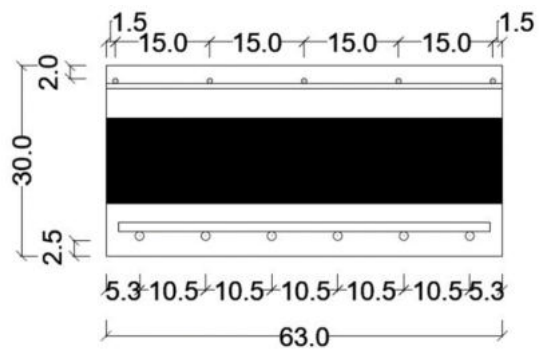


Datenblatt Prüfkörper ARW-1

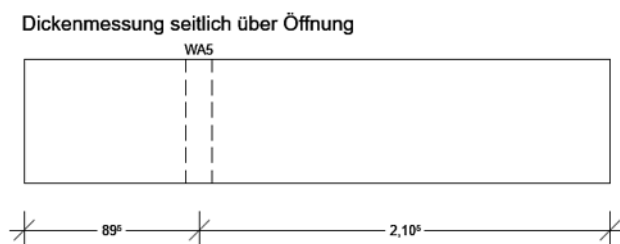
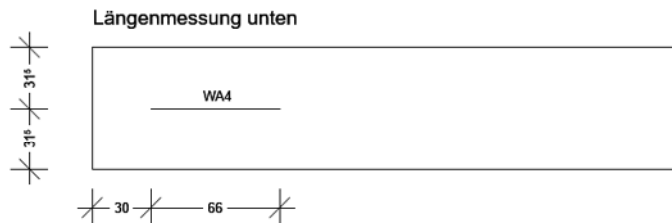
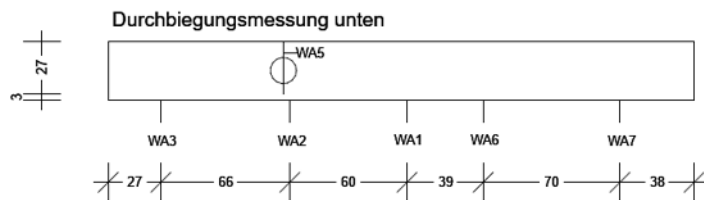
Referenzkörper - keine Bleche - Öffnung rund - $f_{cm,cube} = 38,4 \text{ N/mm}^2$ - $V_{Test} = 166,6 \text{ kN}$



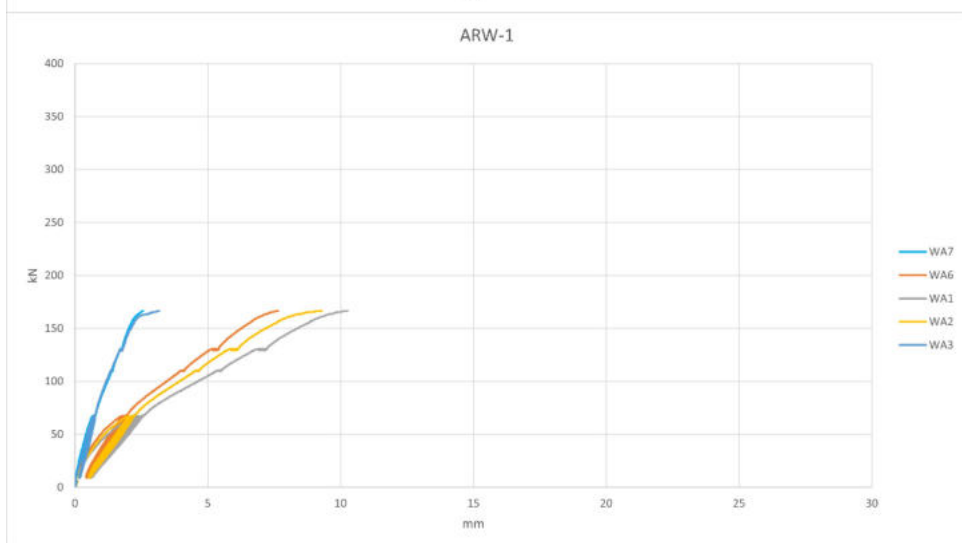
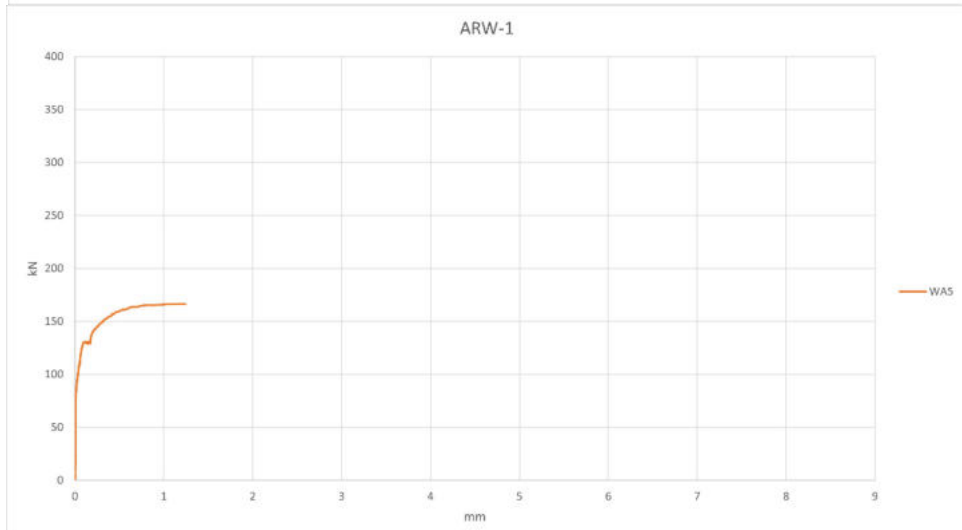
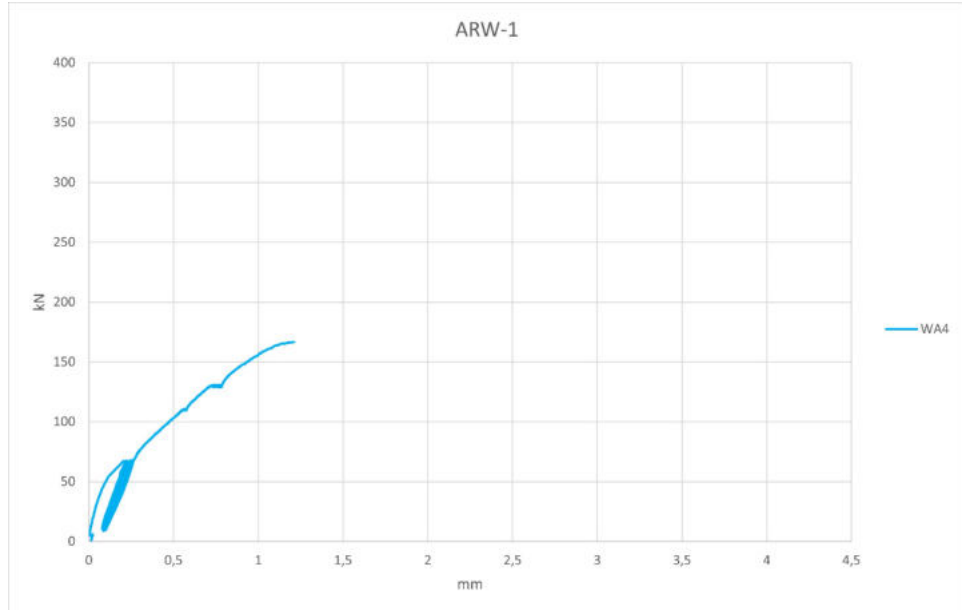
Fixierung der oberen Bewehrung mit $\text{Ø}12$ auf der Schalung.
Entfernung nach dem Betonieren.

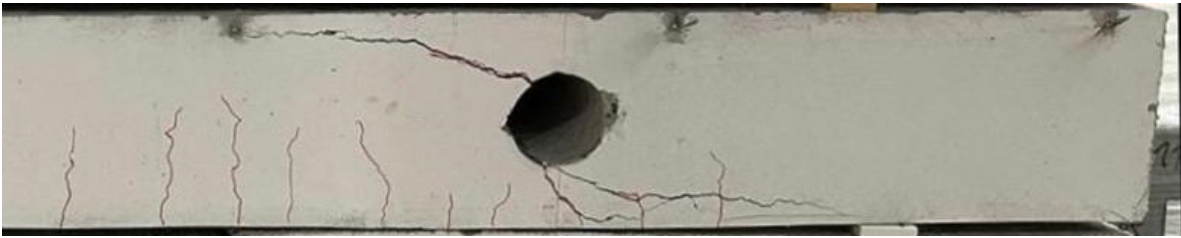
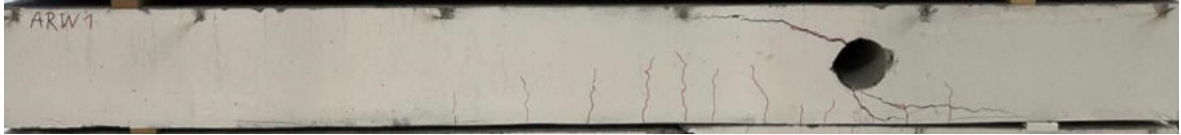


Anordnung der Wegaufnehmer



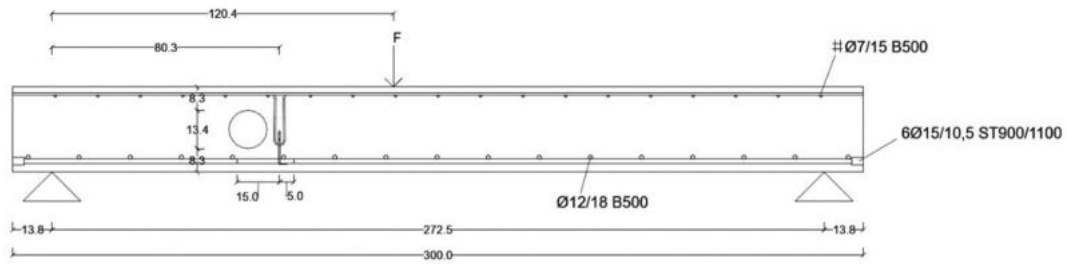
Last-Verformungs-Kurven



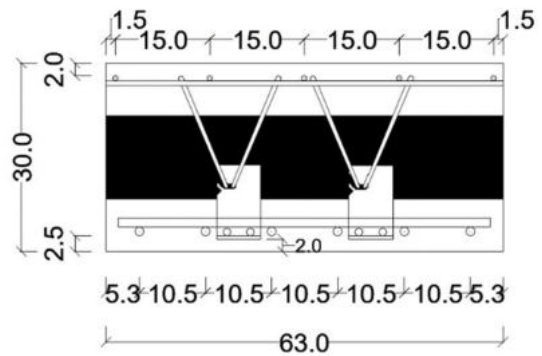


Datenblatt Prüfkörper ARW-3

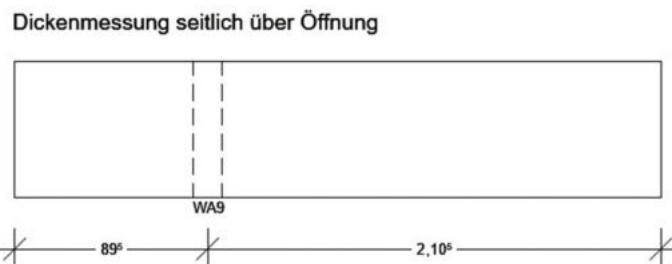
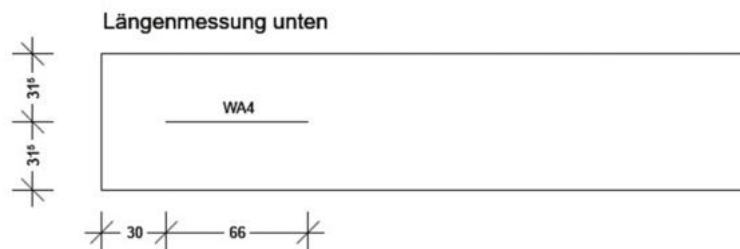
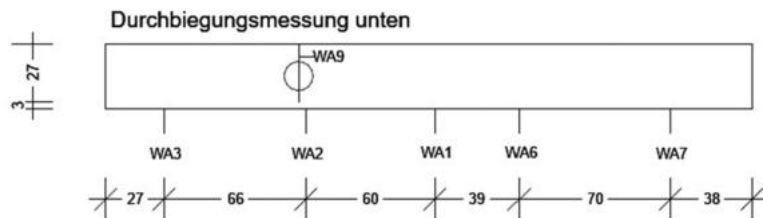
2Ø6 Bügel - 2 Bleche - Öffnung rund - $f_{cm,cube} = 38,4 \text{ N/mm}^2$ - $V_{Test} = 285,3 \text{ kN}$



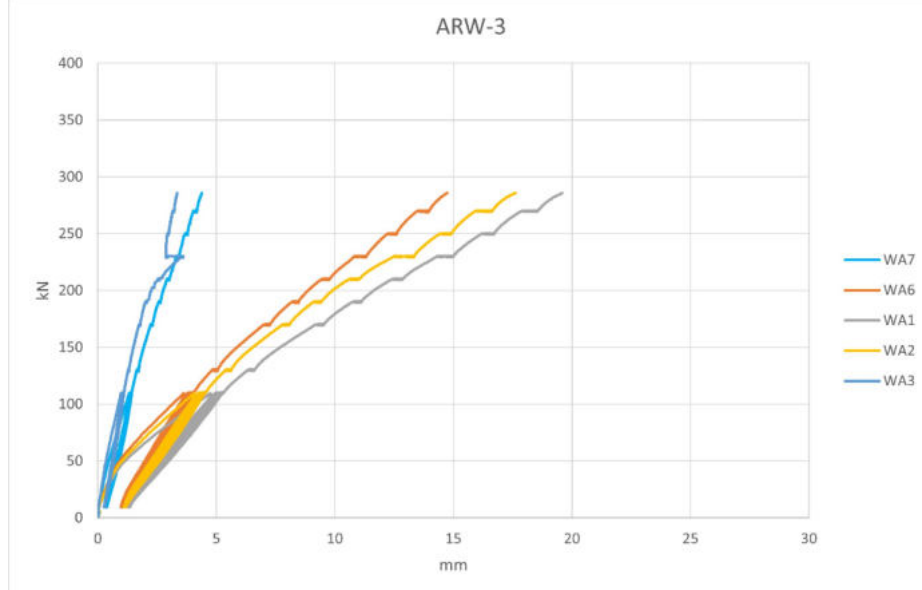
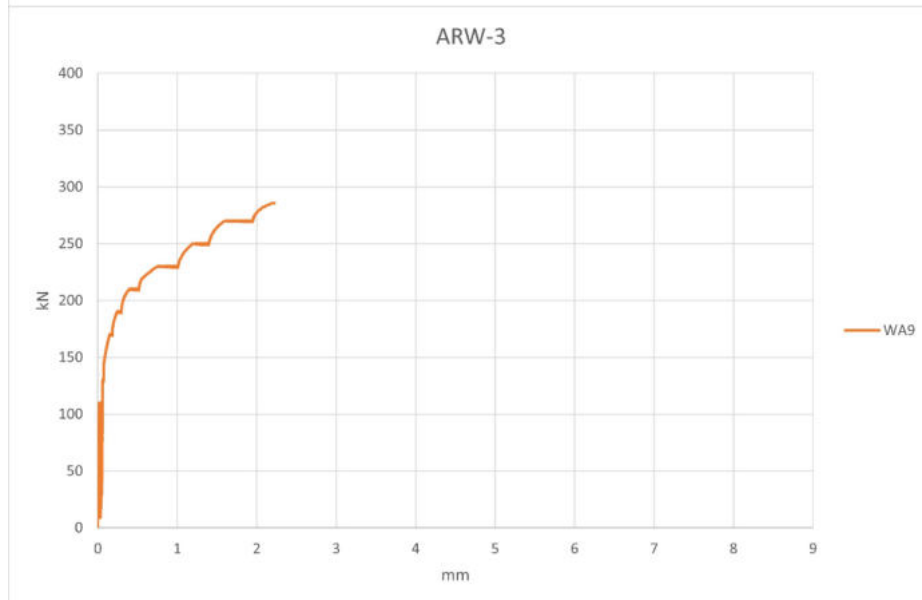
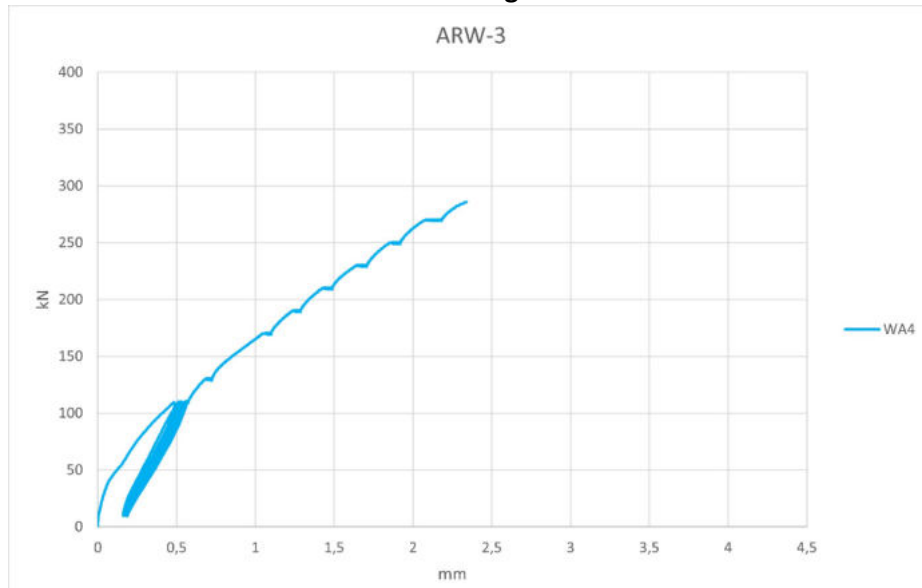
Die obere Bewehrung wurde in 2cm tiefe Schlitz in der Schalung eingelegt.

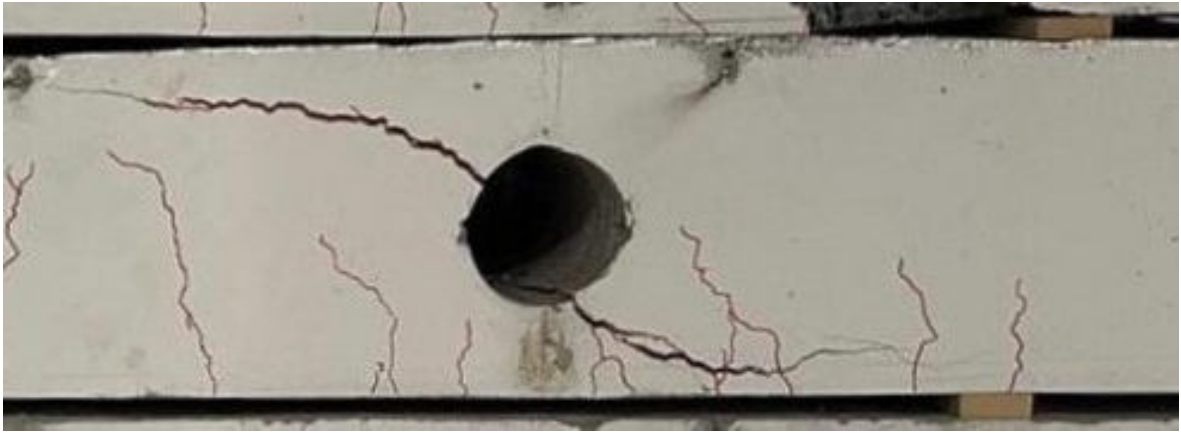
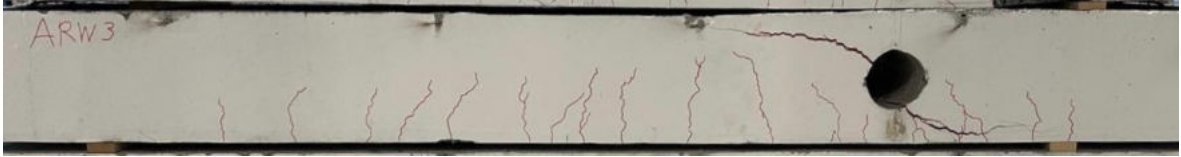


Anordnung der Wegaufnehmer



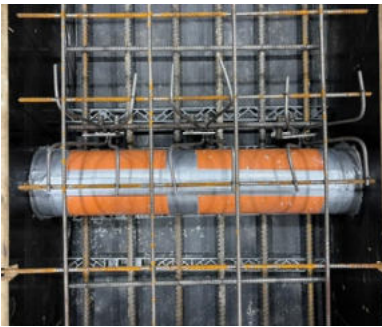
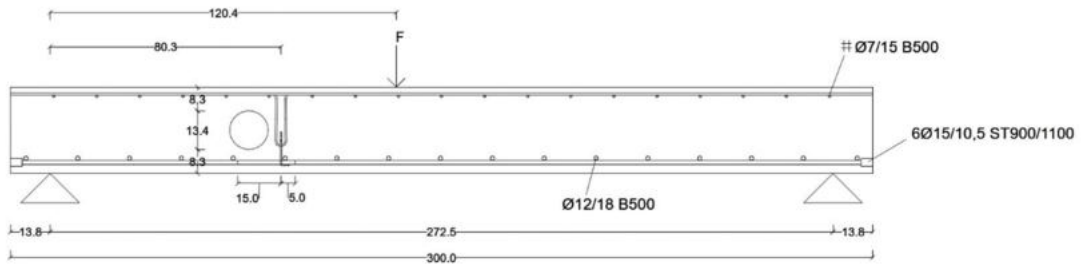
Last-Verformungs-Kurven



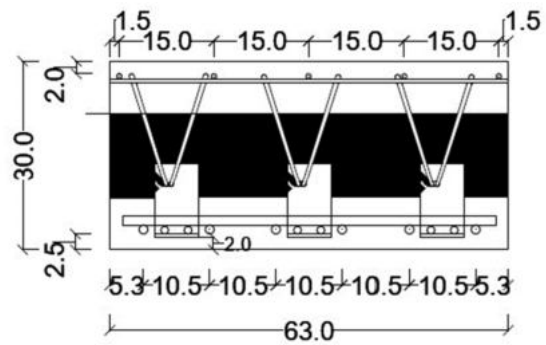


Datenblatt Prüfkörper ARW-4

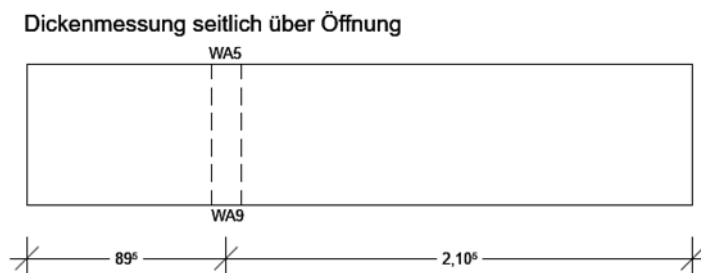
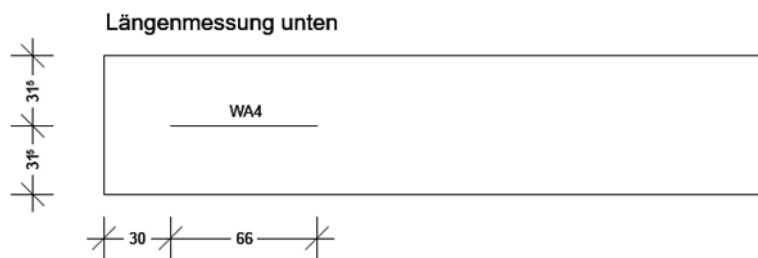
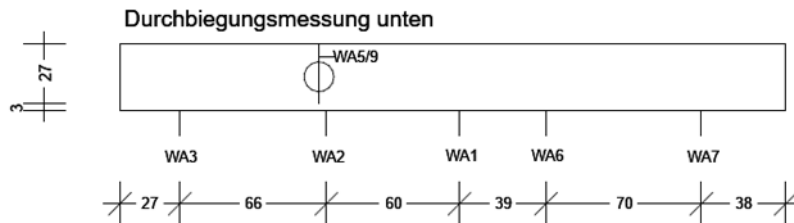
2Ø6 Bügel - 3 Bleche - Öffnung rund - $f_{cm,cube} = 38,4 \text{ N/mm}^2$ - $V_{Test} = 310,5 \text{ kN}$



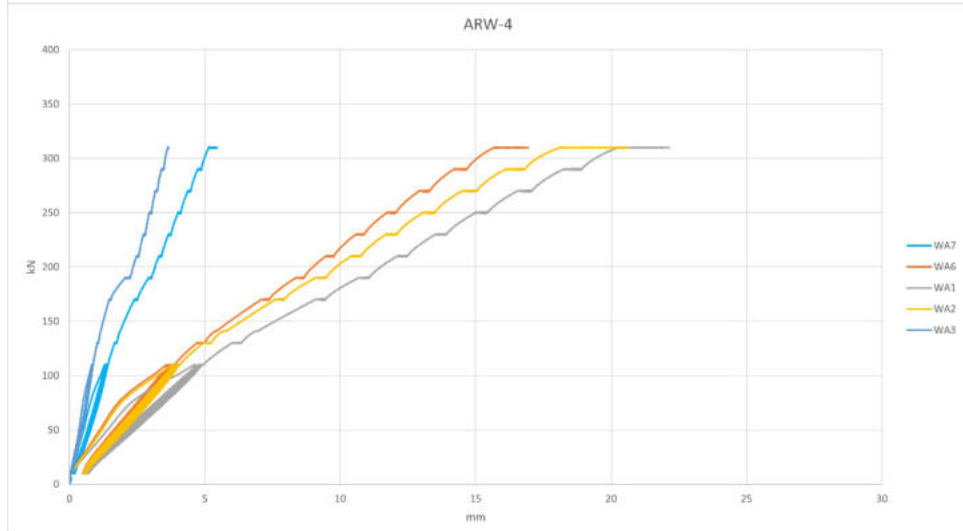
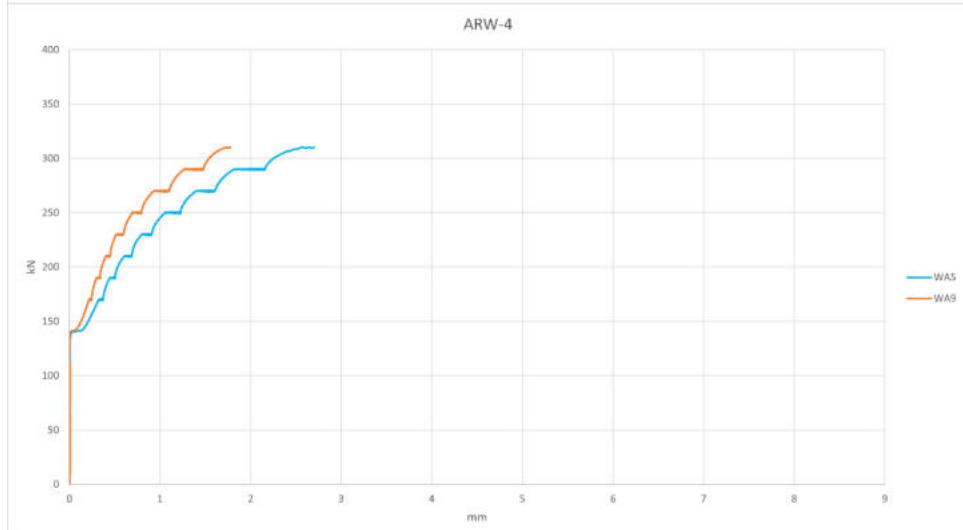
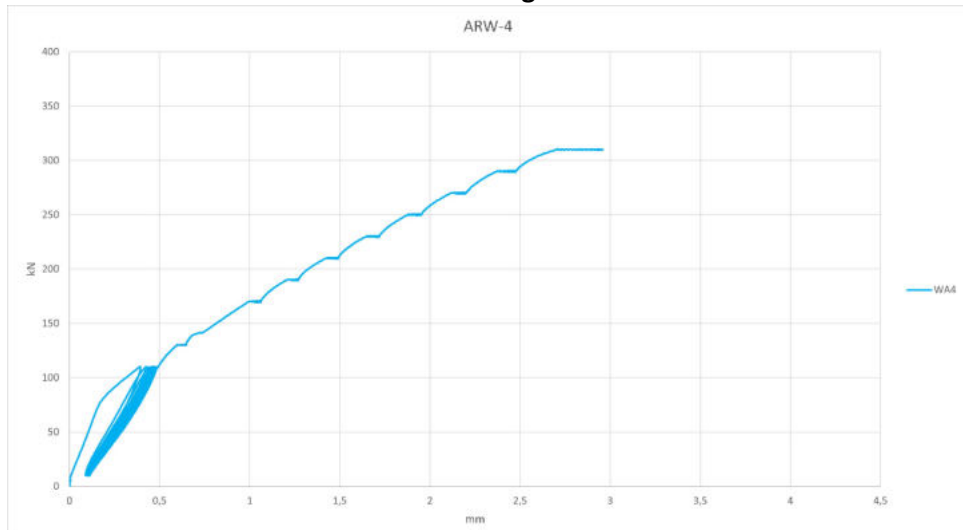
Die obere Bewehrung wurde in 2cm tiefe Schlitz in der Schalung eingelegt.



Anordnung der Wegaufnehmer



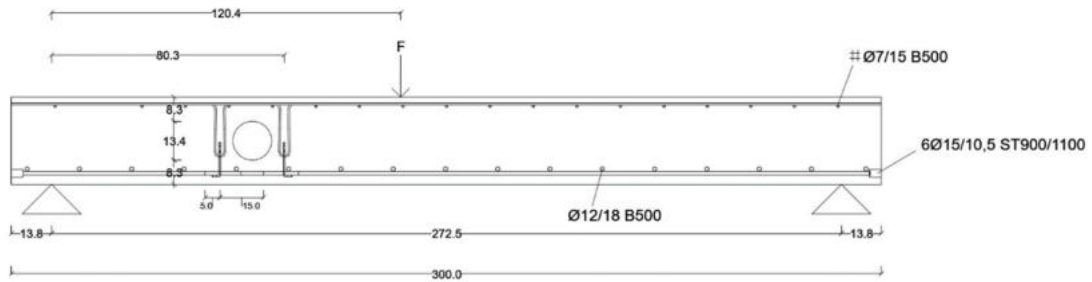
Last-Verformungs-Kurven



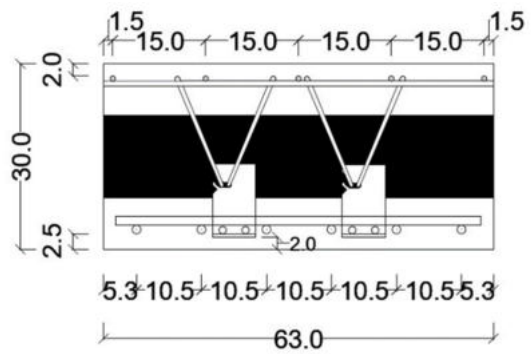


Datenblatt Prüfkörper ARW-5

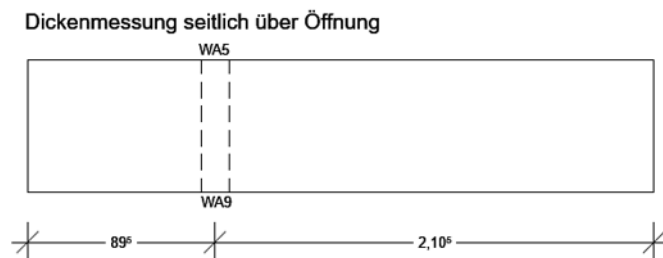
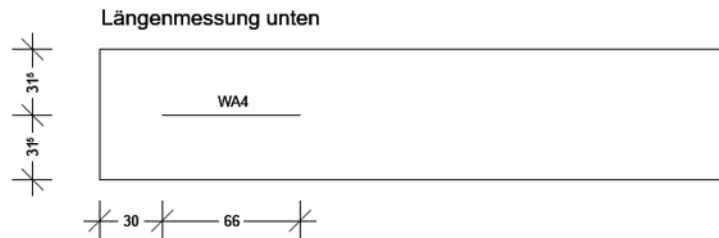
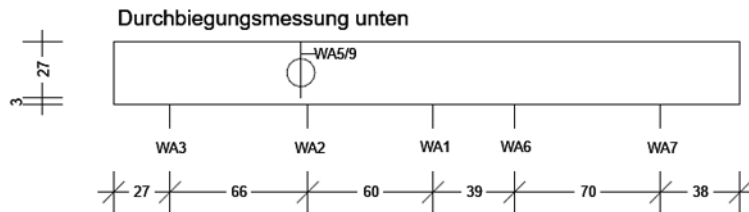
2Ø6 Bügel - 4 Bleche - Öffnung rund - $f_{cm,cube} = 38,4 \text{ N/mm}^2$ - $V_{Test} = 329,2 \text{ kN}$



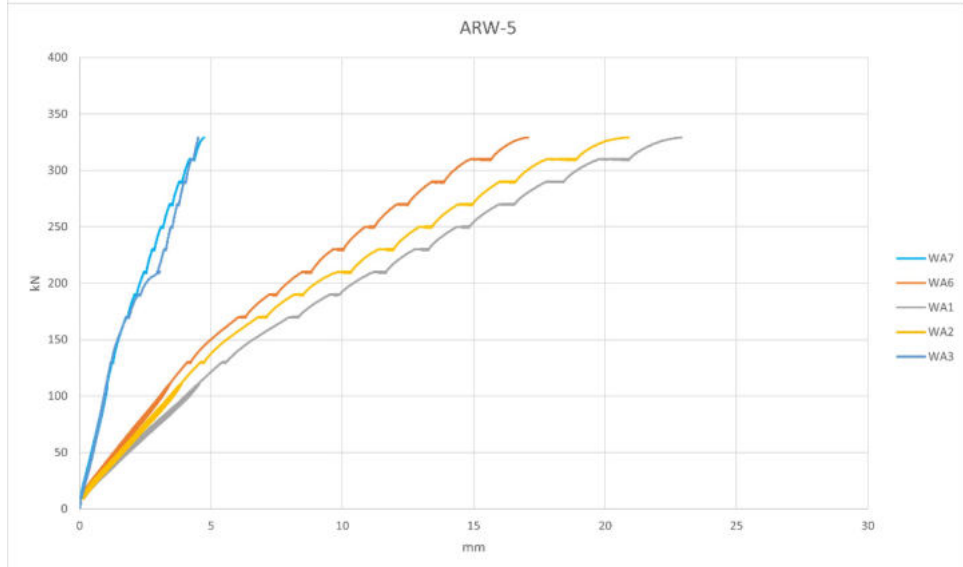
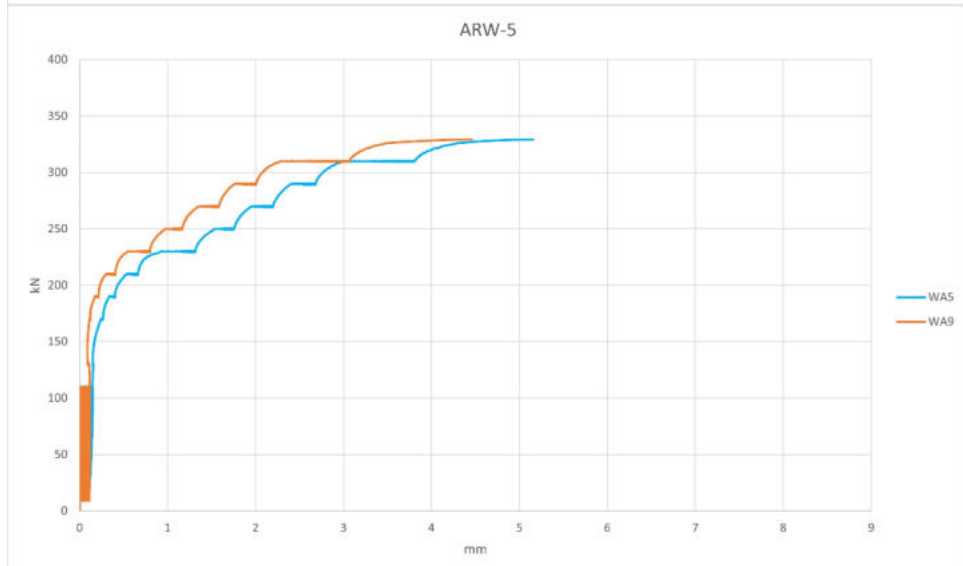
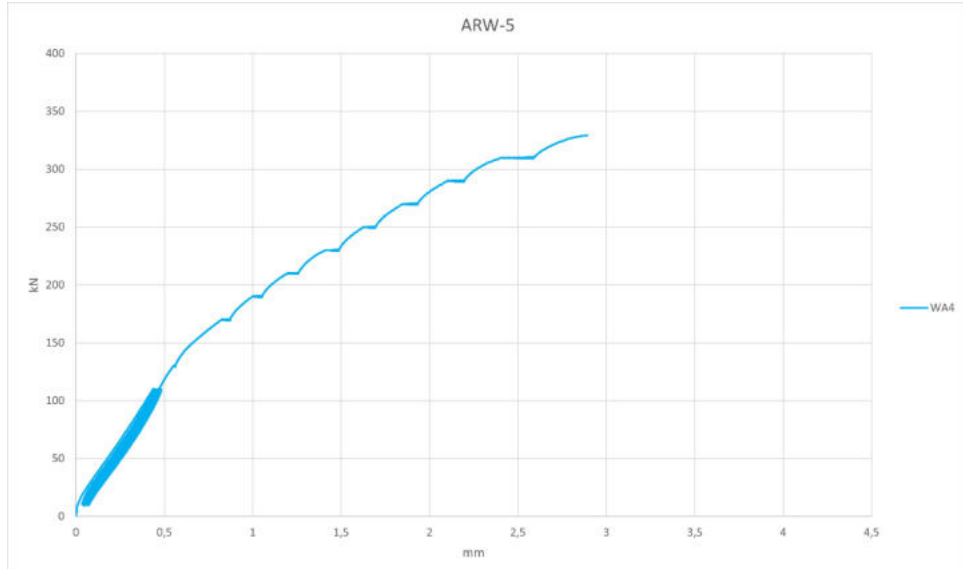
Die obere Bewehrung wurde in 2cm tiefe Schlitz in der Schalung eingelegt.



Anordnung der Wegaufnehmer



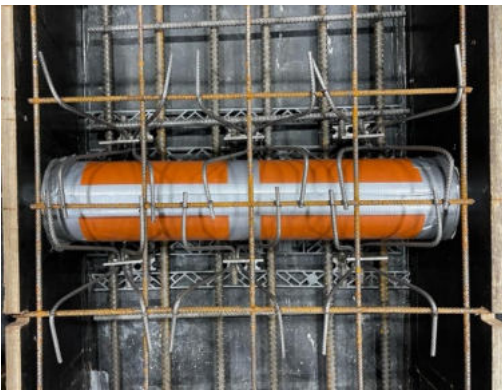
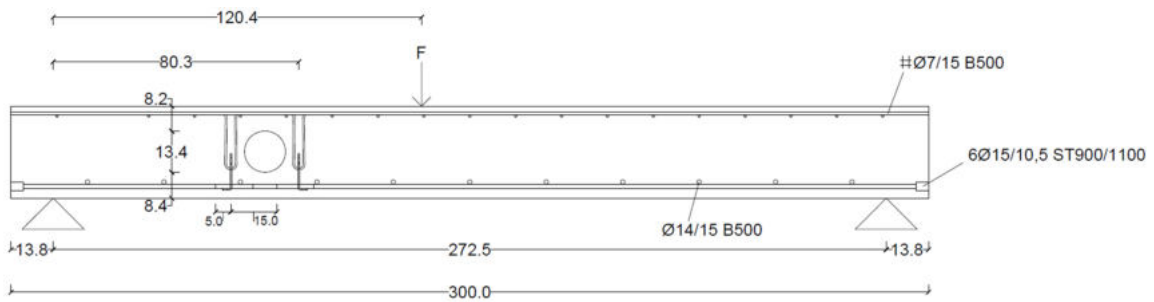
Last-Verformungs-Kurven



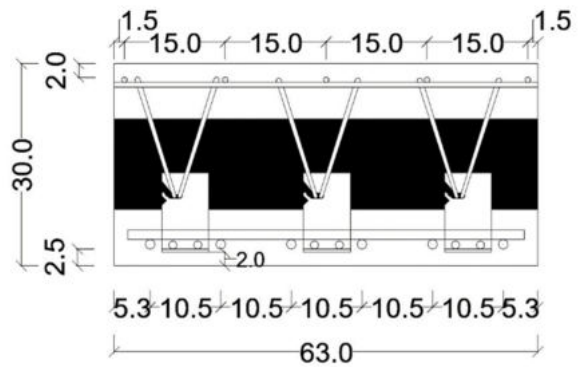


Datenblatt Prüfkörper ARW-6

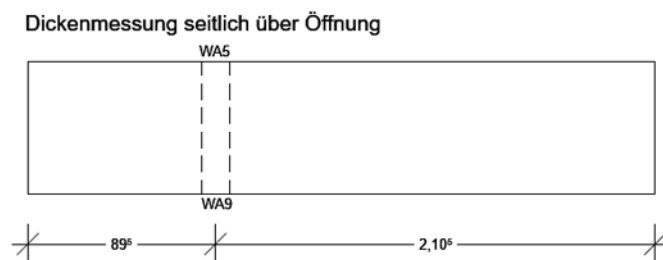
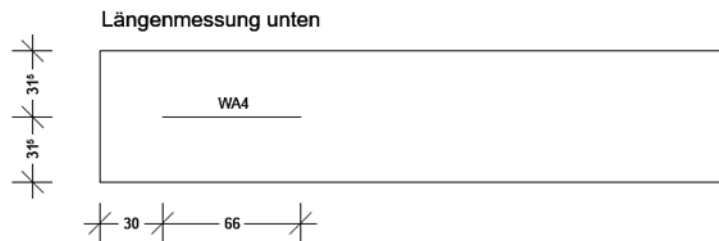
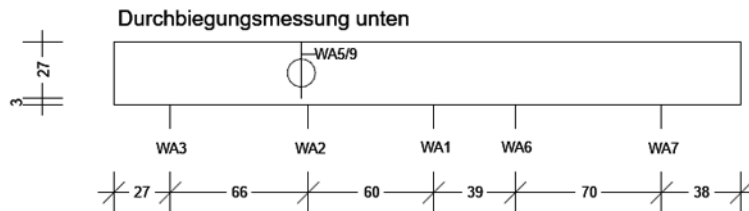
2Ø6 Bügel - 6 Bleche - Öffnung rund - $f_{cm,cube} = 40,6 \text{ N/mm}^2$ - $V_{Test} = 349,5 \text{ kN}$



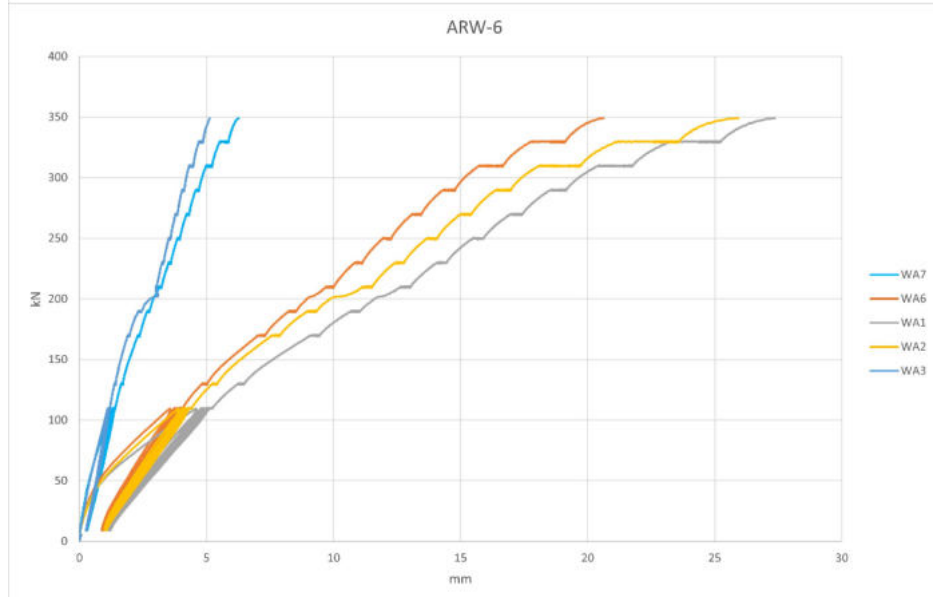
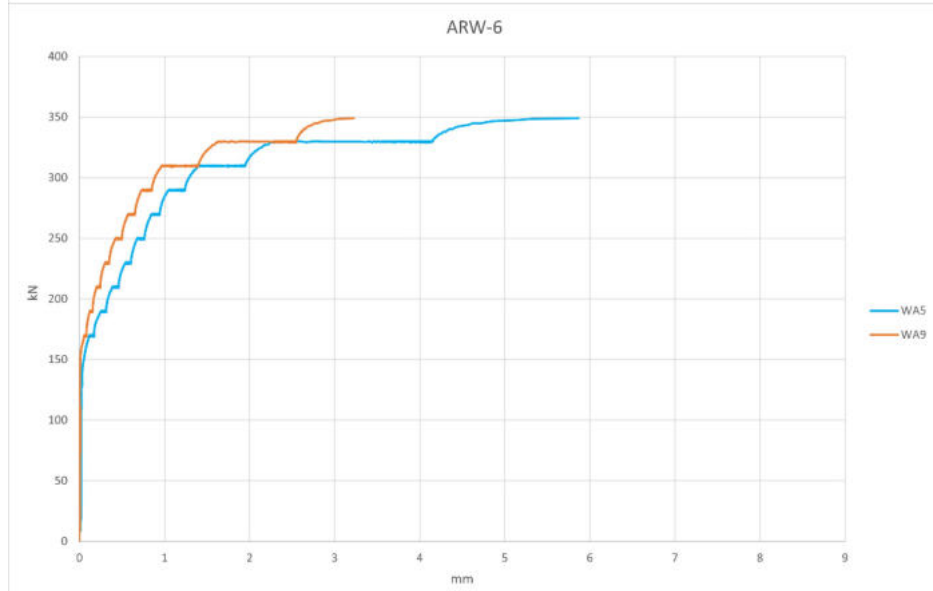
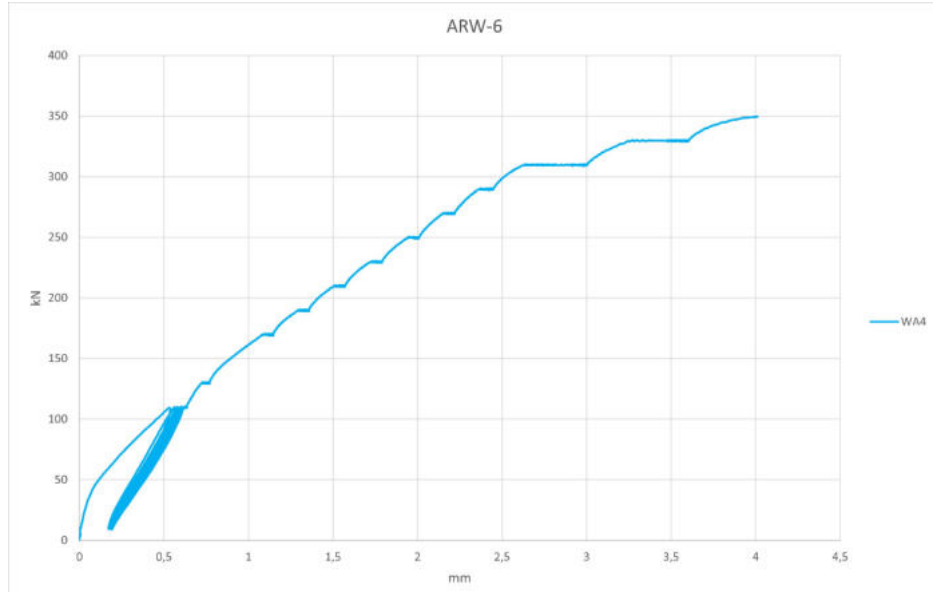
Die obere Bewehrung wurde in 2cm tiefe Schlitz in der Schalung eingelegt.

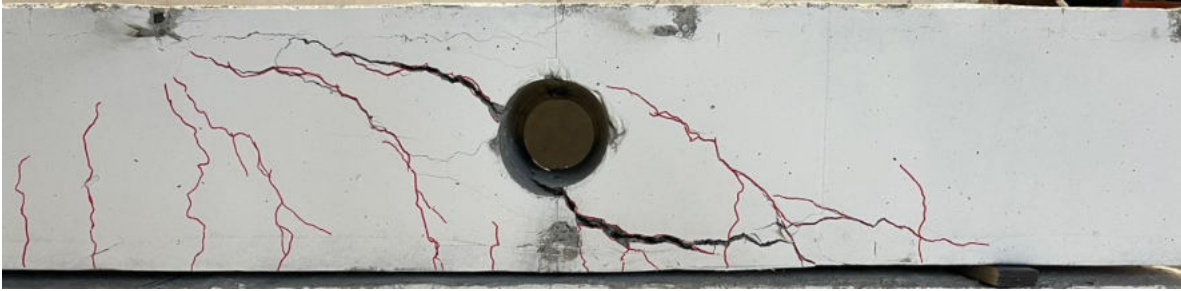


Anordnung der Wegaufnehmer



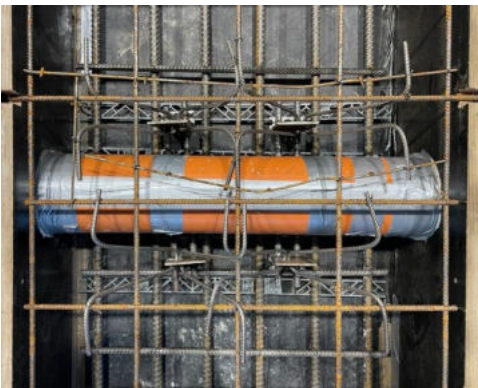
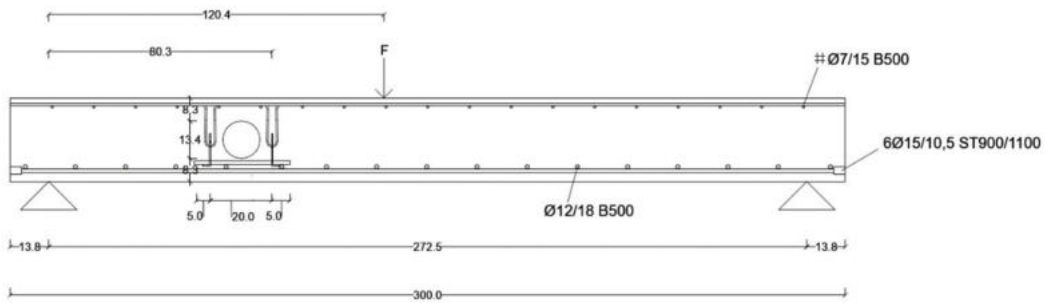
Last-Verformungs-Kurven



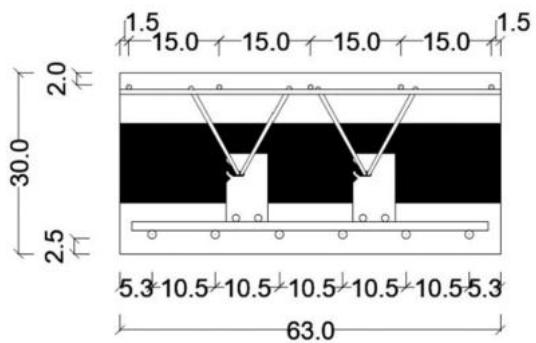


Datenblatt Prüfkörper ARW-7

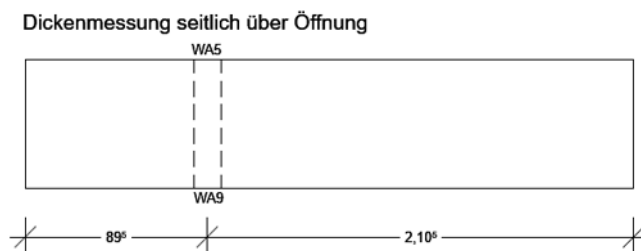
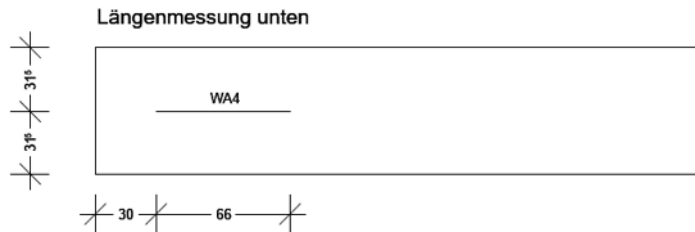
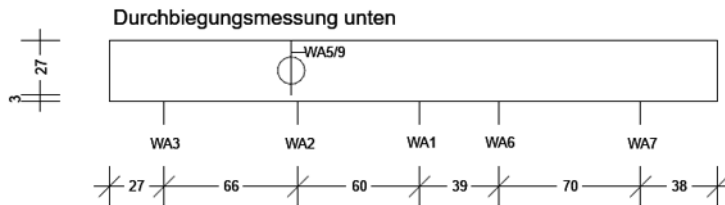
2Ø6 Bügel - 4 Bleche - Öffnung rund - aufgelegt - $f_{cm,cube} = 41,1 \text{ N/mm}^2$ - $V_{Test} = 270,3 \text{ kN}$



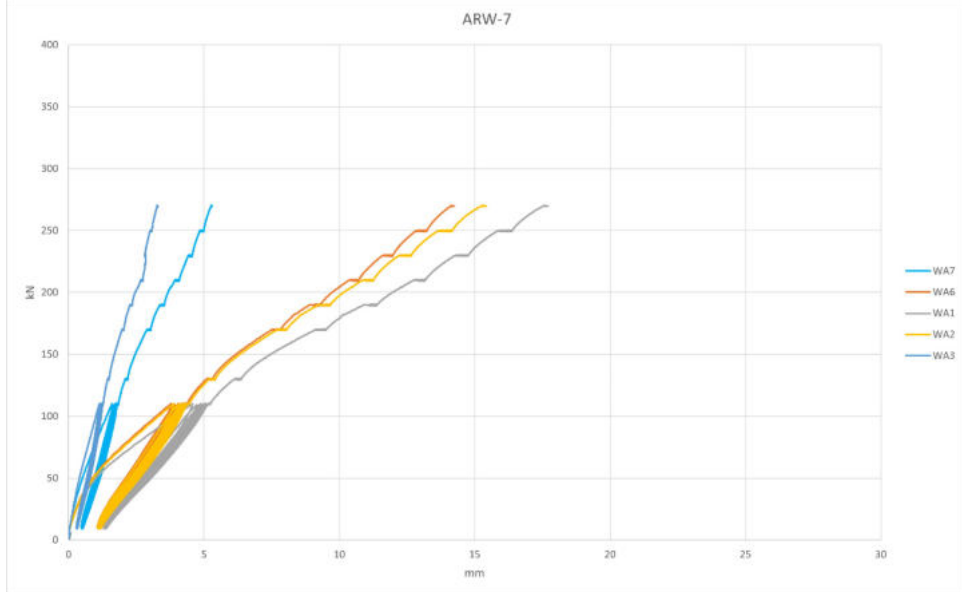
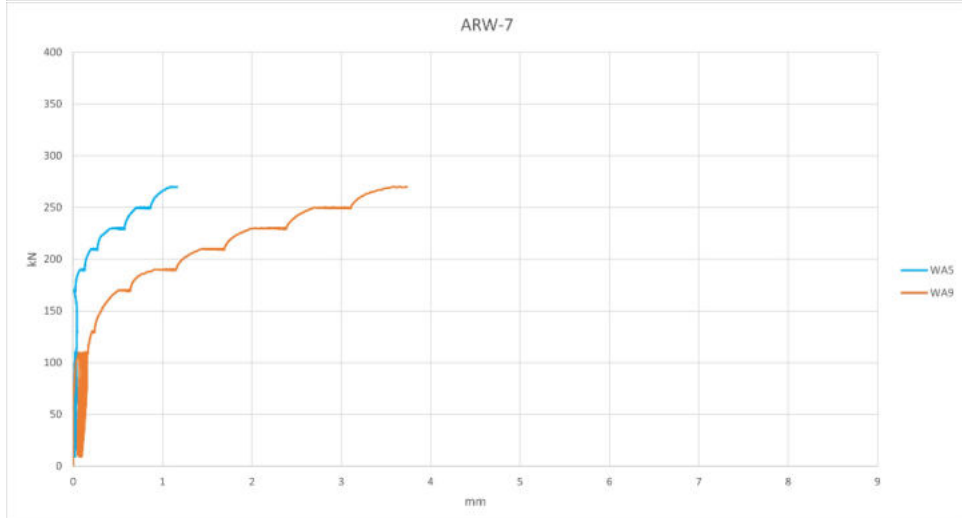
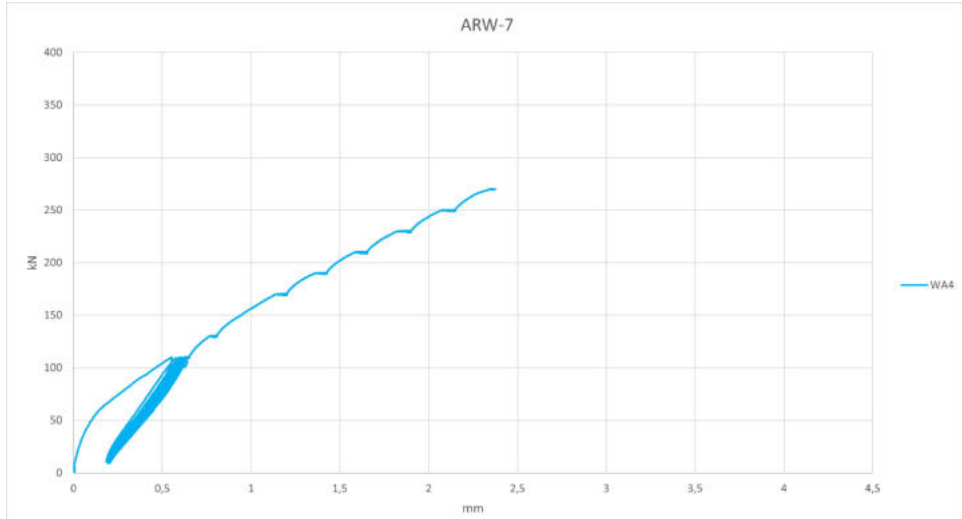
Die obere Bewehrung wurde in 2cm tiefe Schlitze in der Schalung eingelegt.

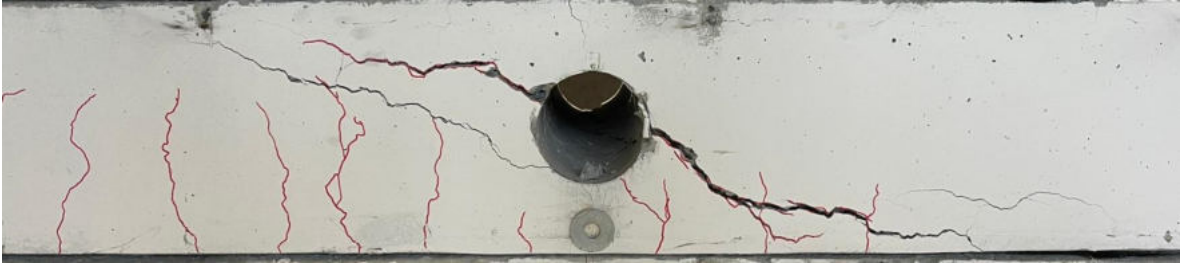
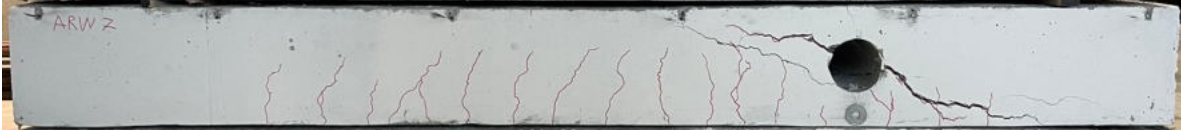


Anordnung der Wegaufnehmer



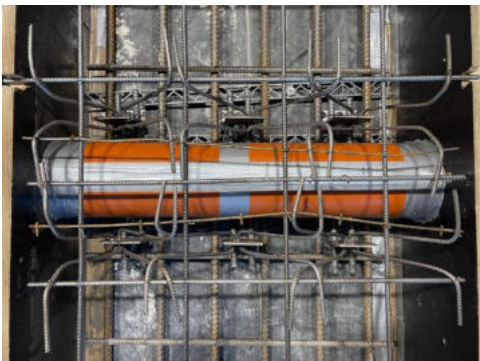
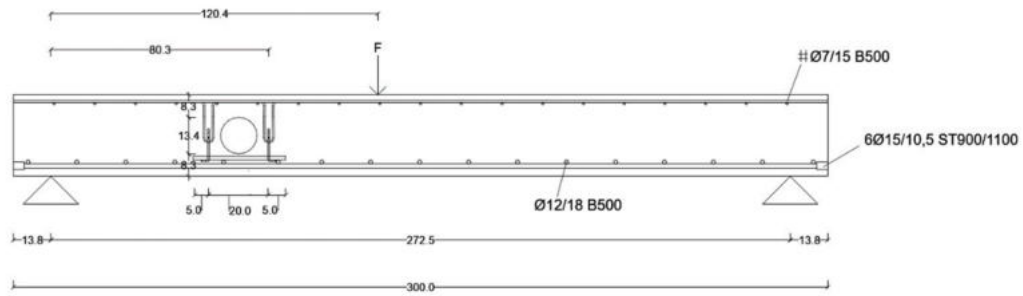
Last-Verformung-Kurven



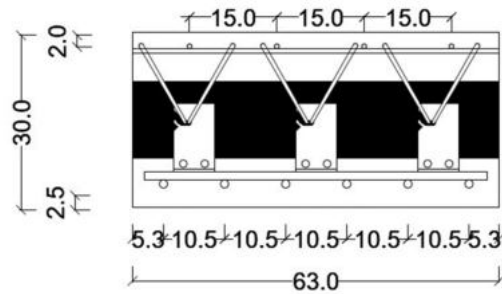


Datenblatt Prüfkörper ARW-8

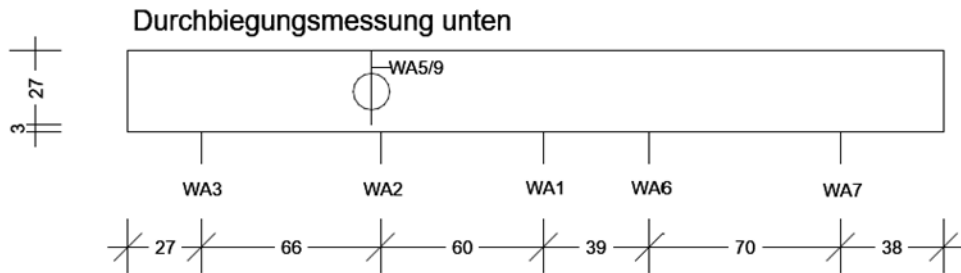
2Ø6 Bügel - 6 Bleche - Öffnung rund - aufgelegt - $f_{cm,cube} = 41,1 \text{ N/mm}^2$ - $V_{Test} = 310,3 \text{ kN}$



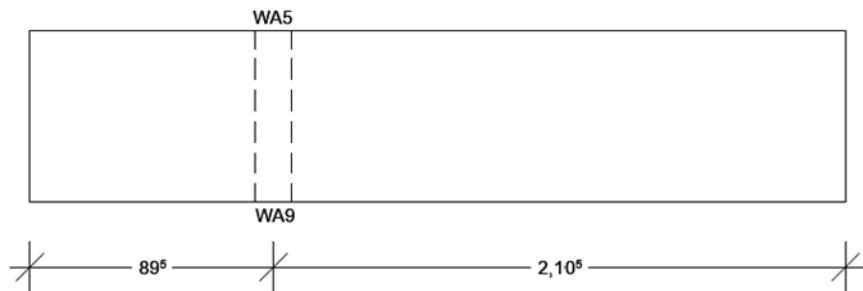
Die obere Bewehrung wurde in 2cm tiefe Schlitz in der Schalung eingelegt.



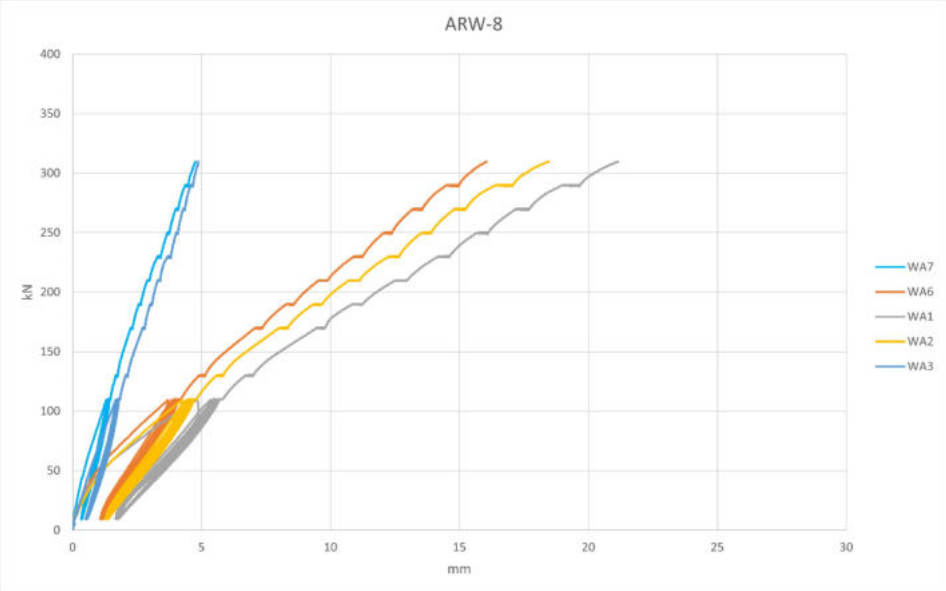
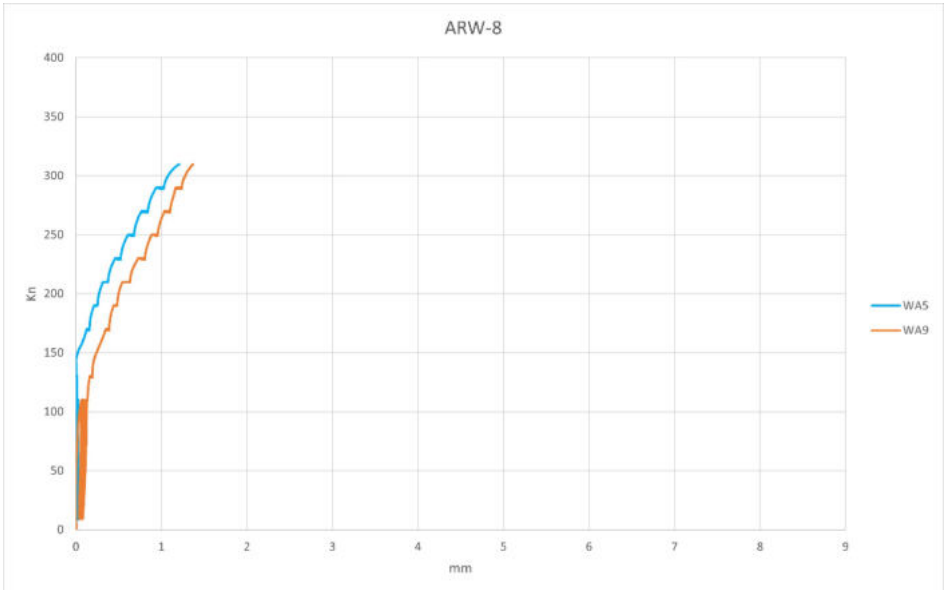
Anordnung der Wegaufnehmer

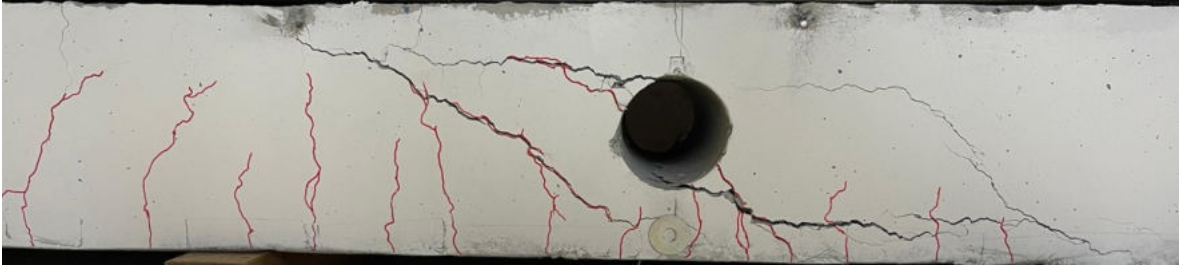


Dickenmessung seitlich über Öffnung



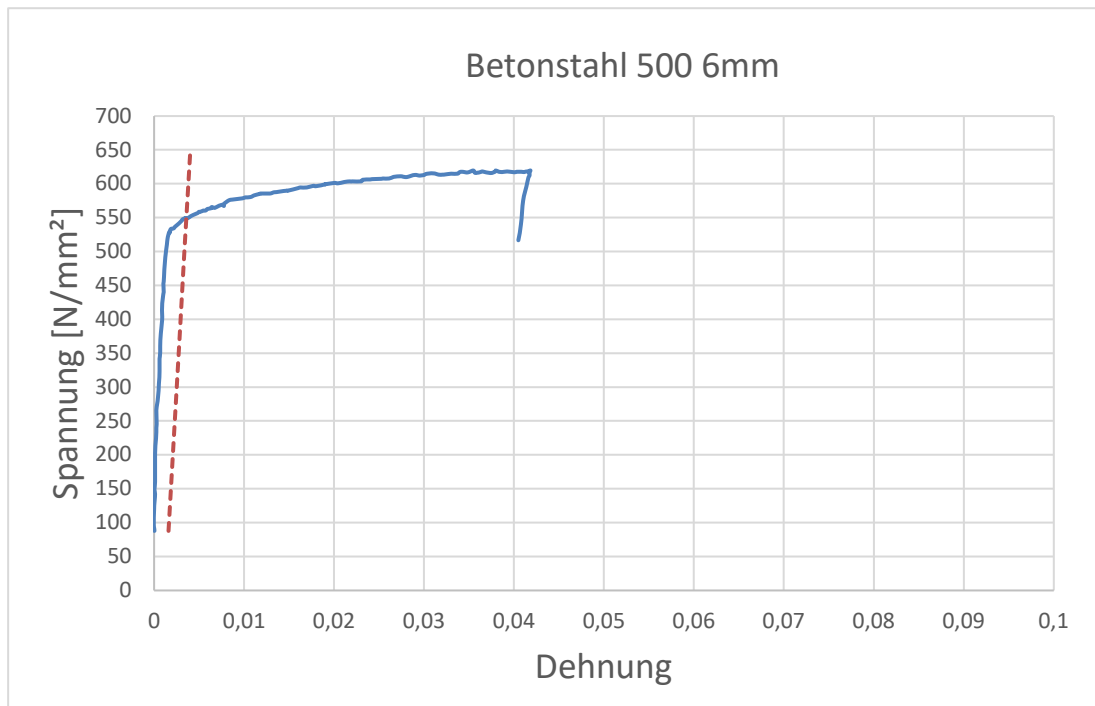
Last-Verformung-Kurven





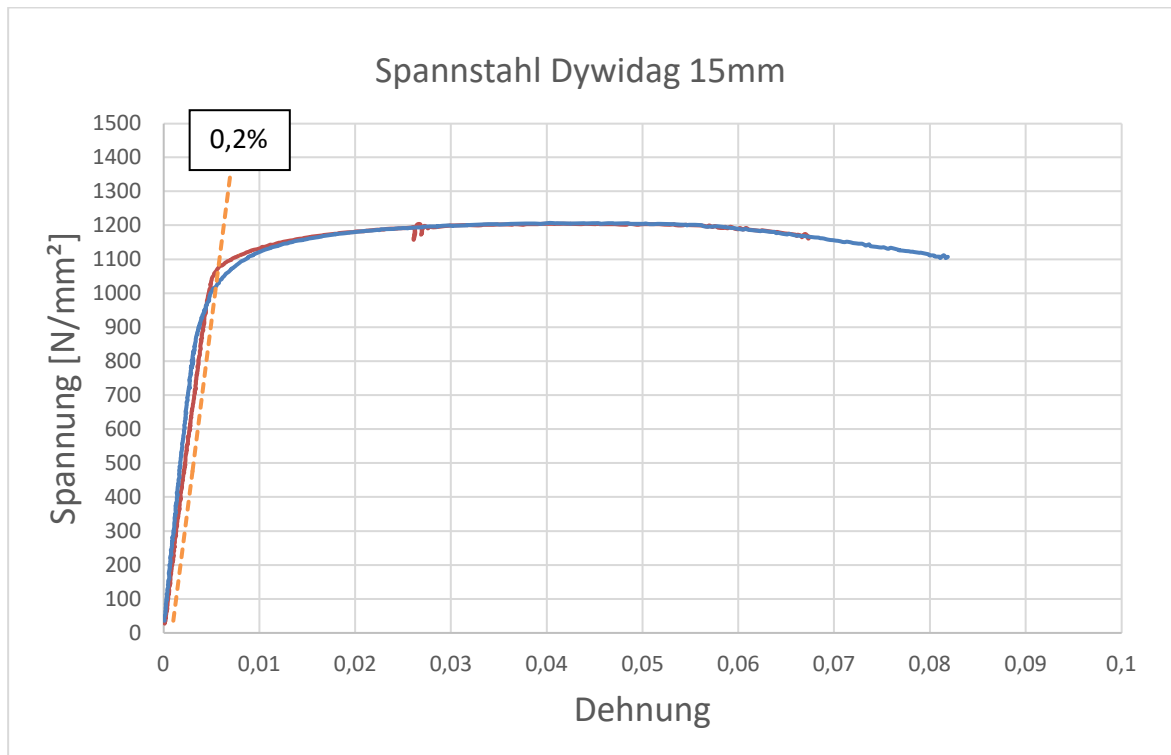
Stahlkennwerte - Zugversuche

Betonstahl 500 mit Durchmesser 6mm



B500 Durchmesser = 6mm		
Versuchskörper	Zugfestigkeit f_t [N/mm ²]	Streckgrenze $f_{0,2k}$ [N/mm ²]
Stab1	620	550
Stab2	619	520
Stab3	608	530
Mittelwert	615	533

Spannstahl Dywidag ST900/1100 mit Durchmesser 15 mm



Dywidag ST900/1100 Durchmesser = 15 mm		
Versuchskörper	Zugfestigkeit f_t [N/mm ²]	Streckgrenze $f_{0,2k}$ [N/mm ²]
Stab1	1206	1080
Stab2	1208	1010
Mittelwert	1207	1045