

The FLIMU-System – Connection of Reinforcing Steel



- FLIMU – The coupling system – DYWIDAG technology that has been successful for more than 25 years.
- Mechanical splices for all reinforcing steel bars range from Ø 16 mm to Ø 50 mm.
- Generally approved for construction: German approval „FLIMU-System” Z-1.5-150.

- FLIMU-Splices transfer 100 % of the force of the reinforcement steel in tension and compression loads.
- FLIMU-Splices show exceptionally high fatigue strengths.
- FLIMU-Splices are suitable for buildings in earthquake endangered areas as per DIN ISO 15835-1.

- Preparation of reinforcing steel is not necessary.
- Easy and quick installation with reliable and handy special extrusion rams in all positions of the reinforcing steel.



Content

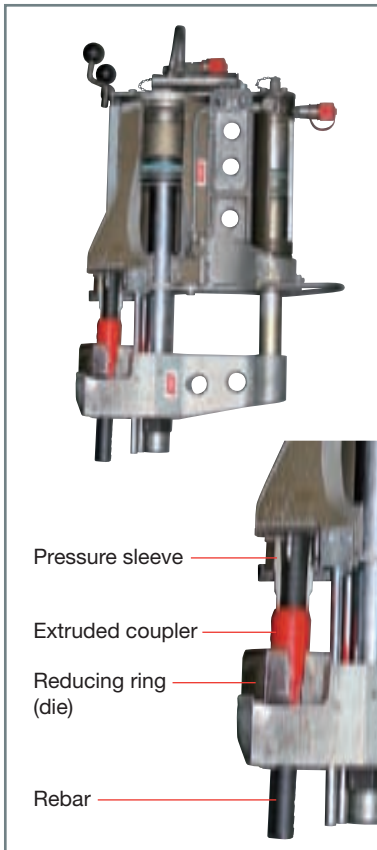
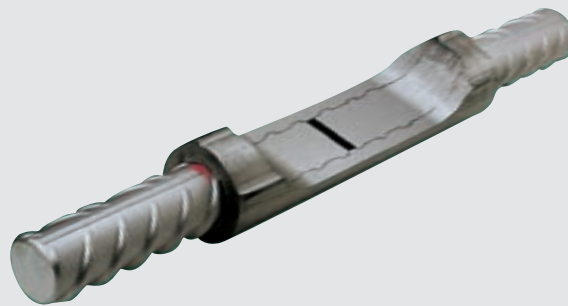
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General



The Extruded Coupler Splice System FLIMU by DYWIDAG is a mechanical splice which connects two reinforcing bars by means of extruding a coupler onto the reinforcing bars.

The extrusion of the coupler takes place by pulling a reducing ring (die) over the coupler. Compared to the outer diameter of the coupler, the reducing ring has a smaller inner diameter. Thus, the soft and specially treated coupler material is pressed onto the ribs of the reinforcing bar during extrusion. This creates a force fit connection between coupler and rebar. For this cold deformation process, robust and handy extrusion equipment has been developed for rough construction conditions.



The FLIMU-System is approved by the German Institute for Civil Engineering for reinforcing steel in diameters of 16 mm to 32 mm.

Approval certificate Z-1.5-150:

Mechanical splice and anchoring of deformed rebar using extruded couplers, nominal diameter: 16 to 32 mm, „FLIMU-System”

Reinforcing bars BSt 500 acc. to DIN 488 and GEWI® Steel BSt 500 S (with special thread pattern of DYWIDAG-Systems International) can be connected by means of the FLIMU-System. Furthermore, special solutions can be provided for any type of reinforcement.

An anchorage for normal rebars can be easily created with the FLIMU-System using a GEWI® Threadbar and its accessories.

The FLIMU-System can create splices of reinforcing bars from diameter $d_s = 16$ mm to $d_s = 50$ mm.

FLIMU-splices are designed to withstand a force corresponding to a minimum of 130 % of the nominal yield of the rebar.

Advantages of FLIMU-Splices for construction

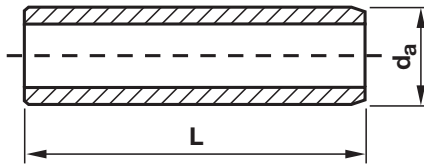
- The full nominal yield load of the spliced rebars can be transferred.
- Once extruded onto the ribs of the rebar, the coupler secures load transmission by means of a force-locked connection.
- Demand for the allowable slip under tension is fulfilled.
- The FLIMU-Splice is a 100 % connection, it fulfills full-tension splice requirements.
- FLIMU-Splices have highest fatigue strength with $\sigma_{s, \text{fat}, d} = 120 \text{ N/mm}^2$.
The reason for this is that the hardened and tempered outer layer of the rebar, manufactured with the Tempcore method will not be damaged during completion of the FLIMU-Splice.
- The requirements of the minimum distances of the rebars and the concrete cover acc. f.i. to DIN 1045-1 apply without restrictions.
- Reducing couplers for connecting rebars of different sizes are available.
- FLIMU-Splices are also suitable for low temperatures (e.g. for liquid gas tanks).
- Easy assembly of an anchorage by coupling with a GEWI®-bar with its accessories.



Advantages of FLIMU-Splices for installation

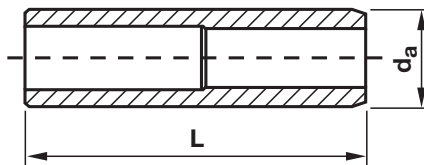
- No preparation for the rebars to be spliced is necessary; the FLIMU-Splice can be done at any location. An adjustment or turning of the rebars to be spliced is not necessary. This means that:
 - easy cutting of rebars at any required point is possible,
 - easy coupling of bent reinforcing steel.
- Slip demand for splices is automatically fulfilled due to extrusion (in contrast to screwed couplers, where torque is necessary).
- Only little space is required for the equipment: short distances between the rebars are possible. Even multi-layered reinforcements can be spliced.
- High performance; up to 30 splices can be done per hour.

Extruded coupler splice (FLIMU)



Extruded coupler (FLIMU)	for rebars BSt 500 S GEWI®-BSt 500 S							
	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	Ø 36	Ø 40	Ø 50
Item number	16 Z 150	20 Z 150	25 Z 160	28 Z 190	32 Z 230	36 Z 280	40 Z 310	50 Z 380
d_a Outer diameter of FLIMU [mm]	28	34	45	48	58	65	70	85
L Length of FLIMU [mm]	150	150	160	190	230	280	310	380
Type resp. force of extruder [kN]	150, 250		250	250	550	550	550	1000

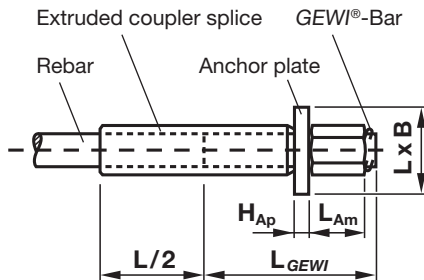
Extruded reducing coupler splice (FLIMU-R)*



Extruded reducing coupler (FLIMU-R)*	for rebars BSt 500 S GEWI®-BSt 500 S							
	Ø 16/20	Ø 20/25	Ø 25/28	Ø 28/32	Ø 32/36	Ø 36/40	Ø 40/50	
Item number	16/20 Z 150	20/25 Z 150	25/28 Z 170	28/32 Z 200	32/36 Z 240	36/40 Z 280	40/50 Z 320	
d_a Outer diameter of FLIMU [mm]	34	45	48	58	70	70	85	
L Length of FLIMU [mm]	150	150	170	200	240	280	320	
Type resp. force of extruder [kN]	250	250	250	550	550	550	1000	

*available on demand only

End anchorage with FLIMU and GEWI®



End anchorage with FLIMU and GEWI® with GEWI®-Anchor nut (T 2002) and Anchor plate (T 2008)	for rebar BSt 500 S GEWI®-BSt 500 S						
	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	Ø 40	Ø 50
Item number	16 Z 150	20 Z 150	25 Z 160	28 Z 190	32 Z 230	40 Z 310	50 Z 380
Outer diameter of FLIMU [mm]	28	34	45	48	58	70	85
L Length of FLIMU [mm]	150	150	160	190	230	310	380
Type resp. Force of extruder [kN]	150, 250		250	250	550	550	1000
L_{GEWI} Length of GEWI®-Bar [mm]	150	160	170	200	240	270	330
M_{kont} Torque moment for locking GEWI®-end anchorages [kNm]	0,2	0,35	0,7	0,95	1,60	2,9	8,0
GEWI®-Anchor nut (T 2002)							
L_{Am} Length of anchor nut [mm]	40	45	50	55	60	70	85
SW Width across flats [mm]	32	36	41	46	55	60	80
GEWI®-Anchor plate (T 2008)							
B Width of square anchor plate [mm]	50	60	70	85	100	120	150
H_{Ap} Height of anchor plate [mm]	8	10	12	14	15	17	20

Extruder

Extruders are special hydraulic jacks developed by DYWIDAG-Systems International. For the preparation of FLIMU-Splices with rebars \varnothing 16 to \varnothing 50 mm, 4 types of extruder are available.



Reducing ring (die), Pressure sleeve

Various exchangeable extruding sets consisting of reduction ring and pressure sleeve can be used for different sizes of rebars. Reducing ring and pressure sleeve are wearing parts and must be replaced after approx. 600 applications. The inner diameter of the reducing ring must not exceed a given value. The shoulder of the pressure sleeve shall not be excessively deformed.

The surface of the reducing ring shall be smooth at its inner side. After repeated use the reducing ring must eventually be polished with a special brush.



Balancer

For easy handling, extruders are suspended from balancers.



Hydraulic aggregates

Extruders are operated by hydraulic aggregates. For the types 150 and 250, hydraulic aggregate types 77-159 are available. Jack types 550 and 1000 are operated by hydraulic aggregate types R 13.3.

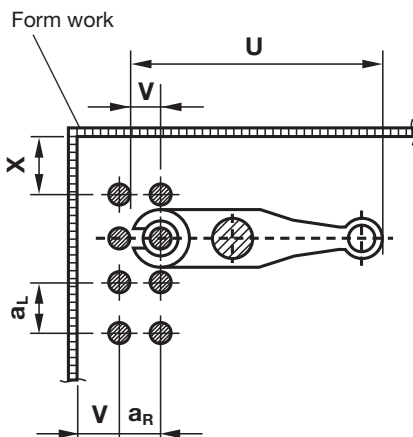
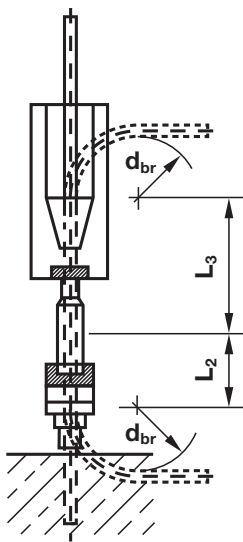
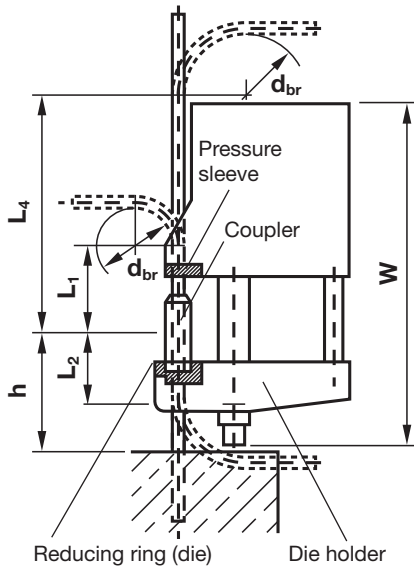


Type R 13.3

Type 77-159

During design and creation of structural drawings, the space required for the handling of the extruder and for the creation of a FLIMU-Splice must be considered.

Space required for the creation of a FLIMU-Splice



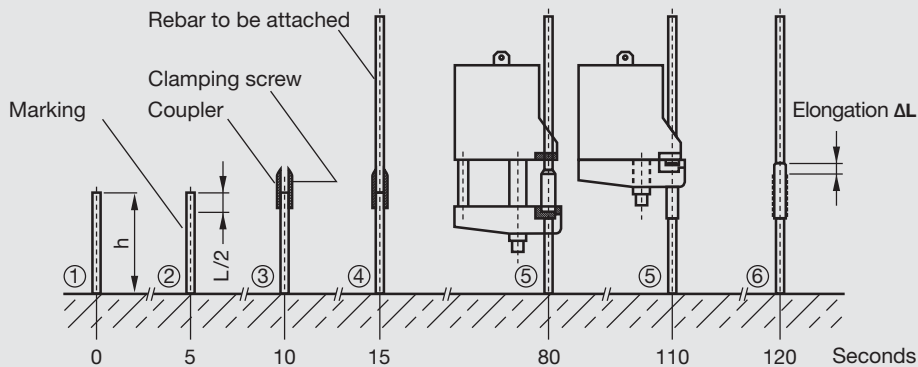
		Extruder								
		Type 150	Type 250		Type 550		Type 1000			
Maximum force of the extruder	[kN]	150	250		550		1000			
Suitable for rebars with diameter	[mm]	Ø 16/20	Ø 16/20	Ø 25	Ø 28	Ø 32	Ø 36	Ø 40	Ø 50	
L/2 Half length of the extruded coupler	[mm]	75	75	80	115	115	140	155	190	
Smallest possible laying distance and smallest minimum dimensions of rebars to be coupled										
a _L	Laying distance of rebars, parallel to form work	[mm]	60	75	80	80	110	115	115	150
a _R	Laying distance of rebars, perpendicular to form work	[mm]	60	70	75	75	100	105	105	150
h	Protrusion of the rebar from the construction joint	[mm]	250	350	350	350	550	550	550	520
L ₁	Distance for bent rebar	[mm]	220	260	260	260	380	380	380	450
L ₂	Distance for bent rebar	[mm]	170	200	200	200	340	340	340	380
L ₃	Distance for bent rebar	[mm]	400	350	350	350	650	650	650	770
L ₄	Distance for bent rebar	[mm]	570	540	540	540	980	980	980	1100
Space requirement of the extruding jack										
W	Length of the extruding jack	[mm]	900	900	900	900	1540	1540	1540	1860
U	Depth of the extruding jack	[mm]	300	400	400	400	650	650	650	800
V	Outer radius of the reducing ring	[mm]	50	60	60	60	80	80	80	110
X	Lateral distance to the form work	[mm]	70	80	80	80	120	120	120	180

Working steps during the installation of a FLIMU-Splice

1. Verify if required bar protrusion h is available.
2. Marking of rebar one half coupler length from end of bar.
3. Put extruding coupler with chamfered end pointing upwards onto the rebar and secure it with a set screw. It is important that the chamber of the coupler is being placed against the pressure sleeve of the extruder. Otherwise, the coupler may get jammed inside the pressure sleeve during splicing.
4. Insert the mating rebar into the extruding coupler.
5. Attach the extruder, splice, detach the extruder.
6. The engagement length of the rebar needs to be controlled by measuring the elongation ΔL of the coupler which was caused by extrusion. If done correctly, the elongation shall be around 10 % of the original coupler length.

The allowable elongations are shown in the following chart:

If several FLIMU-Splices have been put in place, only random inspections are necessary to check the elongation.

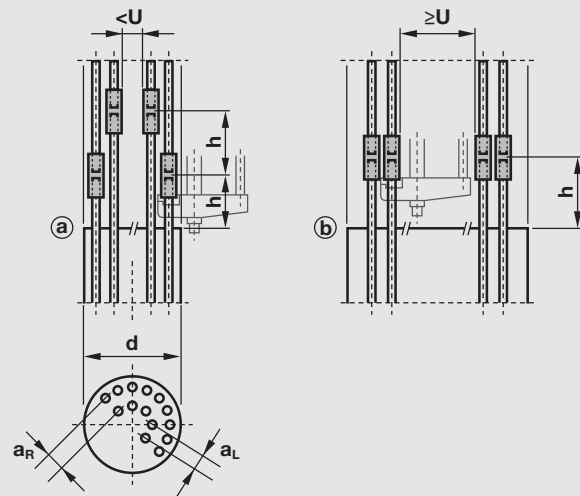


Elongation of the extruded coupler (FLIMU)	For rebars BSt 500 S and GEWI®-BSt 500 S							
	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	Ø 36	Ø 40	Ø 50
Item number	16 Z 150	20 Z 150	25 Z 160	28 Z 190	32 Z 230	36 Z 280	40 Z 310	50 Z 380
L Length of FLIMU coupler [mm]	150	150	160	190	230	280	310	380
ΔL Elongation of FLIMU coupler after extruding and allowable deviation [mm]	15 ±2	15 ±2	16 ±2	19 ±2	23 ±3	28 ±3	31 ±4	38 ±5
L_N Length of FLIMU after extruding and allowable deviation [mm]	165 ±2	165 ±2	176 ±2	209 ±2	253 ±3	308 ±3	341 ±4	428 ±5

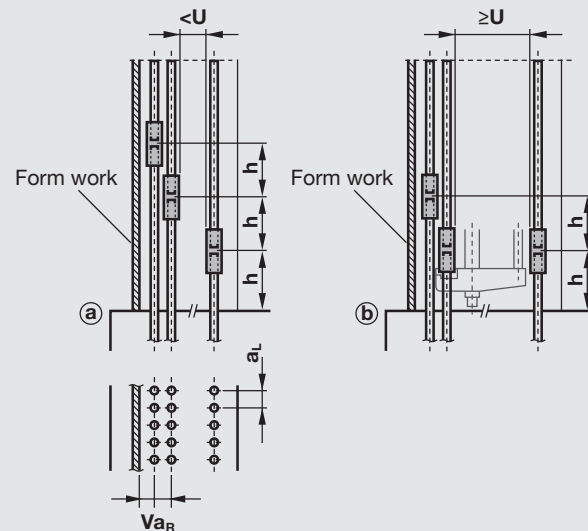
FLIMU-Splices can be used wherever required space is available.

Some typical applications for the FLIMU-System are indicated below. These include the coupling of rebars for columns, walls, slabs and frame edges as well as the anchoring of shear bars in combination with GEWI® anchorages.

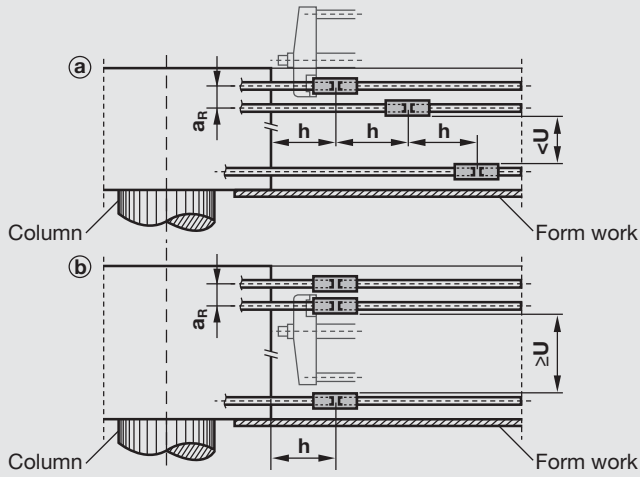
Columns



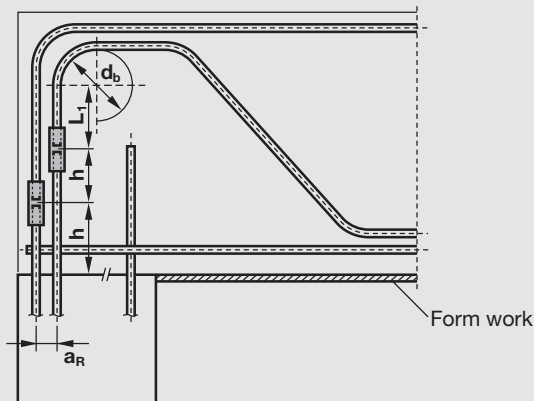
Walls



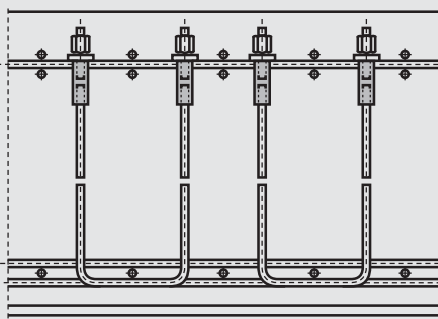
Ceilings



Frame corners



End anchorage of base slab shear reinforcement



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