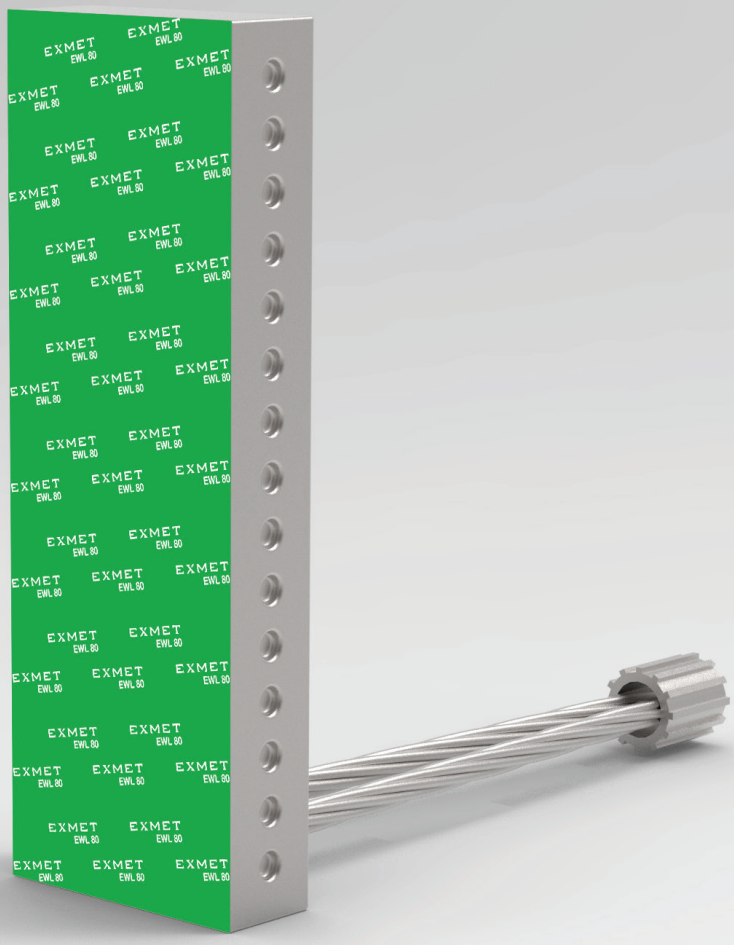
EXMET
PRECAST ACCESSORIES



EWL - 9 SINGLE WIRE LOOP
(WIRE LOOP BOX)

TECHNICAL MANUAL

EXM-EWL-9-DC-1003
R3 - 13.10.2022

TABLE OF CONTENT

EWL - 9 SINGLE WIRE LOOP

1. PRODUCT DESCRIPTION

EWL Wire Loop Boxes are used for wall to wall and wall to column connections. EWL Wire loop box consists of a steel box, wire rope and tape. The key benefits and features of EWL Wire loop box are as below:

- High Strength Galvanized Wire Loop.
- Easy installation, individual boxes are installed.
- Available for lightweight concrete elements.
- Pre-punched nail holes for easy fixing to formwork.

EWL Wire Loop Box is attached to the formwork either with nails or with the help of specially designed Exmet EWL magnet. Before Erection, the tape is taken off, the flexible wire is pulled out and is bended to make the wire loop perpendicular to the joint. The spacing of the Wire Loop Box depends upon the forces to be carried by the joint after casting. The wire loop joint is formed by installing a rebar inside the loop formed by Wire Loop Boxes on both sides of the joint and grouting the space between two walls or wall and column. The joint after grouting can resist shear as well as tensile forces.

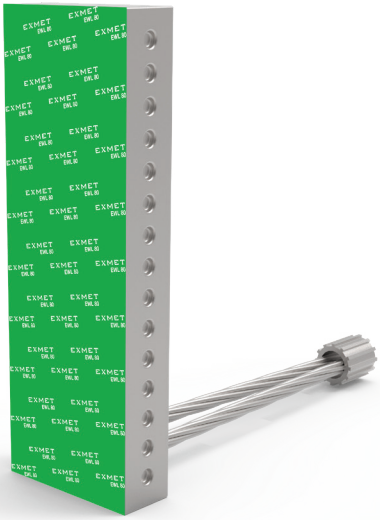


Figure 1. EWL - 9 Single Wire Loop Box

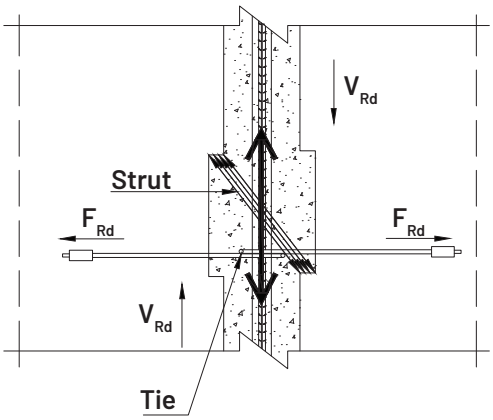


Figure 3: Vertical Shear Load Transfer

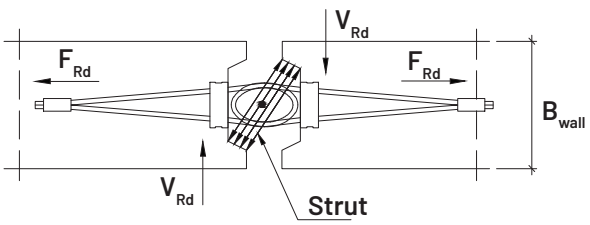


Figure 2: Transverse Shear Load Transfer

2. TECHNICAL INFORMATION

2.1. Structural Behaviour

EWL Wire Loop Box connection is designed to transfer vertical and transverse shear forces, tensile forces and combination of forces. Steel Boxes make recesses in wall joint that help in transferring both vertical and transverse shear forces. The concrete between opposite recesses acts as 'strut' and transfers compression whereas the wire loop acts as a 'Tie' and transfers tension. It is to be noted that the joint does transfer any bending moment.

2.2 Temporary Condition

The wire loop joint cannot be loaded during erection until the joint is grouted. The wall or column element must be held in position by temporary bracing. The joint can only be loaded after it has been grouted and the grout has reached its required strength.

2.3 Final Condition

After the grout reaches the required strength, the joint can be considered load bearing and can be loaded with other structures. The joint transfers load by strut and tie action.

3. APPLICATION CONDITIONS

3.1 Loading and Environmental Condition

EWL Wire Loop Boxes are designed to carry static loads. In case, EWLs are to be used in dynamic or seismic conditions, please contact technical@exmet.ee. Wire Loop Boxes have been designed in accordance with EN 1992.1.1:2004 & EN 1992-1-2:2004. Wire Loop boxes can be used both indoor and outdoor conditions. Standard EWL Wire Loop Box is galvanized and provides resistance against corrosion. However, concrete cover requirements mentioned in EN 1992-1-1 must be followed.

3.2 Thickness of Concrete Wall

Minimum thickness of concrete element and joint width is shown in Table 1.

Table 1. Minimum Thickness of Wall and Joint Width

Wire Loop	B_{wall} [mm]	B [mm]
EWL – 80/9	150	100
EWL – 100/9	150	120
EWL – 120/9	150	140
EWL – 140/9	150	160

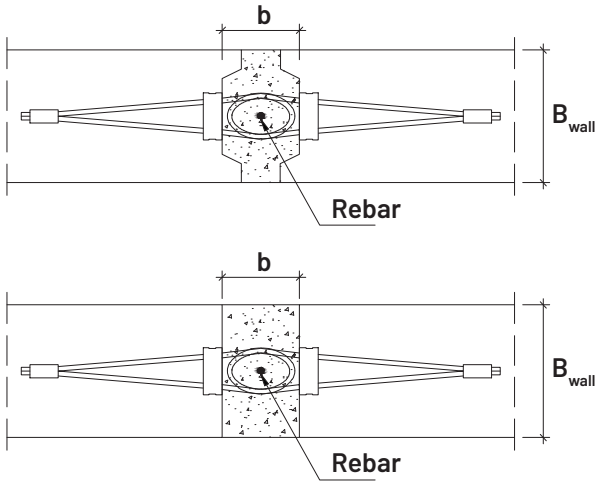


Figure 3: EWL - 9 Wire Loop Box

3.3 Arrangement of the Wire Loop Connection

EWL Wire Loop Box has been designed for use in reinforced concrete walls or columns with minimum concrete grade of C25/30. The strength of grout must be at least the same as that of precast element. Please find below the picture for dimensions of indents to be followed to ensure the resistances presented in this manual .

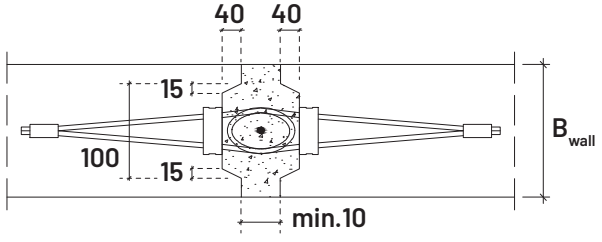


Figure 4: Minimum Dimensions of the Joint for EWL-9

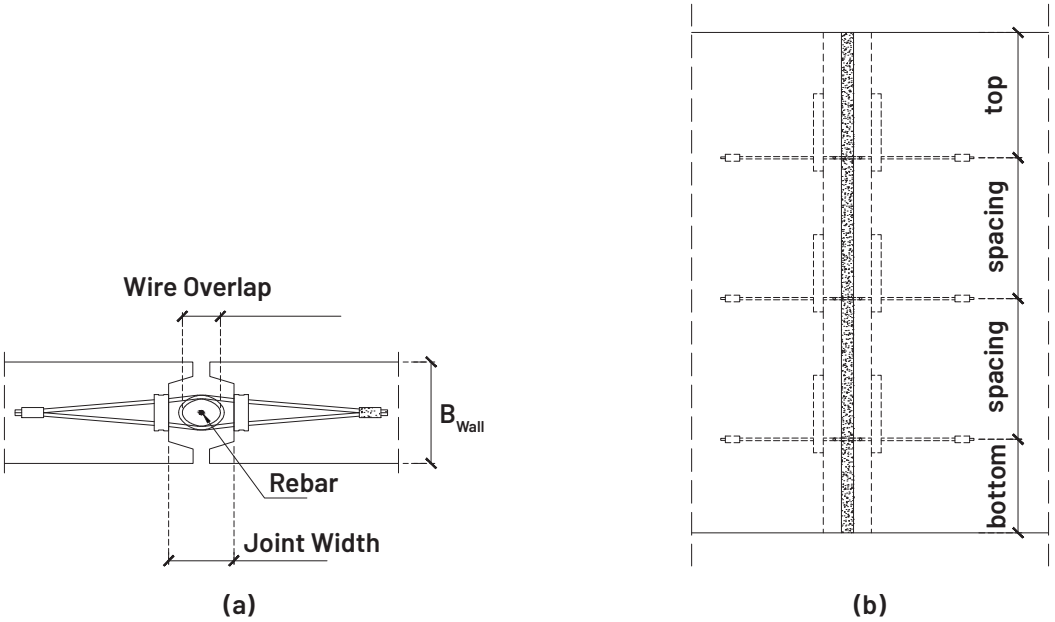


Figure 5: Spacing Requirement for Connection Loops

Table 2. Minimum Spacing Requirement for Connection Loops

Wire Loop	Wall Thickness B_{wall} [mm]	Joint Width [mm]	Wire Overlap [mm]	Top [mm]	Bottom [mm]	Spacing [mm]
EWL – 80/9	150	100	15	≥200	≥200	≥200 / ≤750
EWL – 100/9	150	120	15	≥200	≥200	≥200 / ≤750
EWL – 120/9	150	140	15	≥200	≥200	≥200 / ≤750
EWL – 140/9	150	160	15	≥200	≥200	≥200 / ≤750

4. PRODUCT INFORMATION AND MANUFACTURING

4.1 Materials

EWL - 9 wire loop box are manufactured with the following materials which are shown below:

Table 3. Materials used in EWL - 9 Wire Loop Box

Part	Material	Standard
Box	Galvanized Metal Sheet	JIS G3302
Ferrule	Alloyed Steel	EN 13411-3, GB/T 8162-2018
Wire Rope	Grade = 1770 Steel wire Ø6 9x19 IWRC Steel wire Ø8 9x19 IWRC	EN 12385-2 GB/T 20118-2006
Protective Tape	Duct Tape	

4.2 Wire Loop Dimensions

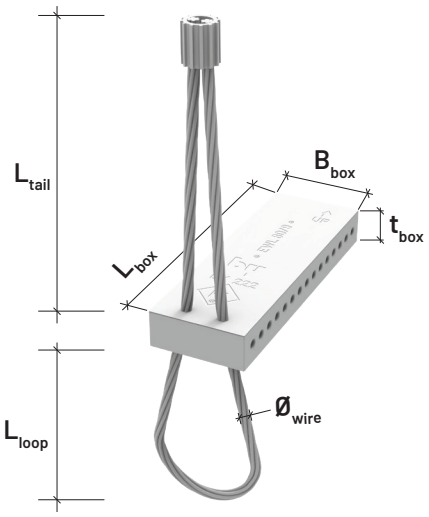


Figure 6. Product Dimension

Table 4. Dimensions and allowable tolerances of EWL - 9 Wire Loop Box

Wire Loop	L_{box} [mm]	L_{loop} [mm]	L_{tail} [mm]	B_{box} [mm]	t_{box} [mm]	$Ø_{wire}$ [mm]	Tape Colour
EWL – 80/9	120	80	250	60	30	9	Blue
EWL – 100/9	160	100	250	60	30	9	Red
EWL – 120/9	160	120	250	60	30	9	Orange
EWL – 140/9	200	140	250	60	30	9	Black

4.3 Manufacturing Markings

Product package is equipped with an EXMET – sticker, which contains the following information:

Product Type
Product Name
Quantity
FI Marking
Product Picture

Products are delivered in plywood boxes on a truck pallet. Plywood boxes are marked with FI and BY (Concrete Association of Finland) logo and the number of certified product declaration and the product name and type.

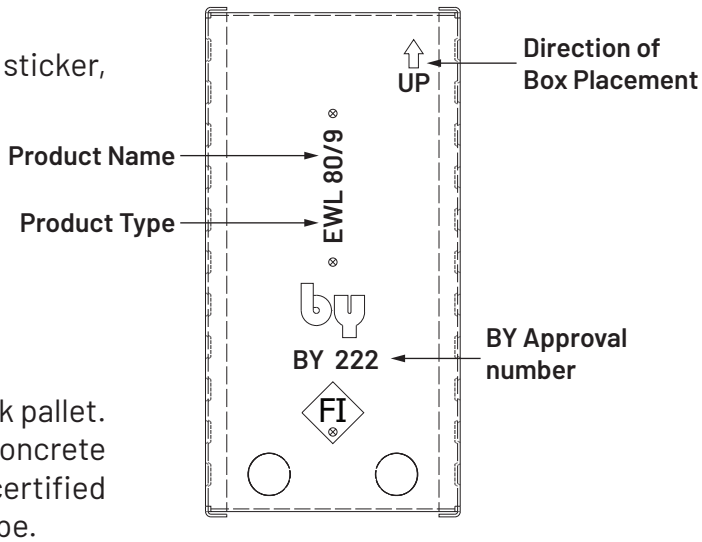


Figure 7. Marking

4.4 Manufacturing Method

The steel box is mechanically cut and bent to shape. The open wire rope is installed to the steel box and is attached by the compression sleeve to form a loop. The wire loop is bent into the steel box and the open part of the steel box is closed by tape to protect from casting concrete.

4.5 Manufacturing Tolerances

Table 5. Materials used in EWL - 9 Wire Loop Box

Part	Material
Wire loop length	± 2.0 mm
Box length	± 2.0 mm

4.6 Quality Control

Quality control of the wire rope loops is done according to EN 1090-2. Exmet PA OÜ has a quality control contract with Inspecta Sertifiointi Oy.

5. RESISTANCES

Design values of shear resistances are referred for following design standards:

5.1 Tensile Resistance

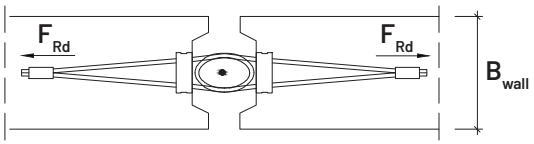


Figure 8: Tensile Resistance of Wire

Table 6. Tensile Resistances for Wire Loop (F_{Rd})

Wire Loop	B_{wall} [mm]	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
EWL – 80/9	≥150	22.17	26.27	30.20	34.09	37.94	41.77
EWL – 100/9	≥150	22.30	26.27	30.20	34.09	37.94	41.77
EWL – 120/9	≥150	22.30	26.27	30.20	34.09	37.94	41.77
EWL – 140/9	≥150	22.30	26.27	30.20	34.09	37.94	41.77

$\Sigma F_{Rd} = n.F_{Rd}$ (n = number of loops pairs as per 1m length of joint)

5.2 Shear Resistance

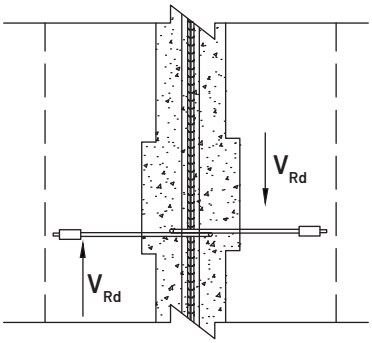


Figure 9: Vertical Shear Resistance

Table 7. Shear Resistances for Wire loop (V_{Rd})

Wire Loop	C12/15	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
EWL – 80/9	150	30.12	35.34	40.30	44.98	49.40	53.55
EWL – 100/9	150	30.12	35.34	40.30	44.98	49.40	53.55
EWL – 120/9	150	30.12	35.34	40.30	44.98	49.40	53.55
EWL – 140/9	150	30.12	35.34	40.30	44.98	49.40	53.55

$\Sigma V_{Rd} = n.V_{Rd}$ (n = number of loops pairs as per 1m length of joint)

5.3 Transverse Shear Resistance

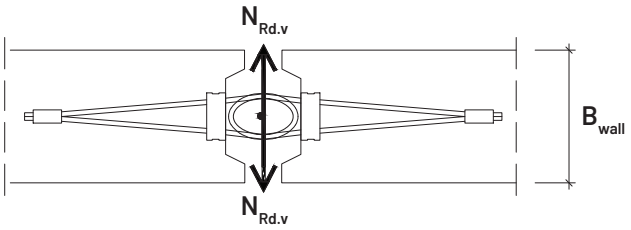


Figure 10: Shear Resistance with Indentation

Table 8. Shear Resistances for Wire Loop with Indentation ($N_{Rd.v}$)

Wire Loop	B_{wall} [mm]	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
EWL – 80/9	150 ≥160	16.09 18.56	17.62 20.33	19.03 21.96	20.35 23.48	21.58 24.90	22.75 26.25
EWL – 100/9	150 ≥160	16.09 18.56	17.62 20.33	19.03 21.96	20.35 23.48	21.58 24.90	22.75 26.25
EWL – 120/9	150 ≥160	16.09 18.56	17.62 20.33	19.03 21.96	20.35 23.48	21.58 24.90	22.75 26.25
EWL – 140/9	150 ≥160	16.09 18.56	17.62 20.33	19.03 21.96	20.35 23.48	21.58 24.90	22.75 26.25

$\Sigma N_{Rd.v} = n.\ N_{Rd.v}$ (n = number of loops pairs as per 1m length of joint)

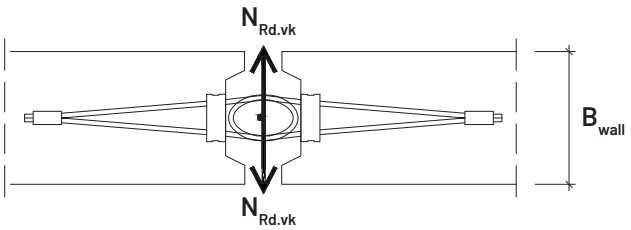


Figure 11: Shear Resistance without Indentation

Table 9. Shear Resistances for Wire Loop without Indentation ($N_{Rd.vk}$)

Wire Loop	B_{wall} [mm]	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
EWL – 80/9	≥150	2.23	2.44	2.64	2.82	2.99	3.15
EWL – 100/9	≥150	2.97	3.25	3.51	3.76	3.98	4.20
EWL – 120/9	≥150	2.97	3.25	3.51	3.76	3.98	4.20
EWL – 140/9	≥150	3.71	4.07	4.39	4.70	4.98	5.25

$\Sigma N_{Rd.vk} = n.N_{Rd.vk}$ (n = number of loops pairs as per 1m length of joint)

5.4 Fire Resistance

Minimum thickness of the wall must fulfil requirements according to EN 1992-1-2: 2004; section 5.4. Connection loops are designed for load bearing and non load bearing walls.

5.5 Design Verification and Example:

If there is no tensile force acting on the joint, the connection can be verified as per equation below:

$$\frac{V_{Ed}}{V_{Rd}} + \frac{N_{Ed}}{N_{Rd}} \leq 1.0$$

Design Example of EWL-80/9

Input Parameters:

Concrete Grade = 25/30
Wall thickness = 150 mm
Height of wall = 3200 mm
Vertical shear load per length of wall (V_{Ed}) = 152.7 kN

Solution:

Assuming spacing b/w loop boxes = 400mm

Number of EWL loop box pairs for total height of joint

Nos. = 3200/400 = 8 nos.

Vertical shear resistance of EWL - 80/9 = V_{Rd} = 30.12 kN

Shear resistance of joint = 8 x 30.12 = 240.96 kN

Verification:

$$\frac{V_{Ed}}{\Sigma V_{Rd}} + \frac{152.7}{240.96} = 0.63 \leq 1.0$$

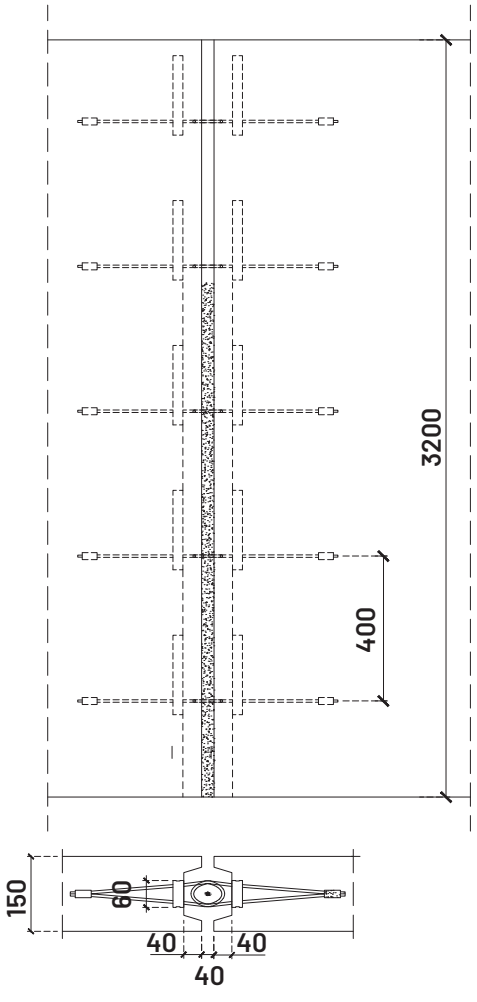


Figure 12: Tensile Resistance without Indentation

6. ADDITIONAL REINFORCEMENT

Additional reinforcement should always be provided for EWL 9. Additional reinforcement in the form of U-Stirrups is provided as close to the loop box as possible and is anchored in the concrete. Element reinforcement can also be treated as additional reinforcement if it meets the criteria mentioned above. Additional reinforcement is provided as shown in figure below for, maximum bearing capacity for wire loop.

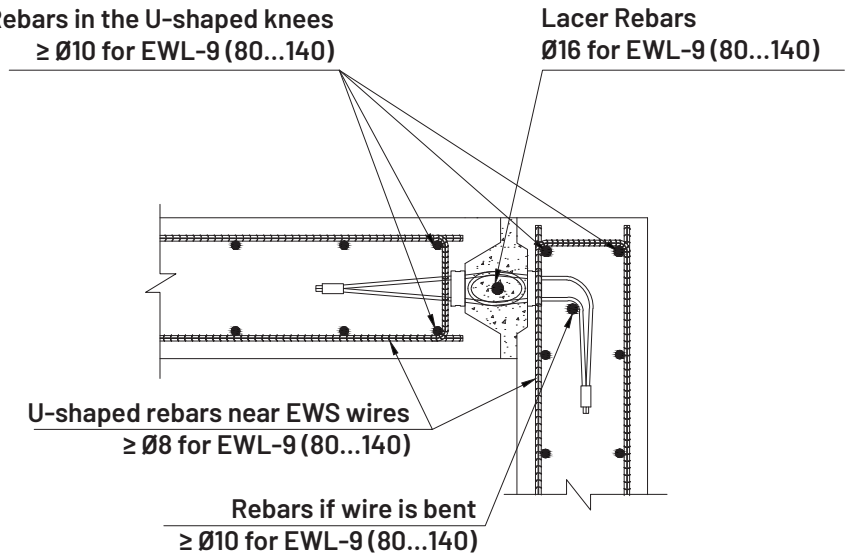


Figure 13: Reinforcement at Wall End with EWL-9 Wire Loops

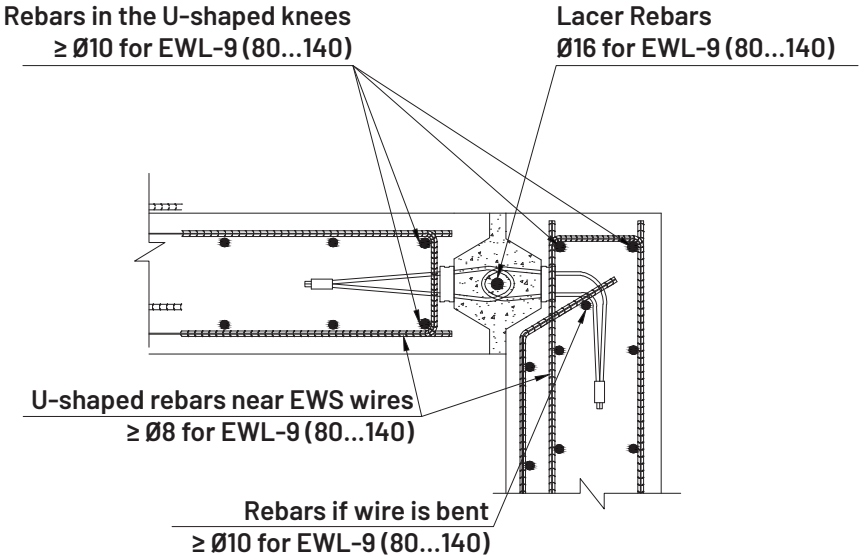


Figure 14: Reinforcement at Wall End with EWL-9 Wire Loops

6.1 Option Arrangement of EWL-9:

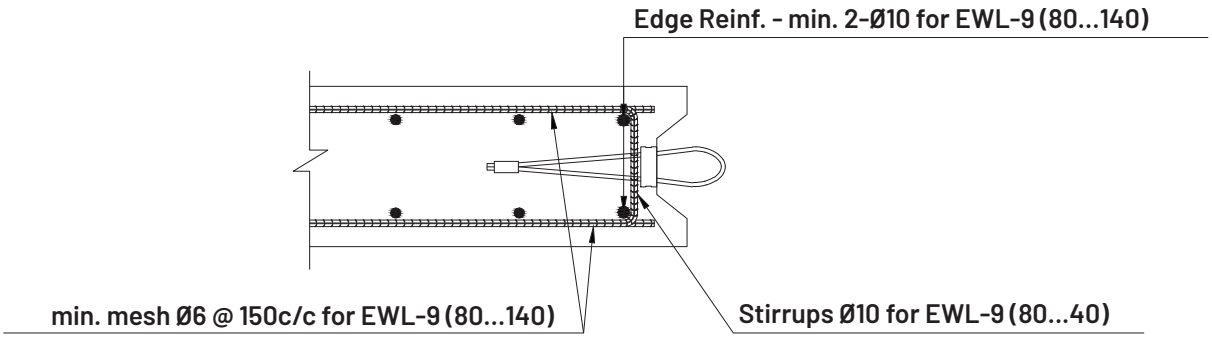


Figure 15: Option for Additional Reinforcement for EWL-9 Wire Loop

6.2 Additional Reinforcement for EWL-9:

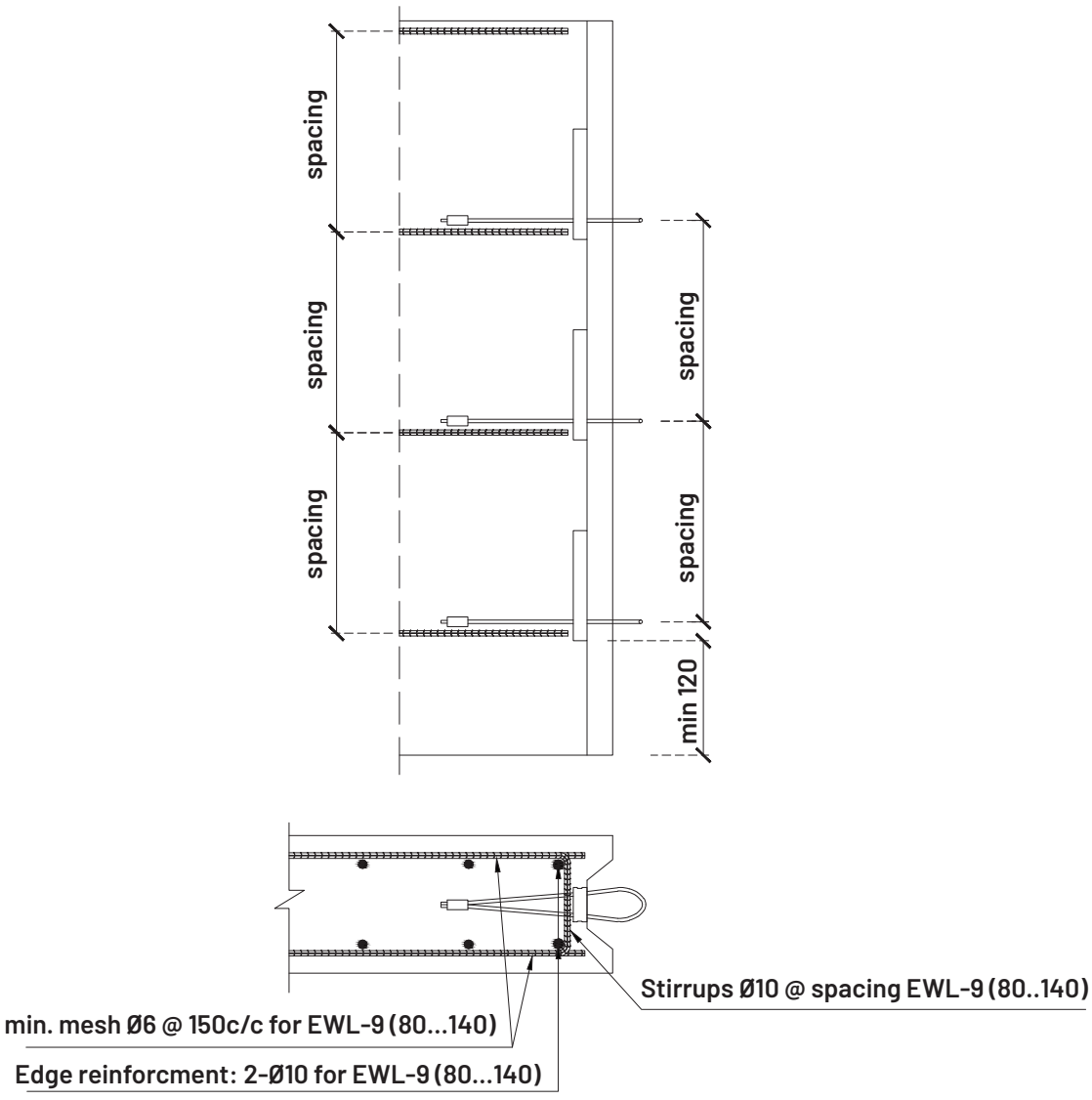


Figure 16: Additional Reinforcement for EWL-9 for Wire Loop

7. SUPERVISION OF INSTALLATION

Before Casting:
- EWL - 9 Wire loop must be checked properly. It should be in a good condition
- Check Positioning of EWL 9 in mould
- Ensure that additional reinforcement has been provided

Casting:
- EWL - 9 wire loop has to stay perfectly and in the right place
- concrete has to be vibrated around the EWL - 9 wire loop

After Casting:
- Ensure that position of the EWL-9 wire loop is according to designs
- Remove tape after the concrete has hardened. Pull out the wire and straighten it to make it perpendicular to the wall height.

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