TABLE
FRP 01.a

BETONTEX

F.R.P. system
REINFORCEMENT OF THE BEAM IN THICKNESS
TRACING PHASE

FIBRE NET
composite engineering

PHASE 0 - Marking and Drilling of Holes

Isometric view of the beam: top view

ASHLAR 1
ASHLAR 2
i
j
k

Axonometric view of the beam: bottom view

i
j
k
ASHLAR 1
ASHLAR 2
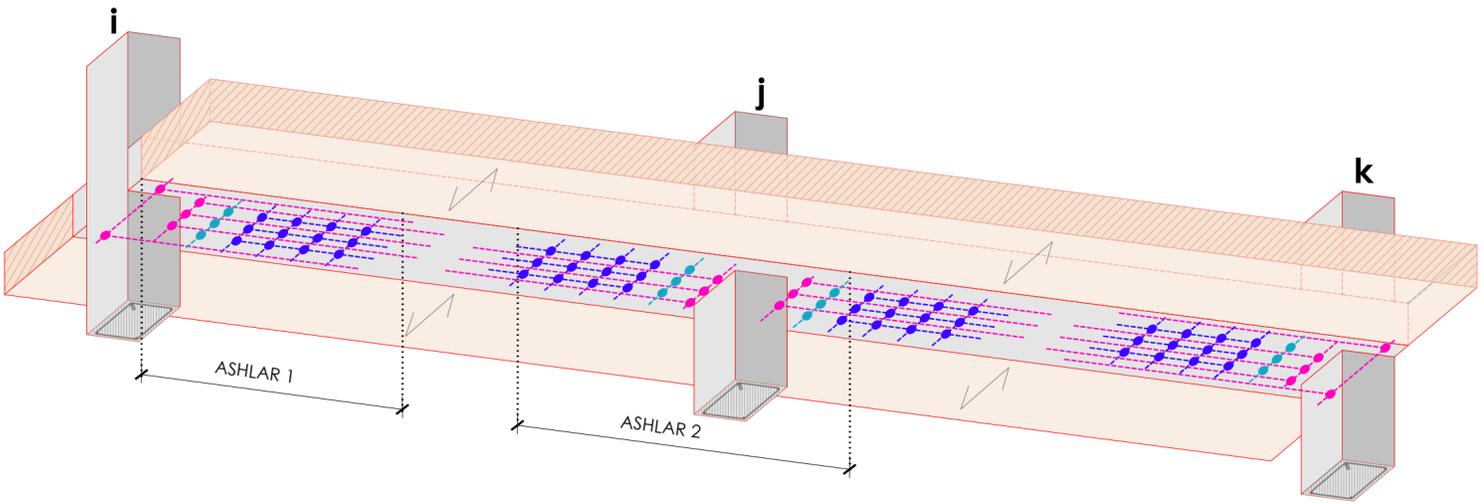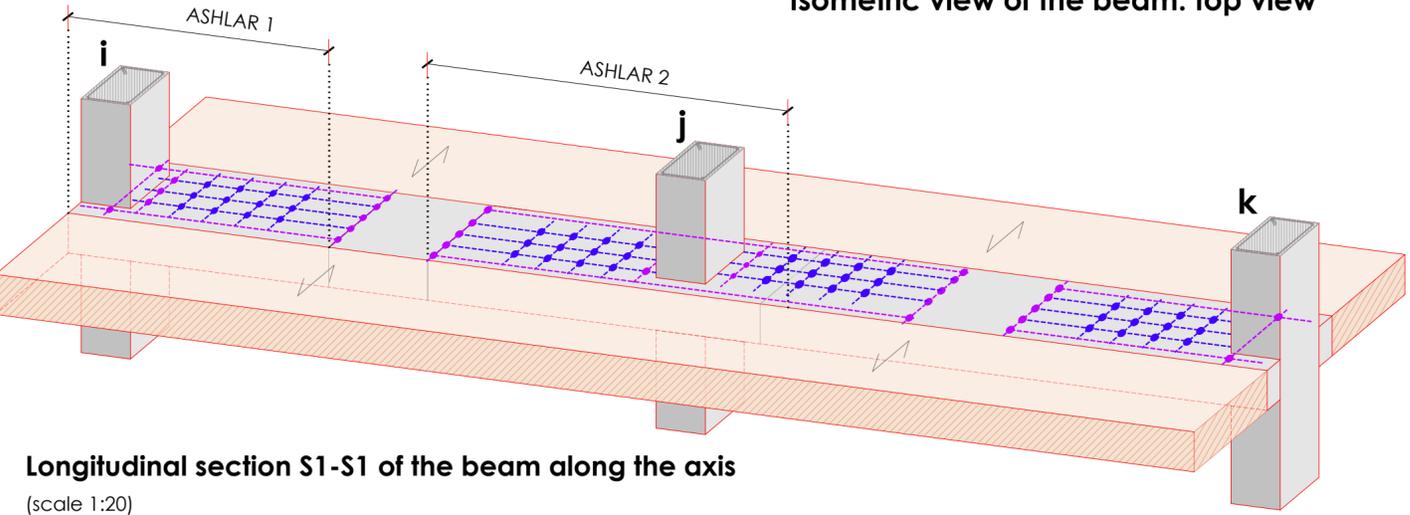
Longitudinal section S1-S1 of the beam along the axis
(scale 1:20)

$2w$ $\geq w+z$ r r r $r + 3w$ r r r $\geq w+z$ $\geq w+z$ r r r $r + 3w$ $r + 3w$ r $2r$ $\geq w+z$ $2w$

$r + 3w$ r r $\geq w+z$

h_{tr}

$L_{fo,1}$ w $\geq w+z$ r r r r $\geq w+z$ w w $\geq w+z$ r r r r $\geq w+z$ w $L_{fo,1}$

$\geq w$ r $\geq w$ $\geq w$

L/3 of the beam | L/3 of the beam | L/3 of the beam | L/3 of the beam | L/3 of the beam | L/3 of the beam

Detail of the hole
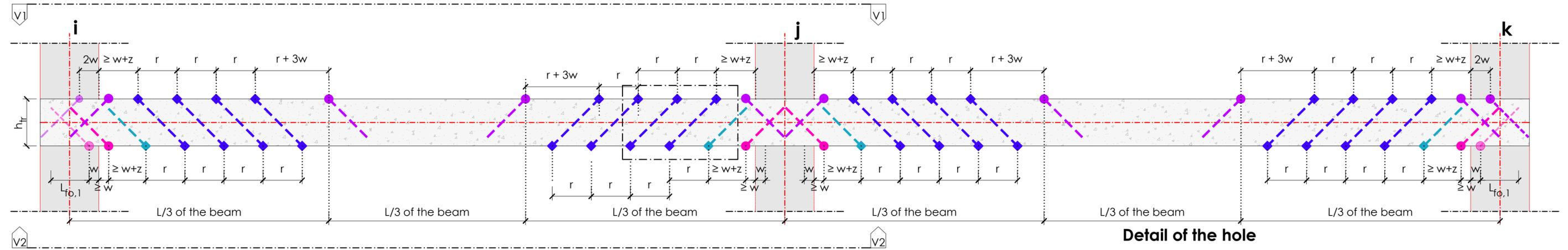
DESCRIPTION OF WORKS - PHASE 0

Once the layout, type, and quantity of fabrics to be applied have been defined, before proceeding with the installation, follow the following preliminary operational steps:

0.1   After removing any existing plaster, carry out mechanical cleaning of the substrate. Always check for possible concrete degradation by performing carbonation depth tests and chloride penetration tests. Conduct rebar detection surveys (pacometric investigations) to minimize interference between the existing reinforcement and the new connectors (See Phase 1);

0.2   Preparation of the reinforced concrete substrate with a possible repair cycle for damaged concrete. For details, refer to the reference drawings. The application surface must not be "smooth" but "rough," with a roughness index between 0.3 – 0.5 mm. It must be free of oils, grease, and/or release agents. Any surface cleaning must be done mechanically, preferably by sandblasting. To verify the suitability of the surface, refer to the guidelines of the ICRI – International Concrete Repair Institute, specifically classes CSP2, CSP3, CSP4, and CSP5 for in-situ laminates, and CSP6 for prefabricated reinforcements;

0.3   Marking of the holes to be made, according to the graphical layout shown in this document;

0.4   Drilling of Ø 12/14 mm holes for anchoring the connectors, with a countersink of Ø 16 mm and a countersink depth greater than 10 mm. Use a rotary-only hammer drill (no percussion). In the case of non-through connectors, the hole depth must be equal to the length of the connector plus 10 mm;

0.5   Cleaning of holes from any debris by blowing with a compressor or brushing with a brush, while simultaneously vacuuming the dust with an appropriate vacuum cleaner.
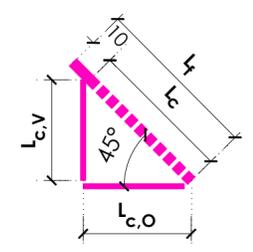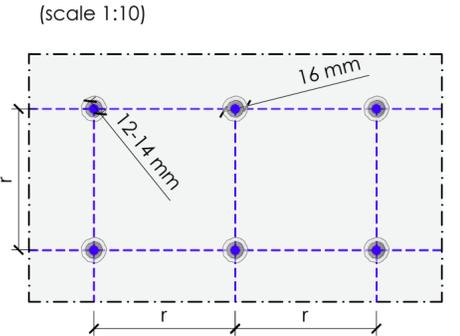
Hole execution

L_f
45°

$L_{c,V}$
45°
$L_{c,O}$
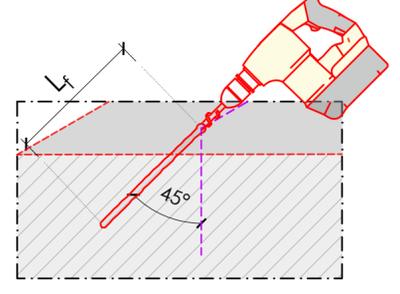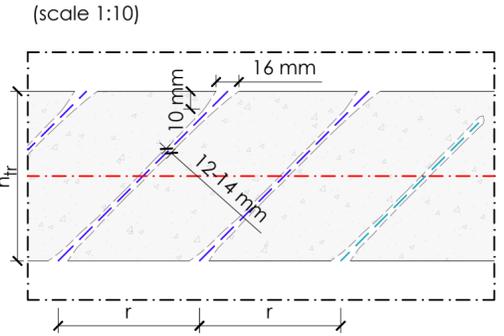
Legend
- L_C = connector length;
- $L_{C,V}$ = projection of the connector relative to the vertical axis;
- $L_{C,O}$ = projection of the connector relative to the horizontal axis;
- L_f = hole length.

Section
(scale 1:10)

16 mm
10 mm
12-14 mm
h_{tr}
r | r

Plan view
(scale 1:10)

16 mm
12-14 mm
r
r | r

HOLE TABLE ON BEAMS

Characteristics
Parameters
$w = 5\,\emptyset$
$z = 200 - 5\,\emptyset$
$r = b_{f,2}$
$t = b_{f,1}/2$

Note:

● ● Marking of connector holes
For anchoring the reinforcement ends for bending

◆ ◆ Marking of connector holes
For shear reinforcement

The measurements are expressed in mm unless otherwise specified

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TABLE
FRP 01.b

F.R.P. system
REINFORCEMENT OF THE BEAM IN THICKNESS
TRACING PHASE

BETONTEX

FIBRE NET
composite engineering

PHASE 0 - Marking and drilling of holes   (scale 1:20)

Ashlar 1
View V1-V1

Ashlar 2
View V1-V1

Ashlar 1
Section S2-S2

Ashlar 2
Section S2-S2

Ashlar 1
Section S3-S3

Ashlar 2
Section S3-S3

Ashlar beam 1
View V2-V2

Ashlar beam 2
View V2-V2
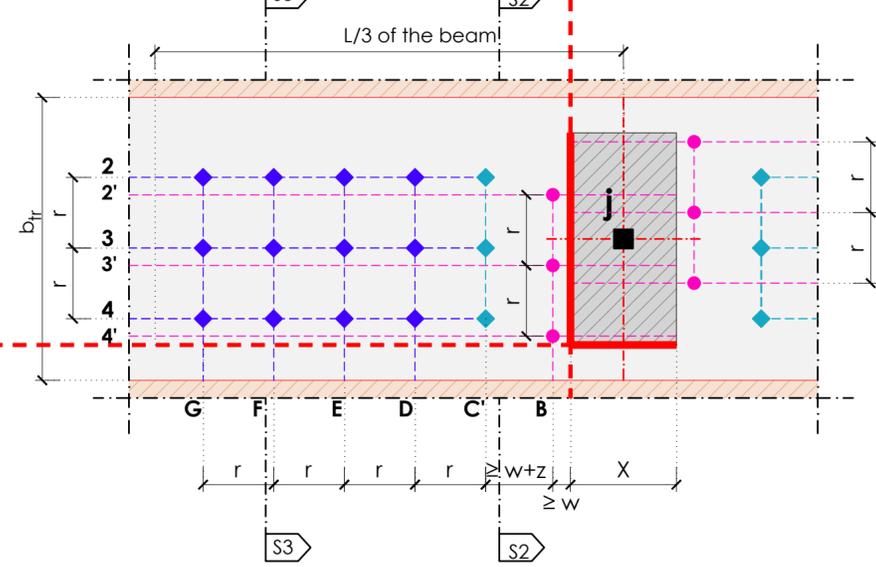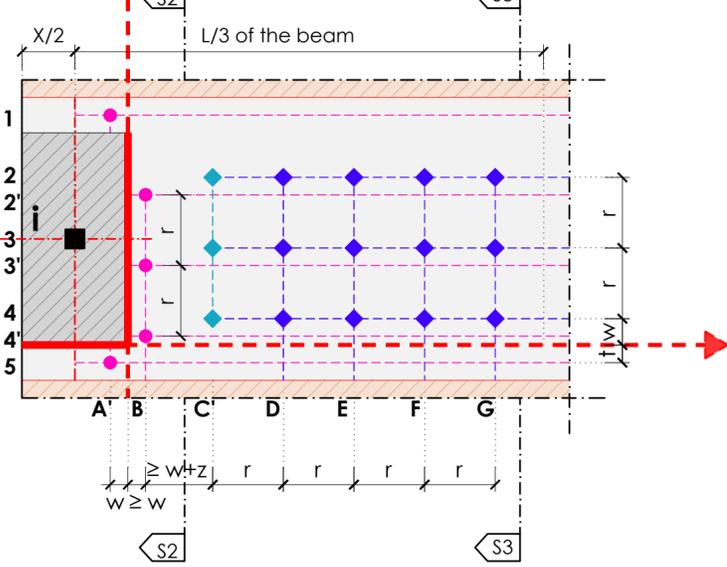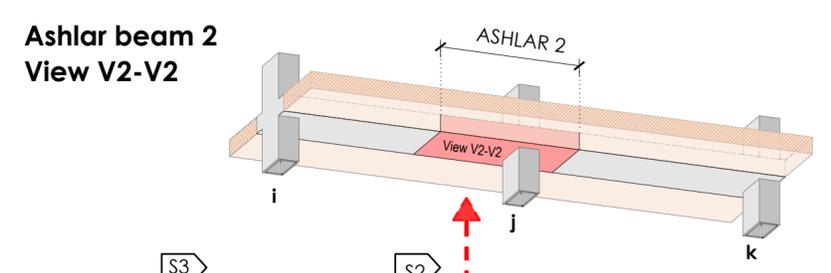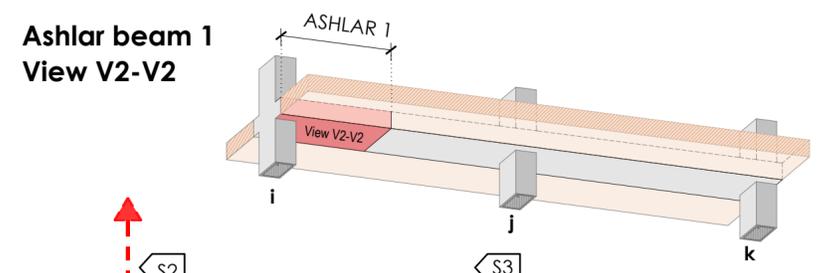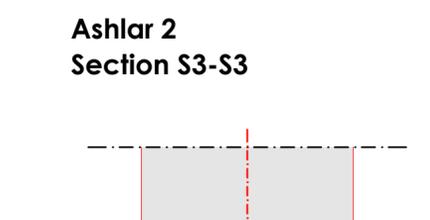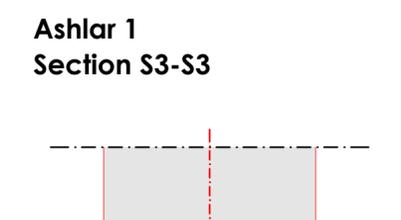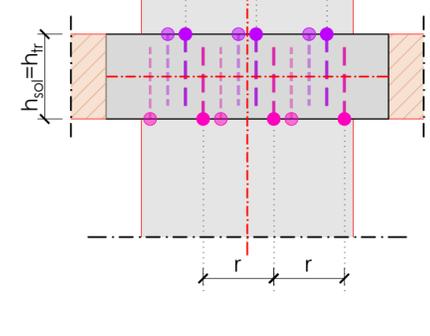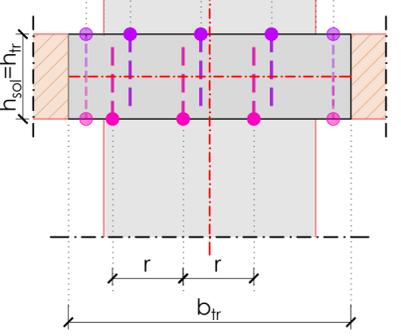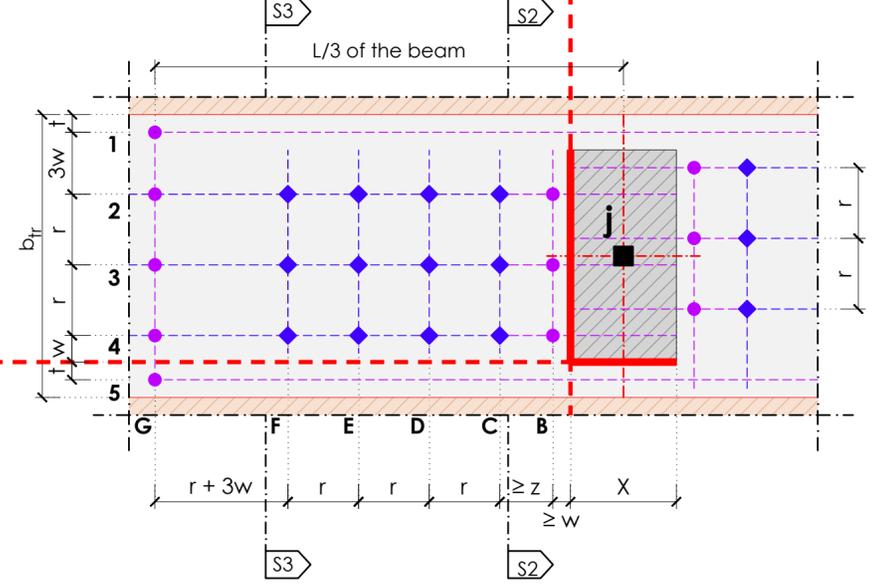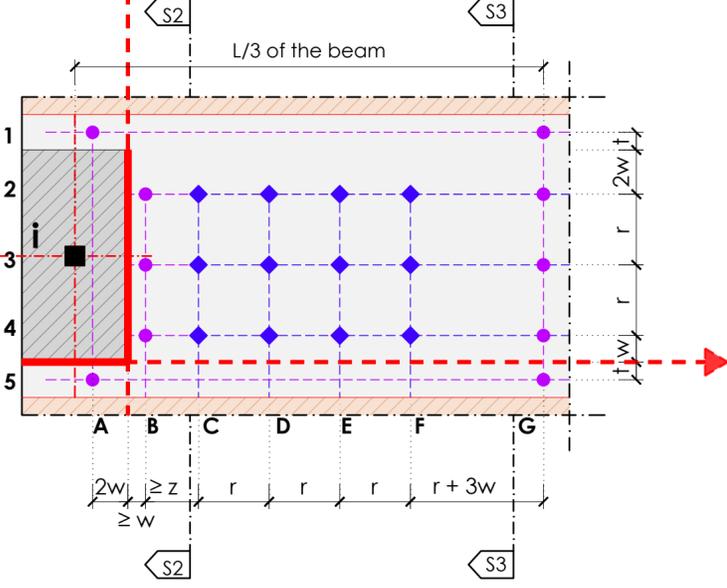
characteristics
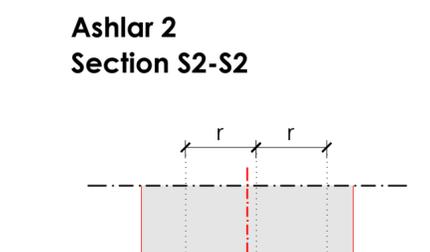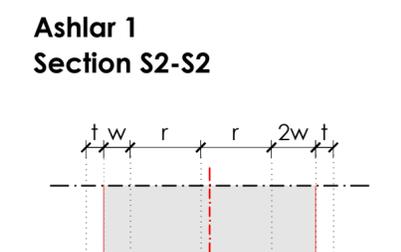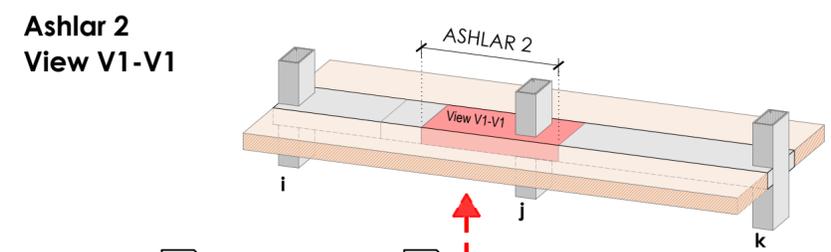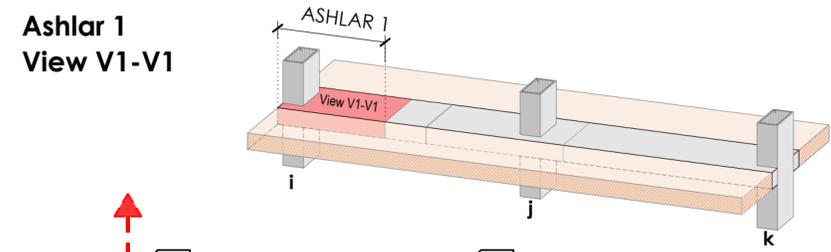
View	Symbol	d. holes	Ø holes	Chamfer	Inclination	Hole length	Parameters
V1-V1	●	$b_{f,1} - b_{f,2}$	12 /14	> 16	45°	$200 +10 \leq L_{fo} \leq \frac{3}{4} X +10$	$w = 5\,\varnothing$
V2-V2	●	$b_{f,1} - b_{f,2}$					$z = 200 - 5\,\varnothing$
V2-V2	◆	$b_{f,2}$					$r = b_{f,2}$
V1-V1 V2-V2	◆	$b_{f,2}$				$200 +10 \leq L_{fo} \leq h_{tr}$	$t = b_{f,1}/2$

Note 1

$b_{f,1}$: width of the reinforcement fabric outside the column;
$b_{f,2}$: width of the reinforcement fabric inside the thickness of the column.

Note 2

For the tracking of the connectors in node **k**, use a criterion similar to the one described for node **i**.

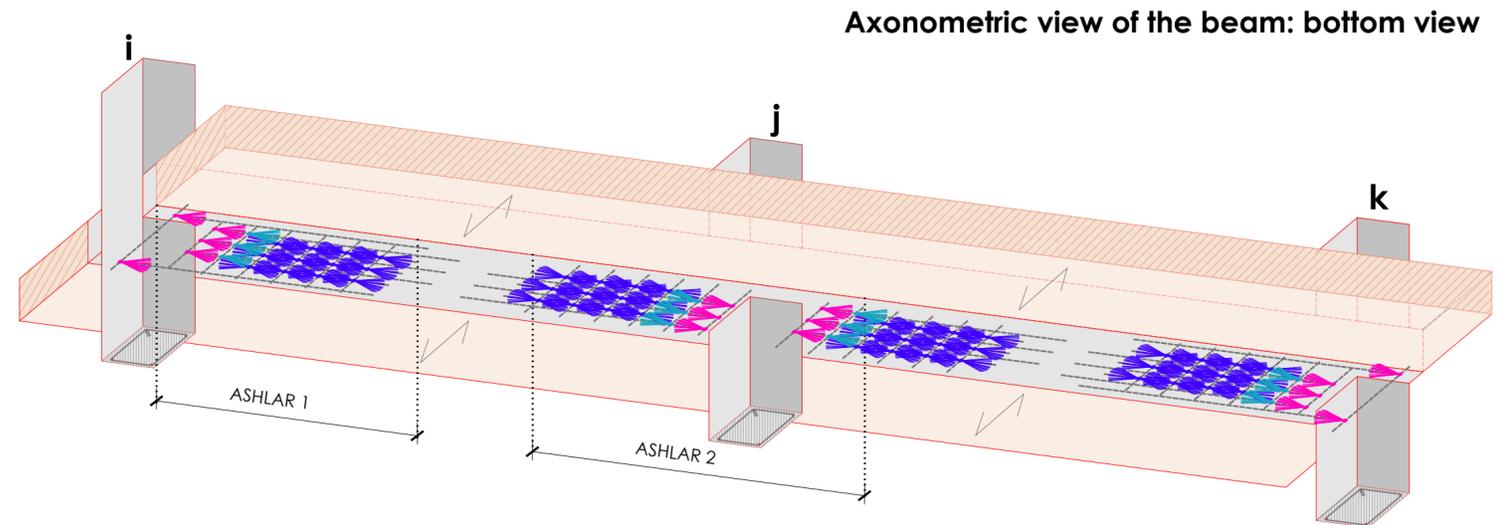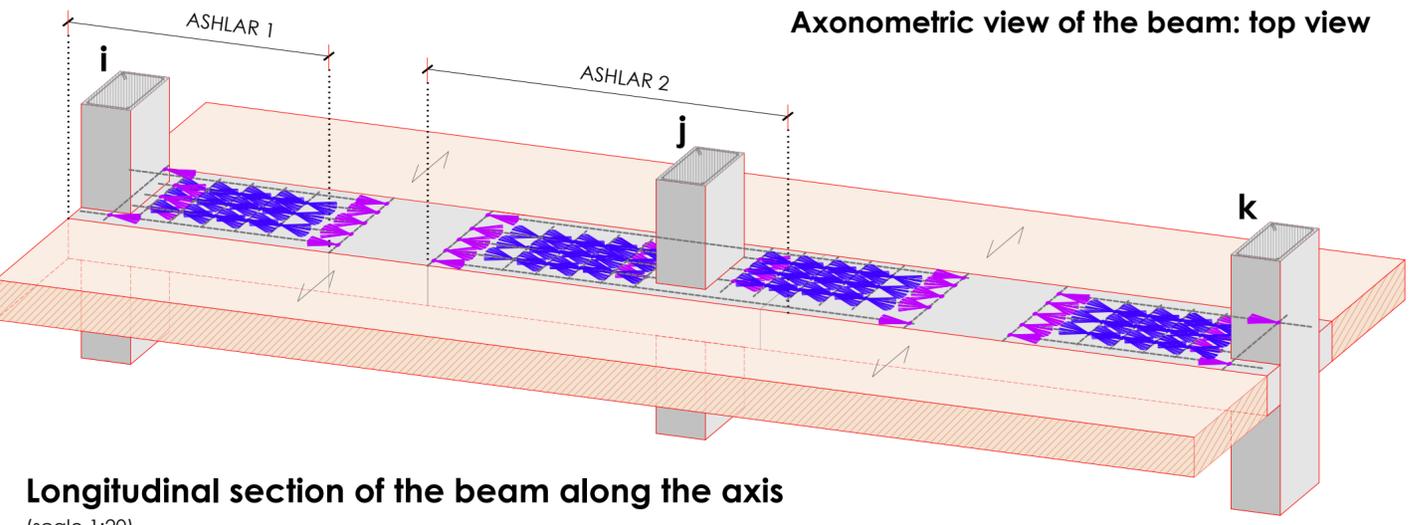The measurements are expressed in mm unless otherwise specified.

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F.R.P. system
REINFORCEMENT OF THE BEAM IN THICKNESS
INSTALLATION PHASE OF THE CONNECTION/ANCHORING SYSTEM

composite engineering

PHASE 1 - Anchoring of connectors in C.F.R.P.

Axonometric view of the beam: top view

ASHLAR 1
ASHLAR 2
i
j
k

Axonometric view of the beam: bottom view

i
j
k
ASHLAR 1
ASHLAR 2

Longitudinal section of the beam along the axis
(scale 1:20)

V1
i
(A1) - pos.1   (A1) - pos.4   (A1) - pos.1
j
k
V1

(A1) - pos.2   (A1) - pos.3

V2
L/3 of the beam | L/3 of the beam | L/3 of the beam | L/3 of the beam | L/3 of the beam | L/3 of the beam
V2

Phases scheme
Installation of passing through connectors.

Note:

Connectors for anchoring the reinforcement ends for bending

Connectors for shear reinforcement.

Phase 0
Phase 1.1-1.2
Phase 1.3
Phase 1.4
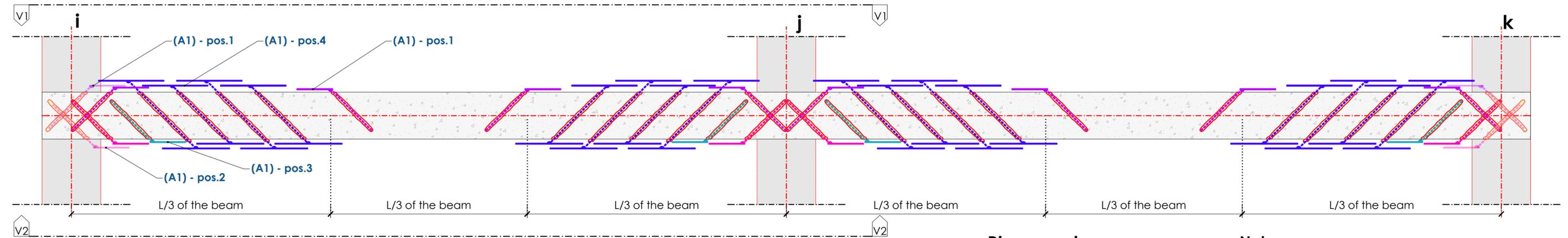
DESCRIPTION OF WORKS - PHASE 1

Once the layout, type, and quantity of reinforcement to be applied have been defined, wait for the repair mortar to cure in accordance with the product technical data sheets. In any case, check the moisture content of the substrate, which must be less than 10%, including by drilling a hole to a depth equal to the thickness of the repair mortar.

The installation of the passing through connectors must be carried out after the preliminary surface preparation and hole drilling phases (See Phase 0), proceeding with the following operational steps:
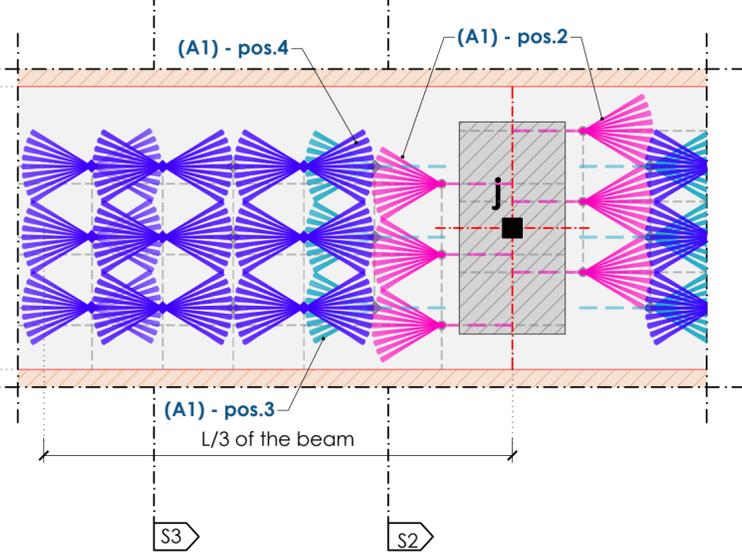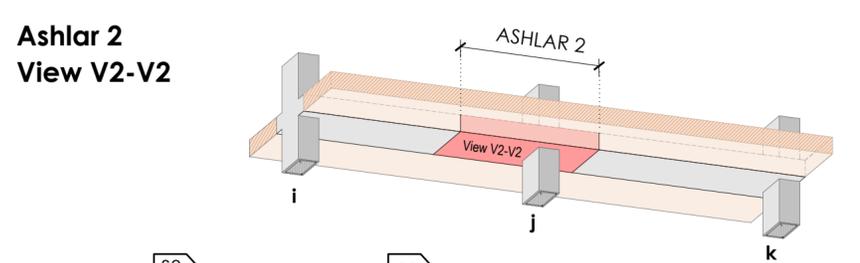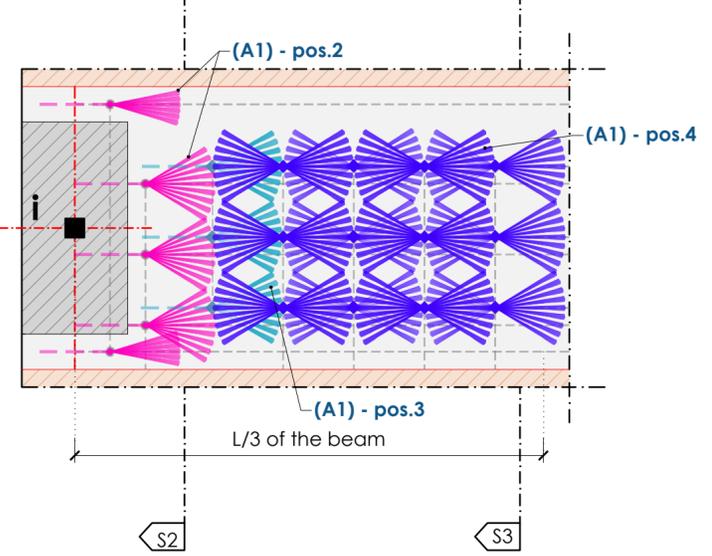
1.1   After thoroughly cleaning the holes (see Phase 0.5) and the surfaces, apply the epoxy primer type **FB-RC01** according to the instructions in the technical data sheet. Wait 1 hour and do not exceed 3 hours. During this waiting period, proceed with the installation of the passing through connectors following the instructions in the subsequent steps, after first applying a layer of impregnating resin **FB-RC02** only at the location of the fiber spreading;

1.2   Injection of resin for anchoring bars (connectors) type **FB-RC30/3**;

1.3   Anchoring of single-ended bowed bars (non-passing through connectors), positions 1-2-3, type **FB-TUP10-CHT1A Ø10**, inclined at 45°, without performing the bowing. Anchoring of double-ended bowed bars (passing through connectors), position 4, type **FB-TUP10-CHT2A Ø10**, inclined at 45°, ensuring one end of the bar is protected using plastic wrap and wrapped with iron wire. The anchoring operation must be carried out by rotating the bar to ensure perfect adhesion of the resin both to the bar itself and to the inner surface of the hole;

1.4   Bowing at a 60° angle on the bars in positions 1-2-3 installed in Phase 1.3, and impregnation of the same with resin type **FB-RC02**. Apply the same procedure to the bars in position 4 (bars bowed on both ends).
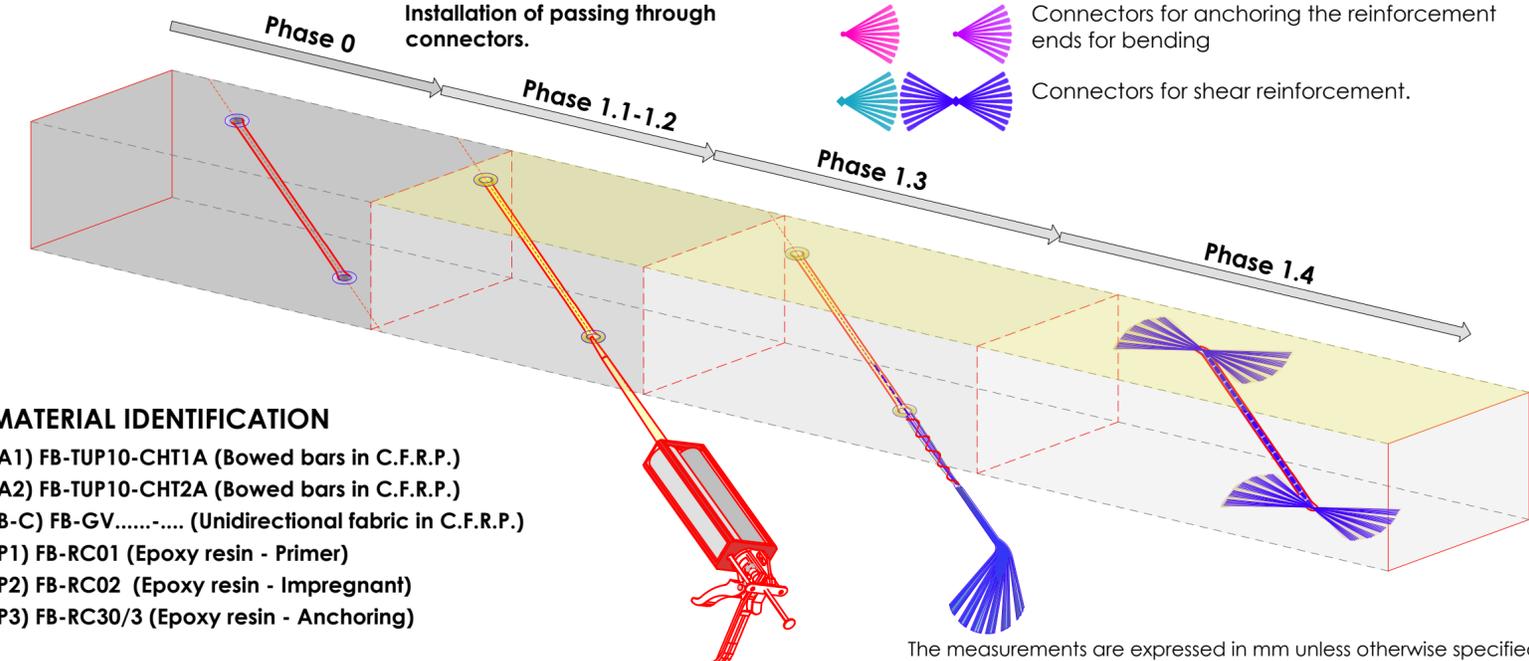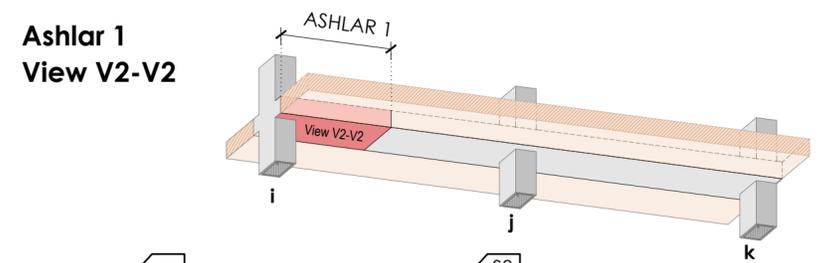
MATERIAL IDENTIFICATION

(A1) FB-TUP10-CHT1A (Bowed bars in C.F.R.P.)
(A2) FB-TUP10-CHT2A (Bowed bars in C.F.R.P.)
(B-C) FB-GV......-.... (Unidirectional fabric in C.F.R.P.)
(P1) FB-RC01 (Epoxy resin - Primer)
(P2) FB-RC02 (Epoxy resin - Impregnant)
(P3) FB-RC30/3 (Epoxy resin - Anchoring)

The measurements are expressed in mm unless otherwise specified
For the materials table, refer to drawing FRP22.

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TABLE
FRP 01.d

F.R.P. system
REINFORCEMENT OF THE BEAM IN THICKNESS
CONNECTION/ANCHORING SYSTEM INSTALLATION PHASE

BETONTEX

FIBRE NET
composite engineering

PHASE 1 - - Anchoring of CFRP connectors. (scale 1:20)

Ashlar 1
View V1-V1

Ashlar 2
View V1-V1

Ashlar 1
Section S2-S2

Ashlar 2
Section S2-S2

Ashlar 1
Section S3-S3

Ashlar 2
Section S3-S3

Ashlar 1
View V2-V2

Ashlar 2
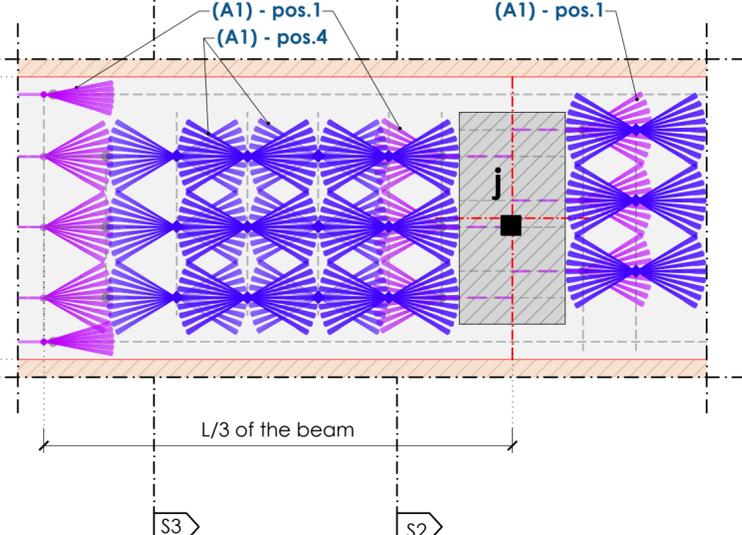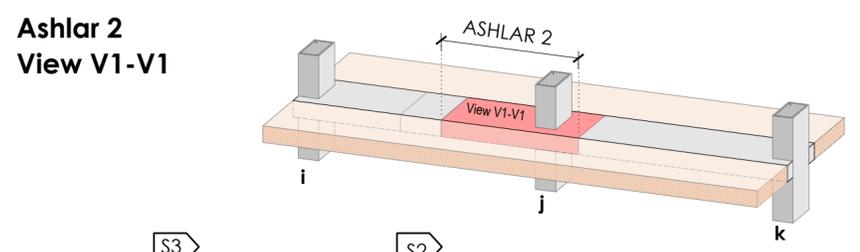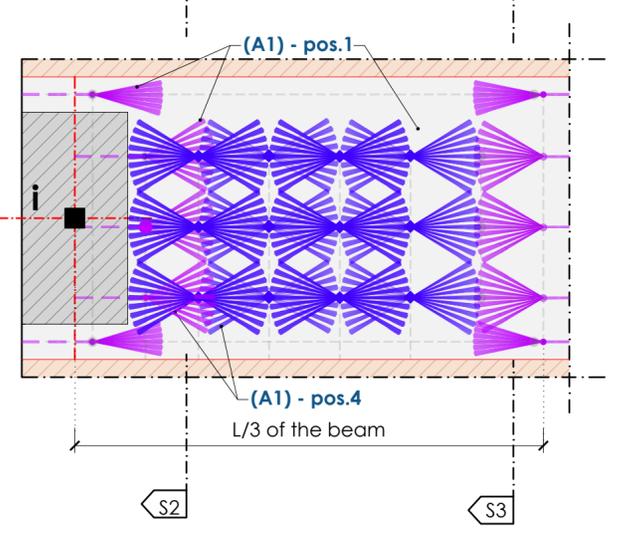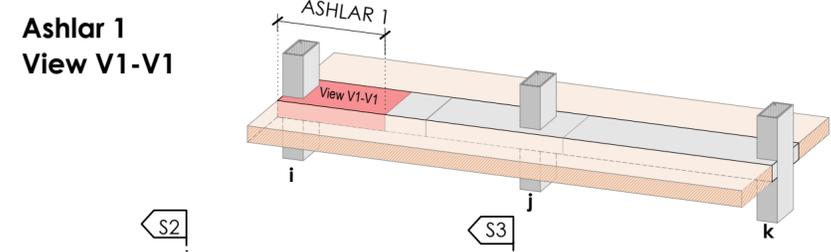View V2-V2

(A1) - pos.1
(A1) - pos.2
(A1) - pos.3
(A1) - pos.4

L/3 of the beam

b_{tr}

Legend :

$n_{fabrics\ INT}$: n° of fabrics contained within the width of the column;

$n_{fabrics\ EXT}$: n° of fabrics external to the width of the column;

n_{nodes}: n° of nodes;

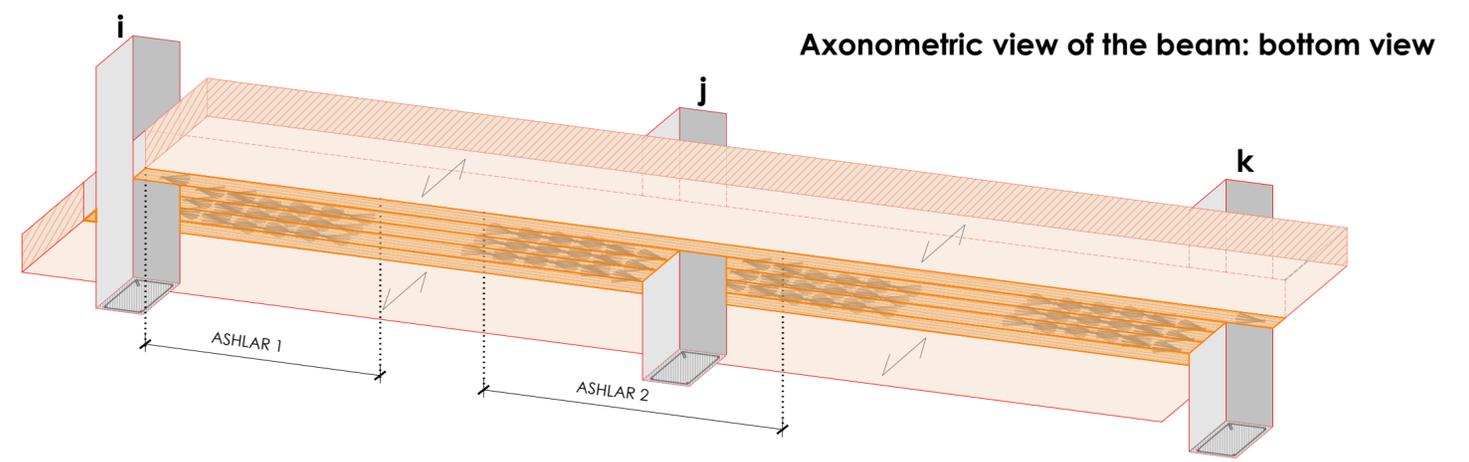$n_{nodesi\ INT}$: n° of internal nodes.

CFRP CONNECTORS TABLE

identification		characteristics			
Material	Symbol	N. connectors	Ø connecto rs	length of connnectors	Position
(A1) - pos.1		$(n_{nodes} - n_{nodes\ INT}) \cdot (n_{fabricsi\ EXT} \cdot n_{nodes} + n_{fabrics\ INT} \cdot (n_{nodes} + n_{nodes\ INT}))$	10	$200 \leq L_{CO} \leq \frac{3}{4} X$	Top face of the beam
(A1) - pos.2		$2 \cdot (n_{fabricsi\ EXT} + n_{fabrics\ INT} \cdot (n_{nodes} -1))$			Bottom face of the beam
(A1) - pos.3		$2 \cdot (n_{nodes} + 1) \cdot n_{fabrics\ INT}$			bottom face of the beam
(A1) - pos.4		$4 \cdot (n_{nodes} + n_{nodes\ INT}) \cdot n_{fabrics\ INT}$		$L_{CO,4} \geq \frac{3}{4} h_{tr}$	bottom face and top face of the beam

The measurements are expressed in mm unless otherwise specified.
For the materials table, refer to drawing FRP22.

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F.R.P. system
REINFORCEMENT OF THE BEAM IN THICKNESS
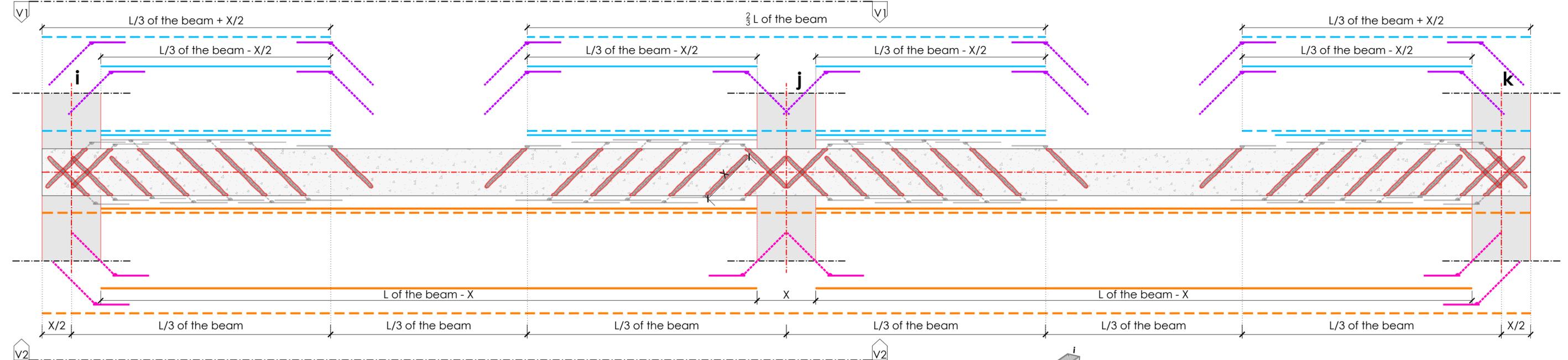### REINFORCEMENT INSTALLATION PHASE

FIBRE NET
composite engineering

PHASE 2 - Installation of reinforcement systems

Axonometric view of the beam: top view

ASHLAR 1
ASHLAR 2

i
j
k

Axonometric view of the beam: bottom view

i
j
k

ASHLAR 1
ASHLAR 2

Longitudinal section of the beam along the axis
(scale 1:20)

V1

$L/3$ of the beam $+ X/2$

$L/3$ of the beam $- X/2$

$\frac{2}{3}$ L of the beam

$L/3$ of the beam $- X/2$

$L/3$ of the beam $- X/2$

V1

$L/3$ of the beam $+ X/2$

$L/3$ of the beam $- X/2$

i
j
k

L of the beam $- X$

X

L of the beam $- X$

X/2

$L/3$ of the beam

$L/3$ of the beam

$L/3$ of the beam

$L/3$ of the beam

$L/3$ of the beam

$L/3$ of the beam

X/2

V2

V2
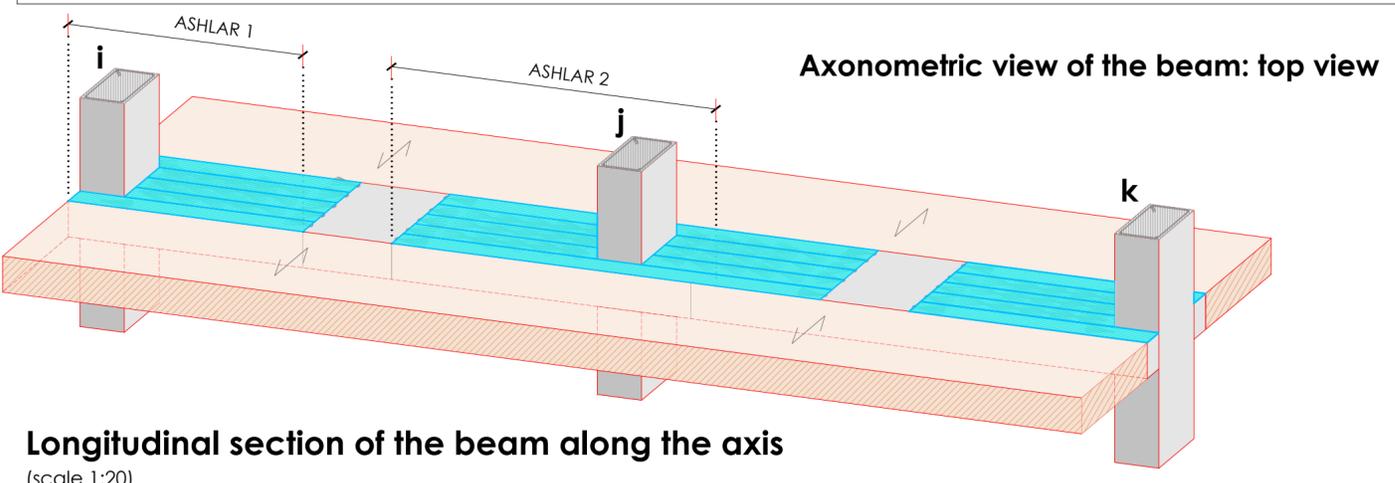
DESCRIPTION OF WORKS - PHASE 2

Once the layout, type, and quantity of fabrics to be applied have been defined, the installation must be carried out according to the following operational steps:

2.1   After applying a layer of impregnating epoxy resin **FB-RC02**, install unidirectional C.F.R.P. fabrics, type **FB-GV......-....,** longitudinally on the bottom surface (intrados) of the beam, ensuring no formation of wrinkles, folds, or air pockets. Use a bubble-breaking roller to facilitate this process. After laying the fabrics, apply a second layer of impregnating resin **FB-RC02** and continue rolling with the bubble-breaking roller until the fibers are fully impregnated;

2.2   Apply the same procedure for unidirectional C.F.R.P. fabrics, type **FB-GV......-....,** on the top surface (extrados) of the beam. Repeat steps 2.1 and 2.2 if additional layers are required according to the design.;

2.3   Apply quartz sand evenly over the surface of the resin composite while it is still fresh, to allow the finishing plaster to adhere.

Phases scheme

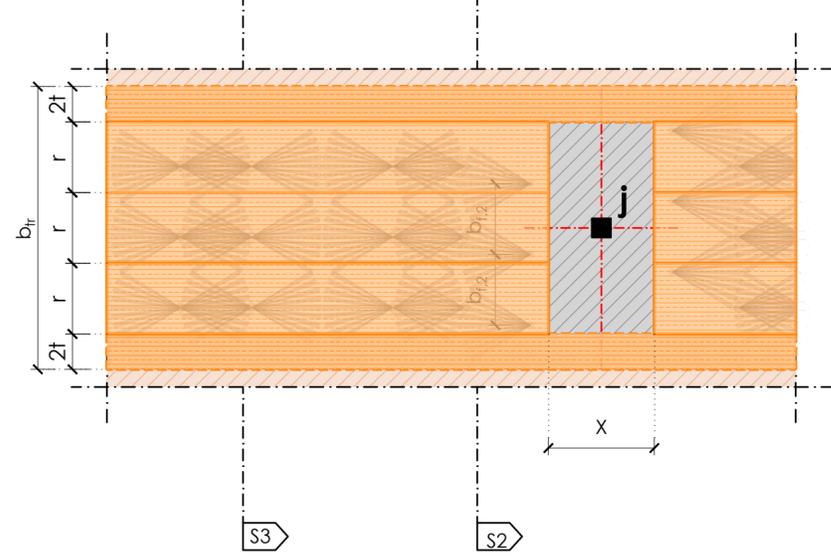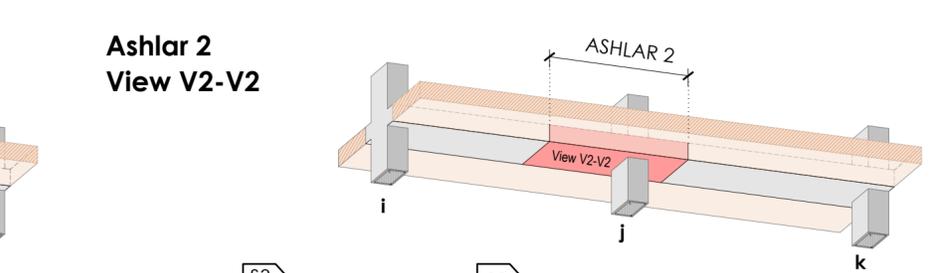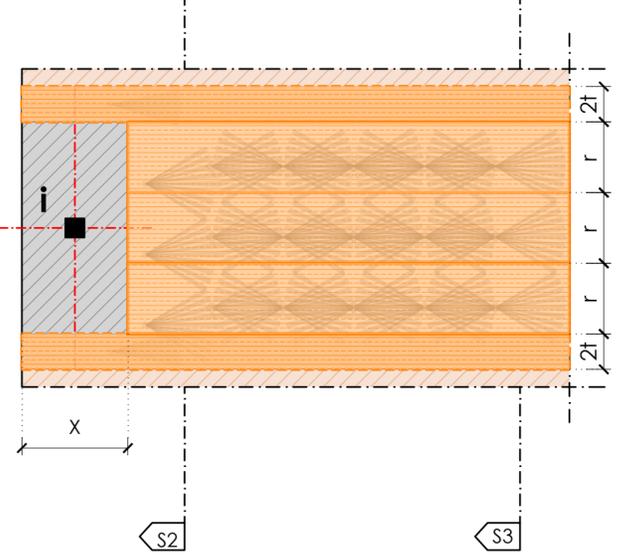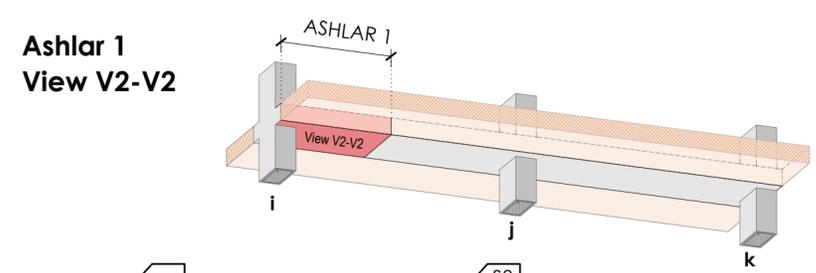**Installation of fabrics on the top surface of the beam**
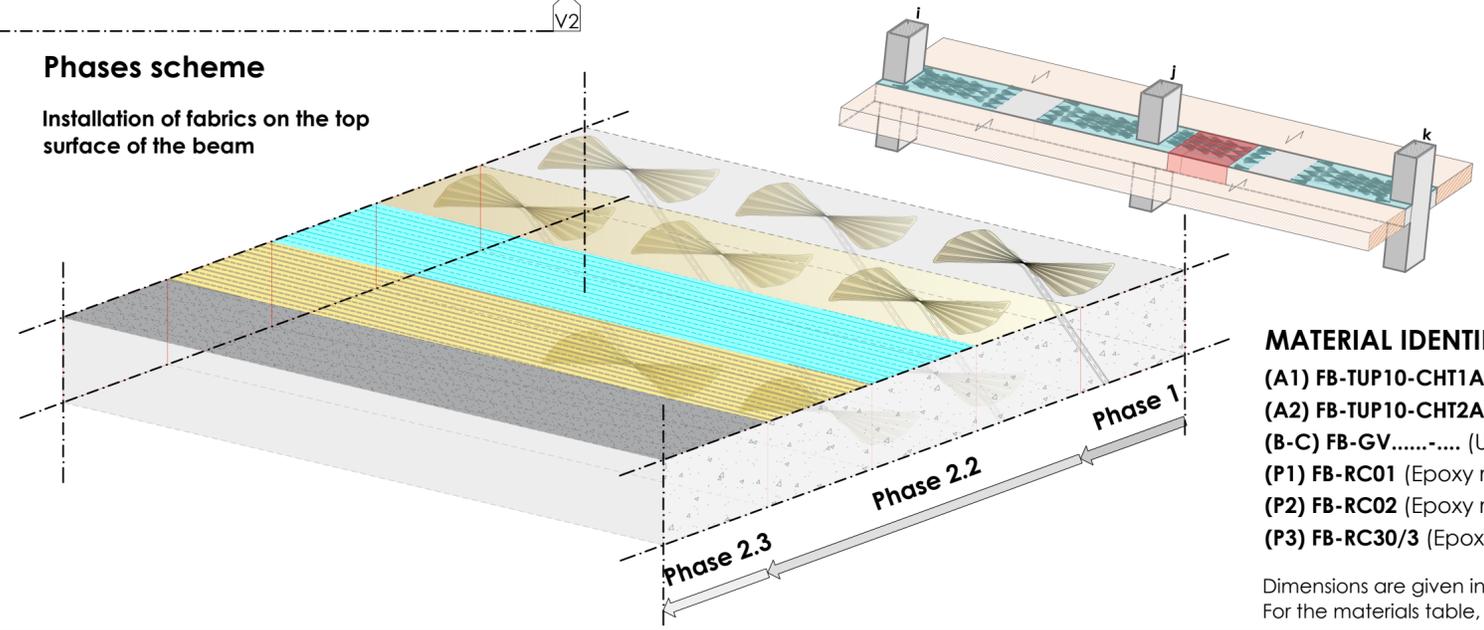
i
j
k

Phase 1
Phase 2.2
Phase 2.3

MATERIAL IDENTIFICATIION

(A1) FB-TUP10-CHT1A (Bowed bars in C.F.R.P.)
(A2) FB-TUP10-CHT2A (Bowed bars in C.F.R.P.)
(B-C) FB-GV......-.... (Unidirectional fabric in C.F.R.P.)
(P1) FB-RC01 (Epoxy resin – Primer)
(P2) FB-RC02 (Epoxy resin – Impregnating agent)
(P3) FB-RC30/3 (Epoxy resin – Anchoring)

Dimensions are given in mm unless otherwise specified.
For the materials table, refer to drawing FRP22.

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TABLE

FRP 01.f

BETONTEX

F.R.P. system
REINFORCEMENT OF THE BEAM IN THICKNESS
REINFORCEMENT INSTALLATION PHASE

FIBRE NET
composite engineering

PHASE 2 - Installation of reinforcement systems   (scale 1:20)

Ashlar 1
View V1-V1

ASHLAR 1

View V1-V1

i   j   k

S2   S3

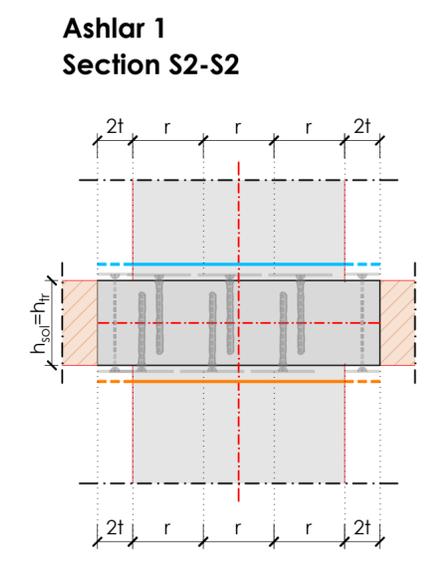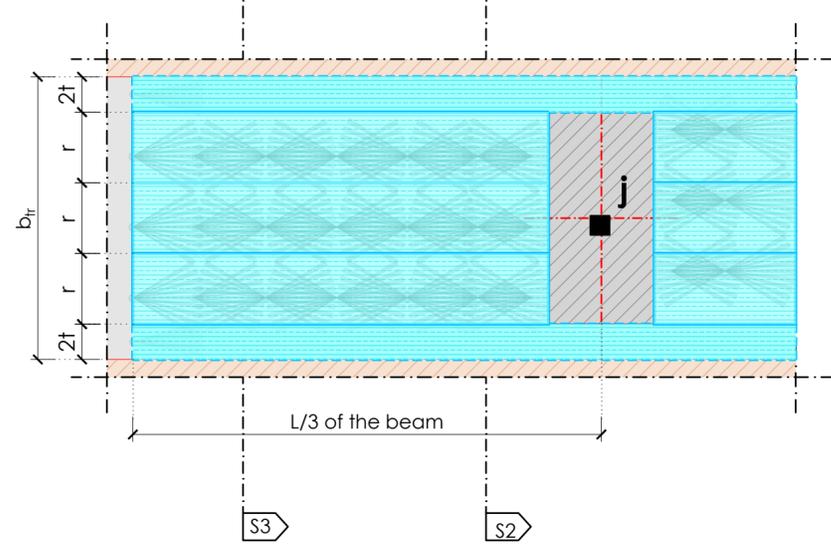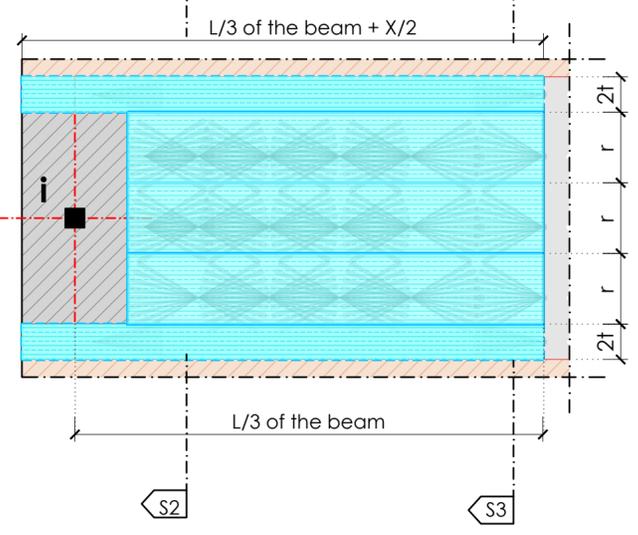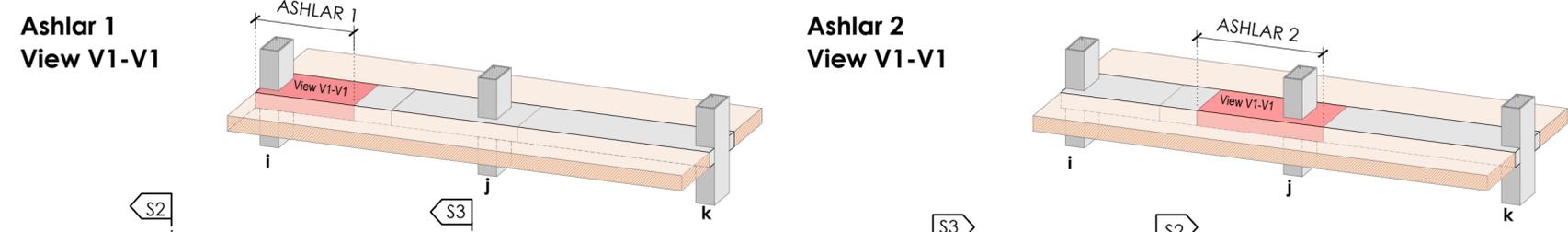L/3 of the beam + X/2

2t
r
r
r
2t

i

L/3 of the beam

S2   S3

Ashlar 2
View V1-V1

ASHLAR 2

View V1-V1

i   j   k

S3   S2

2t
r
r
r
2t

b_{tr}

j

L/3 of the beam

S3   S2

Ashlar 1
View V2-V2

ASHLAR 1

View V2-V2

i   j   k

S2   S3

2t
r
r
r
2t

i

b_{tr}

X

S2   S3

Ashlar 2
View V2-V2

ASHLAR 2

View V2-V2

i   j   k

S3   S2

2t
r
r
r
2t

b_{tr}

$b_{f/2}$
$b_{f/2}$

j

X

S3   S2

Ashlar 1
Section S2-S2

2t   r   r   r   2t

$h_{sol}=h_{tr}$

Ashlar 2
Section S2-S2

2t   r   r   r   2t

Ashlar 1
Section S3-S3

2t   r   r   2t

2t   2t

Ashlar 2
Section S3-S3

2t   r   r   r   2t

2t   2t

CFRP REINFORCEMENT TABLE

identification			caratteristiche		
Material	Symbol	N. layers	Geometric parameters	Fabric length L_f	Position
(C)				$(L_{beam}/3 - X/2) \cdot 2 \cdot n_{fabrici\ INT} \cdot (n_{nodes} -1)$	Top surface of the beam, along the width of the column
(C)		to be defined	b_f, t_f	$L_{beam}/3 \cdot 2 \cdot n_{fabricsi\ INT} \cdot (n_{nodes} -1)$	Top surface of the beam, outside the column
(C)				$L_{beam} \cdot n_{spans} - n_{columns} \cdot x$	Bottom surface of the beam, along the width of the column
(C)				$L_{beam} \cdot n_{spans}$	Bottom surface of the beam, outside the column

Note:

$n_{fabrics\ INT}$: number of fabrics contained within the width of the column.

The measurements are expressed in mm unless otherwise specified.
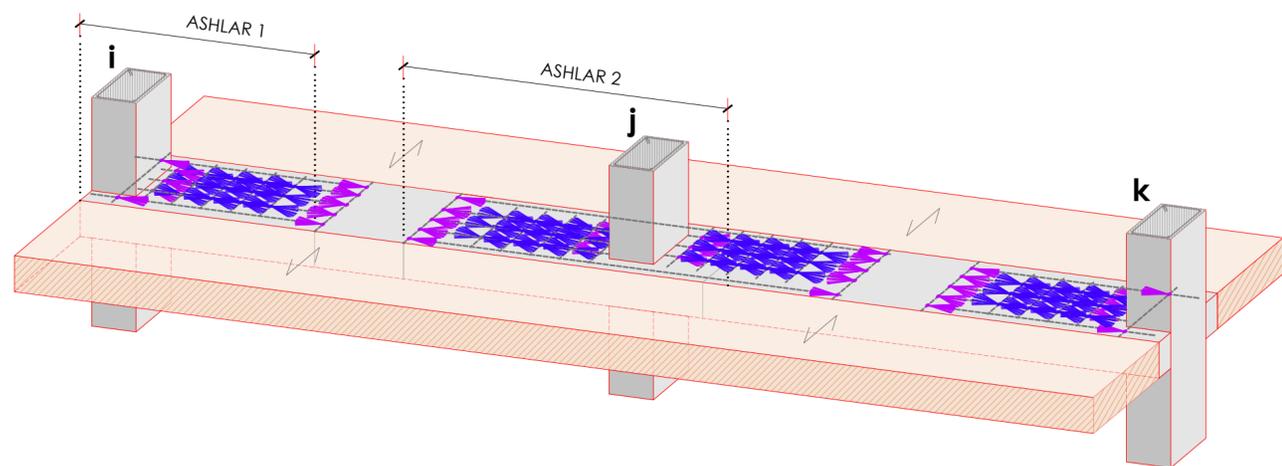For the materials table, refer to drawing FRP22.

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TABLE

FRP 01.g

BETONTEX

F.R.P. system
REINFORCEMENT OF THE BEAM IN THICKNESS
SUMMARY TABLE

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PHASE 0 - marking phase (drawings FRP 01.a - 01.b)

Axonometric view of the beam: top view

Axonometric view of the beam: bottom view

ASHLAR 1
ASHLAR 2
i
j
k

ASHLAR 1
ASHLAR 2
i
j
k
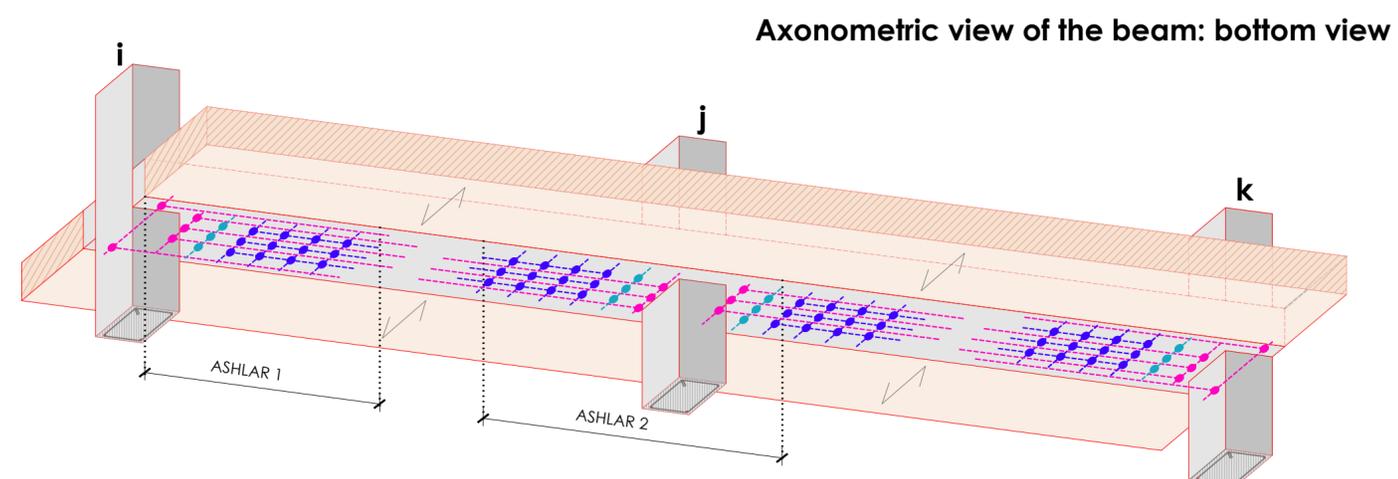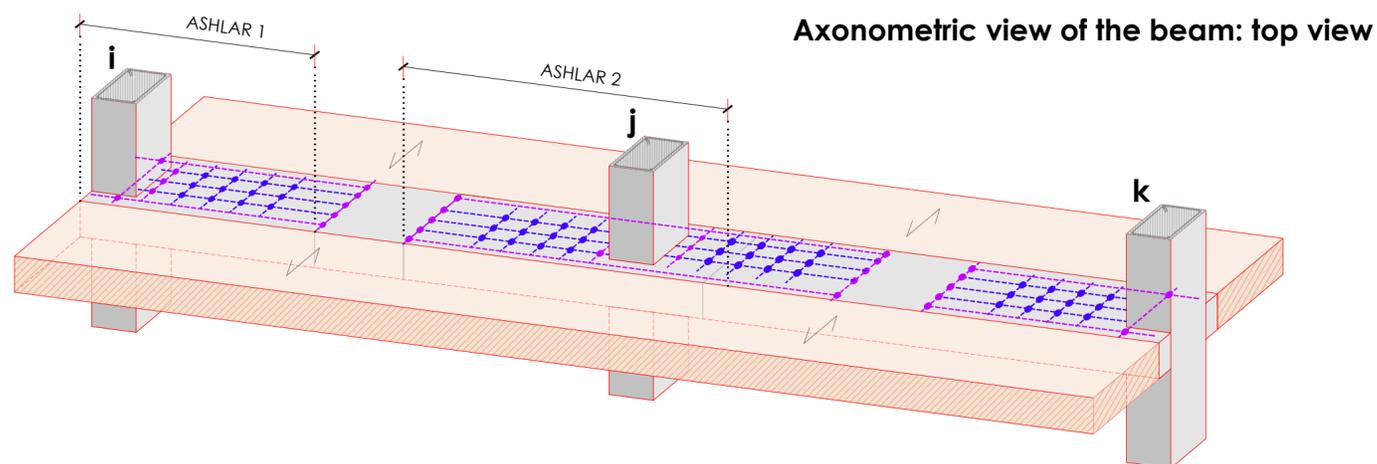
PHASE 1 - Installation phase of the connection/anchoring system (Drawings FRP 01.c - 01.d)

ASHLAR 1
ASHLAR 2
i
j
k

ASHLAR 1
ASHLAR 2
i
j
k
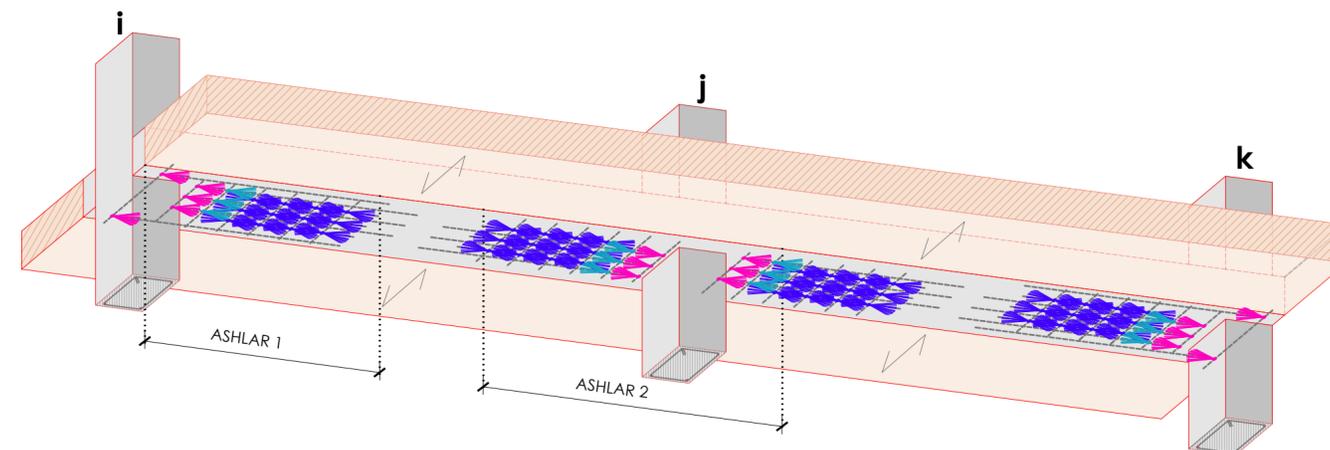
PHASE 2 - Installation phase of the reinforcement (Drawings FRP 01.e - 01.f)

ASHLAR 1
ASHLAR 2
i
j
k

ASHLAR 1
ASHLAR 2
i
j
k

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