CTC

ICC ES AC233 ESR-4645

CE ETA-19/0244

CONNECTOR FOR TIMBER-TO-CONCRETE FLOORS

CERTIFICATION

Timber-to-concrete fastener with specific CE certification according to ETA-19/0244. Tested and calculated with parallel and crossed arrangement of 45° and 30° connectors, with and without wooden planking.

RAPID DRY SYSTEM

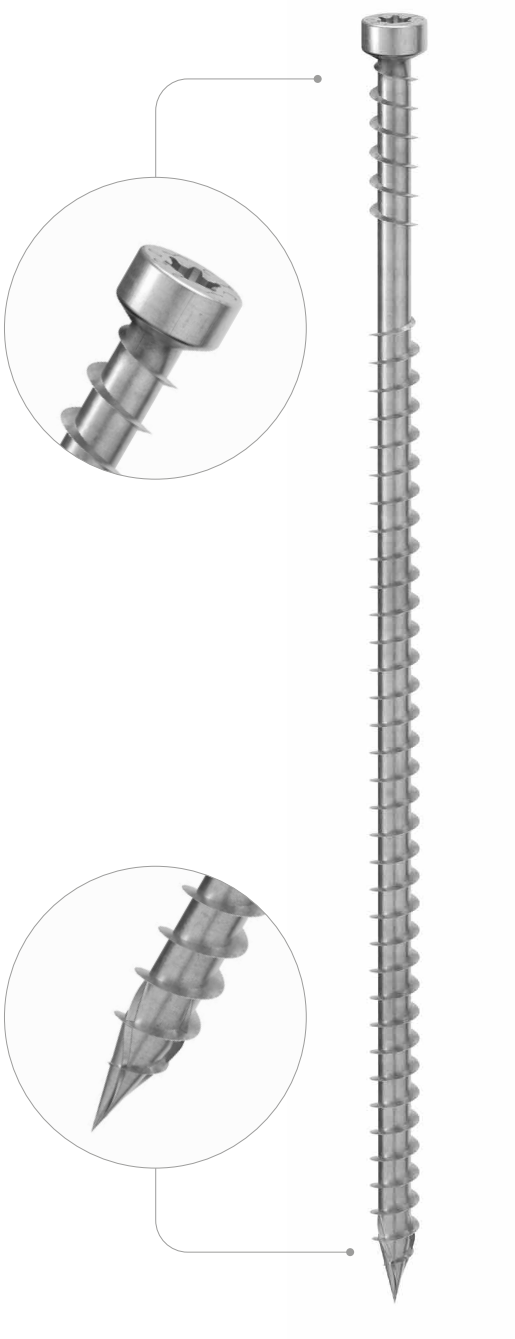
Approved system, self-drilling, reversible, fast and minimally invasive. Optimum static and noise performances, both for new projects and structural restoration.

COMPLETE RANGE

Self-perforating tip with notch and countersunk cylindrical head. Available in two diameters (7 and 9 mm) and two lengths (160 and 240 mm) to optimize the number of fasteners.

INSTALLATION INDICATOR

During installation, the under head counter-thread serves as "correct installation" indicator and increases the fastener tightness inside the concrete.



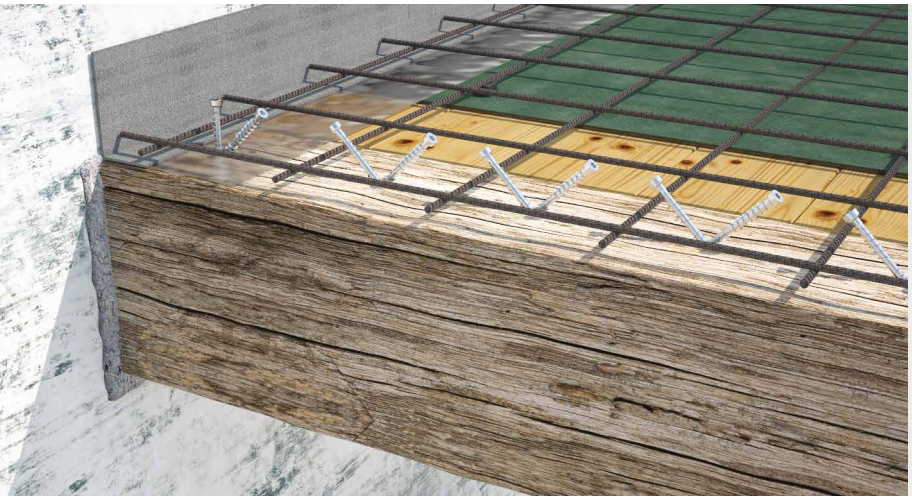
MY PROJECT SOFTWARE

BIT INCLUDED

DIAMETER [mm]	6 (7) 9 16
LENGTH [mm]	52 (160) (240) 400
SERVICE CLASS	SC1 SC2
ATMOSPHERIC CORROSIVITY	C1 C2
WOOD CORROSIVITY	T1 T2
MATERIAL	Zn ELECTRO PLATED electrogalvanized carbon steel

FIELDS OF USE

- timber based panels
- solid timber
- glulam (Glued Laminated Timber)
- CLT and LVL
- high density woods
- concrete EN 206-1
- lightweight concrete EN 206-1
- lightened concrete based on silicates

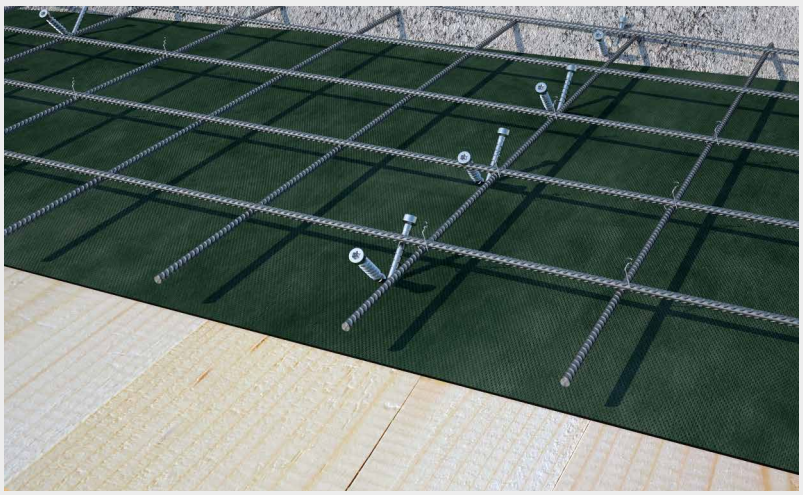


TIMBER-TO-CONCRETE

Ideal for composite floors and for renovation of existing floors. Stiffness values also calculated in the presence of vapour barrier sheet or soundproofing layer.

STRUCTURAL RESTORATION

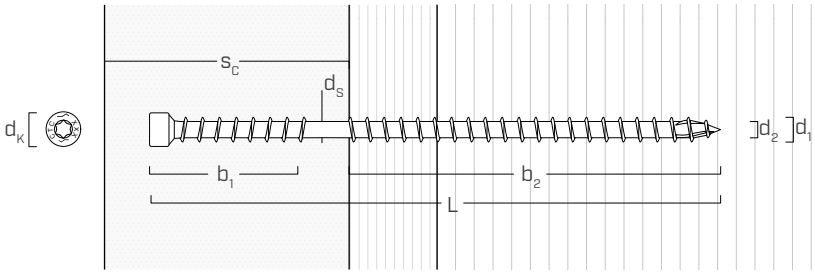
Values also tested, certified and calculated for high density woods. Certification specific for application in timber-concrete structures.



Composite timber-concrete floors on CLT panel with 45° connectors arranged in a single row.

Composite timber-concrete floors with 30° connectors arranged in a double row.

GEOMETRY AND MECHANICAL CHARACTERISTICS



GEOMETRY

Nominal diameter	**d_1**	**[mm]**	**7**	**9**
Head diameter	d_K	[mm]	9,50	11,50
Thread diameter	d_2	[mm]	4,60	5,90
Shank diameter	d_S	[mm]	5,00	6,50
Pre-drilling hole diameter(1)	$d_{V,S}$	[mm]	4,0	5,0

(1) Pre-drilling valid for softwood.

CHARACTERISTIC MECHANICAL PARAMETERS

Nominal diameter	**d_1**	**[mm]**	**7**	**9**
Tensile strength	$f_{tens,k}$	[kN]	20,0	30,0
Yield moment	$M_{y,k}$	[Nm]	20,0	38,0
Coefficient of friction(2)	μ	[-]	0,25	0,25

(2) The friction component μ can be considered only in arrangement with inclined non-crossed screws (30° e 45°) and without the soundproofing foil.

			softwood *(softwood)*	**concrete [EN 206-1] + soundproofing layer**	**concrete [EN 206-1](3)**
Withdrawal resistance parameter	$f_{ax,k}$	-	11,3 N/mm^2	10,0 kN	15,0 kN
Associated density	ρ_a	[kg/m^3]	350	-	-
Calculation density	ρ_k	*[kg/m^3]*	*≤ 590*	-	-

(3) Value only valid in the absence of soundproofing foil for arrangements with 45° angled, uncrossed connectors

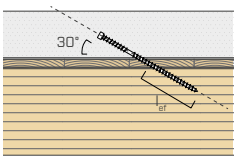
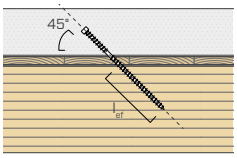
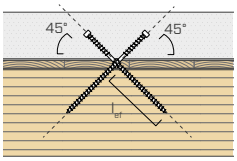
CODES AND DIMENSIONS

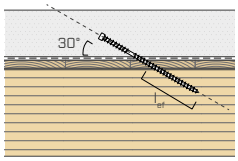
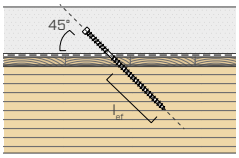
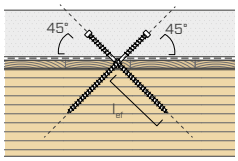
d_1 [mm]	CODE	L [mm]	b_1 [mm]	b_2 [mm]	pcs
7 TX 30	CTC7160	160	40	110	100
	CTC7240	240	40	190	100

d_1 [mm]	CODE	L [mm]	b_1 [mm]	b_2 [mm]	pcs
9 TX 40	CTC9160	160	40	110	100
	CTC9240	240	40	190	100

SLIP MODULUS K_{ser}

The K_{ser} slip modulus is to be understood as relating to a single connector or a pair of crossed connectors subject to a parallel force at the slip surface.

connector arrangement without soundproofing layer	K_{ser} [N/mm] CTC Ø7	K_{ser} [N/mm] CTC Ø9
 parallel at a 30°	80 l_{ef}	80 l_{ef}
 45° parallels	48 l_{ef}	60 l_{ef}
 45° crossed	70 l_{ef}	100 l_{ef}

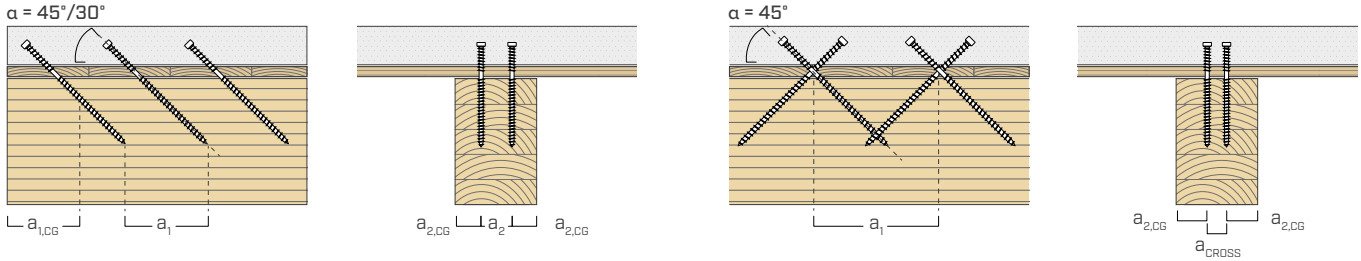
connector arrangement with soundproofing layer	K_{ser} [N/mm] CTC Ø7	K_{ser} [N/mm] CTC Ø9
 parallel at a 30°	48 l_{ef}	48 l_{ef}
 45° parallels	16 l_{ef}	22 l_{ef}
 45° crossed	70 l_{ef}	100 l_{ef}

l_{ef} = depth of CTC connector pull-through into timber element, in millimetres.
Soundproofing foil is defined as a resilient underscreed foil, in bitumen and polyester felt, like SILENT FLOOR.

MINIMUM DISTANCES FOR AXIALLY LOADED CONNECTORS

d_1	[mm]	7	9
a_1	[mm]	130·sin(α)	130·sin(α)
a_2	[mm]	35	45
$a_{1,CG}$	[mm]	85	85
$a_{2,CG}$	[mm]	32	37
a_{CROSS}	[mm]	11	14

α = angle between connector and grain



parallel at 30°/45°

45° crossed

NOTE on page 269.

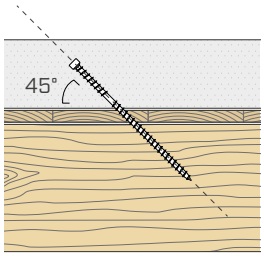
STRUCTURAL VALUES - CALCULATION STANDARD NTC 2018

NTC2018
UNI EN 1995:2014

PRELIMINARY SIZING OF CTC CONNECTORS FOR TIMBER-TO-CONCRETE FLOORS

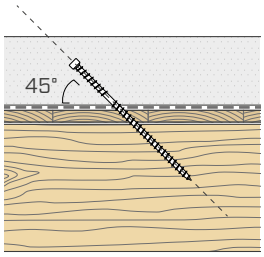
Solid timber C24 (EN 338:2004) - not subject to continuous monitoring

Installation at a 45° angle, without soundproofing layer.



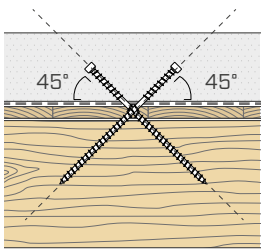
beam section BxH [mm]		span [m]					
		3	3,5	4	4,5	5	6
80 x 160	no. connectors per beam	32	32				
	CTC	7x160	7x240				
	distance[mm]	100/100	120/120	-	-	-	-
	no. of lines	1	1				
	no. connectors/m^2	16,2	13,9				
120 x 120	no. connectors per beam	36	60	84			
	CTC	9x160	9x160	9x160			
	distance[mm]	200/200	100/200	100/100	-	-	-
	no. of lines	2	2	2			
	no. connectors/m^2	18,2	26,0	31,8			
120 x 200	no. connectors per beam		22	20	28	44	
	CTC		7x160	9x240	9x240	9x240	
	distance[mm]	-	150/200	200/300	150/200	100/150	-
	no. of lines		1	1	1	1	
	no. connectors/m^2		9,5	7,6	9,4	13,3	
120 x 240	no. connectors per beam			16	24	32	64
	CTC			7x240	9x240	9x240	9x240
	distance[mm]	-	-	250/300	200/200	150/200	150/300
	no. of lines			1	1	1	2
	no. connectors/m^2			6,1	8,1	10,8	19,4

Installation at a 45° angle, with soundproofing layer.



beam section BxH [mm]		span [m]					
		3	3,5	4	4,5	5	6
80 x 160	no. connectors per beam	18					
	CTC	7x160					
	distance[mm]	200/200	-	-	-	-	-
	no. of lines	1					
	no. connectors/m^2	9,1					
120 x 120	no. connectors per beam	22	64				
	CTC	9x160	9x240				
	distance[mm]	150/150	100/150	-	-	-	-
	no. of lines	1	2				
	no. connectors/m^2	11,1	27,7				
120 x 200	no. connectors per beam		22	20	28	88	
	CTC		7x160	9x160	7x240	9x240	
	distance[mm]	-	150/200	200/300	150/200	120/120	-
	no. of lines		1	1	1	2	
	no. connectors/m^2		9,5	7,6	9,4	26,7	
120 x 240	no. connectors per beam			16	24	24	124
	CTC			7x240	7x240	7x240	9x240
	distance[mm]	-	-	250/300	250/300	200/300	100/100
	no. of lines			1	1	1	2
	no. connectors/m^2			6,1	8,1	8,1	37,6

Crossed installation at a 45° angle, with or without soundproofing layer.



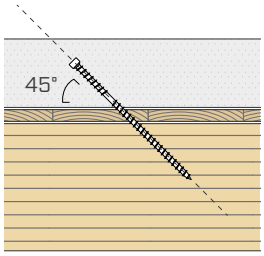
beam section BxH [mm]		span [m]					
		3	3,5	4	4,5	5	6
80 x 160	no. connectors per beam	32	48				
	CTC	7x160	7x240				
	distance[mm]	200/200	150/150	-	-	-	-
	no. of lines	1	1				
	no. connectors/m^2	16,2	20,8				
120 x 120	no. connectors per beam	40	60				
	CTC	9x160	9x160				
	distance[mm]	150/150	100/150	-	-	-	-
	no. of lines	1	1				
	no. connectors/m^2	20,2	26,0				
120 x 200	no. connectors per beam		26	32	48	68	
	CTC		7x240	7x240	7x240	7x240	
	distance[mm]	-	250/400	250/250	150/300	150/150	-
	no. of lines		1	1	1	1	
	no. connectors/m^2		11,3	12,1	16,2	20,6	
120 x 240	no. connectors per beam			24	32	52	82
	CTC			7x240	7x240	7x240	9x240
	distance[mm]	-	-	300/400	250/350	200/200	120/200
	no. of lines			1	1	1	1
	no. connectors/m^2			9,1	10,8	17,5	24,8

STRUCTURAL VALUES - CALCULATION STANDARD NTC 2018

PRELIMINARY SIZING OF CTC CONNECTORS FOR TIMBER-TO-CONCRETE FLOORS

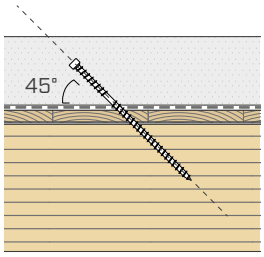
Glulam GL24h (EN14080:2013) - subject to continuous monitoring

Installation at a 45° angle, without soundproofing layer.



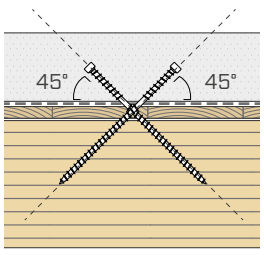
beam section BxH [mm]		span [m]						
		3	3,5	4	4,5	5	5,5	6
120 x 160	no. connectors per beam	10	20	26	36			
	CTC	9x160	7x240	9x240	9x240			
	distance[mm]	400/400	150/300	120/250	100/200	-	-	-
	no. of lines	1	1	1	1			
	no. connectors/m^2	5,1	8,7	9,8	12,1			
120 x 200	no. connectors per beam		10	16	30	38	44	
	CTC		7x240	9x240	9x240	9x240	9x240	
	distance[mm]	-	400/400	300/300	120/250	100/250	100/200	-
	no. of lines		1	1	1	1	1	
	no. connectors/m^2		4,3	6,1	10,1	11,5	12,1	
140 x 200	no. connectors per beam			18	24	32	42	62
	CTC			7x240	9x240	9x240	9x240	9x240
	distance[mm]	-	-	1	1	1	1	1
	no. of lines			250/250	150/300	120/250	100/250	100/100
	no. connectors/m^2			6,8	8,1	9,7	11,6	15,7
140 x 240	no. connectors per beam				18	28	36	48
	CTC				7x240	7x240	9x240	9x240
	distance[mm]	-	-	-	1	1	1	1
	no. of lines				300/300	150/250	120/250	100/200
	no. connectors/m^2				6,1	8,5	9,9	12,1

Installation at a 45° angle, with soundproofing layer.



beam section BxH [mm]		span [m]						
		3	3,5	4	4,5	5	5,5	6
120 x 160	no. connectors per beam	10	14	20	48			
	CTC	7x160	7x160	7x240	7x240			
	distance[mm]	400/400	250/400	200/300	100/100	-	-	-
	no. of lines	1	1	1	1			
	no. connectors/m^2	5,1	6,1	7,6	16,2			
120 x 200	no. connectors per beam		10	14	22	40		
	CTC		7x160	7x160	7x160	7x240		
	distance[mm]	-	400/400	300/400	200/300	100/200	-	-
	no. of lines		1	1	1	1		
	no. connectors/m^2		4,3	5,3	7,4	12,1		
140 x 200	no. connectors per beam			12	22	36	58	
	CTC			7x240	7x240	7x240	7x240	
	distance[mm]	-	-	400/400	200/300	150/150	100/100	-
	no. of lines			1	1	1	1	
	no. connectors/m^2			4,5	7,4	10,9	16,0	
140 x 240	no. connectors per beam				14	16	32	48
	CTC				7x160	7x240	7x240	7x240
	distance[mm]	-	-	-	400/400	350/350	150/250	100/200
	no. of lines				1	1	1	1
	no. connectors/m^2				4,7	4,8	8,8	12,1

Crossed installation at a 45° angle, with or without soundproofing layer.



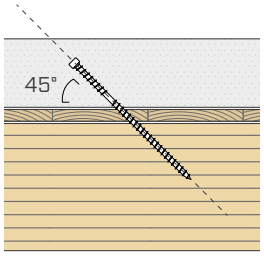
beam section BxH [mm]		span [m]						
		3	3,5	4	4,5	5	5,5	6
120 x 160	no. connectors per beam	16	30	44	68			
	CTC	7x160	7x240	7x240	9x240			
	distance[mm]	400/400	200/300	150/250	100/200	-	-	-
	no. of lines	1	1	1	1			
	no. connectors/m^2	8,1	13,0	16,7	22,9			
120 x 200	no. connectors per beam		18	32	48	68		
	CTC		7x160	7x240	7x240	7x240		
	distance[mm]	-	400/400	200/400	150/300	150/150	-	-
	no. of lines		1	1	1	1		
	no. connectors/m^2		7,8	12,1	16,2	20,6		
140 x 200	no. connectors per beam			28	46	62	84	
	CTC			7x240	7x240	7x240	7x240	
	distance[mm]	-	-	250/400	150/350	120/250	100/200	-
	no. of lines			1	1	1	1	
	no. connectors/m^2			10,6	15,5	18,8	23,1	
140 x 240	no. connectors per beam				32	44	74	100
	CTC				7x240	7x240	9x240	9x240
	distance[mm]	-	-	-	300/300	200/300	150/150	120/120
	no. of lines				1	1	1	1
	no. connectors/m^2				10,8	13,3	20,4	25,3

STRUCTURAL VALUES - CALCULATION STANDARD EN 1995-1-1-2014

PRELIMINARY SIZING OF CTC CONNECTORS FOR TIMBER-TO-CONCRETE FLOORS

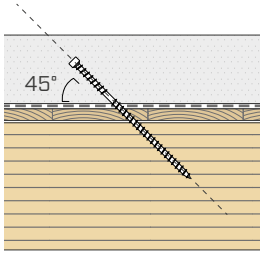
Glulam GL24h (EN14080:2013)

Installation at a 45° angle, without soundproofing layer.



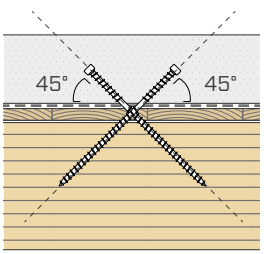
beam section BxH [mm]		span [m]						
		3	3,5	4	4,5	5	5,5	6
120 x 160	no. connectors per beam	10	16	26	32	44		
	CTC	9x160	9x240	9x240	9x240	9x240		
	distance[mm]	400/400	200/400	150/200	120/200	100/150	-	-
	no. of lines	1	1	1	1	1		
	no. connectors/m^2	5,1	6,9	9,8	10,8	13,3		
120 x 200	no. connectors per beam		10	16	24	38	44	
	CTC		7x240	9x240	9x240	9x240	9x240	
	distance[mm]	-	400/400	300/300	200/200	100/250	100/200	-
	no. of lines		1	1	1	1	1	
	no. connectors/m^2		4,3	6,1	8,1	11,5	12,1	
140 x 200	no. connectors per beam			16	24	32	42	52
	CTC			7x240	9x240	9x240	9x240	9x240
	distance[mm]	-	-	1	1	1	1	1
	no. of lines			300/300	200/200	150/200	100/250	100/150
	no. connectors/m^2			6,1	8,1	9,7	11,6	13,1
140 x 240	no. connectors per beam				18	28	36	42
	CTC				7x240	7x240	9x240	9x240
	distance[mm]	-	-	-	1	1	1	1
	no. of lines				300/300	200/200	120/250	120/200
	no. connectors/m^2				6,1	8,5	9,9	10,6

Installation at a 45° angle, with soundproofing layer.



beam section BxH [mm]		span [m]						
		3	3,5	4	4,5	5	5,5	6
120 x 160	no. connectors per beam	10	14	20	48			
	CTC	7x160	7x160	9x160	7x240			
	distance[mm]	400/400	400/400	200/300	100/100	-	-	-
	no. of lines	1	1	1	1			
	no. connectors/m2	5,1	6,1	7,6	16,2			
120 x 200	no. connectors per beam		10	14	20	40		
	CTC		7x160	9x160	9x160	7x240		
	distance[mm]	-	400/400	350/350	200/350	100/200	-	-
	no. of lines		1	1	1	1		
	no. connectors/m2		4,3	5,3	6,7	12,1		
140 x 200	no. connectors per beam			12	16	32	58	
	CTC			7x240	7x160	7x240	7x240	
	distance[mm]	-	-	400/400	250/400	150/200	100/100	-
	no. of lines			1	1	1	1	
	no. connectors/m2			4,5	5,4	9,7	16,0	
140 x 240	no. connectors per beam				14	16	30	48
	CTC				7x160	7x240	7x240	7x240
	distance[mm]	-	-	-	400/400	350/400	150/300	100/200
	no. of lines				1	1	1	1
	no. connectors/m2				4,7	4,8	8,3	12,1

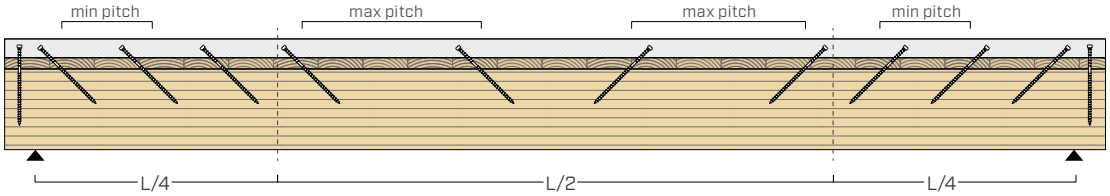
Crossed installation at a 45° angle, with or without soundproofing layer.

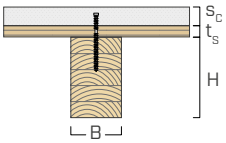


beam section BxH [mm]		span [m]						
		3	3,5	4	4,5	5	5,5	6
120 x 160	no. connectors per beam	16	28	48	76			
	CTC	7x160	7x160	9x160	9x160			
	distance[mm]	400/400	200/350	150/200	100/150	-	-	-
	no. of lines	1	1	1	1			
	no. connectors/m2	8,1	12,1	18,2	25,6			
120 x 200	no. connectors per beam		18	32	48	68		
	CTC		7x160	7x240	7x240	7x240		
	distance[mm]	-	400/400	200/400	150/300	150/150	-	-
	no. of lines		1	1	1	1		
	no. connectors/m2		7,8	12,1	16,2	20,6		
140 x 200	no. connectors per beam			24	46	60	74	
	CTC			9x160	7x240	7x240	7x240	
	distance[mm]	-	-	300/400	150/350	150/200	120/200	-
	no. of lines			1	1	1	1	
	no. connectors/m2			9,1	15,5	18,2	20,4	
140 x 240	no. connectors per beam				35	44	66	82
	CTC				7x240	7x240	7x240	7x240
	distance[mm]	-	-	-	350/350	200/300	150/200	120/200
	no. of lines				1	1	1	1
	no. connectors/m2				11,8	13,3	18,2	20,7

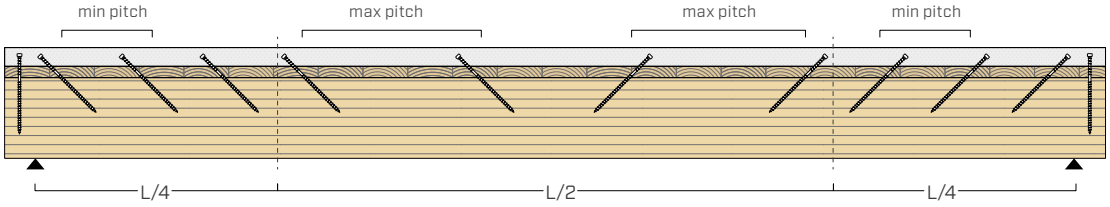
EXAMPLES OF POSSIBLE CONFIGURATIONS

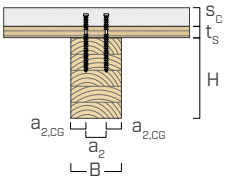
CTC CONNECTORS ARRANGED AT 45° IN PARALLEL CONFIGURATION ON 1 ROW



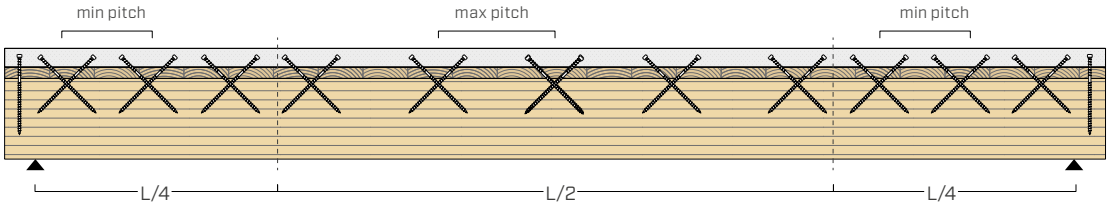


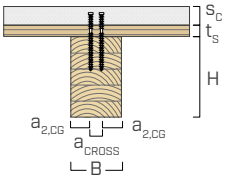
CTC CONNECTORS ARRANGED AT 45° IN PARALLEL CONFIGURATION IN 2 ROWS





CTC CONNECTORS ARRANGED AT 45° IN CROSSED CONFIGURATION ON 1 ROW





STRUCTURAL VALUES

GENERAL PRINCIPLES

- For the mechanical strength values and the geometry of the screws, reference was made to ETA-19/0244.
- The design shear strength of the single inclined connector is given by the minimum contribution between the design strength on the timber side ($R_{ax,d}$), the concrete design shear strength ($R_{ax,concrete,d}$) and the steel design shear strength ($R_{tens,d}$):

$$R_{v,Rd} = (\cos\alpha + \mu \cdot \sin\alpha) \cdot \min \begin{cases} R_{ax,d} \\ R_{tens,d} \\ R_{ax,concrete,d} \end{cases}$$

  where α is the angle between connector and grain (45° or 30°).
- Soundproofing foil is defined as a resilient underscreed foil, in bitumen and polyester felt, like SILENT FLOOR.
- The friction component μ can be considered only in arrangement with inclined non-crossed screws (30° e 45°) and without the soundproofing foil.
- The minimum height of the timber beam must be H ≥ 100 mm.
- The concrete collaborating slab must have a thickness s_C of 50 mm ≤ s_C ≤ 0,7 H; however, it is recommended to limit the thickness to a maximum of 100 mm to ensure the correct distribution of forces between the slab, connector and timber beam.

NOTES

- The pre-dimensioning of the CTC connectors was performed according to Appendix B of EN 1995-1-1:2014 and ETA-19/0244.
- The predimensioning tables for the number of connectors were calculated according to both the Italian standard NTC 2018 and the European standard EN 1995-1-1:2014, making the following assumptions:
  - distance between beams i = 660 mm;
  - class C20/25 concrete slab (R_{ck}=25 N/mm^2) with thickness s_C=50 mm;
  - the presence of a 20 mm thick t_s board with a characteristic density of 350 kg/m^3;
  - in the concrete slab, a Ø8 electrowelded mesh with a mesh size of 200 x 200 mm is planned.
- The predimensioning tables for the number of connectors were calculated according to both the Italian standard NTC 2018 and the European standard EN 1995-1-1:2014, considering the following loads as agents:
  - own weight g_{k1} (timber beam + wooden planking + concrete slab);
  - permanent non-structural load g_{k2} = 2 kN/m^2;
  - variable load of medium duration q_k = 2 kN/m^2.
- Pitch means the minimum and maximum spacing values at which the connectors are positioned, respectively at the sides (L/4 - minimum spacing) and in the central part of the beam (L/2 - maximum spacing).
- The connectors may be arranged in several rows (1 ≤ n ≤ 3) along the beam, subject to the minimum distances.
- For different calculation configurations, the MyProject software is available (www.rothoblaas.com).