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# - European Technical Assessment ETA 23/0906 of 20/12/2023

*English version prepared by Itecons*

## General Part

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|---|---|
| **Technical Assessment Body issuing the European Technical Assessment:** Itecons - Instituto de Investigação e Desenvolvimento Tecnológico para a Construção, Energia, Ambiente e Sustentabilidade | |
| **Trade name of the construction product** | StrongJoint Simple Wave<br>StrongJoint Two Wave<br>StrongJoint Ajustável (10.8, 10.6, 6.6, 5.6 (inox))<br>StrongJoint Simple (10.8, 10.6, 6.6, 5.6 (inox)) |
| **Product family to which the construction product belongs** | Structural Metallic Products and Ancillaries<br><br>Product area code: 20 |
| **Manufacturer** | Strongfloor, Unipessoal Lda<br>Travessa da Charneca do Algar d'Água, nº 175<br>2495-405 Fátima<br>Portugal |
| **Manufacturing plant** | Strongfloor, Unipessoal Lda<br>Travessa da Charneca do Algar d'Água, nº 175<br>2495-405 Fátima<br>Portugal |
| **This European Technical Assessment contains** | 14 pages |
| **This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of** | EAD 200089-00-0302 – *In-situ concrete slab permanent joint former* |

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## Specific parts

### 1. Technical description of the product

In-situ concrete slab permanent joint formers StrongJoint Simple Wave, StrongJoint Two Wave, StrongJoint Junta Ajustável (10.8, 10.6, 6.6, 5.6 (inox)) and StrongJoint Simple (10.8, 10.6, 6.6, 5.6 (inox)), hereinafter refered to also as StrongJoint joints, are leave-in-place formwork and joint system supplied in mild, stainless, galvanized steel or a combination of these materials.

The StrongJoint joints provide continuity of reinforcement for ground supported slabs and transfer the loads through the edges of each panel of the slab to another. In addition, this joint will provide protection to slab edges and ensure continuing serviceability of the ground floor slab.

The StrongJoint joints are composed of:

- Slab edge protection - to protect edges from impacts;
- Concrete anchorage - provided by shear studs;
- Divider plate - to physically constrain the concrete during the casting;
- Dowels - load transfer mechanisms which are welded to the divider plate.

The components of the StrongJoint joints are presented in Table 1.

**Table 1**: Components of the joints

| Joint | Component | | Material |
|---|---|---|---|
| **StrongJoint Simple Wave** | Slab edge protection | Central waved steel bar with dimensions of 10 mm x 25 mm x 3000 mm | EN 10277-2 S235JR |
| | | Double steel bar with dimensions of 10 mm x 40 mm x 3000 mm | EN 10277-2 S235JR |
| | Concrete anchorage | Anchorage connector with dimensions of 10 mm x 100 mm | EN 10277-2 S355JR |
| | Divider plate | Steel angled plate with 2 mm thickness, welded to the double steel bar | EN 10277-2 S235JR |
| | Dowels | Load transfer system composed by metallic plates with thickness of 6 mm or 8 mm covered with plastic sleeves | EN 10277-2 S355JR |
| **StrongJoint Two Wave** | Slab edge protection | Waved double steel bar with dimensions of 10 mm x 30 mm x 3000 mm | EN 10277-2 S235JR |
| | | Double steel bar with dimensions of 10 mm x 40 mm x 3000 mm | EN 10277-2 S235JR |
| | Concrete anchorage | Anchorage connector with dimensions of 10 mm x 100 mm | EN 10277-2 S355JR |
| | Divider plate | Formwork divider plate in angled steel with 2 mm thickness and variable height, welded to the double steel bar | EN 10277-2 S275JR |
| | Dowels | Load transfer system composed by metallic plates with thickness of 6 mm, 8 mm covered with ribbed plastic sleeves | EN 10277-2 S355JR |

| Joint | Component | | Material |
|---|---|---|---|
| **StrongJoint Junta Ajustável (10.8, 10.6, 6.6, 5.6 (inox))** | Slab edge protection | Double steel bar with dimensions of 10/6/5 mm x 40 mm x 3000 mm | EN 10277-2 S235JR |
| | Concrete anchorage | Welded anchorage connector with dimensions of 10 mm x 100 mm | EN 10277-2 S355JR |
| | Divider plate | Two angled steel plates, with thickness of 2 mm and variable height, welded to the central corrugated steel bar | EN 10277-2 S275JR |
| | Dowels | Load transfer system composed by metallic plates made of S355JR steel with thickness of 6 mm or 8 mm covered with ribbed plastic sleeves | EN 10277-2 S355JR |
| **StrongJoint Simple (10.8, 10.6, 6.6, 5.6 (inox))** | Slab edge protection | Double steel bar with dimensions of 10/6/5 mm x 40 mm x 3000 mm | EN 10277-2 S235JR |
| | Concrete anchorage | Anchorage connector with dimensions of 10 mm x 100 mm | EN 10277-2 S355JR |
| | Divider plate | Formwork divider plate in angled steel with 2mm thickness and variable height, welded to the double steel bar | EN 10277-2 S275JR |
| | Dowels | Load transfer system composed by metallic plates of steel with thickness of 6 mm, 8 mm covered with ribbed plastic sleeves | EN 10277-2 S355JR |

In the case of StrongJoint Junta Ajustável and StrongJoint Simple, references 10.8, 10.6, 6.6, 5.6 refer to the thickness of the slab edge protection (ex. 10 mm), followed by the thickness of the dowel (ex. 8 mm).

Further information is given in Annex A.

## 2. Specification of the intended use(s) in accordance with the applicable European Assessment Document (hereinafter EAD)

### 2.1. Intended use

In-situ concrete slab permanent joint formers are leave-in-place formwork that provide continuity of reinforcement in ground supported slabs and transfer the loads from one slab to the next if required, providing a continuum in slab deformation to the required level. In addition, the joints will provide protection to slab edges and ensure continuous serviceability of the ground floor slab.

Slab edges are vulnerable to damage caused by the transit of materials handling equipment, with wider joints being more susceptible. The small hard wheels of pallet trucks and similar equipment are particularly aggressive.

The number and type of joints in a floor will depend on the floor construction method and its design. The chosen method should consider the intended use of the floor, among other factors.

StrongJoint joints are free-movement joints, designed to provide a minimum restraint to horizontal movements caused by drying shrinkage and temperature changes in the slab, while restricting relative vertical movement.

The provisions made in this European Technical Assessment are based on an assumed working life of 50 years as minimum according to the EAD, provided that the conditions lay down for the installation, packaging, transport and storage as well as appropriate use, maintenance and repair are met. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a mean for choosing the right product in relation to the expected economically reasonable working life of the works.

## 3. Performance of the product and references to the methods used for its assessment

The assessment of the StrongJoint joints according to the Basic Work Requirements (BWR) was carried out in compliance with EAD 200089-00-0302. The characteristics of the components shall correspond to the respective values laid down in the technical documentation of this ETA, checked by Itecons.

### 3.1. Mechanical resistance and stability (BWR 1)

#### 3.1.1. Load transfer capacity

The load-transfer capacity depends mainly on the mechanism of the joint. Sub-base support may have some influence, but it is not considered in the design process. Joint mechanisms can be composed of round or square dowel bars, or plate dowels.

The transit of material handling equipment will cause some relative deflection across joints; hence, they should be designed to reduce such deflection to a negligible amount.

The load transfer capacity of the joints depends on the compressive strength of concrete and the geometry and strength of the dowels at yield. Their load transfer capacity was determined according to annex A of EAD 200089-00-0302 and the results are presented in Annex B of this ETA.

#### 3.1.2. Durability

The durability of the product depends on the durability of the materials used. The part of the floor in which the joint systems are intended to be installed or applied must be assessed according to their chemical composition, thickness of material layers, intended use, concrete cover thickness and the environmental exposure to which they are subject. To assess the durability, the following cases must be considered:

- Stainless steel products can be considered fit for purpose from a durability aspect;
- Galvanized or mild steel elements with a minimum 30 mm concrete cover can be considered fit for purpose from durability aspect;
- Galvanized steel must have a minimum of 25 µm galvanized coating if not covered by a minimum of 30 mm concrete cover for floors exposed to frequently wet or corrosive conditions;
- Galvanized steel must have a minimum of 85 µm galvanized coating if not covered by a minimum of 30 mm concrete cover for continuously wet floors.

If all products assessed comply with these requirements, no further investigation regarding durability is required.

#### 3.1.3. Dimensions, tolerances on dimensions and shape

The dimensional tolerances of the steel components of the StrongJoint joints are ± 0.5 mm, as established by the production control.

The tolerances for angles between the systems components, as established in the production control, are ± 0.5°.

## 3.2. Energy economy and heat retention (BWR 6)

### 3.2.1. Thermal performance

No performance assessed.

### 3.2.2. Condensation risk

No performance assessed.

## 4. Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

According to the Decision 1998/214/EC of European Commission as amended by the European Commission Decision 2001/596/EC, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No. 305/2011) is 2+.

## 5. Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

The ETA is issued on the basis of agreed data/information, deposited at Itecons, which identifies the product that has been assessed and judged. It is the manufacturer's responsibility to make sure that all those who use the construction product are appropriately informed of specific conditions laid down in this ETA.

Changes to the in-situ concrete slab permanent joint former or the components or their production process should be notified to the Itecons before the changes are introduced. Itecons will decide whether or not such changes affect the ETA and if so whether further assessment or alterations to the ETA shall be necessary.

Issued in Coimbra on 20.12.2023

By

Technical Assessment Unit of

Itecons – Instituto de Investigação e Desenvolvimento Tecnológico para a Construção, Energia, Ambiente e Sustentabilidade

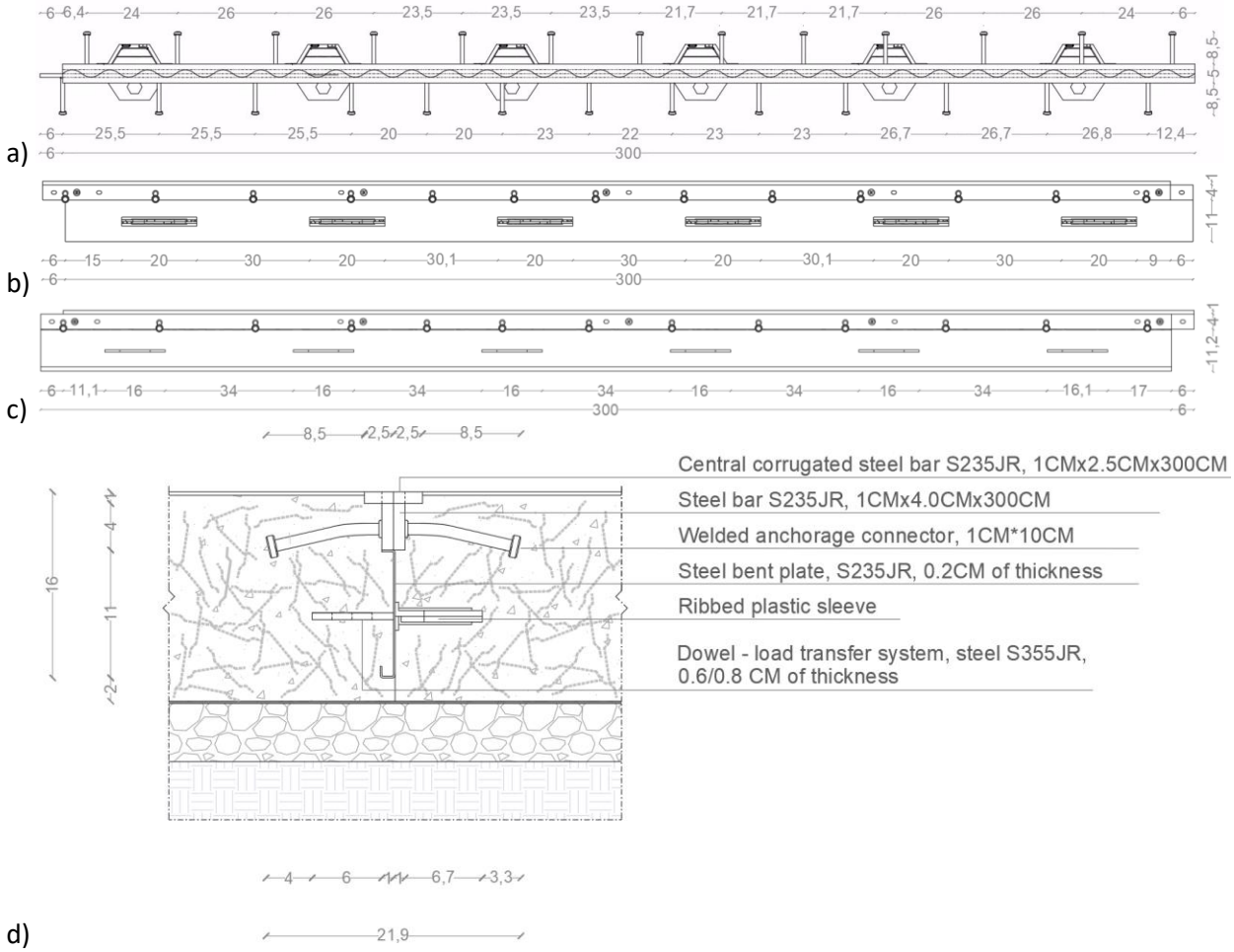
Andreia Gil
Senior Official

(*Technical Assessment Unit Coordinator*)

Validated document

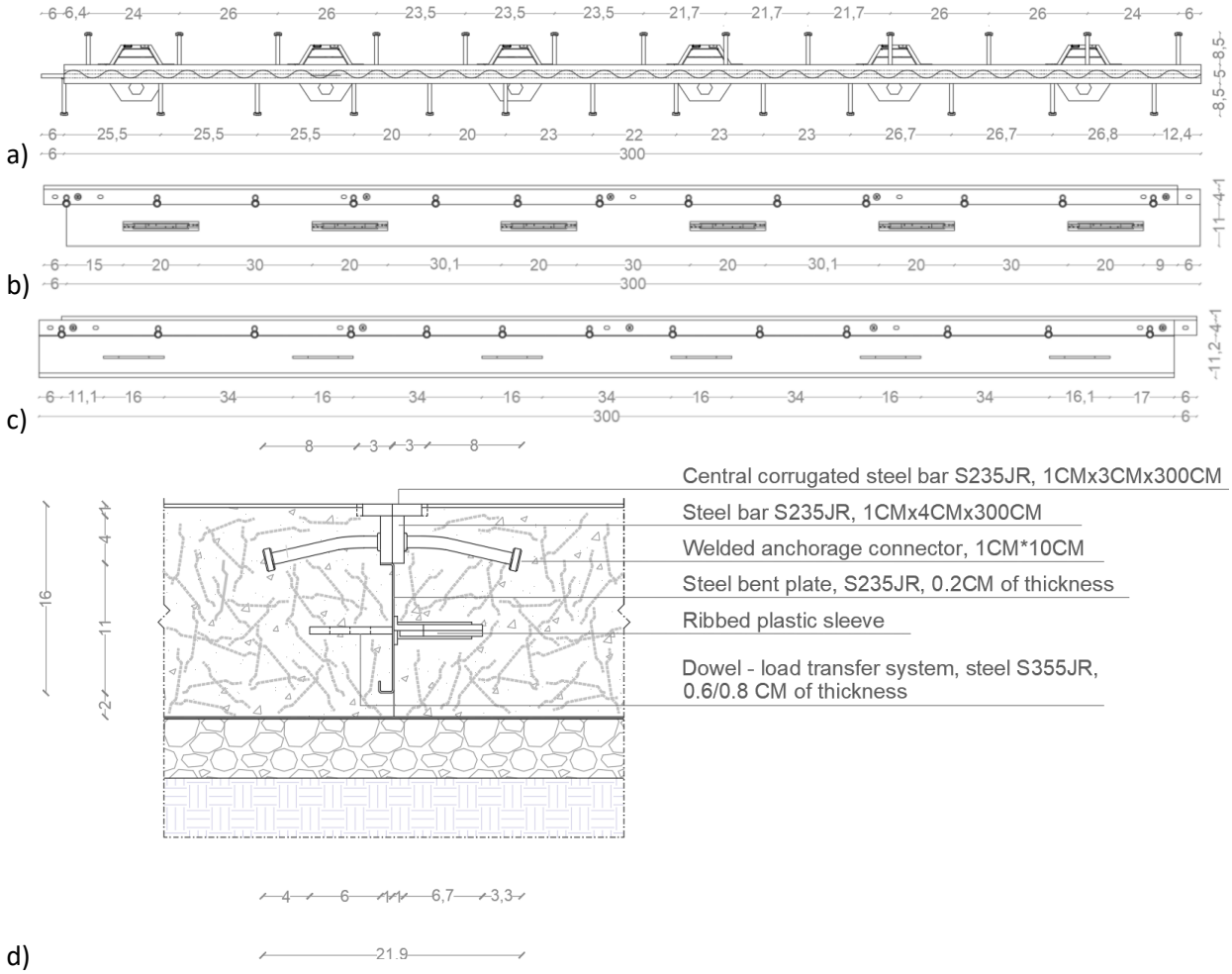
(Administration)

## ANNEX A – Detailed Drawings



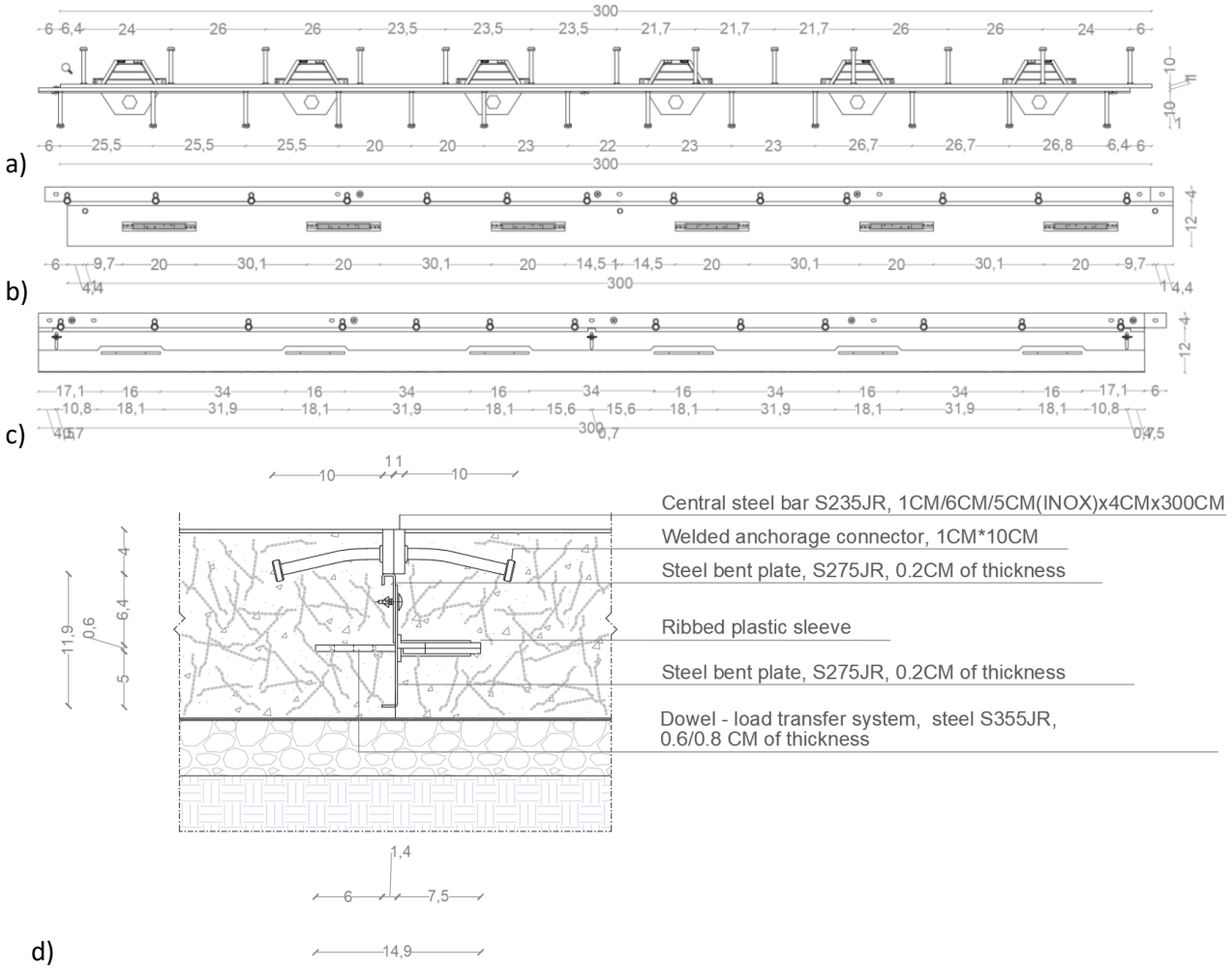

Dimensions in cm

**Figure A.1**: Detailed drawings of the StrongJoint Simple Wave: a) Top view; b) Right side view; c) Left side view; d) Cross-section view



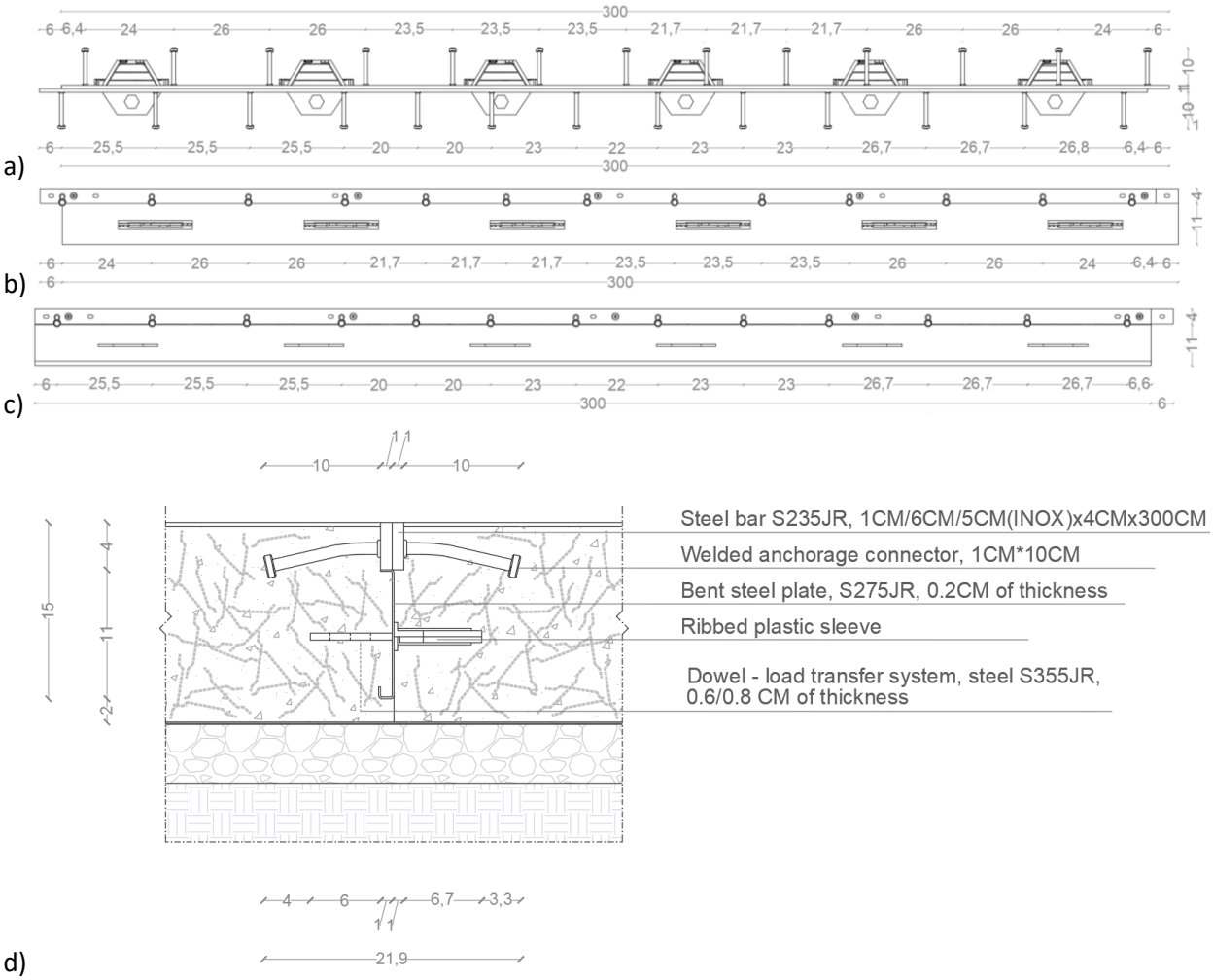

Dimensions in cm

**Figure A.2**: Detailed drawings of the StrongJoint Two Wave: a) Top view; b) Right side view; c) Left side view; d) Cross-section view




Dimensions in cm

**Figure A.3**: Detailed drawings of the StrongJoint Junta Ajustável (10.8, 10.6, 6.6, 5.6 (inox)): a) Top view; b) Right side view; c) Left side view; d) Cross-section view




Dimensions in cm

**Figure A.4**: Detailed drawings of the StrongJoint Simple (10.8, 10.6, 6.6, 5.6 inox)): a) Top view; b) Right side view; c) Left side view; d) Cross-section view

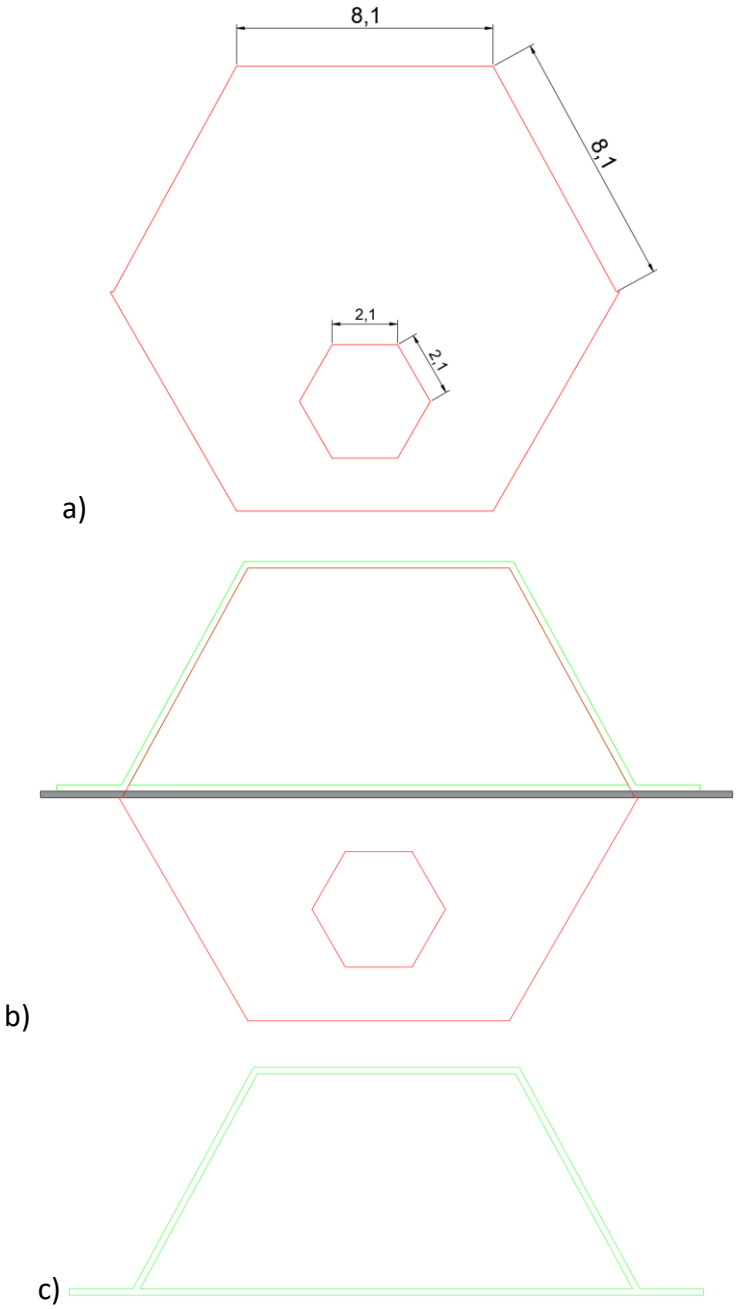



**Figure A.5**: Detailed drawings of the: a) Dowel of the StrongJoint joints; b) Dowel and sleeve assembly; c) Sleeve

## ANNEX B – DOWEL LOAD TRANSFER

The methodology used for calculating the load transfer capacity of dowels was adopted from TR34, Fourth edition (2016), according to EAD 200089-00-0302, with modifications due to the variable geometry of the plate dowels. The calculation method and the results are presented in the following sections.

### B.1 Calculation parameters

**Table B1.1**: Characteristic strength and design strength of the concrete

| Class | Characteristic compressive cylinder strength $f_{ck}$ [MPa] | Design compressive cylinder strength $f_{cd}$ [MPa] |
|---|---|---|
| C20/25 | 20 | 13.33 |
| C25/30 | 25 | 16.67 |
| C30/37 | 30 | 20.00 |
| C35/45 | 35 | 23.33 |
| C40/50 | 40 | 26.67 |

**Table B1.2**: Characteristic yield strength and design yield design strength of the steel

| Class | Characteristic Yield strength $f_{yk}$ [MPa] | Design yield strength $f_{yd}$ [MPa] |
|---|---|---|
| S355 | 355 | 308.70 |

The open joints considered (2 x e): 1 mm, 5 mm; 10 mm; 15 mm; 20 mm and 25 mm.

### B.2 StrongJoint Dowels

Discrete plate dowels are commonly used as alternatives to traditional bar dowels. These are not to be confused with continuous plate dowels which have been found to perform poorly in service and are not recommended.

The bearing/bending capacity of the StrongJoint Dowels is given by the following equations:

$$\begin{cases} P_V = P_{max,plate} = k_3 \cdot f_{cd} \cdot \sum_{i=1}^{n} p_{b,i} \cdot \Delta x_i \quad , \quad with \ x_1 = \sum_{i=1}^{n} \Delta x_i \\ P_M = P_{max,plate} = \left( t_p^2 \cdot p_b(x_1) \cdot \frac{f_{yd}}{4} + k_3 \cdot f_{cd} \cdot \sum_{i=1}^{n} p_{b,i} \cdot \Delta x_i \cdot d_i \right) \Big/ (e + x_1) \end{cases}$$

Where: $b_1 = 2e.k_3.f_{cd}.p_b$

$c_1 = 2k_3.f_{cd}.P_b^2.t_p^2.f_{yk}$

*e* = Half of joint opening width

$k_3$ = 3, a constant determined empirically

$f_{cd} = f_{ck}/\Upsilon_c =$ Concrete design compressive cylinder strenght

$\gamma c$ = 1.50

$p_b$ = Plate width

$d_i$ = Distance from the centre of slice i to the point of zero shear

$p_{b,i}$ = Plate width of the slice i

$t_p$ = Plate thickness

$f_{yk}$ = characteristic yield strength

$\gamma s$ = 1.15

$\Delta xi$ = lenght of the slice i

Solving the equations, the shear capacity of the StrongJoint Dowels is given by:

$$P_{sh,plate} = 0.9 \cdot t_p \cdot p_{b,i} \cdot 0.6 \cdot f_{yk}$$

However, the calculations revealed that the critical section is always the section where the dowel has maximum shear value, on the face of the concrete slab (section n=1). Therefore, the equation can be written as follow:

$$P_{sh,plate} = P_{sh,plate,1} = 0.9 \cdot t_p \cdot p_{b,1} \cdot 0.6 \cdot f_{yk}$$

The calculated values for $P_{max,plate}$ and $P_{sh,plate}$ using equations above are presented in following tables.

**Table B2.1:** StrongJoint Dowel 6 mm S355 steel – $P_{max,plate}$

| **PARAMETERS** | | **Open joint – 2 x *e* [mm]** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.0** | **5.0** | **10.0** | **15.0** | **20.0** | **25.0** |
| $t_p$ [mm] | | 6.0 | | | | | |
| C20/25 | $x_1$ [mm] | 11.1 | 9.4 | 7.7 | 6.4 | 5.4 | 4.6 |
| | $p_b$ [mm] | 142.8 | 140.4 | 136.8 | 132.8 | 128.4 | 123.8 |
| | **$P_{max,plate}$ [kN]** | **66.3** | **54.6** | **43.2** | **34.6** | **28.2** | **23.3** |
| C25/30 | $x_1$ [mm] | 9.9 | 8.2 | 6.6 | 5.4 | 4.5 | 3.8 |
| | $p_b$ [mm] | 144.1 | 141.6 | 138.0 | 133.9 | 129.4 | 124.7 |
| | **$P_{max,plate}$ [kN]** | **74.2** | **60.0** | **46.5** | **36.6** | **29.4** | **24.1** |
| C30/37 | $x_1$ [mm] | 9.0 | 7.3 | 5.8 | 4.6 | 3.8 | 3.2 |
| | $p_b$ [mm] | 145.1 | 142.6 | 138.9 | 134.7 | 130.1 | 125.3 |
| | **$P_{max,plate}$ [kN]** | **81.2** | **64.6** | **49.1** | **38.2** | **30.4** | **24.7** |
| C35/45 | $x_1$ [mm] | 8.3 | 6.7 | 5.1 | 4.1 | 3.4 | 2.8 |
| | $p_b$ [mm] | 145.9 | 143.3 | 139.5 | 135.2 | 130.6 | 125.8 |
| | **$P_{max,plate}$ [kN]** | **87.7** | **68.6** | **51.3** | **39.4** | **31.1** | **25.1** |
| C40/50 | $x_1$ [mm] | 7.8 | 6.1 | 4.7 | 3.7 | 3.0 | 2.5 |
| | $p_b$ [mm] | 146.5 | 143.9 | 140.1 | 135.7 | 131.0 | 126.1 |
| | **$P_{max,plate}$ [kN]** | **93.6** | **72.2** | **53.2** | **40.4** | **31.7** | **25.5** |

**Table B2.2:** StrongJoint Dowel 6 mm S355 steel – $P_{sh,plate}$

| PARAMETERS | Open joint – 2 x *e* [mm] | | | | | |
|---|---|---|---|---|---|---|
| | **1.0** | **5.0** | **10.0** | **15.0** | **20.0** | **25.0** |
| $t_p$ [mm] | 6.0 | | | | | |
| $p_b$ [mm] | 154.9 | 150.6 | 145.1 | 139.7 | 134.3 | 128.8 |
| $\boldsymbol{P_{sh,plate}}$ **[kN]** | **178** | **173** | **167** | **161** | **154** | **148** |

**Table B2.3:** StrongJoint Dowel 8 mm S355 steel – $P_{max,plate}$

| PARAMETERS | | Open joint – 2 x *e* [mm] | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.0** | **5.0** | **10.0** | **15.0** | **20.0** | **25.0** |
| $t_p$ [mm] | | 8.0 | | | | | |
| C20/25 | $x_1$ [mm] | 14.9 | 13.1 | 11.2 | 9.7 | 8.4 | 7.4 |
| | $p_b$ [mm] | 138.7 | 136.3 | 132.9 | 129.2 | 125.1 | 120.8 |
| | $\boldsymbol{P_{max,plate}}$ **[kN]** | **87.6** | **75.2** | **62.4** | **52.0** | **43.6** | **36.9** |
| C25/30 | $x_1$ [mm] | 13.3 | 11.5 | 9.7 | 8.2 | 7.1 | 6.2 |
| | $p_b$ [mm] | 140.4 | 138.0 | 134.6 | 130.7 | 126.5 | 122.1 |
| | $\boldsymbol{P_{max,plate}}$ **[kN]** | **98.4** | **83.3** | **67.9** | **55.8** | **46.3** | **38.8** |
| C30/37 | $x_1$ [mm] | 12.1 | 10.4 | 8.6 | 7.2 | 6.1 | 5.3 |
| | $p_b$ [mm] | 141.7 | 139.3 | 135.8 | 131.8 | 127.6 | 123.1 |
| | $\boldsymbol{P_{max,plate}}$ **[kN]** | **108.0** | **90.3** | **72.5** | **58.8** | **48.3** | **40.2** |
| C35/45 | $x_1$ [mm] | 11.2 | 9.5 | 7.7 | 6.4 | 5.4 | 4.7 |
| | $p_b$ [mm] | 142.7 | 140.3 | 136.7 | 132.7 | 128.4 | 123.8 |
| | $\boldsymbol{P_{max,plate}}$ **[kN]** | **116.9** | **96.5** | **76.4** | **61.3** | **49.9** | **41.3** |
| C40/50 | $x_1$ [mm] | 10.5 | 8.7 | 7.1 | 5.8 | 4.9 | 4.2 |
| | $p_b$ [mm] | 143.5 | 141.1 | 137.5 | 133.4 | 129.0 | 124.3 |
| | $\boldsymbol{P_{max,plate}}$ **[kN]** | **125.0** | **102.1** | **79.9** | **63.5** | **51.3** | **42.1** |

**Table B2.4:** StrongJoint Dowel 8 mm S355 steel – $P_{sh,plate}$

| PARAMETERS | Open joint – 2 x *e* [mm] | | | | | |
|---|---|---|---|---|---|---|
| | **1.0** | **5.0** | **10.0** | **15.0** | **20.0** | **25.0** |
| $t_p$ [mm] | 8.0 | | | | | |
| $p_b$ [mm] | 154.9 | 150.6 | 145.1 | 139.7 | 134.3 | 128.8 |
| $\boldsymbol{P_{sh,plate}}$ **[kN]** | **238** | **231** | **223** | **214** | **206** | **198** |