EUROPEAN ASSESSMENT DOCUMENT

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IN-SITU CONCRETE SLAB PERMANENT JOINT FORMER

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1 SCOPE OF THE EAD

1.1 Description of the construction product

In-Situ concrete slab permanent joint formers (see Figure 1) are leave-in-place formwork and joint system supplied in mild steel, stainless steel or galvanised steel. The system provides edge reinforcement by way of solid, steel top strips or folded/rolled steel with shear studs for anchorage. Dowels are Metal Inert Gas (MIG) welded and shear studs are drawn arc welded and provide anchorage to the concrete slab. The system comprises fixed or adjustable depth divider plate for different slab thicknesses.

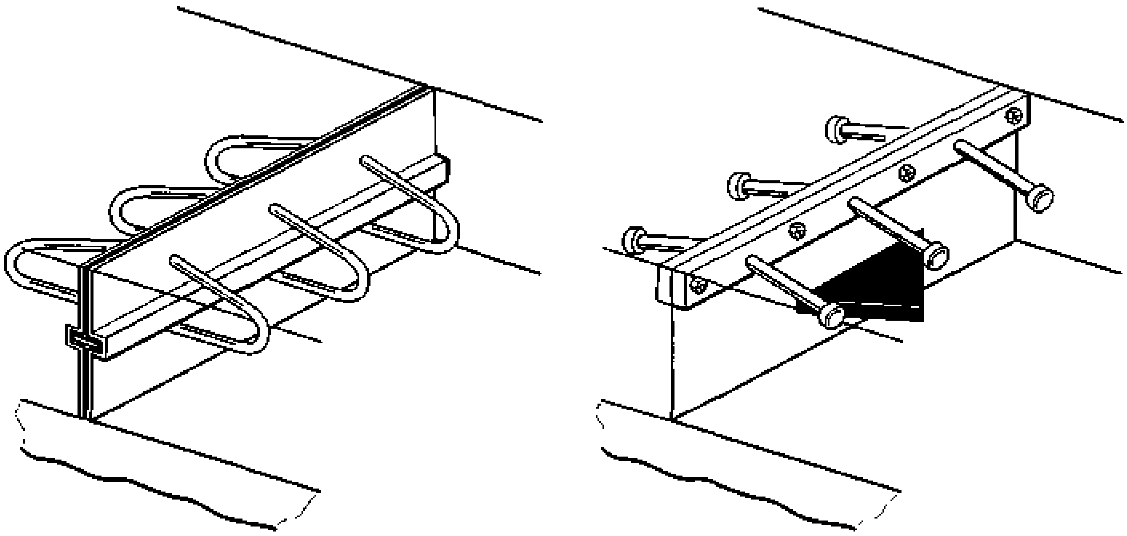

Figure 1. Permanent joint former

The product is not covered by a harmonised European standard (hEN).

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise their clients on the transport, storage, maintenance, replacement and repair of the product as they consider necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The products covered by this EAD are leave-in-place formwork and joint systems to provide continuity of reinforcement in ground supported slabs and transfer the loads through the edges of each panel of the slab to another if required to provide deformation continuity in the slab to the required level. Also the joints will provide protection to slab edges and ensure continuing serviceability of the ground floor slab.

Joints are unavoidable elements in all concrete floors and their design and construction requires careful attention as they can be a significant potential source of problems. The edges of slab panels are vulnerable to damage caused by the passage of materials handling equipment, with wider joints being more susceptible. The small hard wheels on pallet trucks and similar trucks are particularly aggressive. The number and type of joints in a floor will depend on the floor construction method and its design. The method chosen should be related to the planned use of the floor and other factors.

The load-carrying capacities of a slab at a free edge and at a free corner are approximately 50% and 25% of the capacity at the centre of the slab. True free edges or corners that are required to carry loads are relatively unusual, as they generally occur only at the periphery of a building. Joints between panels and the intersections of these joints are of greater importance: provision must be made to transfer load across them ('load-transfer capacity'), and to prevent differential vertical movement. If load transfer across a joint is not provided or cannot be assumed, a slab will have to be designed for the free-edge/corner load cases.

The joint formers assessed in this EAD form “free-movement joints”. Free-movement joints are designed to provide a minimum of restraint to horizontal movements caused by drying shrinkage and temperature changes in the slab, while restricting relative vertical movement. There is no reinforcement across the joint. Dowels or other mechanisms provide load transfer. Load transfer mechanisms including dowels and dowel sleeves should be engineered to minimise vertical movement. A free-movement joint should be provided between a floor slab and an adjoining structure where the adjoining structure forms part of the floor surface trafficked by material handling equipment.

Free-movement joints are usually provided to coincide with a planned concrete pour or to maintain an acceptable aspect ratio of the floor panel. Dowel systems provide load transfer.

Plate systems can be of various shapes to allow lateral movement. These can be incorporated into permanent formwork systems, which provide steel faces to the arrises.

The primary purpose of free-movement joints is to provide for shrinkage. Therefore, joint former sections should be discontinuous at joint intersections.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer’s request to take into account a working life of the in-situ concrete slab permanent joint former for the intended use of 50 years when installed in the works (provided that the in-situ concrete slab permanent joint former is subject to appropriate installation). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of the in-situ concrete slab permanent joint former is assessed in relation to the essential characteristics.

Table 1 **Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics**

No	Essential characteristic	Assessment method	Type of expression of product performance *(level, class, description)*
Basic Works Requirement 1: Mechanical resistance and stability			
1	Load transfer capacity	2.2.1	*Level*
2	Durability	2.2.2	*Description*
3	Dimensions, tolerances on dimensions and shape, mass	2.2.3	*Level*
Basic Works Requirement 6: Energy economy and heat retention			
4	Thermal performance	2.2.4	*Description*
5	Condensation risk	2.2.5	*Description*

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

2.2.1 Load transfer capacity

Load-transfer capacity is principally dependent 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 consist of round or square dowels or plate dowels. Some of these joint designs incorporate steel protection for armouring the joint arris.

The movement of materials handling equipment will cause some relative deflection across joints. Joints should be designed to reduce this to a negligible amount. As deflections increase through loss of aggregate interlock, failure of joint mechanisms to continue to provide a close fit between dowel and sleeve or loss of subgrade support, the rate of degeneration increases under dynamic loads.

The arrises at formed free-movement joints can be protected by steel armouring. Most joint systems are combined with permanent formwork and load-transfer systems; some comprise strips at only the upper part of the joint faces. Where a load transfer mechanism is included, its design should take into account the effective depth of the concrete that surrounds it when considering bearing and burst-out capacity.

The load transfer capacity of the joints depends on the compressive strength of concrete and the geometry and strength of the dowels at yield. A proposed design methodology is presented in Annex A adopted from

Technical Report 34 by the Concrete Society [1]. The ETA would state the properties of the dowels including their geometric characteristics and strength. The structural designer of the works where the product is to be installed will use these values to find the load transfer capacity of the slab.

2.2.2 **Durability**

The durability of the products shall be the typical durability of the materials used. The part of the floor in which the joint systems are intended to be installed or applied shall 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 following cases must be considered:

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

2.2.3 Dimensions, tolerances on dimensions and shape, mass

The tolerances for dimension of steel components of the system is +/- 0.5mm. The tolerances for angles between the components of the system is +/- 0.5^{o}.

2.2.4 Thermal performance

The joint system may increase heat loss (thermal bridging) in external elements and junctions. The heat loss associated with elements (U-values) and junctions (ψ-values), incorporating the system, shall be determined in accordance with EN ISO 10211 : 2017.

2.2.5 Condensation risk

The joint system may increase thermal bridging in external elements and junctions. The risk of surface condensation for elements and junctions incorporating the system shall be determined by comparison of temperature factors, f_{Rsi}, (established in accordance with EN ISO 10211 : 2017) with the maximum temperature factor, $f_{Rsi,max}$ (established in accordance with EN ISO 13788 : 2012). Elements and/or junctions are acceptable when $f_{Rsi}>f_{Rsi,max}$. The supporting calculations for condensation risk are left to the manufacturer for each specific case.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 1998/214/EC, amended by 2001/596/EC

The system's level of attestation is 2+.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 2.2)*	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [**including testing of samples taken at the factory in accordance with a prescribed test plan**]					
1	Load transfer capacity Shear capacity – bar dowels Shear capacity – plate dowels	2.2.1	As per Manufacturer's Control Document	1	When starting the production or a new production line
2	Dimensions, tolerances on dimensions and shape, mass	2.2.3	Dimension tolerance: +/- 0.5mm Angle tolerance: +/- 0.5º	3	Per year

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for in-Situ concrete slab permanent joint former are laid down in Table 3.

Table 3 Control plan for the notified body; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 2.2 or 3.4)*	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for systems 1+, 1 and 2+ only)*					
1	Inspection of factory and factory production control	2.2.3	Dimension tolerance: +/- 0.5mm Angle tolerance: +/- 0.5º	3	Before certification
2	Inspection of the testing facilities of the manufacturer	-	-	-	-
Continuous surveillance, assessment and evaluation of factory production control *(for systems 1+, 1 and 2+ only)*					
3	Surveillance and assessment of factory production control	2.2.3	Dimension tolerance: +/- 0.5mm Angle tolerance: +/- 0.5º	3	Once a year
4	Surveillance of the testing facilities of the manufacturer	-	-	-	-

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

[1] Technical Report 34 (TR34): Concrete Industrial Ground Floors – a guide to design and construction, Forth Edition, *the Concrete Society,* 2016

[2] EN10025-4 : 2004 Hot rolled products of structural steels. Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels

[3] EN 10088-5 : 2009 Stainless steels. Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes

[4] EN 13877-3 : 2004 Concrete pavements. Specifications for dowels to be used in concrete pavements

[5] EN ISO 10211 : 2017 Thermal bridges in building construction. Heat flows and surface temperatures. Detailed calculations

[6] BS EN ISO 13788 : 2012 Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods

ANNEX A - DOWEL LOAD TRANSFER CAPACITY

This proposed methodology for calculating the load transfer capacity of dowels is adopted from TR34, Fourth edition (2016). The dowels are classified to bar dowels and plate dowels and the calculation method is presented for each separately.

A1. Conventional bar dowels

Dowels in accordance with EN 13877-3 : 2004 [2] are short lengths of smooth steel of either round, square or rectangular section used at joints to enable loads to be transferred from one side of the joint to the other with no significant differential deflection.

The shear capacity is given by:

$$P_{sh\,dowel} = 0.6\, f_{yd} A_v \qquad \text{Equation 1}$$

Where: $f_{yd} = f_{yk}/\gamma_s$ = design yield strength of dowel

A_v= Shear Area of taken as 0.9 x area of the dowel section

f_{yk}= yield strength of dowel

γ_s = partial safety factor for steel, taken as 1.15.

The bearing/bending capacity per dowel,P_{bear}, is given by:

$$P_{max\,dowel} = d_d^2 (f_{cd} f_{yd})^{0.5} [(1+\alpha^2)^{0.5} - \alpha] \qquad \text{Equation 2}$$

Where: d_d = diameter of round dowel or width of a square bar

$f_{cd} = f_{ck}/\gamma_s$ = concrete design compressive cylinder strength

$f_{yd} = f_{yk}/\gamma_s$ = characteristic strength of steel dowel

$\alpha = 3e\left[(f_{cd}/f_{yd})^{0.5}\right]/d_d$

e = half of joint opening width

A2. Plate 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 shear capacity is given by:

$$P_{sh\,plate} = A * 0.9 * 0.6\, p_y \qquad \text{Equation 1}$$

Where: A = cross-sectional area of plate

p_y= plate steel design yield strength

The bearing/bending capacity per plate dowel is given by:

$P_{max\,plate} = 0.5[(b_1^2 + c_1)^{0.5} - b_1]$ Equation 2

Where: $b_1 = 2ek_3 f_{cd} P_b$

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

e = half of joint opening width

k_3 = a constant determined empirically

$f_{cd} = f_{ck}/\gamma_s$ = concrete design compressive cylinder strength

P_b = Plate width

t_p = Plate thickness

$f_{yd} = f_{yk}/\gamma_s$ = characteristic strength of steel plate