SCIENCE INSTITUTE
CONSTRUCTION EDUARDO TORROJA
C/ Serrano Galvache nº 4. 28033 Madrid
Tel (+34) 91 3020440 Fax(+34) 91 3020700
e-mail: dit@ietcc.csic.es
http://www.ietcc.csic.es

TECHNICAL APPROVAL: No. 611R/20

Generic / Intended Use Area:	**COLUMN FORMWORK SYSTEM**
Trade name:	**TBT FORMWORKS**
Beneficiary:	**FATEC, S.A.**
Headquarters:	Camino de la Aldea s/n 45930 Méntrida (Toledo) - España Telf. 91 817 71 31 http://www.fatecsa.com
Manofacture´s place:	Camino de la Aldea s/n 45930 Méntrida (Toledo)
Valid. Since: **Until:**	December 18, 2020 December 18, 2025 (Subject to annual monitoring)

This document consists of 15 pages

MEMBER OF:

EUROPEAN UNION FOR THE EVALUATION OF THE TECHNICAL APPROVAL
UNION EUROPEENNE POUR L'AGREMENT TECHNIQUE DANS LA CONSTRUCTION
EUROPEAN UNION OF AGREMENT
EUROPÄISCHE UNION FÜR DAS AGREMENT IN BAUWESEN

VERY IMPORTANT

The TECHNICAL APPROVAL is by definition a favorable technical assessment by the Institute of Construction Science Eduardo Torroja (IETcc), fitness for employment in construction materials, systems and nontraditional procedures for a particular and specific use. Not, by itself, any administrative purpose, or it is authorization for us e or guarantee. The responsibility of the IETcc does not extend to aspects related to intellectual or industrial property or to the patent rights of the product, system or manufacturing or installation procedures that appear in the DIT.

Before using the material, system or process to which it refers, it must be in full knowledge of the document, so it must be supplied by the holder thereof in its entirety.

The change in the characteristics of the products or failure to follow the conditions of use, as well as observations of the Committee of Experts, invalidate this technical evaluation.

C.D.U: 69.057.5
Encofrados
Coffrage
Formwork

DECISION No. 611/15

THE DIRECTOR SCIENCE INSTITUTE CONSTRUCTION EDUARDO TORROJA

- by Decree No. 3,652 / 1963 of 26 December, the Prime Minister, by which empowers the Institute of Construction Science Eduardo Torroja, to extend the technical approval of materials, systems and procedures nontraditional used in building construction and civil engineering, and Order No. 1,265 / 1988 of 23 December, the Ministry of Parliamentary Relations and the Government Secretariat, for which the grant is regulated,

- considering Article 5.2, paragraph 5, of the Technical Building Code (hereinafter CTE) on compliance with the CTE of products, equipment and innovative systems, which states that a building system complies with the CTE if evaluation available favorable technical suitability for its intended use,

- considering the specifications in the Regulations for Monitoring the DIT of 28 October 1998,

- considering the request made by the FATEC, S.A. Company for the RENOVATION of the Technical Approval Number 611/15, System Formwork of TBT.

- under the current statutes of l'Union Européenne pour l'Agrément technique dans la construction (UEAtc)

- taking into account the reports of visits to works by representatives of the Institute of Construction Science Eduardo Torroja, the reports of the trials in the IETcc as well as the comments made by the Committee of Experts, at its meeting on 2 July 2015 and 17 December 2020.

DECIDES:

Renew the technical approval number 611/15, the **Column formwork system TBT**, DIT number 611R/20,

considering that,

The technical assessment to conclude that the system **conforms with the technical BUILDING CODE**, provided that the full contents of this document and in particular the following conditions are respected:

GENERAL CONDITIONS

This technical approval evaluates only the formwork system proposed by the manufacturer, as described in this document and shall in each case, in accordance with current regulations, accompanied by the corresponding technical project and be completed by address corresponding work.

FATEC, S.A. this project will contribute to the respective data sheets and documents relating to the components of the system specifications necessary graphic documentation in which the geometry detailing, tolerance of each of the pieces and the conditions of placing.

CALCULATION CONDITIONS

In each case it will be checked, according to the calculation conditions indicated in the Technical Report of this document, that the solution adopted complies with the premises defined therein for stability, resistance and admissible deformations, justifying the adequacy of the system according the Technical Building Code and the Structural Concrete (EHE) or code that replaces it.

MANOFACTURATION AND CONTROL CONDITIONS

The manufacturer shall maintain self-control that currently performed on the raw materials, the manufacturing process and finish, according to the indications given in paragraph 5 above product.

CONDITIONS OF USE AND START WORK

The TBT Formwork System evaluated herein is intended to implement concrete pillars. It is a formwork system for single use and is not permanently incorporated into the building. The system contributes to the stability of the construction during the execution of the structure**.**

The System commissioning work must be performed according to the manufacturer's manual, depending on conditions and fields covered by this document applicable within the comments made by the Committee of Experts and supervised by the Architect of the work.

All necessary arrangements for the stability of the buildings during assembly, that the beneficiary will set for that relative to the formwork system for TBT pillars with the approval of the Construction Management, in front of the risks of falling, of suspended loads, protection of people and, in general, the provisions will be considered in the current health and safety regulations be adopted at work.

VALIDITY

This Technical Approval number 611 / R20, it substitutes and cancels document nº 611/15 and it is valid for a period of five years provided:

- that the manufacturer doesn´t modify any of the characteristics of the product referred to in this Technical Approval,
- that the manufacturer conduct a systematic self-production as indicated in the Technical Report,
- that monitoring is carried out annually by the Institute, which finds fulfillment of the above conditions, visiting, if appropriate, some of the works.

With the favorable result of monitoring, IETcc issue annually a certificate must accompany the DIT to give it validity.

This document should therefore be renewed before December 18, 2025.

Firmado por CASTILLO TALAVERA ANGEL - DNI 52507605P
Fecha: 28/01/2021 16:21:02 CET

DIRECTOR OF THE INSTITUTE OF SCIEN
CE CONSTRUCTION EDUARDO TORROJA

Ángel Castillo Talavera

TECHNICAL REPORT

1. PURPOSE

The TBT system is a lightweight formwork system and single use for pillars, which allows the execution of circular pillars, squares, rectangular and special shapes.

The system is designed with criteria of strength, safety, durability, maneuverability and economy, facilitating the process of formwork, optimizing the outcome of concrete implementation.

2. DESCRIPTION OF THE SYSTEM

TBT formwork system is based on a waterproof tube formed by the spiral arrangement of several sheets of KP complex (Kraft plastic) thermo-welded.

The TBT forms are especially indicated for implementing structures seen as pillars of their use are finished with continuous, seamless apparent.

A steel wire placed inside the formwork TBT allows easy, quick and safe stripping. (See Figure 2).

TBT formwork system responds to four different solutions:

2.1 ***TBT*** **CIRCULAR**

Formwork for circular pillars of diameters between 150 mm and 1200 mm with increase of 50 by 50 mm. (Figure 1).

If a smooth concrete completion desired, a PVC sheet is embedded in the interior.

Once the concrete has set, stripping the pillar and I verified the correct implementation, TBT circular can be used to place as protective cover to prevent surface damage against hits or spotting during the rest of the work.

2.2 ***TBT*** **PRISMA**

It is a formwork for square and rectangular columns. To the circular tube section basis are incorporated pieces of EPS to form the desired shape in section and an inner plastic continuous sheet of BOPP polypropylene which is what is in contact with the concrete. The measurements are between 150 mm to 150 x 800 x 800 mm, with increase of 50 by 50 mm in both dimensions.

The chamfers of square pillars with this formwork are 32 mm. (Figure 3).

The inner sheet does not adhere to concrete, which facilitates the stripping without incorporating additives or pretreatment of the formwork.

The manufacturer has parts column formwork concreting to be located next to an existing element (together, medians, etc.). (Figure 4).

TBT **CLASSIC**

Fluted column formwork shaft imitating classical style columns (Figure 5). The circular tube are incorporated pieces of EPS to form the desired section and a plastic film inside which is what is in contact with the concrete.

2.4 ***TBT*** **FORMS**

Column formwork of special shapes (Figure 5). The circular tube are incorporated pieces of EPS to conform to the shape of the desired section.

3. MATERIALS AND COMPONENTS OF THE SYSTEM

3.1 **KP Complex**

The main material is the complex KP (Kraft plastic) that makes up the bands that are welded helically in successive layers.

These bands or layers in turn consist of different sheets whose characteristics are listed in the Table 1, that being listed from outside to inside by placement order to generate the tube.

Table 1. Composition of complex layer KP

sheet	**grammage**	***tolerance***
Polyethylene	20 g/m^2	±5 g/m^2
Long fibre kraft	270 g/m^2	±10g/m^2
Polyethylene	20 g/m^2	±5 g/m^2

The total thickness of each tube depends on KP complex layers superimposed and heat sealed. Ranging between 0.4 and 0.7 mm depending on the diameter of the formwork or what is the same, the pressure of fresh concrete that is supported.

3.2 **Adhesive termofusible**

Hot melt adhesive based on rubber modified thermoplastic suitable for an application temperature of at least 140 ° C.

3.3 **Expanded Polystyrene (EPS)**

It is the material that is located inside the tube to create complex KP square section or the desired pillar shape. Their identifying characteristics are shown in the Table 2:

Table 2. Characteristics identification EPS

Dimensional stability	< 0,5 %
Nominal density	15 kg/m^3
Flexural strength	> 90 KPa
Compressive strength	> 100 KPa
Fire classification	E

The blocks or slabs of EPS will have the Declaration of benefits (CE marking) according with UNE-EN 13163: 2013 + A2:2017 [1].

3.4 **Plastic sheet**

It is placed inside the tube when it is required that the abutment is smooth finish because, in this way, not the spiral tube is marked on the finished surface.

Depending on the design and dimensions of the structure, it will be used for this:

3.4.1 Foil BOPP

It is polypropylene film (BOPP) whose identifying features are shown in the following table 3:

Tabla 3. Características de identificación del BOPP

DensiTY		0,91 g/cm^3
Tensile strength at break	Longitudinal	130 MPa
	Cross	240 MPa
Seal initiation temperature		115 ºC

3.4.2 PVC sheet

They are rigid sheets of polyvinyl chloride (PVC) with a smooth surface and 400 microns thick, which will be duly certified by the supplier.

3.5 **Fiberglass tape**

Tape bidirectional fiber reinforced glass used for finishing the end of the tubes so that the core tube is flush with KP plastic film, PVC film, pieces of EPS, as appropriate. Its characteristics are shown in table 4

Table 4. Characteristics of the tape

Total thickness	150 µm
Adhesiveness	15 N/cm*
Tensile strength	290 N/cm*

** Refers to a test piece of 1 cm*

3.6 **Easy open wire**

This is a steel wire of 0.5 mm diameter is placed inside of the tubes and facilitates the stripping of the column. It must be certified according to the UNE-EN 10270-1: 2012 + A1:2017 [2].

4. MANUFACTURING

4.1 **Manufacturing place**

The TBT forms produced in the factory located in Camino de la Aldea street, w / n. 45930 – Méntrida - Toledo - Spain

4.2 **Manufacturing process**

The production process consists of the complex band arrangement KP (Kraft plastic) helically thermowelded.

The system adopted by the company mainly takes the following steps:

- Machines with complex bands of varying widths KP feed.
- The equipment that generates the spiral of TBT is overlapping and heat-welding the bands, creating a tube thickness and diameter commensurate to the page of manufacture.
- The tube is cut to the length of the manufacturing needs.

Depending on the desired finishing and the final product are incorporated into the following process steps:

- It is cut and placed inside plastic sheet.
- EPS rods with holmet applicator (for TBT PRISMA, CLASIC and FORMS) .
- Place the wire easy open system.
- It is topped with pipe tape.
- Each tube is identified

5. QUALITY CONTROL

FATEC, S.A. has implemented an Integrated based on the guidelines established in the UNE-EN ISO 9001 quality management system: 2008 certified by Bureau Veritas Certification to "manufacture and sale of packaging and cardboard tubes."

5.1 **Reception Control**

This control is performed according to the Operational Verification Procedure FATEC, S.A raw materials, which establishes guidelines for inspection of the goods received to verify that they meet specific requirements.

The identification of raw materials and components is done through the documents accompanying the material and is reflected by the corresponding reception stamp in shipping documentation.

5.1.1 *KP Complex*

The main raw material, the KP complex received coils of different diameters.

[1] UNE-EN 13163:2013 + A2:2017. Thermal insulating products for building applications. Products manufactured from expanded polystyrene (EPS).

[2] UNE-EN 13163:2013 + A2:2017. Steel wires for mechanical springs. Part 1: wire for unalloyed steel springs patented cold drawing.

After the first weighing of the consignment, a visual inspection and shipping photographed is performed to check the general state of the same, the stowage, palletizing, etc.

In at least one coil of each consignment, material samples are taken for a test weight.

For the record control receiving coils complex KP "Report of receipt paper-coil" it is made. After the tare weight of the transport and positioning control of the material in the storage area provided the report of receipt is recorded along with the delivery note with the "reception stamp paper-coil" is concluded.

5.1.2 *Expanded Polystyrene (EPS)*

On receipt of EPS blocks a visual check of the integrity and identity of blocks and a dimensional control thereof is performed. In addition, the correspondence with the purchase order is verified transport documents and the supplier certificate.

5.1.3 *Rest of components*

For the other components used in the manufacture of TBT formwork (plastic film, PVC film, tape with fiberglass, and easy open system wire and hotmelt) a documentary check is done by verifying the correspondence of purchase order with the shipping papers and certificate provider, to be met as indicated in the corresponding section of paragraph 3 of this Technical Report.

The handling and storage of these components from receipt to use, should be made according to their data sheets and safety data sheets.

5.2 **Manufacturing Control**

Production is carried out using the procedures set forth in the following documents:

- Technical Sheet Manufacture: on it the characteristics of the order (type, size and amount to manufacture) are defined as well as the customer and the expected delivery date.
- Formwork sheet path TBT: where the results of checks carried out (length, diameter and thickness of the pipe, temperature of thermo-welded, stucked and separation of bands, placement of inner sleeve and easy open system and wire finish) are recorded and frequency of these and the responsible for each stage. Control of the consumption of raw materials and auxiliary materials and possible non-conformities is also included in this document.
- Control Guidelines pipe manufacturing formwork TBT: where the characteristics to be inspected are collected, the method and frequency to Control the tolerance**.**

The main production tolerances established in the control guidelines are shown in Table 6:

Table 6. formwork production tolerances TBT

Tube inner diameter	- 0,3 / + 0,5 mm
Thickness of the tube wall	± 0,5 mm
Tube length	± 10 mm
Length of the plastic sheet	+20 / -10 mm
Width of the plastic sheet	± 0,5 mm

5.3 **Controls finished product**

Once grouped tubes for placement into the stock, a visual check of the state of the test tubes and their length by comparison performed ends.
It also found that the thickness of the wall - parameter critical to the strength of the formwork depending tube- diameter corresponds to the profile specified in manufacturing.

6. PRODUCT IDENTIFICATION

On the tube shuttering an identification label on which shall be indicated at least be placed:

- Commercial brand
- Identification of the manufacturer
- Type formwork
- Dimensions (section and length)
- Date of manufacture
- Logo and number of DIT

7. STORAGE AND TRANSPORT

The finished product is placed upright palletizing or metal for use in warehouses horizontally cages. In any case, they keep covered in the factory premises.

Amounts cage vary depending on the dimensions of the tubes, with a maximum height of collection tubes others of 4 meters.

Transportation may be by single units (in case of different diameters, some units may be placed inside another) or wire cages themselves truck / container. In the latter case, the cages must be properly secured to prevent damage.

Moreover, it is not required any additional prerequisite, only the minimum conditions of cleanliness, hygiene and safety.

Once at building site, you should store the parts controlled area away from any other material that could weigh on the and damaging them and protected from the wind, because due to its light weight can fly and impact with any object nearby. It is recommended that the storage is under cover.

8. INSTALLATION IN BUILDING SITE

The conditions of implementation and application of each of the elements are defined in the relevant "technical specifications" of the manufacturer.

A sequence of images commissioning work can it be seen in Figure 2. In general, it states:

- Installation must be done according to the specifications of the "Instruction of Structural Concrete" (EHD) or code that replaces it.
- Do not pour concrete over parts if they are not underpinned with assurance systems of verticality and stability than the manufacturer recommended or approved or required by the project management.

The process of placing described herein refers to the TBT pillars formwork system. Other operations such as staking, armed, concrete, etc., shall be made as usual.

8.1 **Placing the formwork tubes**

Formwork tubes can be transported by a single person. Placement in final position, outside the assembly, will be made with aids as instructed by the Security Plan and the current regulations work in prevention of occupational hazards.

It must be taken into account in case of non-circular sections, take the position that faces, chamfers, unique sections, etc., for the correct positioning of the formwork.

To stabilize and insure the verticality of the tubes during casting and therefore, the vertical rear pillar, one may employ struts stabilizing system and special parts manufacturer or use traditional supported correctly solution telescopic struts and tensioned even place the tube into a traditional metal box, which should be verified in any case by the Department of Technical Building Site execution of the work prior to concreting.

In using this system the application of release (de-mould) agents is not required.

8.2 **Concreting**

The concrete must be executed according to the specifications of the "Instruction of Structural Concrete" (EHE) or code that replaces it.

The pouring of the concrete can be performed with the same means as in traditional forms (pump, bucket, etc.) taking care not to hit the edge of the tube TBt, it may separate the inner sheet.

No need for a specific consistency of the concrete but to favor the complete filling of the formwork and taking into account the characteristics of the system, is very important to make a correct and careful vibrating of concrete.

8.3 **Formwork remove**

Both stabilizers to remove props to proceed to stripping, is to meet certain deadlines to guarantee that concrete strength is sufficient. The decision on those deadlines by the Directorate for Build Ejecution.

Stripping works are performed by pulling the wire easy open system arranged for this purpose from the top to the bottom of the shuttering part.

Once the pillar has been inspected, the TBT tube can be left as its protection until the end of the work.

9. CALCULATION REPORT

The system must resist the actions that will be submitted during the construction process (pressure of fresh concrete, compaction effects during commissioning work, weight and pillar actions during its setting) and shall have the sufficient to ensure that they will meet the tolerances specified in the project stiffness.

Tests have been conducted without concreting parts to determine their resistance to internal pressure under implementation as described in section 11 of this Technical Report.

Forms should be able to retire without causing abnormal shock or damage to the concrete. In this regard there have been concrete and stripping tests that are also described in section 11 of this Report.

10. REFERENCES OF USE.

The building system formwork TBT pillars began to be used in 1990. Since then, with the use of this system have been executed civil engineering structures and buildings of different use: educational, administrative, residential, industrial, etc. The manufacturer provides references:

- New University Hospital of Toledo, Toledo. TBT CIRCULAR. 2008.
- Visitor Reception Center of the Museum of Human Evolution, Ibeas de Juarros (Burgos).TBT FORMA. 2010.
- Public Library in Alcala de Henares (Madrid). TBT PRISMA 400 x 400 mm. 120 units de 3, 4, 5 y 6 m. 2012.
- Residential Montearroyo, St. Ventisquero de la Condesa (Madrid). TBT Circular. 2014.
- Residential Jardines de la Condesa, calle Mirador de la Reina (Madrid). TBT CIRCULAR.2014.
- EH Valdebebas 4,calle José Antonio Coderch, Parque de Valdebebas (Madrid) TBT CIRCULAR. 2014.
- Residential Valdehigueras, St. Fina de Calderón,Parque de Valdebebas (Madrid) TBT CIRCULAR. 2014.
- Residential 27 houses Carabanchel, St. Antonio González Porras (Madrid). TBT CIRCULAR. 2014.

The IETcc has made several visits to works and surveys end users, all with satisfactory results.

11. TEST

The following tests were carried out at the premises of FATEC, SA and the Institute of Construction Science Eduardo Torroja.

11.1 **Component identification tests**

Identification tests of the main components (EPS and helical tube) are included in Report No. 742/14 of IETcc.

11.1.1 *Water absorption tube formwork*

a) Test target

The purpose of the test is to rule out the possible absorption of water by the concrete formwork during setting of the pillar.

b) Test arrangement

In three samples of 200 x 200 mm tube samples taken from shuttering selected by the IETcc in FATEC facilities, SA, the absorption test was performed as established in the UNE-EN ISO 62: 2008[3].

c) Results obtained

The values obtained are shown in the Table 7:

Table 7. Formwork tube water absorption test results.

Sample	1	2	3
Initial weight (g)	37,19	37,86	38,32
Final weight (g)	37,19	37,88	38,32

Absorption does not exist, therefore, on the part of formwork's wall

11.1.2 *EPS bulk density*

a) Test targert

El objeto del ensayo es comprobar las prestaciones del EPS empleado para los acabados de secciones cuadradas, clásicas o formas.

b) Test arrangement

About 5 cubes EPS testing density determination was made apparent as set out in the UNE-EN 1602: 2013 [4].

c) Results obtained

The average value of bulk density obtained was 17,74kg / m3. Verified therefore the density of the EPS parts is greater than 15 kg / m3, ie the stated by the manufacturer and supplier.

11.1.3 *Behavior to compression of the EPS*

a) Test target

The purpose of the test is to verify the performance of expanded polystyrene used for finished square sections, classical or forms with

[3]UNE-EN ISO 62:2008. Plastics. Determination of water absorption.

[4]UNE-EN 1602:2013. Thermal insulating products for building applications. Determination of the bulk density.

b) Test arrangement

About 5 cubes of EPS is carried out in the test for determining compressive behavior as set out in the UNE-EN 826: 2013 [5].

c) Results obtained

The average applied load value was 1104.118 N which corresponds to a voltage of 0.11 MPa.

It is verified, therefore, that the compressive strength of the parts of EPS corresponds to what was stated by the manufacturer and its supplier.

11.2 **Internal hydraulic pressure tests for concrete tubes**

The internal hydraulic pressure tests for concrete tubes are contained in Report No IETcc LI-14017.

a) Test target

The object of the test is to quantify internal hydraulic pressure of tube pillars proposed formwork resistance.

b) Test arrangement

At each end of tubes 200 Ø400 and Ø300 cm length of 150 cm length placed a pneumatic seal with an outlet for evacuating the air inside the cylinder and one to fill and pressurize water.t each end of tubes 200 Ø400 and Ø300 cm length of 150 cm length placed a pneumatic seal

c) Results obtained

It Can Be Concluded That the samples tested exceeded 2.5 bar, Because in any case there has-been breakage of pipes, equivalent to a water column of 25 meters.

11.3 **Proficiency testing job**

11.3.1 *Concreting and demould of pillars in the manufacturer's facilities*

The tests described below were carried out at the facilities of FATEC, SA in Méntrida (Toledo), in the presence of representatives of IETcc (Report on initial visit to the factory).

a) Test target

The purpose of the test is to verify both start the system work as the final result obtained by stripping.

b) Test arrangement

Around of three minimum vertical reinforcement, shuttering TBT three tubes are placed for subsequent concreting:

- 1 unit TBT PRISMA 300 x 300 x 3000 mm
- 1 unit TBT CIRCULAR smooth Ø300 x 5000 mm

In addition, the stripping and surface finish of the pillars is monitored shuttering three tubes TBT:

- 1 unit TBT PRISMA 300 x 300 x 3000 mm
- 1 unit TBT CIRCULAR liso Ø300 x 5000 mm

c) Results obtained

The result of the process was satisfactory assembly and concreting.

The result of the stripping process was satisfactory with acceptable evenness of concrete.

11.3.2 *Concreting and demould of pillars in the IETcc facilities*

The tests Described below are Contained in Report No. 20213-01 IETcc.

a) Test target

The purpose of the trials is to evaluate the behavior during concreting and finishing after the stripping of formwork system pillars TBT.

b) Test arragement.

The following formwork tube samples selected by the IETcc in FATEC, S:A facilities were used for this assay.

- 1 unit TBT CIRCULAR spiral. 4 m high and Ø600 mm
- 1 unit TBT CIRCULAR smooth. 4 m high and Ø600 mm
- 1 unit. TBT PRISMA 300 x 300 4 mm high.

The three formwork tubes were installed, supported and tied on a porch of 3.5 m high, with a minimum to allow handling after concreting and on a metal base plate armor.

We proceeded to the concrete by direct discharge of the three tubes with concrete to build with soft consistency and maximum aggregate size of 20 mm. For tasks of a vibrator vibrating needle he was used.

Five days later he proceeded to the stripping of the three pillars, using the built-in easy-open tube formwork system.

[5] UNE-EN 826:2013. Thermal insulating products for building applications. Determination of compression behavior.

c) Results obtained

During the concreting formwork tubes perform satisfactorily, holding pressure of the fresh concrete and compacting effects without experiencing buoyancy effect or appreciable deformations.

After stripping, the overall look of the finished was adequate with no significant defects and surface regularity.

In the case of TBT PRISMA tested, once seen stripping halfway up the pillar a small discontinuity in the section of the concrete pillar, attributable to a small rotation of the lower section of EPS from the upper.

12. ASSESSMENT OF USE APTITUDE

The system, as described in this document is fit for the purpose for which it is intended.

12.1 **Compliance with national regulations**

These formwork systems, not permanently incorporated works, without consideration of "construction product" according to the "Construction Products Regulation" (CPR) and therefore does not apply fulfill the basic requirements .

However, the design and construction of the formwork should be according to the requirements of "Structural Concrete" (EHE).

During the design and execution of the work, the provisions of existing legislation on Safety and Health at Work will continue.

System components, according to the manufacturer's declaration not contain or release dangerous substances according to European and national legislation.

12.2 **Product's use. Placing in Building site and use limitations**

12.2.1 *Placing in building site*

The placing in building site of the system must be performed by qualified personnel.

It will be up to the Department of Execution of the Building site the decision on the timing of partial or complete stripping as well as the possible shoring and concreting of an upper structure.

12.2.2 Limitations of Use

This covers only technical evaluation system applications contained in this document.

Following the outcome of the essays in paragraph 11.3.2 of this Technical Report, in the case of formwork tubes 2 meters in length using pieces of EPS to generate the shape of the abutment (TBT PRISMA, FORM, CLASSIC), can show discontinuities between the sections, but it exclusively affects the aesthetics and not to the structure itself, unless relative rotation became apparent decreased effective column section.

12.3 **Waste management**

As EHE indicates must be properly managed formworks to prevent they are stay incorporated-for example, by further operations of the lands-moving machinery, once removed.

Generally, the specifications of Royal Decree 105/2008 on the production and management of construction and demolition waste, as well as regional and local regulations that apply will continue to be regulated.

12.4 **Maintenance and service conditions**

Once concreting formwork and the abutment element will continue with maintenance instructions typical of structures in situ concrete.

13. CONCLUSIONS

Considering that:

- during the manufacturing process it is carried out a quality control corresponding to autocontrol system, by wich the maker checks the appropiateness of raw materials, manufacturing process and final product.
- the process of placing it is sufficiently proved by practice.
- the results of the tests and the visits at work performed.

The fitness of the proposed systems is estimated favorably, with the observations of the Committee of Experts in this DIT, by the manufacturer.

14. EXPERT COMMISSION OBSERVATIONS [6]

The main observations of the Committee of Experts[7] celebrated on july 2 , 2015 and december 17, 2020 were follow:

- The concrete pillars must be designed and constructed according to the specifications of the EHE and the CTE.
- Any use of the system that would be considered singular must have a specific project and technical assistance from the manufacturer.
- The props are not part of the system.
- Avoid the support struts on slabs produce excessive burden concentrations of providing them, where necessary, appropriate cast parts. Likewise it shall apply in the case of the pillars on the ground, especially if it is deformable.
- As with other formwork systems, you should pay special attention to the consistency and concreting to optimize the surface finish.
- In any case the formwork elements of the system are re-used.
- It is recommended that a copy of this Technical Approval is provided with the delivery of the material and joins the documentation of the work.

[6] The Committee of Experts in accordance with Regulation concession DIT (OM of 23/12/1988), its function, advise on the test plan and the procedure for technical evaluation proposed by the IETcc.

The comments and observations made by members of the Commission, are inherently technical endorsement or recommendation of preferential use of the target system.

The responsibility of the Committee of Experts reached the following:

a) Proprietary or patent rights of the product or system.

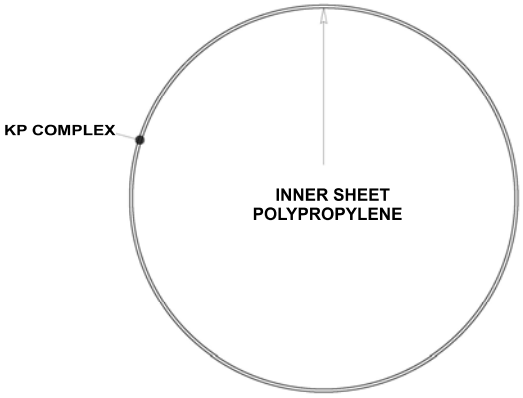
b) Market the product or system´s rights

c) Works executed or under way in which the product or system is installed, operated or maintained, nor about its design, construction methods and training of workers involved.

[7] The experts' committee that has evaluated and approved this concession was formed for:

- Top Advice of Architects' Colleges of Spain (CSCAE)
- FCC Construction
- Engineers' Laboratory of the Army (INTA-MINISDEF)
- Technical University of Madrid (UPM)
- Institute of sciences of the Construction Eduardo Torroja (IETcc – CSIC).

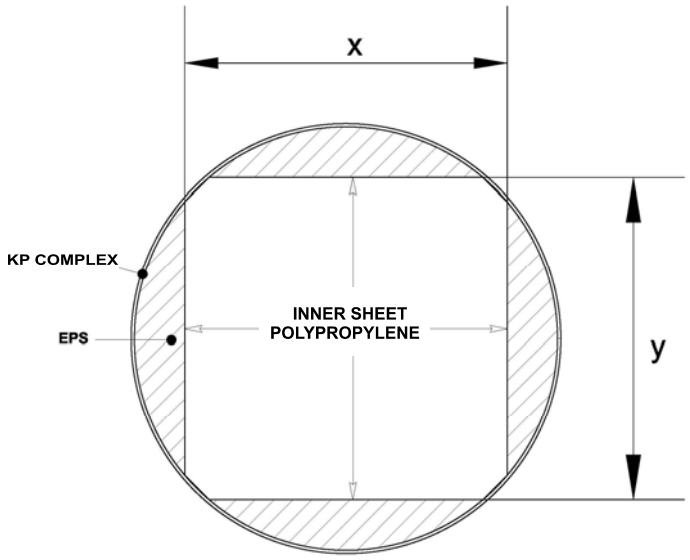
Picture 1. TBT CIRCULAR.



Ø (mm)
200 – 1.100

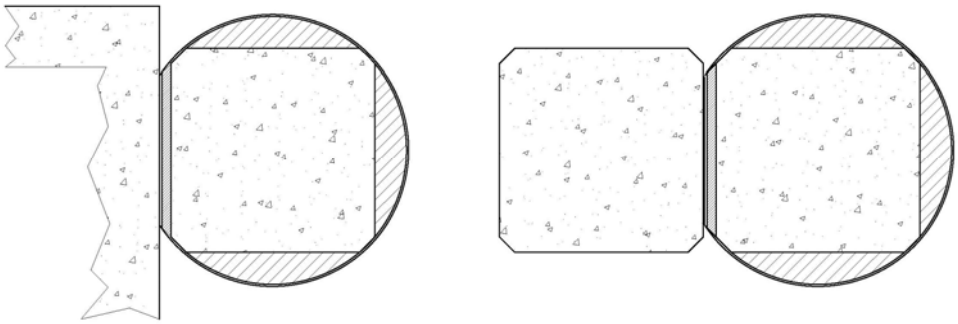
Picture 2. Laying in site of TBT formworks.

Picture 6. TBT PRISMA.



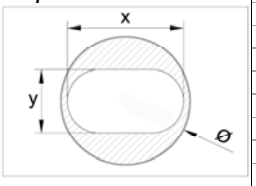
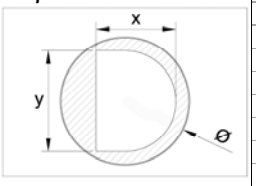
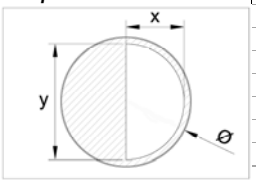
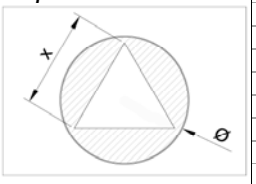
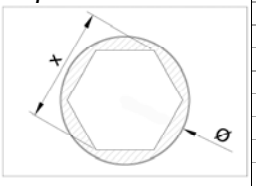
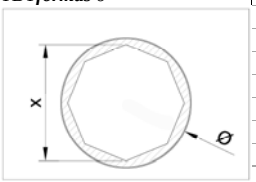
x (mm)	y (mm)	Ø exterior (mm)
150-800 (in steps of de 50 mm)	150-800 (in steps of de 50 mm)	200 – 1.100 (in steps of de 50 mm)

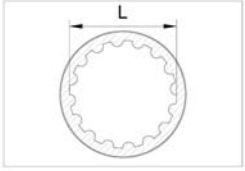
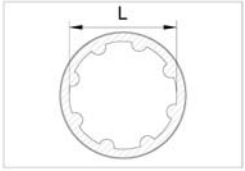
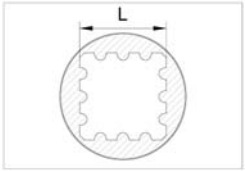
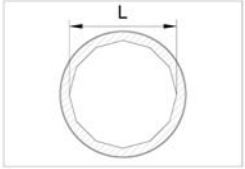
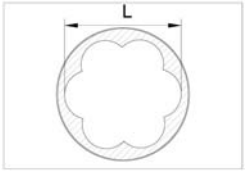
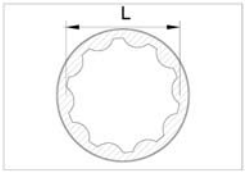
Picture 4. TBT PRISMA JOINT (Details parts for singular points of joint with wall and pillar).



x (mm)	y (mm)	Ø exterior (mm)
150-450 (in steps of de 50 mm)	150-450 (in steps of de 50 mm)	200 – 600 (in steps of de 50 mm)

Picture 5. TBT FORMAS and TBT CLASSIC.

MODEL		X (mm)	Y (mm)	Ø (mm)
TBT***formas*** *1* 	A	300	200	350
	B	350	250	400
	C	400	300	450
	D	500	350	550
	E	600	400	650
	F	700	450	750
	G	750	500	850
	H	800	550	900
	I	900	600	1000
TBT***formas*** *2* 	A	200	200	300
	B	250	250	400
	C	300	300	450
	D	350	350	500
	E	400	400	550
	F	450	450	650
	G	500	500	700
	H	550	550	750
	I	600	600	850
TBT ***formas*** *3* 	A	100	200	200
	B	125	250	250
	C	150	300	300
	D	175	350	350
	E	200	400	400
	F	225	450	450
	G	250	500	500
	H	275	550	550
	I	300	600	600
TBT***formas*** *4* 	A	200		250
	B	250		300
	C	300		400
	D	350		450
	E	400		500
	F	450		550
	G	500		600
	H	550		650
	I	600		700
TBT***formas*** *5* 	A	200		250
	B	250		300
	C	300		350
	D	350		400
	E	400		450
	F	450		500
	G	500		550
	H	550		600
	I	600		650
TBT***formas*** *6* 	A	200		250
	B	250		300
	C	300		350
	D	350		400
	E	400		450
	F	450		500
	G	500		550
	H	550		600
	I	600		650

MODEL		L (mm)
TBT ***classic*** 1 	A	200
	B	250
	C	300
	D	350
	E	400
	F	450
	G	500
	H	550
	I	600
TBT ***classic*** 2 	A	200
	B	250
	C	300
	D	350
	E	400
	F	450
	G	500
	H	550
	I	600
TBT ***classic*** 3 	A	200
	B	250
	C	300
	D	350
	E	400
	F	450
	G	500
	H	550
	I	600
TBT ***classic***4 	A	200
	B	250
	C	300
	D	350
	E	400
	F	450
	G	500
	H	550
	I	600
TBT ***classic***5 	A	200
	B	250
	C	300
	D	350
	E	400
	F	450
	G	500
	H	550
	I	600
TBT ***classic*** 6 	A	200
	B	250
	C	300
	D	350
	E	400
	F	450
	G	500
	H	550
	I	600