TECHNICAL APPROVAL DOCUMENT N°. 577/11

COATING SYSTEM OF VENTILATED FACADES WITH CERAMIC PLATES OF REDUCED THICKNESS AND MECHANICAL FIXINGS HIDDEN

System Name:

EPSILON “T”

Beneficiary:
Fachadas del Norte, S.L.

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Validity, From: December 22, 2011
To: December 22, 2016

Subject to annual review

This document consist of 29 pages
Translation by Fachadas del Norte, S.L

MEMBER OF:
UNIÓN EUROPEA PARA LA EVALUACIÓN DE LA IDONEIDAD TÉCNICA
UNION EUROPÉENNE POUR L'AGRÉMENT TECHNIQUE DANS LA CONSTRUCTION
EUROPEAN UNION OF AGRÉMENT
EUROPÄISCHE UNION FÜR DAS AGRÉMENT IN BAUWESEN
**VERY IMPORTANT**

The TECHNICAL APPROVAL DOCUMENT is, by definition, a favorable technical assessment by the Institute of Science Construction Eduardo Torroja of the fitness for use in building materials, systems and procedures nontraditional for a particular and specific use. Before using the equipment, system or procedure referred, must full document knowledge, so this must be supplied by the holder thereof in its entirety. The change in the characteristics of the goods or failure to follow the conditions of use, as well as comments of the Committee of Experts, invalidates this technical assessment.

C.D.U.: 692.232.4
Ventilated Facades
Bardage
Cladding kit

**DECISION NO. 577/11**

THE DIRECTOR OF THE INSTITUTE OF SCIENCE BUILDING EDUARDO TORROJA,

- By Decree N.º 3.652/1963, of December 26 of the presidency of Government, by empowering the Institute of Construction Sciences Eduardo Torroja, to extend APPROVAL TECHNICAL materials, systems and procedures are not used in traditional building construction and public works, and the Order N.º 1.265/1988, of December 23, the Ministry of Parliamentary Relations and the Secretariat of the Government, by regulating the grant,

- According to the request of Fachadas Del Norte, S.L, to issue the TECHNICAL APPROVAL DOCUMENT N° 577/11 EPSILON "T" System of ceramic plates of reduced thickness in ventilated facade and mechanical fixings hidden

- Considering Article 5.2, paragraph 5, of the Technical Building Code (Spanish CTE) on conformity with the CTE of the products, equipment and innovative systems, which provides that a construction is accordance with the CTE if you have a favourable technical assessment of their suitability for the intended use,

- Considering the specifications laid down in the Regulations for Monitoring the DIT October 28 1998,

- Under the current Constitution de 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 Science Construction Eduardo Torroja, reports of tests conducted on IETcc and observations made by the Committee of Experts, in its meeting held on October 27, 2011,

**DECIDED:**

Granting TECHNICAL APPROVAL DOCUMENT number 577/11, EPSILON "T" System of ceramic plates of reduced thickness in ventilated facade and mechanical fixings hidden, whereas The technical assessment to conclude that the system is in accordance with the Technical Code BUILDING (Spanish CTE), while respecting the full content of this document and in particular the following conditions:

**GENERAL CONDITIONS**

This TECHNICAL APPROVAL DOCUMENT evaluates only the construction system proposed by the petitioner must in each case, in accordance with current regulations, accompanied by the
mandatory project building and be completed by the relevant site management. Will the building project that addresses the actions that the system transmits to the overall structure of the building, ensuring that they admissible. 

In each case, Fachadas del Norte, S.L in view of the architectural design of the facade designed by architect author of the project, provide the graphic definition from the technical point of view the ventilated façade technical assistance sufficient to permit the calculation and definition for execution, including all information necessary for each of the components. The technical design of the ventilated facade shall include a calculation to justify the appropriate system behavior against the actions. 

In general, be taken into account, both the project and the execution of the work, all prescriptions contained in the regulations.

CONSTRUCTION AND CONTROL

Fachadas del Norte, S.L., shall maintain self-control that currently performed on raw materials, the manufacturing process and the finished product, in accordance with the indications given in paragraph 5 of the herein. And besides, must keep control of the reception of the ceramic plates in the Today is performed according to the indications given in paragraph 5 above. A copy of the current list of manufacturers of ceramic tiles available in IETcc

CONDITIONS OF USE AND START WORK

The Epsilon “T” System does not contribute to the stability of the construction. The laying of the system must be performed by Fachadas del Norte, S.L., or by specialized companies and qualified, recognized by it under its control technician. These companies ensure that the use of System is made in the conditions and fields of application covered by this document respecting the observations made by the Committee of Experts. A copy of the current list of companies installers recognized by Fachadas del Norte, S.L., will be available in the IETcc. They take all measures necessary for the stability of the buildings during assembly to fall hazards suspended loads, protection of persons and, in general, be taken into account provisions contained in the regulations of Health and Safety at Work.

VALIDITY

This Technical Approval Document Nº577/11, is valid for a period of five years provided:  
- That the manufacturer does not modify any of the characteristics of the product specified in this document Technical Approval,  
- The manufacturer perform a self systematic production as described in the Technical Report,  
- That are tracked annually by the Institute, to find the fulfillment of the conditions previous visit, if appropriate, any work done.  

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

This document must therefore renew before December 22, 2016.

Madrid, December 22, 2011
THE DIRECTOR OF THE CONSTRUCTIONS SCIENCE INSTITUTE  
EDUARDO TORROJA.

Victor R. Velasco Rodriguez
1. OBJECT

System designed for exterior ventilated cladding with plates made of material ceramic of reduced thickness, anchored to Aluminum alloy substructure by hidden mechanical fixing (Delta Staples).

The plates are fixed to the anodized aluminum alloys staples with Slotted practiced by the upper and lower edges of the plates.

The substructure consists of vertical profiles lacquered aluminum, adjustable brackets (called angular load or support) and eyebolts corresponding to placed on walls and vertical planes, of or concrete factory or on a structure metal (see Figures 1 and 3).

No part of the System, and therefore has no tested, the fixing anchors of the substructure to support or insulation. In any case, the anchor must be defined in the technical project of the façade according ventilated support and loads transmitted.

2. SYSTEM DESCRIPTION

EPSILON "T" System consists of: (see Figures 1 and 3):

a) Ceramic plates not supplied by Fachadas del Norte, S.L

b) Ventilated air chamber which is placed the thermal insulation usually not supplied by Fachadas del Norte, S.L

c) Substructure anchored to the substrate. This substructure, provided by Fachadas del Norte, S.L. Comprises:

C.1 Load or support Anglers of anodized aluminum of natural silver color for the transmission of loads and the supporting substructure through anchors.

C.2 Vertical profiles lacquered aluminum matte black.

C.3 Mechanical Hidden fastening system of anodized aluminum. Staples or clamps called Delta Staples.

d) Anchors to support separators.

e) Various accessories for the treatment of singular points.

3. MATERIALS AND SYSTEM COMPONENTS

3.1 Plates

The ceramic plates, planned for the system, shall comply with the following features.

3.1.1 Physical and mechanical properties

The plates were classified as ceramic plates dry pressed with low water absorption according to UNE-EN 14411:2007 (1), with following characteristics to be declared for the manufacturer:

<table>
<thead>
<tr>
<th>Table 1. PLATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
</tr>
<tr>
<td>Manufacturing Method</td>
</tr>
<tr>
<td>Dimensional Tolerances</td>
</tr>
<tr>
<td>Length and width</td>
</tr>
<tr>
<td>Thickness</td>
</tr>
<tr>
<td>Orthogonality</td>
</tr>
<tr>
<td>Surface Flatness</td>
</tr>
<tr>
<td>Physical Properties</td>
</tr>
<tr>
<td>Apparent Density</td>
</tr>
<tr>
<td>Water Absorption</td>
</tr>
<tr>
<td>Flexural Strength</td>
</tr>
<tr>
<td>Breaking Strength</td>
</tr>
<tr>
<td>Thermal Expansion coefficient</td>
</tr>
<tr>
<td>Thermal Shock Resist</td>
</tr>
<tr>
<td>Frost Resistance</td>
</tr>
<tr>
<td>Fire Reaction</td>
</tr>
</tbody>
</table>

* According to the Commission Decision 96/603/EC of 4 October 1996 laying down the list of products belonging to Classes A (No contribution to fire).

3.1.2 Dimensional Characteristics

The dimensions of the standard manufacturing plates correspond to those defined in Table 2.

<table>
<thead>
<tr>
<th>Table 2. STANDARD DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Format (mm)</td>
</tr>
<tr>
<td>300 x 600</td>
</tr>
<tr>
<td>600 x 600</td>
</tr>
<tr>
<td>450 x 900</td>
</tr>
<tr>
<td>600 x 1200</td>
</tr>
</tbody>
</table>

1) UNE-EN 14411: Ceramic plates. Definitions, classification, characteristics and marking.
For specific designs are available other dimensions by machining plate described below with tolerances equivalents and the same thickness, provided and when those efforts will be subject is less than those defined in this document. The plates were machined with a grooving that is specified in Figure 9. This machining at the factory and should not be done on site.

3.2 Substructure for fixing plates

3.2.1 Materials

Aluminum

The support and load angular are manufactured by extruded anodized aluminum alloy AW6063 in natural silver matte. The vertical profiles of aluminum alloy extrusion lacquered AW6063 matte black, and Delta staples by extrusion AW6063 aluminum alloy in natural silver anodized mate. Its characteristics are detailed in the table 3.

<table>
<thead>
<tr>
<th>Table 3. ALUMINIUM SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alloy</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>Normal</td>
</tr>
</tbody>
</table>

Physical Properties

- Specific Weight: 2.7 g/cm\textsuperscript{3}
- Coefficient of linear thermal expansion: 23.5 \texttimes 10
- Elasticity Modulus: 68,600 MPa
- Poisson Coefficient: 0.33

Mechanical Properties

- Tensile Resistance (R\textsubscript{m}): \geq 175\textsubscript{0.2} y 220\textsubscript{0.02} MPa
- Yield (R\textsubscript{p0.2}): \geq 130\textsubscript{0.2} y 170\textsubscript{0.02} MPa
- Elongation (\%): \geq 6\% y 14\% \%
- Brinnel Hardness (HRB): 65 kg/mm\textsuperscript{2}

3.2.2 Angle Support and load Anglers (brackets)

The geometrical and mechanical characteristics of the load and support anglers are detailed in the Table 4. Tolerances are defined according to UNE-EN 755-9: 2009 (6).

<table>
<thead>
<tr>
<th>Table 4. ANGULAR FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
</tr>
<tr>
<td>Section (mm\textsuperscript{3})</td>
</tr>
<tr>
<td>Perimeter (mm)</td>
</tr>
<tr>
<td>weight (kg/m)</td>
</tr>
<tr>
<td>x\textsubscript{m} (mm)</td>
</tr>
<tr>
<td>I\textsubscript{m} (cm\textsuperscript{4})</td>
</tr>
<tr>
<td>r\textsubscript{m} (mm)</td>
</tr>
<tr>
<td>y\textsubscript{m} (mm)</td>
</tr>
<tr>
<td>I\textsubscript{m} (cm\textsuperscript{4})</td>
</tr>
<tr>
<td>r\textsubscript{m} (mm)</td>
</tr>
</tbody>
</table>

3.2.3 Vertical profiles

The geometrical and mechanical characteristics of the vertical profiles are detailed in Table 5. The Standard tolerances are defined by the UNE-EN 755-9:2001.

The vertical profiles are made of aluminum extruded (AW6063 T5) matt black lacquered shaped T or L. The properties of aluminum are described in the section 3.2.1. The geometry and dimensions of the vertical profiles are listed in Figure 6.

<table>
<thead>
<tr>
<th>Table 5. VERTICAL PROFIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
</tr>
<tr>
<td>Section (mm\textsuperscript{2})</td>
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<tr>
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<tr>
<td>Weight (kg/m)</td>
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<tr>
<td>x\textsubscript{m} (mm)</td>
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<tr>
<td>I\textsubscript{m} (cm\textsuperscript{4})</td>
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<tr>
<td>r\textsubscript{m} (mm)</td>
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<tr>
<td>y\textsubscript{m} (mm)</td>
</tr>
<tr>
<td>I\textsubscript{m} (cm\textsuperscript{4})</td>
</tr>
<tr>
<td>r\textsubscript{m} (mm)</td>
</tr>
</tbody>
</table>
3.2.4 Fixing Staples

The staples for mechanical hidden fixing of the vertical plates are made in extruded aluminum AW6063 and thickness between 3 mm and 1.2 mm. The properties of aluminum were described in section 3.2.1. The dimensional characteristics of the staples are gathered in Figure 7.

3.3 Screws

For fixing the vertical profile to the anglers is used self drilling screws DIN 7504 K or DIN 7504N diameter 5.5 mm and length “L”: 19 mm ≤ L ≤ 50 mm. Manufactured in stainless steel AISI-304. See Table 6.

The dimensional characteristics of the staples are gathered in Figure 7.

3.4 Anchors to the support.

The anchorages fixing of the substructure not part of the system and therefore not tested. However, in the project technician should be defined type, position and number of anchors fixing the bracket to the wall spacer. Depending on the material base of support and stress transmitted thereto. These data will be reflected in the technical project ventilated façade and define for each supporting base material, depending on the recommendations of the manufacturer of anchors. It is the responsibility of the installation company and the Project Manager, checking the adequacy of the anchor, defined in the project technical support element with respect to the executed at work.

5.3 Polyurethane caulk.

Among the vertical “T” and “L” and the plates ceramics (dry and free of any element that could interfere with adhesion) is applied bead of caulk to achieve adequate finish and flatness avoid "movement" of plates. It employs a bead of polyurethane caulk MS SIMES FLEX or similar.

3.6 Accessories

If necessary replace the plates Fachadas del Norte, S.L., has a clip in...
AISI-304 stainless steel replacement. Its geometry and dimensions are defined in Figure 8.

4. MANUFACTURING

4.1 Place of manufacture

The manufacturing takes place in the profiles companies and shaped extrusion profiles aluminum, ensuring the required quality and homogeneity thereof by at least controls referred to in paragraph 5. The fabrication is performed under control and Fachadas Del Norte S.L supervision, which preferably opt for companies that have Certificate of Registration of Company under UNE-EN ISO 9001. A copy of the current list of company’s manufacture of profiles recognized by Fachadas Del Norte, S.L., will be available in the IETcc.

4.2 Manufacturing Process

The raw material used in manufacturing is quality aluminum AW 6063 and AW 6005 (according to standard UNE 38337) supplied in form elements cylindrical commonly referred to as "billes". The manufacturing process consists of the following phases:
- Extrusion, which provides heating the "Billet" in a gas oven to put into plastic state and the passage thereof through the "Matrix" by the pressure corresponding exerted through the press,
- Stretching, which consists in applying a force pulling both ends of the profile extruded aluminum, once cooled, for give the required shape and righteousness.
- Court of extruded profile.
- Temple in oven for 9 h at a temperature of 185 ° C. Process necessary to give the flexibility and hardness final.

5. QUALITY CONTROL

5.1 Plates

These items are not manufactured by Fachadas Del Norte, S.L., so it requires suppliers in each supply a certificate concerning the technical specifications and respective compliance. The ceramic plates shall hold CE marking according to UNE-EN 14411.

5.2 Screws

These items are not manufactured by Fachadas Del Norte, S.L., so it requires suppliers in each supply a certificate concerning the technical specification.
concerning the technical specifications and respective compliance. Controls that Fachadas del Norte, S.L., performs hardware to the receipt of these items are:
- General appearance and finish.
- Dimensions.
- Check the manufacturer’s certificate concerning the technical specification.

5.4 Anchors

The supplier of the anchor must ensure that anchor system products have passed internal controls and final product manufacture, according to the rules and procedures thereof. Also, all these products meet material specifications and Load force values given in the manuals and supplier catalogs, provided when installed according to its recommendations and instructions. Where appropriate, the anchor must be possession of the CE mark.

5.5 Polyurethane Filler

It keeps receiving control the putty, providers requiring a certificate of each provision on technical specifications and compliance respectively.

6. MACHINING AND LABELING, PACKAGING, TRANSPORTATION, RECESSION AT WORK, COLLECTING AND HANDLING

The plates were machined with a grooving that is specified in Figure 9. This machining at the factory and should not be done on site.
The plates shall be marked as provided in UNE-EN 14411:2007, including:
- Trade name of manufacturer and country of origin.
- Premium Brand.
- Reference standards are met.
- Nominal dimensions and manufacturing.
- Nature of the surface of the plate (Glazed or non-glazed).
- CE marking.
- Control Number: traceability code includes month and year of manufacture.
The plates are supplied in cartons clearly identified, not strapping in bales above three cases, holsters and palletized. The pallets must include the logo and DIT number.

The plates are arranged in the transportation vehicle of displacement can damage them during transport.
The discharge of material shall be as close possible to the place of employment, to avoid rushing unnecessary.
Not be sought plates slide over each other, lifting them one by one, so that does not deteriorate the friction surface with particles sharp.
In the discharge and handling will be avoided materials that impact or falling.
The substructure is supplied in cartons boxes with corresponding identification label where include at least the following information:
- Reference: Fachadas Del Norte, S.L
- Type of piece.
- Number of units.
- Logo and Nº of DIT.

During execution of the assembly work all elements of the Façade will be collected in a orderly avoiding breakages occurring deformation thereof. Whenever the work permits, the collection will be made within the building.
The receipt of materials will work according with the regulations in vigour, paying special attention to the profiles of great length.
It will provide the proper attention and care in all handling and storage on site of all elements avoiding any incident that may cause its deformation; it will be used for ancillary’s construction cranes, pallet, etc.

7. START WORK

7.1 General Specifications

For each work and in view of the project architectural project will be a technical ventilated façade which is calculated and determine the items to be used and their available.
This project will include the plans and details necessary for the proper construction understanding and subsequent installation of the system on staff at work.
In any case, Fachadas del Norte, S.L, provide all the information necessary to make the design and execution of the
ventilated facade; must provide, if requested, assistance technique for the design and construction phases, including resolution of the singular points.

Installation of ventilated facade system EPSILON "T" has to make by authorized specialist staff by Fachadas del Norte, S.L, under their control and technical assistance, by fasteners previously described.

Plaques and should not be placed under tension and should have sufficient freedom of movement. For these purposes should provide margin enough holes to make the connections, thereby allowing for expansions humidity and temperature.

7.1.1 Substrate preparation and fixation system

At work, before installing the system, you must check stability and bearing capacity anglers and the anchors (see section 3.4) provided in the technical project are appropriate to it, by pulling the appropriate tests control plan as the work, supervised by the architects.

In the event that the anchor is not intended appropriate, shall be replaced with the approval of the Project Manager, taking precautions necessary regarding position and number anchors.

The installer of the facade gives their conformity before placing the system.

The substructure must be properly aligned to ensure the flatness of coating system.

The fastening system shall provide for the expansion plates and defined according to:
- Wind loads.
- Maximum distances between attachment points panels.
- Format and dimensions of the panels;
- Building expansion joints and components.

7.1.2 Ventilated air chamber

It should be noted that there is a continuous air chamber, between 3 and 10 cm thick, ventilated by natural convection upward behind casing.

The total effective area of the ventilation openings be at least equal to 120 cm² per 10 m² facade of cloth between slabs, spread to 50% between top and bottom. These effects may be counted the joints between plates.

7.2 Mounting

The sequence of operations of work should be as follows (see Figure 2):
- Stakeout.
- Placement of anglers.
- Placement of profiles.
- Placing the insulation if necessary.
- Placement successive staples and plates, with joint establishment and application of putty.
- Placement of plates at the lower end of the façade.

7.2.1 Stakeout

It will challenge the facade checking irregularity of the substrate to be coated, verifying the good choice of anchor. The axes of the vertical profiles are placed in depending on the dimensions of the plate coating, by a distance equal to or less than 120 cm, depending on the format plate, as defined in the project and justified by calculation.

The characteristics of the support, both in collapses as flatness, must meet the CTE conditions specified in, and in the applicable rules and regulations.

7.2.2 Placement of anglers (brackets)

It will set the load anglers to the joists and / or edges of the floor and wall anglers to the support with anchors suitable.

Be posted and distributed the aligned anglers vertically distributed between forged. The vertical distance depends on the type and status and in turn support the load shave to transmit the same, being provided permitting the support, less than 120 cm.

7.2.3 Placement of the vertical profiles

The vertical profiles in "T" or "L" will be set to the angular by screws described in 3.4, keeping a distance between theirs of 120 cm (Max) depending on the size of plates and their use category (see the point 12.1.3).
To ensure flatness of the system coating and absorb possible irregularities of the structural elements the building, load and Support angles have slotted holes that permit adjusting the position of the vertical profiles ensuring their poise and alignment.

The minimum horizontal joint between vertical profiles is 2 mm per meter of profile.

7.2.4 Placing insulation
Whenever applicable, will cover the entire face and outside of the supporting wall structure resistant the building according to the specifications of the project.

7.2.5 Stapling
The placement of staples and plates are made of bottom up. Initially, on the vertical profile in "T" or "L" be applied, first, in the area where support ceramic pieces a bead of polyurethane caulk, whose features are set out in section 3.5 herein. Then the staples are screwed, starting from the bottom, at a distance between them which will be determined by the format the plates being used, successively plates and placed top clips.

7.2.6 Placing ceramic plates
The plates are fitted on the lower staple and subsequently are fixed by staples above. In the case that calculation is needed, the plates be fixed at the four corners and the point half of its horizontal dimension by a profile vertical intermediate.

7.2.7 Joints
The joints between plates must always be open. The vertical joint must be ≥ 2 mm, the horizontal joint will be of 5 to 8 mm. Expansion joints should always building coincide with a vertical joint system facade with a double profile. A single plate can not be set to two vertical profiles different in the vertical direction.

7.2.8 Placement of plates in the lower of façade.
At the lower end of the front, in the area accessible by the public, it must increase the number of vertical profiles, considering a maximum spacing of 40 cm between them. These not may be taken into account when to resist wind actions. The plates are affixed to these intermediate profiles via a cord putty. (Polyurethane or equal) All areas will be auctioned starting with a aluminum grid.

8. MAINTENANCE
To clean the plates will be followed recommendations of the manufacturer of these, cleaning being similar to the plates Common ceramic. Replacement, by breakage or for any other cause, not affect the assembly of the facade. The system has a staple replacement, that the staples corresponding hooking, lets you set the new plates. The assembly procedure is the same as defined in section 7.2.6. Before the plate is fitted, previously slotted nails in Staples lower and then fixed thereto by the substitution staples. In any case, when the plates will replace which take into account the difference in color tone respect to the previously placed.

9. Calculation report
Using the System of Fachadas del Norte, S.L, requires the development of a technical project according to current regulations.

The technical design of the ventilated façade should include a calculation to justify the proper system behavior against the actions planned and checked for stability, resistance, and justifying admissible deformations adequate for supporting system composition mechanical stresses arising from appropriate action to limit states ultimate and serviceability.

The calculation must verify that the values resistance to bending, shear and impact of plates, for dimensions and spacing projected placated supports are sufficient and provide for an appropriate safety factor to efforts that are subject to the same and that the latter are admissible depending on the mechanical properties of the same plates.

9.1 Determination of Actions
Actions on the ventilated facade system be calculated as set out in the CTE-DB-
SE-AE Shares on the building, with coefficients of mayoration. Actions in the CTE-DB-SE on Structural Safety.

For calculations of System it is considered that ceramic plates must withstand wind load (pressure / suction) and pass it along with your weight own, through the substructure and the anchors to the support. The ceramic plates, fasteners, substructure and anchorages must withstand stresses caused by wind, along with its own weight.

For buildings up to 30 m high and the limitations contained in the CTE-DB-SE-AE relative to the wind, these determined as set out in that Basic Document, having used the coefficients wind pressure / suction collected on Schedule D of the Basic Document (Table D.1), depending on the thinness of the building and the position of the plate, given as area the influence of the plate itself.

For greater heights and / or for cases departing from the scope of application of the Basic Document, or when providing for actions wind than those considered in the CTE-DB-SE-AE, a study will be necessary specific actions to determine wind and wind pressure coefficients / suction.

9.2 Calculation parameters

The mechanical properties of the plates are described in section 3.1.1 of this document. The mechanical properties of the profiles aluminum are described in section 3.2.1 of herein. The resistance values of the pressure / suction Wind fixing points of the plate to the substructure can be taken of the results 11.3.1 trial, affected by its corresponding safety factor. This value shall compared with wind load obtained for provided facade configuration. The safety coefficient values resistance mountings should be specified in the technical project of the façade ventilated, not recommended a coefficient less than 2.5.

9.3 Calculation assumptions

We consider the following calculation assumptions:

• The wind actions on the plates and the weight of the same, are transmitted directly by the plates themselves to the profiles vertical through the staples.  
• Compared to the action of wind, the ceramic plates be considered as minimum supported four fixing points on the uprights, tested must flexural strength against wind actions planned. Front own weight, the plate behaves like a beam of great singing.  
• The attachment points between the plate and the substructure must be capable of transmitting shear provided according to the area tax that corresponds to that point fixation.

10. Works made

Fachadas Del Norte, S.L., began its first work in June 2009 and to date, according to the company, the total area executed is approximately 75,000 m². The manufacturer provides the following work references:

• “Antas Houses” Building, Paranhos (Oporto, Portugal), 4,600 m² (2008).
• Building in Rebolo Street (Lugo), 500 m² (2009).
• “Jesus Babio” Store in Boisaca-Santiago (A Coruña), 300 m² (2009).
• “Pereira” Building in Valadares (Vila Nova de Gaia, Portugal), 100 m² (2010).
• Shoe Factory of Inditex Group in Elche (Alicante), 2,000 m² (2011).
• Salesiano High School in Baracaldo (Vizcaya), 1,000 m² (2011).
• “Palacio de Justicia” Pamplona (Navarra), 1,500 m² (2011).
• Building in Sarria (Lugo), 1,200 m² (2011).
• Building “Flex” in Burgos, 4,000 m² (2011).
• Building in Bergantiños Av. Carballo (A Coruña), 625 m² (2011).

The IETcc has made several visits to works and as a user survey, all with satisfactory result.
11. TESTS

The following tests were performed in the Institute of Building Sciences Eduardo Torroja (IETcc) (Report n. No. 19727-1 according with the UNE-EN 14411:2007 (13) and EN ISO 10 545 (14), EOTA Technical Report TR 001 "Determination of impact resistance of panels and panel assemblies "and EOTA draft Guide 

11.1 Identification Tests ceramics plates.

Of the plates used in the tests of the complete system, have been verified, once mechanized, the following characteristics.

11.1.1 Dimensional features

Tests performed according to the UNE-EN ISO 10545:2:1998 (15), the values obtained under the UNE-EN 14411:2007

11.1.2 Apparent density and water absorption.

Tests performed according to standard UNE-EN ISO 10545-3:1997 (16), the values obtained in accordance with the UNE-EN 14411:2007.

11.1.3 Flexural strength.

Test carried out according to the specifications in the UNE-EN ISO 10545-4:1997 (17) for plates 1200x550x11.

The values obtained are higher than required by the standard of the product by the manufacturer in the technical report.

The tensile strength was obtained in the tests of 38.22 MPa (N/mm²) equivalent to a wind pressure (no safety factor or mayoración load) of 4.5 KN/m².

11.2 Durability test plates

Once the aging tests accelerated, as described below, determines the values of tensile strength according defined in section 11.1.3.

11.2.1 Heat to 80 ° C

The plates are maintained in oven at 80 ° C for 28 and 56 days.

From the results of the test for resistance to bending was observed that there were no decreases the flexural strength, compared with the values obtained in the assay 11.1.3 reference.

11.2.2 Saturation and drying

The test consists of subjecting the plates ceramics action of cycles, which defines in the UNE-EN 494 A3: 2007, Test 7.3.5. From the results of the test for resistance to bending was observed that there were no decreases the flexural strength, compared with the values obtained in the assay 11.1.3 reference.

11.2.3 freeze-thaw

Perform test cycles consisting of freeze-thaw, as defined in the standard UNE-EN 10545-12:1997. From the results of the test for resistance to bending was observed that there were no decreases the flexural strength, compared with the values obtained in the assay 11.1.3 reference.

In the side plates having no slits rupture occurred in any of the plates tested.

3.11 Employment System Testing

11.3.1 Test-suction pressure points fixing

Test performed according to internal procedure (Institute of Building Sciences Eduardo Torroja (IETcc)) for the determination of resistance to wind suction system. To carry out the test was not available polyurethane caulk described in section 3.5.

We obtained the following values:

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th>1200x550x11</th>
</tr>
</thead>
<tbody>
<tr>
<td>V° (kN)</td>
<td>0.62</td>
</tr>
<tr>
<td>P°* (kN/m²)</td>
<td>2.75</td>
</tr>
</tbody>
</table>

* V° = Approximate resistance of corner fixing
** P° = Wind Pressure without safety factor or load majoración

11.3.2 Resistance to wind suction

Test performed according to specifications established EOTA draft Guide, section 5.4.1.1 "Wind suction test" for Mounting of APAVISA plates 1200 x 600 with mechanical hidden fastening on T-profiles
The test performed in a chamber of pressure / suction, the failure occurred due to rupture of grooving. The test result confirms the suction resistance values of points obtained in the test fixing 11.3.1.

### 11.3.3 Impact strength of soft body

Test performed according to specifications established EOTA draft Guide, section 5.4.4.2 "Resistance to soft body impact" for two series of plates, each with distances between supports of 1.20 m without intermediate profile and other with intermediate profile. The following results were obtained:

<table>
<thead>
<tr>
<th>Impact Energy (Jules)</th>
<th>Dimensions: 1,200 x 600 x 11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Intermediate profile</td>
</tr>
<tr>
<td>10 J</td>
<td>No Damage</td>
</tr>
<tr>
<td>3 x 60 J</td>
<td>No Damage</td>
</tr>
<tr>
<td>300 J</td>
<td>Break</td>
</tr>
<tr>
<td>400 J</td>
<td>---</td>
</tr>
</tbody>
</table>

### 11.3.4 Resistance to hard body impact

Test performed according to specifications established EOTA draft Guide, section 5.4.4.1 "Resistance to hard body impact" for two series of plates, each with distances between supports of 1.20 m without intermediate profile and other with intermediate profile. The following results were obtained:

<table>
<thead>
<tr>
<th>Impact Energy (Jules)</th>
<th>Dimensions: 1,200 x 600 x 11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Intermediate profile</td>
</tr>
<tr>
<td>1 J</td>
<td>No Damage</td>
</tr>
<tr>
<td>3 J</td>
<td>No Damage</td>
</tr>
<tr>
<td>10 J</td>
<td>Break</td>
</tr>
</tbody>
</table>

### 11.3.5 Testing the vertical profile

To perform the test we used a profile aluminum (T 40x100) with a length of 1.40 m. and a load is applied in its middle section. From the result of tests it has been found that the vertical profile features correspond to the data provided by the manufacturer (Table 5, sec. 3.2.3).

### 11.3.6 Test for vertical load

Test performed according to specifications established EOTA draft Guide section 5.4.2.6.2 "Resistance of vertical load". To perform the test was available one assembly consists of a ceramic plate 1,200 mm long and 600 mm wide, with 11 mm thick, secured by staples to the T vertical profiles, in turn anchored to the wall by leveling support brackets and aplomb. Then fleximeter has been placed on the center of the plate to measure the vertical displacement thereof under a static load corresponding to the two weight of cladding elements (40 kg). After 24 hours not observed deformation or apparent damage on plate or anchors.

### 11.4 System durability testing

#### 11.4.1 Suction fatigue test

Test performed according to internal procedure (Institute of Building Sciences Eduardo Torroja (IETcc)) determination of fatigue resistance of the wind suction fixing systems for ventilated façades. The tests were performed by applying a load to a frequency of 0.5 Hz for 25,000 cycles. Completed the fatigue test of the trial initial static suction type wind, no significant decrease observed resistance of the fastening points.

### 12. FITNESS ASSESSMENT OF EMPLOYMENT

#### 12.1 Compliance with Spanish regulations

##### 12.1.1 SE - Structural Safety

EPSILON “T” System of coating of ventilated facades with ceramic plate not contributes to the stability of the construction, and therefore not applicable The Basic Structural Safety Requirements. However, it should be noted that the structural behaviour of the ventilated facade must be such as not to compromise the others performance Basic Requirements of, and in particular The Security Using and Habitability, according indicated in the Construction Planning Law: “Safety in use so that the use normal building no risk of accident for people” (Article 3.1.b.3), and
other functional aspects of the constructive elements or the installations that facilitate the satisfactory use of the building (Article 3.1.c.4).

Using the Epsilon “T” System requires the development of a technical project in accordance with the rules.

The project will test the stability, admissible deformation resistance and justifying adequate for supporting mechanical stresses arising from appropriate action to ultimate limit states and service ability.

The calculation is based on the location and height of the building and the values of resistance characteristic of the panel. Also Special attention will be paid to the phenomena localized of instability that wind can occur in certain parts of the buildings, especially in tall buildings.

The support of the system, usually formed by a wall of enclosure, must meet the essential requirements of structural safety. The junction between the substructure and the rear enclosure must be provided to ensure that during the period of use are not exceeded tensions extreme limit or limit values durability.

12.1.2 SI - Safety in case of fire

The composition of the enclosure, including the insulation, must conform to the CTE, Basic Document of fire safety (DB-SI), as Stability refers to the fire, as well as fire performance of materials in it.

According to Commission Decision 96/603/EC on October 4, 1996, clay products cooked obtain a reaction classification fire class A1 (no contribution to fire) without need for testing.

The coating material must meet the requirement included in CTE-DB-SI (SI-2 section 1.4) relative to external propagation for materials outer facade cladding and inner surfaces of the chambers ventilated façade.

As in all ventilated façade systems, in case of fire may occur spread by the chimney effect, whereby, specifications must be respected burning behavior of materials and their case, provide fire zones.

In any case, remember that the facade design must satisfy the SI DB-2 in order to avoid horizontal and vertical spread of fire.

12.1.3 SU - Safety in use

The CTE does not specify requirements for the security systems for use. However, for areas floors of buildings in areas accessible by public must be positioned vertical profiles intermediate as described in point 7.2.8.

From the results of resistance testing hard body impact and soft body impact, the system can be used in use categories IV (18) set in The draft Guide EOTA 034 "Guideline for European Technical Approval of Kits for external wall claddings. Part 1: Ventilated cladding elements and associated fixing devices (May 2011 edition) relative on safe use.

For use in category I (18), the maximum separation between vertical profiles is 40 cm as described in point 7.2.8. While for the use in Category II and III (18), the maximum separation is 60 cm.

12.1.4 HS - Health

The complete enclosure solution must ensure a minimum degree of impermeability required for the building to be incorporated, as CTE is described in DB-HS, to satisfy the basic requirement for protection against humidity (HS 1).

As is described in the Technically Report System, the ventilated air space may have consideration of "very high resistance barrier the filtration" (B3) as described in the CTE-DB-HS, HS 1, paragraph 2.3.2, provided that:

• respect dimensions of the chamber air amount joints and openings ventilation described in paragraph 7 of the Technical Report.

• The insulation should be not be hydrophilic and located between the air chamber and the element support.

• Is provided at the bottom of the chamber and when it is interrupted, a system of collection and evacuation of the filtered
water (as described in section 2.3.3.5 (CTE-DB-HS, HS-1).

In any case, the particular attention in the design of the facade, the incorporation of windows and lighting elements, and the correct solution of singular points, external fixings, etc., for achieve an adequate seal at these points, avoiding the accumulation and water filtration.

Checking limiting moistures surface and interstitial condensation must made as provided in section HE-1 (Limitation of energy demand) of CTE-DB-HE (HE-1, section 3.2.3). The components of the system, as stated by the manufacturer, not contain or release hazardous substances according to the legislation national and European level.

### 12.1.6 HR - Protection against noise

The enclosure solution, and fundamentally the support wall and the insulation, must comply with the requirements CTE-DB-HR with respect to the protection against noise.

Consideration will find constructive solution of the facade elements with the separation vertical so as to avoid the transmission of noise flanks.

### 12.1.5 HE - Energy saving

The entire enclosure constructive solution must meet the requirements of the CTE-DB-HE As hygrothermal behavior.

The system as recited in Technical Report, for purposes of calculating the thermal transmittance, as described in Appendix E of CTE-DB-HE, the air chamber will consideration of "well ventilated air chamber" and the total thermal resistance of the air chamber and the other layers between the air chamber and the outside environment, and including corresponding outer surface resistance still air, equal to the surface resistance inside of the same element (HE-1, Appendix E).

### 12.2 Product Use.

It should take into account, in implementing of singular points as sills, lintels, jambs, suits, etc., sealing thereof and waterproofed beforehand if necessary, proper evacuation and avoiding water accumulation. You will follow the recommendations given in the Section 6 of the Technical Report for handling plates. Furthermore, when handling the plates must use protective gloves.

### 12.3 Limitations of Use

Issues relating to the calculation set out in paragraph 9 of this document refer to scope of the Basic Document Structural Safety Shares on the Building, CTE (DB-SE-AE). For those cases that are out of bounds implementation of the Basic Document, or when the wind actions are planned over the considered in the CTE-DB-SE-AE, it will be necessary conduct a study to determine the specific wind actions.

### 12.4 Waste management

You will follow the specifications of Royal Decree 105/2008 for regulating the Production and Waste Management Construction and Demolition, as well as regional and local regulations that are application.

### 12.5 Terms of Service

According to the durability tests and visits made to work, it is considered that the System has satisfactory performance accordance with the requirements for durability; provided that the facade, installed in accordance with the described in this document is subject to the proper use and maintenance, as the provisions of CTE.

### 13. CONCLUSIONS

Verifying that the manufacturing process of profiles performing a quality control...
comprises a self-monitoring system whereby the manufacturer checks the suitability of the raw materials, manufacturing process and control product.

Verifying that the ceramic plates are in CE mark possession and also have made for each factory of ceramic plates, specific tests of bending strength, resistance to grooving cycles and freeze / thaw resistance of fixations. Verifying that the elements making the substructure is performed under the supervision of Fachadas del Norte, S.L, which takes a receiving said control elements.

Whereas the manufacturing process and star work is sufficiently contrasted in practice and results in the tests, it is estimated favorably with the observations of the Committee of Experts in this DIT, the fitness of the proposed system by the manufacturer.

SPEAKERS:

Antonio Blázquez, Architect
Francesca Aulicino, Architect

14. COMMISSION EXPERTS COMMENTS

The main observations of the Experts Committee on at the meeting held at the Institute of Construction Science Eduardo Torroja, October 27, 2011 (19), were as follows:

- It is advisable to collect the Technical Project expressly and design solutions execution of the holes and singular points.

- Remember that depending on the situation concrete building, its shape and dimensions, the suction pressure values of wind and certain points may be extreme, it to be taken into account in the calculations.

- Sheathing joints shall be account in relation to the expansion joints building, as indicated at point 7.2.7 of the Technical Report.

- Since the vertical profiles are not continuous, should exercise extreme levelling sections.

- The type and size of plate should be able to resist the forces due to wind and transmitting them to the substructure, which in turn must provide specific benefits required, depending on the efforts and their own characteristics, as shown in Point 9 of the Technical Report.

- It is recalled that coating systems ventilated façade rely on a support, usually constituted by a wall enclosure. Such support should be able of withstanding the loads transmitted by the system of ventilated façade cladding, having comply with the essential requirements of structural safety are proper.

- Check that the anchor type defined project is suitable for the type and condition of support. In the Book of the building should be reflected the type of anchor-installed.

- A test for the continuity of insulation if already placed.

- The complementary metal elements contact the system must not cause corrosion problems.

- For exceptional conditions of high exposure to the presence of chlorides, is recommends using a stainless steel AISI-316 for anchors and hardware (and study the behaviour of the rest of the profiles).

- It is recalled that coating systems of ventilated facades no guarantee, only with the outer sheet, the sealing of the enclosure. In any case it is recommended study the behaviour of the whole full enclosure, as described in the CTE, Basic Document of Health (DB-HS) with respect to protection against humidity (HS-1).

- It is recommended that a copy of this Technical Approval is incorporated the Book Building.

- Depending on the location and orientation of building is advisable to place a perforated plate or grating to prevent access by insects or animals.

- It is considered very useful in the incorporation the Book of Building and Repair Manual replacement.

19) The Expert Committee was composed of representatives of The following organizations and entities:

- Ferrovial-Agroman, S.A.
- FCC Construcción, S.A.
- ACCIONA INFRASTRUCTURE, DIR.
- ENGINEERING, S.A.
- Dragados, S.A.
- ANDIMAT.
- ETSI Agronomists. UPM.

- Army Engineering Laboratory.
- Institute of Construction Sciences Eduardo Torroja (IETcc). (Madrid)
1. CERAMIC PLATE
2. LOAD ANGLER
3. SUPPORT ANGLER
4. HIDDEN STAPLE
5. "T" PROFILE
6. SUPPORT ANCHOR
7. WALL SUPPORT
8. OUTSIDE WRAPPER

Figure 1. VERTICAL SECTION
1. CERAMIC PLATE
2. LOAD ANGLER
3. SUPPORT ANGLER
4. HIDDEN STAPLE
5. "T" PROFILE
6. SUPPORT ANCHOR

Figure 3. DESCRIPTION SYSTEM
Figure 4. HIDDEN FIXATION DETAIL
Figure 5. ANGLERS

Figure 6. VERTICAL PROFILS

Figure 7. HIDDEN STAPLES
1. CERAMIC PLATE
2. LOAD ANGLER (60+40)X80X3
3. SUPPORT ANGLER (60+40)X48X3
4. HIDDEN STAPLE
5. "T" PROFILE
6. SUPPORT ANCHOR
7. WALL
8. OUTSIDE LAYER
9. POLYURETHANE CAULK
10. SELFDRILL SCREW 5.5X22

Figure 10. HIDDEN FIXATION SYSTEM
Figure 11. HIDDEN FIXATION SECTION DETAIL

1. CERAMIC PLATE
2. LOAD ANGLER (80+40)x80x3
3. SUPPORT ANGLER (60+40)x48x3
4. HIDDEN STAPLE
5. "T" PROFILE
6. SUPPORT ANCHOR
7. WALL
8. OUTSIDE LAYER
9. POLYURETHANE CAUK
10. SELFDRILL SCREW 5.5x22
11. ALUMINUM FINISH

Figure 12. HIDDEN FIXATION. START DETAILS

1. CERAMIC PLATE
2. SUPPORT ANGLER (60+40)x48x3
3. HIDDEN STAPLE
4. "T" PROFILE
5. SUPPORT ANCHOR
6. OUTSIDE LAYER
7. POLYURETHANE CAUK
8. SELFDRILL SCREW 5.5x22
9. ALUMINUM GRILL
1. CERAMIC PLATE
2. LOAD ANGLER (60+40)X80X3
3. SUPPORT ANGLER (60+40)X46X3
4. HIDDEN STAPLE
5. "T" PROFILE
6. SUPPORT ANCHOR
7. WALL
8. OUTSIDE LAYER
9. POLYURETHANE CAULK
10. SELF DRILL SCREW 5.6X22
11. WINDOWS OUTLINE
12. "L" PROFIL
13. CARPENTRY AND MEET

Figure 13. WINDOWS OUTLINE. EXAMPLE 1.
1. CERAMIC PLATE  
2. LOAD ANGLER (60°+40°)X80X3  
3. SUPPORT ANGLER (60°+40°)X40X3  
4. HIDDEN STAPLE  
5. "T" PROFILE  
6. SUPPORT ANCHOR  
7. WALL  
8. OUTSIDE LAYER  
9. POLYURETHANE CAUK  
10. SELFDRILL SCREW 5.5X22  
11. WINDOWS OUTLINE  
12. "L" PROFIL  
13. CARPENTRY AND MEET

Figure 14. WINDOWS OUTLINE. EXAMPLE 2
Figure 15. CORNER DETAIL

1. CERAMIC PLATE
2. LOAD ANGLER (60+40)x80x3
3. SUPPORT ANGLER (60+40)x46x3
4. HIDDEN STAPLE
5. "T" PROFILE
6. SUPPORT ANCHOR
7. OUTSIDE LAYER
8. POLYURETHANE CAUK
9. SELFDRILL SCREW 5.5x22
10. "L" PROFILE

Figure 16. INSIDE CORNER DETAIL

1. CERAMIC PLATE
2. LOAD ANGLER (60+40)x80x3
3. SUPPORT ANGLER (60+40)x46x3
4. HIDDEN STAPLE
5. "T" PROFILE
6. SUPPORT ANCHOR
7. OUTSIDE LAYER
8. POLYURETHANE CAUK
9. SELFDRILL SCREW 5.5x22
10. "L" PROFILE
Figure 17. EXPANSION JOINT