

CeTur-SPECIAL URBAN TRANSFORMER SUBSTATION

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ABSTRACT

The technological explosion that has taken place across the planet in the last decades, together with the population growth causes that as the demand for new services grows it is necessary to provide cities with new infrastructure and equipment that, together with the already existing, makes integration with the urban environment very difficult.

This situation is in contrast with an increasing sensitivity in society with environmental issues. Progress at any price has given way to greater concern over human interaction with the environment, more efficient use of space and more care for the environment.

The sustainability criteria promoted by the United Nations through the agenda 21 program, pleads for reclaiming spaces that are currently taken by pieces of urban furniture (advertising billboards, technical equipment, signals...etc) The problem we face is how to claim these spaces back without giving up the services we have been enjoying so far, services that even need to be expanded due to increased demand.

The answer lies in creating multifunctional platforms that can develop different services so the space is optimized with a device of high added value.

*TWELCON has made a great innovative effort in order to develop **CeTur**, an enclosure that can house a transformer substation of up to 630 KVA, and also includes an aesthetic external enclosure equipped with four standard (1200 x 1800 mm) advertising boards that turn into an additional source of revenue, which will reduce dramatically the return of the investment.*

CeTur thanks to its innovative design meets three goals:

- Remarkable reduction of floor space used.
- Improved aesthetics through integration of the equipment in the urban environment.
- Added services that will offset sooner **CeTur**'s initial investment.

INTRODUCTION

Current methods of installing Power Substations (hereinafter PS) on public areas include:

- Concrete prefabricated PS.
- Underground or semi buried PS.
- Indoor PS.

On the ground facilities generally have industrial finishes that will not integrate with the urban environment and they will very often be the targets of vandalism, such as graffiti.

Underground facilities are, from an aesthetical point of view, the most suitable option but have great disadvantages like their high cost, they are prone to flooding, difficult thermal evacuation, difficult rescue of victims in case of accident and, depending on the type of grid used, they can be a nuisance to pedestrians.

A good option may be concealing the PS, in a ground floor location. The main disadvantage will be the cost incurred by the promoter or builder which will create tensions with the power distribution company. As well as the aforementioned inconveniences, increased noise and electromagnetic levels will be endured by local residents.



Image 1: Examples of traditional power substation enclosure and CeTur.

As an alternative to these methods, TWELCON has devised and developed CeTur, an outdoor transformer substation comprised of double enclosure. The external enclosure has been designed to blend CeTur into the urban landscape reducing the visual impact as well as providing standard advertising boards (1200 x 1800 mm). The revenue generated from advertising offsets, in a shorter period of time, CeTur's initial investment.

CeTur's CONSTRUCTIVE CHARACTERISTICS

General features

Definition

CeTur represents a new concept in the transformer substations arena.

It is comprised of an internal enclosure housing all the elements of a compact transformer substation consisting of a Transformer + RMU + Low voltage panel + Tele-control Panel, and an aesthetic external enclosure with the function of integrating the equipment in the urban environment. Both enclosures are independent of each other.

CeTur's main function is to provide a suitable low voltage supply. Depending on the local electricity supply requirements **CeTur** can house three different types of power substations: A distribution substation, a customer substation or a switching substation of up to 630 KVA for MV network voltages $\leq 24\text{KV}$ or $\leq 36\text{KV}$.

Description

CeTur is comprised of two independent enclosures: the internal enclosure and the aesthetic external enclosure. The external enclosure is in the shape of an advertising milestone made of AISI 316 stainless steel, 5mm fiberglass reinforced polyester (roof), and aluminium in different finishes. The front, back and sides are made of lacquered aluminium and 4mm transparent polycarbonate with sun filters on the outside and 3 mm translucent polycarbonate on the inside. **CeTur** is equipped with four stainless steel dividers between the advertising spaces and a 5mm stainless steel base for adapting to the ground surface.

CeTur has following features:

- On the East/West sides, one sliding door and one fixed door that can be removed. Both types of doors have external access for replacement of the advertising boards and lighting, completely independent, and isolated, from the medium voltage equipment.

- On the North/South sides, doors with standard advertising spaces (1200 x 1800) and internal up and fold door for access to the low voltage panel. Free space to provide access for ventilation and other facilities: low voltage panel, cabin panel, tele-control panel, telecommunications equipment.

The aesthetic external enclosure, made of 2mm galvanized plate, designed with an array of conduits for hot/cold air, evacuation of SF₆ on shooting by internal arc and transformer noise attenuation. IP-23 protection and mechanical impact protection of IK-10.



Image 2: Aesthetical external enclosure and **CeTur**'s internal layout.

The internal enclosure alone complies with all current European Union standards for metal substations therefore **CeTur** could also work without the external enclosure and will house most transformers approved by European utilities.

The quality of the materials used: stainless steel, lacquered aluminium, 4mm outdoors polycarbonate with sun filter and fiberglass reinforced polyester ensure a long service life of the equipment even in the most severe conditions.

Installation

CeTur requires an excavation of a maximum of 1300 mm deep, in order to place the concrete base that will serve as the base for the assembly. Above this concrete foundation there is a polyester, reinforced with fiberglass, container which besides bearing the weight of the equipment, serves as a permanent formwork and as an oil collecting pit.

The assembly is quick and easy using minimum resources: one crane, two operators and one supervisor and **CeTur** will be installed correctly in less than half a day.

Distinctive features

Reduction of space

CeTur's innovative design reduces greatly the space this type of arrangement takes up.

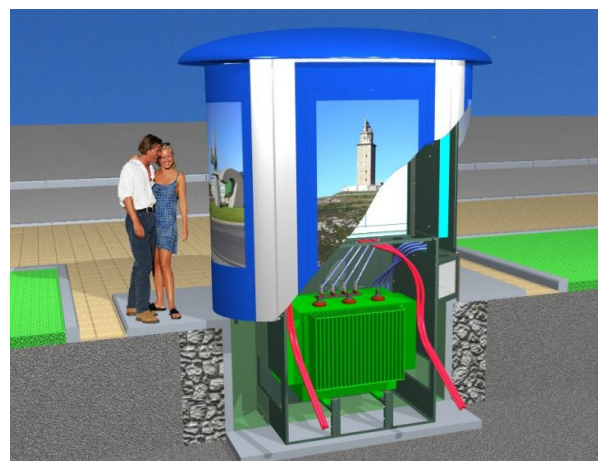


Image 3: Detail of the internal equipment layout.

CeTur is completely modular and unlike conventional transformer substations that lay all their elements on the same level, it arranges the internal equipment on two superimposed levels: the transformer is half buried; the RMU and the low voltage panel are above the transformer. Therefore, the footprint of a 630 KVA transformer substation for MV network voltage of up to 24KV has an elliptical shape of 2800 x 1380 mm (approximately 3 m²).

Interchange ability

The internal elements of the transformer substation, (transformers, medium voltage cubicles, low voltage panels) are interchangeable.

CeTur can house a great variety of devices developed and tested by the most important electrical manufacturers and approved by electricity companies.

Guarantee of supply

CeTur's low voltage panel is completely independent of the transformer and the RMU. If there is a fault and it is required to change either the transformer or the RMU, a generator set can be connected to the low voltage panel externally to minimize the interruption of supply and the repair time.

Protection against electromagnetic radiation

In countries with existing regulations for protecting the public from non-ionizing radiation, indoor power substations are shielded with metallic boxes or shelters. In the same way, the two metallic enclosures that are part of **CeTur** work as a shield, minimizing the electromagnetic radiations.

Safety

CeTur complies with all current European Union Regulations. Its design includes innovative solutions that ensure operating safety and protection both for electricity operators and for the public:

- The access to the advertising spaces is completely independent from the access to the medium voltage equipment. The person changing the advertising cannot access medium voltage devices.
 - The access door to the MV/LV transformer is independent from the access door to the RMU and incorporates a safety mechanism: an integrated mechanical interlocking system prevents opening the transformer's door until the RMU load disconnection is carried out.
 - The access door to the RMU opens up with a central hinge. When the door is completely opened, it serves as a shelter which increases the protection for electricity operators.
 - The low voltage panel and the tele-control panel are located outside of the internal enclosure. Low voltage operations are safer.
 - The air conduction system has a labyrinth type design which favours heat dissipation and noise attenuation.
- In the event of an internal arc fault, the metallic particles, SF₆ gas and the rest of gases produced, are forced to travel long distances across the conduction labyrinth, which causes a decrease in the temperature and pressure as shown in figures 1, 2 and 3.

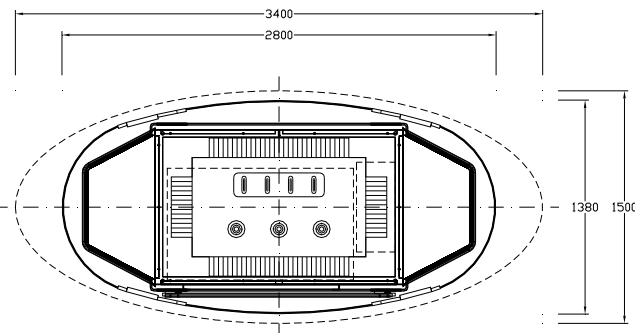


Figure 1: Top view.

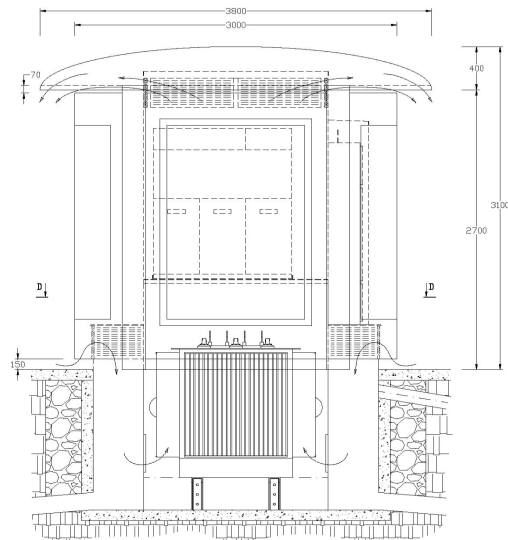


Figure 2: Ventilation system diagram.

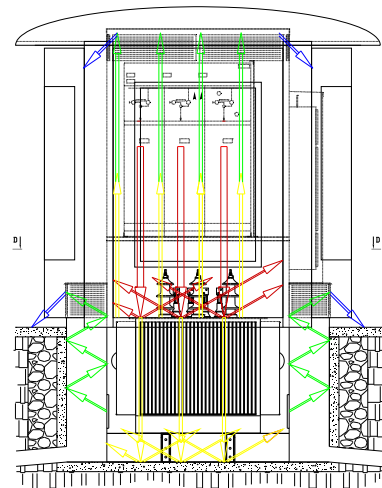


Figure 3: **CeTur**'s internal structure reduces the outlet temperature of gases produced by an internal arc fault.

The evacuation of gases takes place from two different points:

- The upper ventilation grilles located approximately 2.20 meters above floor level. When the RMU access door is opened, it serves as a shelter; therefore the operator will be protected from the gas flow and the projection of metallic particles.
 - The lower ventilation grilles located at a maximum height of 0.42 meters above the floor level.
- Amongst all the different transformer substations, **CeTur** provides the greatest distance between the mechanical fuses of the RMU and the operator.

CeTur housing pad-mount substations

CeTur can also conceal pad-mount substations. The dimensions of this type of substations are reduced but unlike **CeTur**, its appearance is very industrial.

If electricity companies decide to install pad-mount substations in the streets, they can conceal the device with our enclosure. Twelcon has developed two different versions of **CeTur**: **CeTur** P-24 and **CeTur** P-36. Their internal footprints are respectively 1130 x 1465 mm and 1200 x 1900 mm. Dimensions in both cases enable to hold an indoor pad-mount substation or an outdoor pad-mount substation with a reduced cable box.



Image 4: Pad mounted substation concealed by a **CeTur** enclosure.

Integration in protected and listed areas

One of the main advantages that **CeTur** brings is its great ability for integration in visually sensitive areas such as historic centres. In these monumental areas, the visual integration of new transformer substation is very difficult. **CeTur** can solve this problem offering the possibility of customizing its appearance. The roof can come in different finishes, resembling old copper, cast iron or even wood, the doors ash grey and the rest in stainless steel colour.

Besides the aforementioned special finishes, **CeTur**'s external enclosure can carry the corporate colours of the electricity company.

Return of investment

The aesthetically pleasing external enclosure is equipped with 4 advertising spaces of standard size (1200 x 1800mm) backlit from with fluorescent lamps. This format is used across the outdoor advertising industry in bus shelters and other locations, therefore **CeTur** works as an advertising medium.

By adding a new service to a technical device we bring a new business opportunity which contributes greatly to pay off the initial investment. The return of investment of a conventional transformer substation is always more than 20 years. Taking into account the additional revenue that **CeTur** generates by advertising, **CeTur**'s return of investment will take place in less than 5 years, in a worst case scenario.

For instance, the average price of 1 standard advertising panel of 1200x1800mm in the Spanish market is 90€ a week, so the 4 advertising spaces that **CeTur** provides, are worth 360€ a week.

This means a more than 18000€ annual income. The price of a standard advertising panel in the most important European cities rises above 100€ a week. In this case, **CeTur** return of investment will be less than two years.

Sustainability & CeTur

By combining several functions: A complete transformer substation, four advertising panels, space for other facilities within **CeTur** such as electrical lighting cabinets or traffic-lights cabinets, into a single structure that has optimized most of the space available (approximately 3m²), allows to reduce greatly the space taken from the street without impacting on the supply of the services that citizens need and demand.

CeTur manages to satisfy people's needs in an environmentally friendly way, improving quality of life.

CONCLUSIONS

TWELCON has designed **CeTur** to offer an innovative solution to electricity companies which have to face the problem of meeting growing demand for energy in cities with a lack of space available.

CeTur represents an alternative that provides the same technical capacity as a conventional transformer substation but reducing the space taken up and blending the device into the urban environment.

CeTur's internal design, besides complying with current regulation, offers solutions that reinforce the versatility, functionality and safety of the compact transformer substation concealed inside it.

The possibilities of customizing **CeTur** are infinite. It can incorporate the corporate image of the electricity company and there are also special features to integrate **CeTur** in monumental areas.

Its slender and modern design can become a source of good publicity for the electricity company.

The four advertising spaces that **CeTur** offers represent a new source of revenue which minimizes the return of the initial investment. Cities are now looking for solutions that combine technological development and urban sustainability.

CeTur complies with the Agenda 21 principles for developing habitable and sustainable cities.

Inside **CeTur**, Electricity and Advertising companies may share the space with other services like public lighting and traffic light management, waste water management, even telecomm operator racks, therefore creating a new concept called "Technological Island".