

DAP®CONSTRUCTION SYSTEM. EPDS FOR CONSTRUCTION PRODUCTS IN SPAIN

Xavier Casanovas, Toni Floriach & Jordi Arboix

Col·legi d'Aparelladors, Arquitectes Tècnics i Enginyers d'Edificació de Barcelona,
Spain

ABSTRACT

The DAP®construction system is an adaptation of EPDs to the Spanish market for construction materials and products, the aim of which is to offer quantified, homogenous and validated information about the environmental impact of materials to the market and to a new professional, who assists the designer and is defined as a "building dietician". Based on three years of rigorous research and a knowledge of international standards, the scientific and operational mechanisms that underpin the System have been established and various pilot tests have been conducted to contrast different materials and manufacturers. All this has enabled us to offer the market type III ecolabels, based on the Life Cycle Analysis (LCA) of materials, an indispensable tool for evaluating the sustainability of buildings which has a direct application in the environmental assessment of buildings.

1. INTRODUCTION

Sensitivity to environmental issues and a commitment to sustainability have increased substantially all over Europe in recent decades and there is now a growing social demand, which has, little by little, developed into a commercial and sales approach. In fact, adjectives with ecological or sustainable connotations have great market value. The deregulation of these concepts makes them especially attractive as descriptors that can be used without scientific rigour or coherence. "Everything other than measurement is opinion" is a recurrent phrase that encapsulates the essence of the problem facing us today: we need to define parameters and a homogenous calibration system which will enable us to compare the environmental impact of products.

In the building sector sustainable development requires us to take into account a range of parameters that analyse different aspects. In a rigorous analysis we can distinguish two different stages: construction (which includes the manufacture of materials) and use, the designer being the person who defines the environmental objectives which have to be reached in the utilization phase. To do this, he decides how they can be met, specifying the materials he considers to be most suitable. The environmental impact of the construction phase is very important and varies, depending on the aspects we wish to consider. If what we have in mind is the consumption of non-renewable resources, the generation of (non-domestic) waste or human toxicity, for example, this stage accounts for nearly 100% of this impact, but, if we want to evaluate energy consumption or greenhouse gas emissions, we can see how the *embodied energy* of the materials and the building process have a considerable initial impact, which, if it is spread out over the entire useful life of a building, amounts to 30 to 50% of the energy and emissions that result from its use.

In order to rationally incorporate the construction stage in the evaluation of building sustainability, quantified and homogenous information about the materials which are to be used is required. With this information, the designer can determine the real impact of a building during each of the stages of its useful life and, consequently, choose the materials and building solutions which are most appropriate environmentally. EPDs (DAP®construction ecolabels) are the tools that offer this information and guarantee its homogeneity, accuracy and credibility, ensuring the transparency and reliability of the data that companies provide and adjusting it to the needs of professionals in the sector when they need to evaluate global impact objectively. We must not forget that European directives and Spanish regulations on construction indirectly require the use of materials with environmental certifications that include LCA assessment in their calculation of environmental impact.

2. BACKGROUND AND OBJECTIVES

2.1. 20 Years of commitment to sustainability

For nearly 20 years the *Col·legi d'Aparelladors, Arquitectes Tècnics i Enginyers d'Edificació de Barcelona* (CAATEEB) (Association of Surveyors, Technical Architects and Building Engineers of Barcelona) has supported the use of environmental criteria in the building sector. With this goal in mind, it has worked continuously to train, inform, promote awareness and develop strategic projects targeted at collectives of technicians and professionals who are involved in the sector, at the same time delivering a message on the need for sustainability to the general public. CAATEEB also participated in a pioneering study to determine the weight of building materials employed in buildings in Catalonia and their environmental impact, providing information that was indispensable to establish which materials should be prioritized in DAP®construction certification (owing to their importance in the building and/or their impact).

Continuing this line of research, one of the most influential projects in the sector has been the *Agenda de la Construcción Sostenible* (Sustainable Building Agenda) (www.csostenible.net) website created in 1999 by the CAATEEB *Servei Rehabilitación i Medi Ambient* (Renovation and Environment Service) with the collaboration of the Department of Architectural Construction I of the Universidad Politécnica de Catalunya, the Instituto Cerdà and the Asociación de Estudios Geobiológicos GEA. The main aim of the website was to bring together, in a single database, construction materials and products selected in accordance with environmental sustainability criteria, which were initially based on qualitative parameters and type I ecolabels. This resulted in the creation of a useful tool that provided professionals in the building sector with environmental alternatives to the materials that were routinely used in the building industry. For the tool to be really effective, all the building elements had to be represented and, in this respect, the requirements have shown a degree of flexibility and databases have been updated regularly in order to keep up with advances and the new products offered by the market. The sustainability parameters for the inclusion of a material or product focus on: waste, consumption of water and/or natural resources, energy efficiency, renewable energy sources and the reduction of emissions.

2.2. Ecolabels

Advances in our understanding of the impact of materials, as a result of the incorporation of life cycle analysis (LCA) and requirements to ensure the transparency of a market that misuses the concept of sustainability, has enabled progress to be made in the quantification of sustainability parameters. This is the aim of type III environmental labelling: To respond to a market without standards and which is attracted to environmental values by developing a tool which allows us to "measure sustainability".

The ISO 14020:2000 (1) standard sets out the general principles of ecological labels and environmental declarations, establishing guidelines for their development and use. Three types of ecological labels have been defined: type I, type II and type III ecolabels. In this classification system there are three tiers, which offer information about completely different characteristics, value and utility. They are all voluntary environmental grading systems, the aim of which is to promote the demand for products with an objective assessment of their environmental impact. This is a way of stimulating the environmental improvement of the products that are available on the market.

Type III ecolabels or EPDs (Environmental Product Declarations) evaluate and validate the information obtained from the LCA of a product or material. Their implementation internationally has increased considerably in recent years, owing to their contribution to the objective measurement of environmental impact throughout the life cycle of a product. With this as its goal, the *Col.legi d'Aparelladors, Arquitectes Tècnics i Enginyers d'Edificació de Barcelona* (CAATEEB) and the *Departament de Medi Ambient i Habitatge (DMAiH) de la Generalitat de Catalunya* (Department of the Environment and Natural Habitats of the Autonomous Government of Catalonia) decided to launch a project designed to develop the Construction Environmental Product Declaration (DAP®construction) system and include it as a complement to the already extensive experience and prestige of the databases of the Sustainable Building Agenda. The DAP®construction System is now fully operational and any manufacturing company or business organization interested in developing an environmental declaration for its products can access the system.

2.3. Sustainability objectives for the sector

According to ISO 14025:2006 (2), type III or EPD/ DAP®construction ecolabels do not define an environmental preference for products or establish minimum requirements that need to be met. Their purpose is to analyse the manufacturing process for a product and to make a global assessment based on multiple criteria that measure its environmental impact, starting from the raw materials it is made from and finishing at the end of its useful life. This involves applying the LCA methodology and following the Rules the System specifies for each Product Category. With this aim, the System was adapted, drawing up a series of documents which define the procedures that have to be followed during the process of obtaining a DAP®construction document. The system basically consists of some *General System Rules (GSR)* that define its organization and a number of *Product Category Rules (PCR)*.

Through the creation of this system, the intention is to obtain an environmental database for building products with quantifiable values that measure any impact and consumption related to their production. The idea is also to offer technicians reliable and tested values that they can use to measure the impact of buildings during their professional activity. The DAP®construction System was developed with the strategic aim of responding to the current and future needs of

a market with a growing environmental awareness. On the one hand, technicians and professionals require quantified and accurate information in order to calculate the impact of designing sustainable buildings and, on the other, companies and manufacturers, the only repositories of this impact-related information, need to offer it to the market using approved and uniform parameters. An independent and objective third party is also required to certify and guarantee the reliability of the data which is supplied, organize procedures, manage the database and offer this validated information to agents in the sector. We can enumerate some specific objectives on which the DAP®construction System is based, depending on the agents who participate in the building process:

- To provide a tool that provides accurate and validated data as a source of information for designers, specifiers, and building dieticians.
- To provide a service to manufacturers who wish to demonstrate quantitatively the environmental impact of their products by obtaining an Environmental Product Declaration validated by a third party.
- To promote the demand for and manufacture of more ecofriendly building materials. To stimulate market improvement by means of Environmental Product Declarations. Manufacturers understand the processes and inherent impact of making their products better and they can implement measures to reduce their impact. Designers can also estimate the environmental impact of each material and design buildings with controlled impact.

2.4. Pilot trials

The pivotal starting point for the creation of the type III ecolabelling System for the Spanish building sector was the development of pilot trials for two categories of different products. This enabled the previously defined procedures to be tested. The first DAP®construction documents for release onto the market were also obtained and the sector became aware of the increasing importance of these environmental accreditations.

During this process, the Institut de Tecnología de la Construcción de Catalunya (ITeC) (Institute of Building Technology of Catalonia) took part in the project as the entity responsible for validation; three companies participated in the thermal insulation product category and as many as five companies in the category for ceramic covering products. The entire phase during which the DAP®construction System was created received scientific support from GiGa- ESCI, which participated in the international EPD standardization process, forming part of the CEN TC 350 technical committee (3) and the AENOR CTN 198 committee (4). This enabled a System adapted to international regulation requirements to be developed.

The pilot trial for the ceramic covering product category was a joint initiative involving various entities, with the aim of positioning this subsector as a standard-bearer for the environmental transparency of building materials. By means of this

pilot trial, the Product Category Rules (PCR) were developed for the preparation of a ceramic covering product Environmental Product Declaration (DAPc®), based on a sector Life Cycle Analysis (LCA) study of certain products commissioned by ASCER and which received funding from IMPIVA. The study was conducted in collaboration with the Instituto de Tecnología Cerámica (Institute of Ceramic Technology) and involved most of the sector in the process of obtaining the first DAPc® on the Spanish market, thus ensuring greater rigour and agreement amongst the participants.

3. THE DAP®CONSTRUCTION SYSTEM

As we have already mentioned, the DAP®construction system is an adaptation of type III or EPD ecolabels to the Spanish market for construction materials, in accordance with ISO 14025, and as a result of three years of research by a team of LCA experts and the establishment of the scientific and operational mechanisms that underpin the System, culminating in the pilot tests for contrasting different materials and manufacturers.

The starting point for every DAP®construction document is the performance of a LCA of the product, in accordance with the standards established in ISOs 14040 (5) and 14044 (6), in which the principles and methodology that must be applied are defined. The LCA involves the compilation of the relevant input and output data for a process (energy consumed, materials used and waste that is generated), the evaluation of the potential environmental impact associated with these input and output factors (use of resources, effects on human health, ecological consequences, etc.) and, finally, the interpretation of the results, and the assessment and implementation of environmental improvement practices.

EPDs may envisage the entire life cycle of a product ("from cradle to grave") or they may focus on analysing the production stage ("from cradle to factory gate"). Given that construction products may have different applications within a building, the stages of useful life and final waste management are unknown *a priori*. This is why LCAs performed within the framework of the DAP®construction System are of the "cradle to gate" type. The fact that applications are generally foreseeable enables companies to establish possible "scenarios" and voluntarily include different stages of construction, use, maintenance and end of life cycle, as established in the product category rules. Construction materials are regarded as subproducts which form part of a building and the designer defines their use and, consequently, their future impact.

We must not forget that this type of ecolabel is not intended for the final consumer but for the specifier, who, using the information offered to him, can organize the different components in order to achieve an ecofriendly building. In other words, type III ecolabels provide useful information for the specifier, who must process it appropriately. This is the key feature of type III building ecolabels.

They do not inform us about how good a product is but about its properties and impact before it is installed in a building. Eventually, the composition of each of the materials needed for a building project leads to the creation of a new product: the building, which has to be certified with a label that is transparent about its traceability and easy for the final consumer to identify.

3.1. SYSTEM COMPONENTS

The creation of the System requires that the different actors that intervene and their key role must be clearly established. In this case the actors are:

3.1.1 The System Administrator (SA). The Col·legi d'Aparelladors, Arquitectes Tècnics i Enginyers d'Edificació de Barcelona is the entity which co-managed and developed the creation of the DAP®construction System and is its Administrator.

3.1.2 Companies and associations. Any manufacturing company or group of companies interested in developing a DAP®construction project can access the System.

3.1.3 The Accreditative Organization (AO). The Oficina de Acreditación de Entidades Colaboradoras de la Generalitat de Catalunya (Accreditation Office for Collaborative Entities of the Autonomous Government of Catalonia) is the organization which accredits the System. in accordance with the UNE-EN ISO/IEC 17011 regulation.

3.1.4 Inspectors (I). Inspectors are accredited professionals or institutions that determine whether the Ecological Product Declaration (DAP®construction) drawn up by a company complies with international regulations and the requirements of the system.

3.1.5 System consultants. The System has groups of professionals who provide advice and contribute their knowledge of different areas in order to address the interests and opinions of the entire sector. These groups are:

- The Advisory Board (AB). A group of professional experts and representatives of entities that support the System and contribute to the development of procedures.
- Panels of sector representatives (SP). Representatives of sector companies and associations for each product category.

3.2. System documents

To ensure its proper function and transparency, the System is based on a series of public documents established during the creation process and approved by its advisory agents. These documents are:

3.2.1 General System Rules (GSR). The DAP®construction System is based on the UNE-ISO 14025:2006 standard, which regulates type III ecolabelling systems and has its own General System Rules (GSR) that define the objectives, organizational structure, development and inspection guidelines and the procedure for obtaining ecolabels.

3.2.2 Product Category List (PCL). This is a framework which organizes construction products into homogenous categories so that they can be presented within the System.

3.2.3 Product Category Rules (PCR). For each product category the DAP®construction System develops rules to establish the guidelines which need to be followed during LCA. The minimum contents are: Definition and description of the product category; Definition of objectives and scope of LCA; Inventory analysis; Technical and complementary information about LCA; and References.

3.2.4 DAP®construction document. This is a document, containing all the information approved by the System Administrator, which the manufacturer uses to present his product.

3.3. Contents of DAP®construction documents

On the one hand, DAP®construction documents consist of general information, including the company name, a description of the product, its normal use, a description of the main production processes, the production factory, reference PCR and validity period of the document. It also includes an inspection record, with the accreditation of the inspector and his details. On the other hand, the basic information the DAP®construction document contains includes the LCA data, which shows the impact assessment indicators and the lifecycle inventory data itemized for the various life cycle stages and the parameters that have been evaluated.

All DAP®construction documents consist of a basic framework, in which the limits of the system are specified for each of the life cycle stages which have been analysed and the phases corresponding to each of these stages. In accordance with the methodology and characterization factors included in the draft version of the prEN 15804 regulation, the "Indicators of Impact Assessment" obtained from the Life Cycle Analysis must be recorded. These are as follows:

- Global warming potential
- Ozone depletion potential
- Acidification potential.
- Eutrophication potential
- Abiotic resource depletion potential
- Photochemical ozone formation potential

The "Life Cycle Inventory" (LCI) Data are also set out using the same criteria required by international legislation. The parameters which are analysed are:

- Consumption of renewable primary energy
- Consumption of non-renewable primary energy
- Use of non-renewable secondary fuels
- Use of renewable secondary fuels
- Consumption of fresh water
- Waste production
 - Hazardous waste
 - Innocuous waste
 - Radioactive waste
- Output material for
 - Reuse
 - Recycling
 - Energy assessment

3.4. Procedure for obtaining a DAP®construction document

The System establishes a procedure a company must follow to obtain a DAP®construction document and this becomes part of the official CAATEEB registry. The steps this involves are as follows:

Contact must be made with the system Administrator (CAATEEB) in order to obtain the General System Rules and the Product Category Rules (PCR) that apply to your product. If PCR do not exist for your product, the process of redacting them is initiated. This will entail the participation of the advisory groups and will follow the established procedure.

Completion of a Life Cycle Analysis (LCA) assessment in accordance with the Product Category Rules (PCR) which are supplied.

Preparation of a draft version of the EPD based on the LCA study. As soon as the LCA is applied, the System's environmental database can be used.

Inspection by an accredited inspector of the EPD draft to ensure it follows the established regulations and is coherent with the LCA results.

Registration of the new EPD in the official System registry, based on the inspection and LCA reports, for a maximum period of 5 years. If there are variations of +/- 10% in the environmental impact of the product, the data must be reviewed and the DAP®construction document must be renewed.

Reception by the System Administrator (CAATEEB) of the official DAP®construction Document, which must certify that it has been received. It contains all the relevant information and the company is allowed to issue copies to professionals.

4. IMPLEMENTATION

4.1 The first stage of implementation

It was only a few months ago (January 2011) that the DAP®construction System began its operational phase after the official documents certifying the first DAP®construction products were submitted. This involved the eight companies responsible for the manufacture of building products which participated in the pilot tests to develop the system. Since then, other companies have shown interest in the System and some have already initiated the accreditation process, increasing the number of DAPc® documents that have been published and of sectors implicated in promoting environmental transparency in markets. In the years to come we expect to see a significant increase in the registration of products. The chief difficulty the DAP®construction System needs to overcome for it to become a really useful tool for the sustainability of the sector is attaining sufficient "critical mass" with a range of materials that will enable a building project to be tackled as a whole. To do this, the DAP®construction System has joined the Sustainable Building Agenda and it has launched a campaign to promote and support manufacturing companies in order to incentivize their environmental commitment. Thus, starting from the minimum requirements established in the initial criteria, they can gradually increase the quality of their product information until it comes to resemble type I and II ecolabels, carbon footprints and so on and achieve DAP®construction certification, which offers detailed information. The aim is to unite all the companies that are firmly committed to the environment and have environmental accreditations or intend to embark on the process of obtaining them.

In this context, the goal of consolidating the DAP®construction System must be based on providing a useful and efficient service to agents that participate in the building process and, in particular, manufacturing companies, which have the information about their production processes and ought to decide to offer it voluntarily, but in a homogenous, transparent and validated manner. The idea is to attract companies which are committed to sustainability and to reducing the environmental impact of their activities by means of a simple and recognized process. This will enable them to publicly demonstrate their commitment and differentiate them from their competitors in the future. As companies are included, other companies will be motivated to do the same thing and, if necessary, to improve their manufacturing processes so they are not excluded from the market.

The existence in the marketplace of products with validated information about their environmental impact and tools for its management will offer government bodies the possibility of passing legislation on limiting the impact of buildings which is founded on sound knowledge. Consequently, they will be able to consider the prospect of making greater demands in this area and reducing the environmental and energy consumption impacts of the sector. All this, together with the current need to implement measures designed to increase the efficiency of local companies, will increase their competitiveness vis-à-vis companies in other countries and give added value to final products.

4.2. The consolidation of the system by creating a new professional profile

Nowadays, the technicians and professionals in the sector have to meet the challenge of adapting to the new requirements imposed by a legislation which is more and more demanding in the field of the environment and public opinion, which is increasingly sensitive to environmental issues. They will have to familiarize themselves with the DAP®construction System as an indispensable tool for developing their professional skills. The DAP®construction System affords them a database of products with ecolabels and other environmental certificates that accredit their qualities by means of various parameters. Undoubtedly, the inclusion of DAP®construction data during the construction process, as a result of its acceptance by architects, will be the turning point for its true consolidation.

The way we see it, as occurs in other areas of specialization in the construction sector, this issue may entail the appearance of a new professional profile, involving a specialist who is an expert in making construction ecofriendly and who will assist the designer. The "Building Dietician" is a professional who has been trained to improve the quality and performance of a building by interpreting and using the extensive and complex information DAP®construction documents provide. On the basis of this information, he can propose the most suitable materials for each building element and function. It is a matter of going beyond the exclusive appraisal of materials on the basis of their mechanical, aesthetic or economic characteristics and including environmental parameters. In other words, it is a question of considering the use of non-renewable material, waste products, environmental impact, energy consumption, useful life and so on. This specialist would also help government bodies to regulate emissions and the impact of materials and buildings, on the basis of realistic and objectively acceptable parameters, which will enable the demands on the technical resources that are available at any particular time to be adjusted.

As we have already mentioned, the final aim of the whole System is to environmentalize the sector, as well as the objective and quantified certification of buildings. The next step will be the inclusion of the information in the different certification systems (LEED, BREEAM, HQE, CASBEE, etc.) that exist, which will allow the results to be endorsed. Currently, only the Spanish tool VERDE (developed by

GBCe España) supports the building assessment procedure based on the LCA method and it now includes data from the DAP®construction certificates which have so far been issued.

4.3. An international debate

Be this as it may, today there are many queries relating to the consolidation of the DAP®construction System in Spain and EPDs at the international level. As different countries improve their implementation of these systems, it will be a good idea to reinforce the exchange of expertise. From the scientific point of view, different research groups are already making advances in the precise regulation of these systems using the CEN TC 350, which will soon be published. Where most work needs to be done is on operational aspects, given that they are more difficult to standardize. To date, the European Platform for building sector EPD system administrators, in which the DAP®construction System represents the only current Spanish system, is in the process of being developed. The platform has as its goal a mutual agreement to establish a minimum content shared by EPDs, in accordance with the technical specifications of the prEN 15804, in addition to the specific extra information for each region and system.

Currently, many initiatives are being considered internationally to achieve a greater and faster consolidation of EPDs. There are some associations of manufacturers that are developing procedures that should help affiliates to prepare their LCAs and subsequent EPD certification. To this we should add the possibility of developing sector EPDs that indicate the average values for similar products. In the case of the latter, these would be certifications that would be very useful to the designer, given that, in the first stage of a project, when he is not yet faced with the decision of choosing a specific brand, what he really needs is to know the environmental impact of a category of products.

Another aspect that causes considerable difficulty and presents little homogeneity amongst the systems which have so far been developed is the Product Category List. This classification is extremely complicated, if we want it to be practical and useful to the designer, and, at the same time, to group products which, owing to their properties or functions, may be similar, as these two parameters often contradict one another. We are currently witnessing real confusion about this and it is a particularly sensitive issue that affects the consolidation of these systems because international homogenization is required to avoid a multiplicity of Product Category Rules (PCR), which will make the system less dynamic and procedures extremely long, and, consequently, make the system expensive to the administrator and the companies that participate. To the extent that the principal aim is the availability of a range of construction materials with EPDs, with which we can tackle all the components of a building, the agility of the system will become a key factor in its own future. The aforementioned research study to determine the weight and impact of building materials in buildings in Catalonia may turn out to be very useful in achieving this objective.

NOTES

- [1] ISO 14020:2000 Environmental labels and declarations – General principles
- [2] ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- [3] European Committee for Standardization CEN TC 350, Sustainability of Construction Works
- [4] Comité técnico de normalización de AEN/CTN 198/SC1 Sostenibilidad de la Construcción
- [5] ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework
- [6] ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines



Fig. 1 Logo of the DAP® construction System

<p>DECLARACIÓN AMBIENTAL DE PRODUCTO DAPc®.001.001</p>  <p>DE ACUERDO CON LAS NORMAS ISO 14.025 e ISO 21.930</p> <p>PRODUCTO ECO 50 D</p> <p>EMPRESA ISOVER</p> <p>DESCRIPCIÓN DEL PRODUCTO El producto ECO 50 D es un panel compacto de lana de vidrio no hidrófila, sin revestimiento, de 50 mm de espesor, 1350 mm de longitud, 600 mm de ancho y 18 kg/m³ de densidad.</p> <p>RCP DE REFERENCIA RCP001 - Productos aislantes térmicos - V.1 (2010)</p> <p>PLANTA PRODUCCIÓN Saint-Gobain Cristalería, S.A División Aislamiento-ISOVER Azuqueca de Henares, 19200 Guadalajara</p> <p>VALIDEZ Desde: 28.10.2010 Hasta: 28.10.2015</p> <p>La validez de DAPc® 001.001 está sujeta a las condiciones de validez del DAPc. La edición vigente de este DAPc es la que figura en el registro que mantiene CAATEB; a título informativo, se incorpora en la página web del Sistema: http://es.csostenible.net/dapc</p>	<p>DECLARACIÓN AMBIENTAL DE PRODUCTO DAPc®.002.003</p>  <p>DE ACUERDO CON LAS NORMAS ISO 14.025 e ISO 21.930</p> <p>PRODUCTO Gres porcelánico medio</p> <p>EMPRESA PORCELANOSA</p> <p>DESCRIPCIÓN DEL PRODUCTO El producto incluido es un Gres medio que incluye diferentes modelos de gres porcelánico.</p> <p>RCP DE REFERENCIA RCP002 - Productos de revestimiento cerámico - V.1 (2010)</p> <p>PLANTA PRODUCCIÓN PORCELANOSA Carretera N-340, Km 56 Villarreal, 12540, Castellón</p> <p>VALIDEZ Desde: 28.10.2010 Hasta: 28.10.2015</p> <p>La validez de DAPc® 002.003 está sujeta a las condiciones de validez del DAPc. La edición vigente de este DAPc es la que figura en el registro que mantiene CAATEB; a título informativo, se incorpora en la página web del Sistema: http://es.csostenible.net/dapc</p>
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Fig. 2 Two approved DAP®construction documents