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INTELLECTUAL OUTPUT 2
New interactive BIM-learning methods for Circular Economy

TASK O2-A2
Interactive CircularBIM Tool

Erasmus+

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INTRODUCTION

It has been produced an ICT based tool on BIM technology for the CircularBIM project. This content is available for free on the website of the project for being used as a supporting material in the numerous architecture and construction courses distributed within the sector of construction products.

CircularBIM project web: https://circularbim.eu/

This task is included in the O2 (Intellectual Output 2, called New interactive BIM-learning methods for Circular Economy), specifically, the task O2/A2. This interactive tool has been developed to feed the implementation of CircularBIM Course (O1/A4) and the OER (Open Educational Resource, O3), and it is basis on knowledge developed in the O1 of the project (Establishment of common learning outcomes on placing methods based on circular economy criteria, life cycle assessment (LCA) and relative regulations). The guideline notes and functional specifications is described in the previous task O2/A1.

In summary, an Interactive Tool has been developed for integration of CircularBIM objects and products to be read in both free and professional software as well as linked to the project's OER platform. The leader of this task was CYPE and will count with the participation of the rest partners of the consortium.

This task was be divided into two subtasks:

A. Production of CircularBIM object in common BIM format.

To create families of objects to use for characteristics of circular economy and sustainable constructive methods, of the different construction materials selected in the project, that is to say, of the most commonly used constructive elements, with direct linkages to the project's OER for students, teachers and professionals in the sector.

These constructive details will be in common BIM format, to be read in both free and professional software.

B. Integration of CircularBIM Training materials into open software BIM and the most common professional software.

The environmental database has been implemented in a plug-in, developed for open software BIM and the most common professional software with the objective of linking the Training Materials of the project with the most common tools in the educational and professional field. Therefore, CircularBIM object developed for the project was integrated with the environmental database and interconnected with the project's OER (which is developed in IO3).

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The CircularBIM object as well as integration of CircularBIM training material was included in the website of the project, specifically here:

https://circularbim.eu/es/productos-circularbim/

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1. BIM AND ENVIRONMENTAL CHALLENGES

BIM is now a reality: the building construction environment is exposed to new input and more information regarding the digitization and computerization of this sector.

BIM is not only about 3D modelling, but it also allows you to manage a series of information regarding materials, costs and time, which is why it is important to refer to the dimensions of BIM.

In fact, every time a specific type of information is specified into the model, a different dimension is set, and, for this reason, various dimensions are generated. According to BIM fundamentals there are seven recognized “dimensions”:

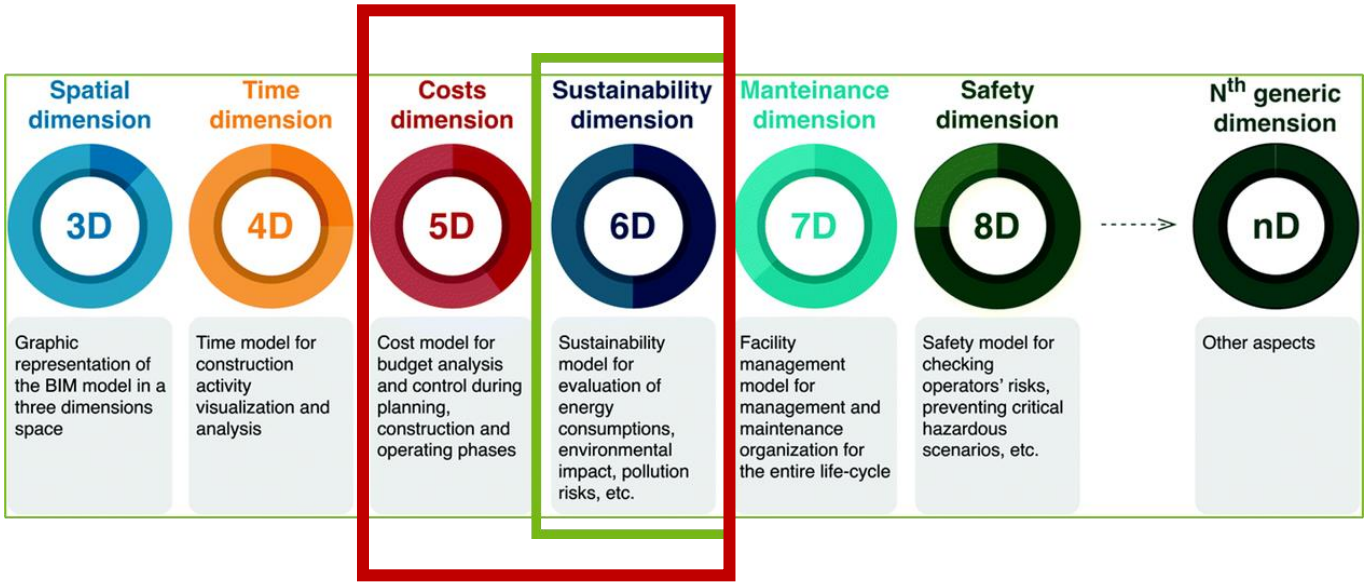
3D modelling | geometrical, graphical information.

4D time-related info| construction sequencing by means of Gantt charts and timelines.

5D cost analysis | cost management, construction cost estimating, etc.

6D sustainability| environmental, economic and social sustainability impact studies.

7D life cycle and maintenance | Facility Management: planning and management of maintenance operations throughout the building’s lifecycle.



In addition to the 7 dimensions mentioned above, there is now an open debate on three “new dimensions of BIM” including:

8D – safety during design and construction

9D – lean construction

10D – construction industrialisation.

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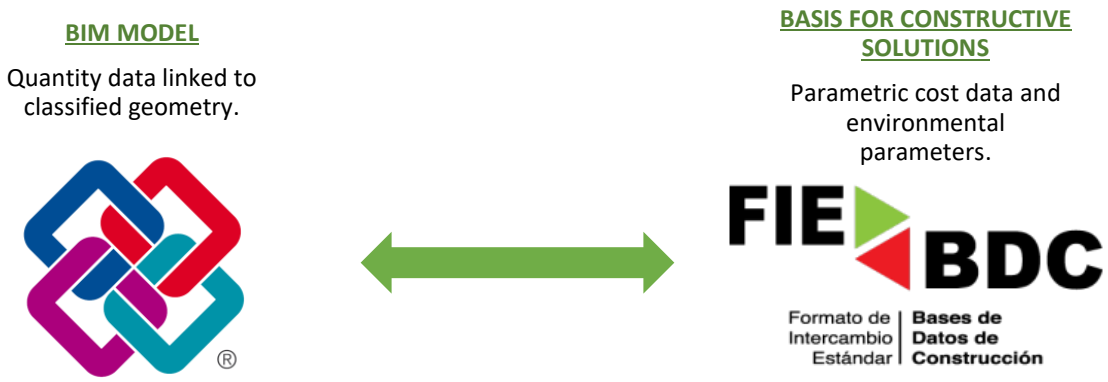
The methodology is applied in CircularBIM project is focused specifically on the sixth dimension, regarding to Sustainability model for evaluation of energy, consumptions, environmental impact, pollution risks, etc.

2. WORKFLOW

2.1. MODELS

The budget generating programs are able to generate the document Construction and Demolition Waste Management Study.

In the CircularBIM Project, which wants to take this methodology one step further, where through a BIM Model, its BIM objects can be linked to environmental data studied by the consortium.



In order to produce this environmental baseline, the document entitled “Base de Costos de Construcción de Andalucía” was used as a basis.

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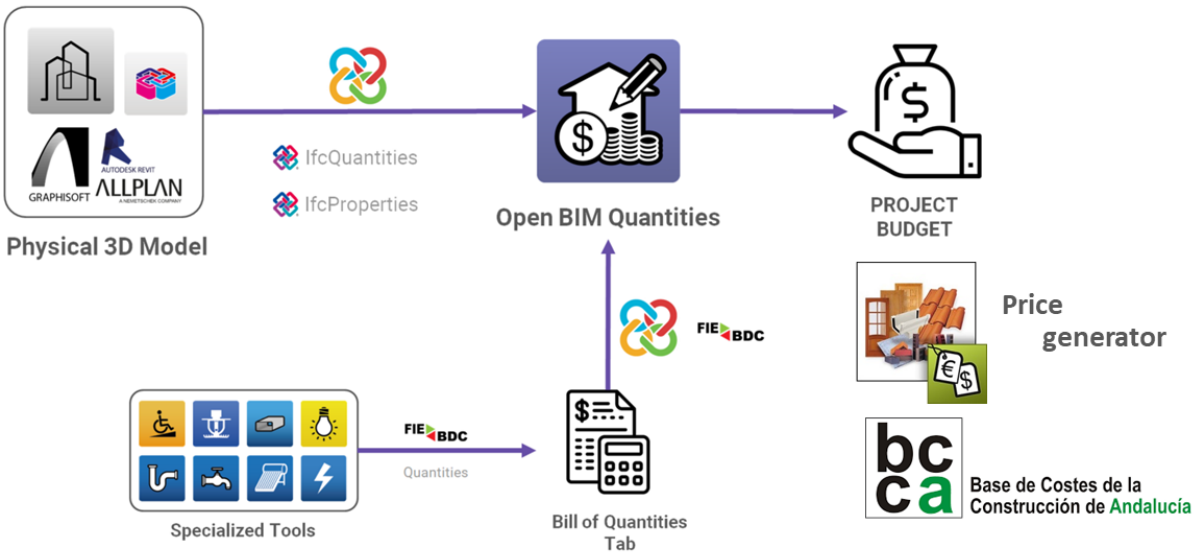
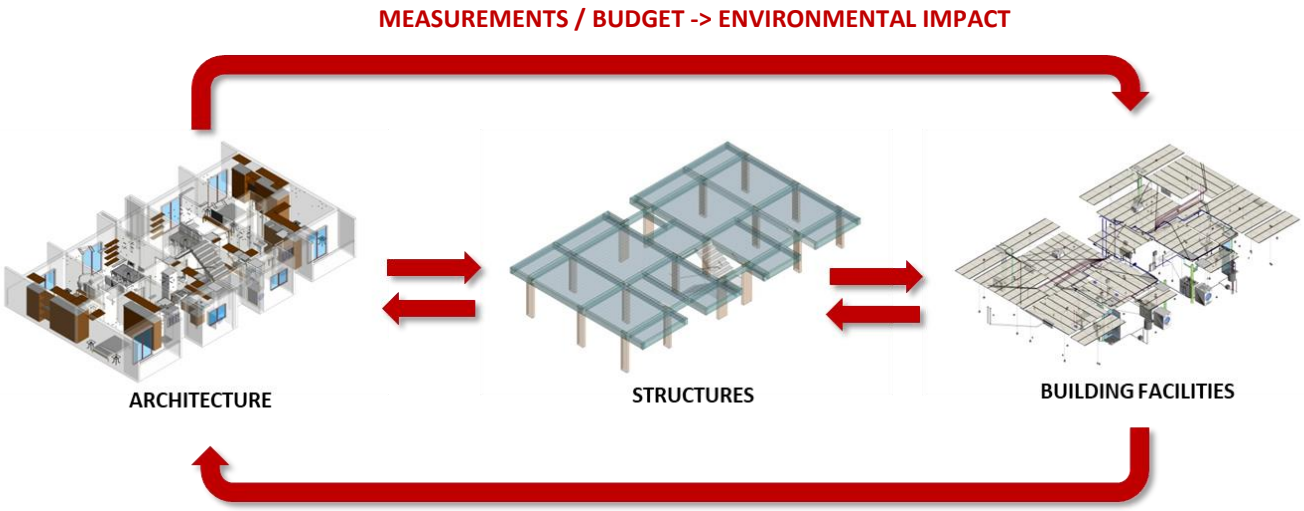


This process will be valid for any phase of the construction process, whether in the structure or in the perimeter enclosure of the façade.



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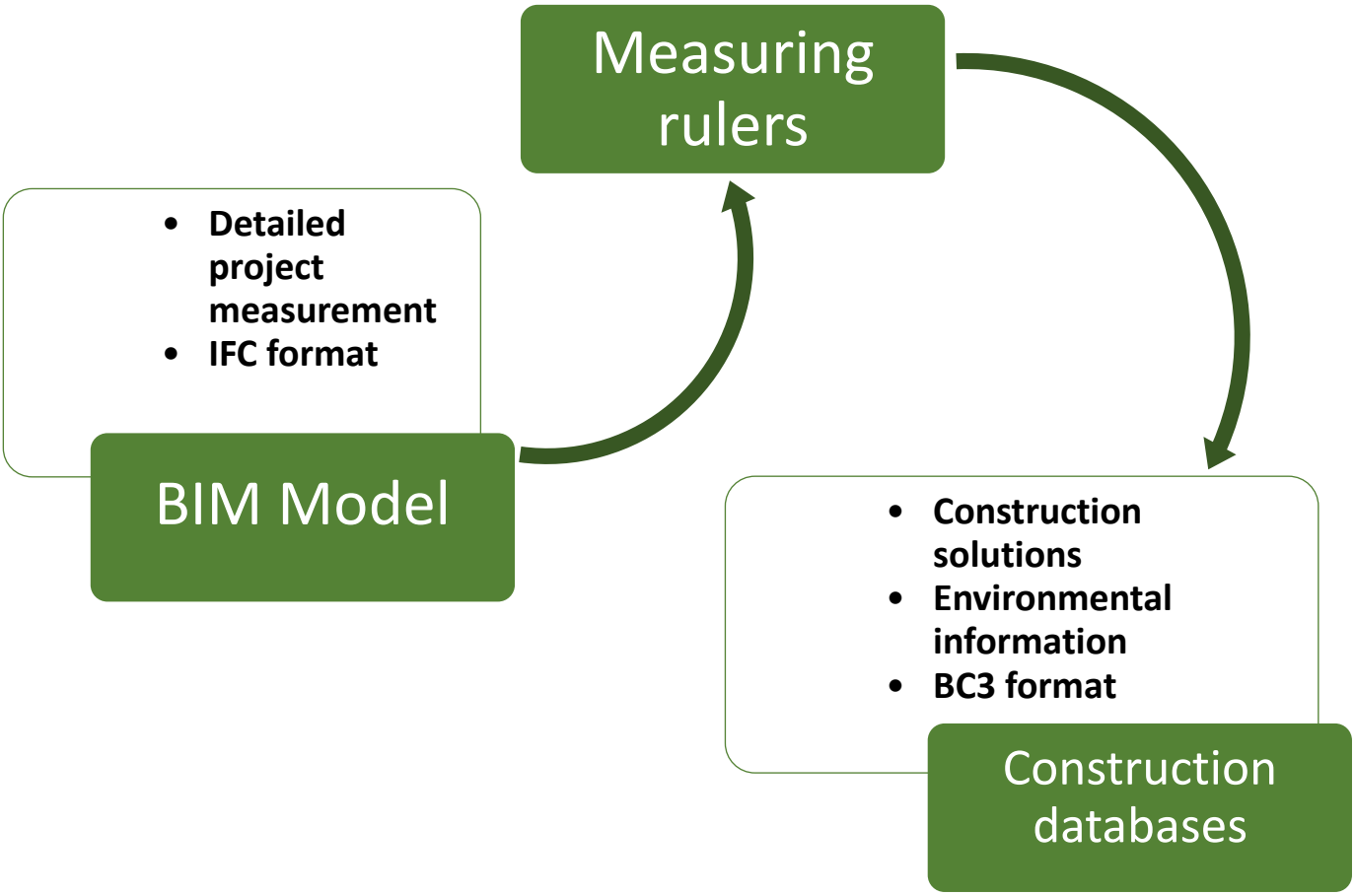
2.2. PROCESS AUTOMATION

Para obtener una buena medición mediambiental, es necesario partir de una con garantías, la cual puede ser obtenida desde un modelo BIM, por ejemplo, con un formato estandar IFC. Posteriormente, esto será que ser combinado y vinculado a una base de datos mediambientales, el cual puede estar en formato xlms o bien en formato BC3.



3. DATABASE OF LYFE CLYCLE ASSESSMENT

As if it were an environmental budget, the project partners, led by the University of Seville, created this budget that will serve as a knowledge base for future courses related to CircularBIM, being this document the valid calculation engine for the workflow explained above. Part of this environmental basis of building products is shown below.

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m2 REUSABLE FAÇADE WITH LOW ENVIRONMENTAL IMPACT MATERIALS

Ventilated façade finished in sandstone slabs of Caliza Capri limestone, honed finish, 1200x60x4 cm. Recycled material has been used in the composition of the product. Category A+ (levels of hazardous substances well below the limits of the applicable regulations). Supported by an auxiliary structure using a vertical anchoring system, Epsilon U with "STROW" pivot, in black lacquered AW 6063 T5 aluminium; fixed to the supporting wall with A2 stainless steel anchor bolts and dowels. Thermal insulation, semi-rigid rock wool panel. Thickness 37 mm, model VENTRIROCK DUO. Fastened to supporting sheet by means of metal screws. Main supporting structure by means of rectangular RHS S275 steel profiles with Sendzimir galvanised coating, with up to 275 gr/m² Zinc coating.

MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
RA05300A	1	m2	Stone cladding	0,18	0,02	32
09TPP00161A	1	m2	Thermal insulation - rock wool	51,5	3,61	67
CA01600A	1	m2	Main structure - Steel sections	40,01	11,5	17,4
FP01200A	1	m2	Gypsum plasterboard - INTERIOR PANELING	140	20,66	0
			TOTAL	231,69	35,79	29,1

UD ALUMINIUM CARPENTRY 75R TECHNAL

HYDRO CYRCAL aluminium carpentry manufactured with a minimum of 75% recycled aluminium. Thermal transmittance 0.68 W/m2- k and dimensions according to project. Energy consumption: 85 MJ/kg.

MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
1LVC80004A	1	m2	Aluminium carpentry 75R - TECHNAL	85	2,3	75
			TOTAL	85	2,3	75

m2 SANITARY SLAB

Sanitary slab made up of IPE 240 beams IPE 120 joists with screwed joints and cement mortar vaults with 30% recycled polypropylene. Compression layer using 40% recycled steel corrugated sheet with 20% recycled material mortar infill and Ø16 steel 275S reinforcement.

MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
CA01300	1	UD	IPE 240 steel beams	44,29	4,37	0
CA01500	1	UD	IPE 120 steel joists	41,5	4	0
CB00600	1	UD	Cement mortar blocks with recycled pp	2,35	0,23	30
CA00700	1	m2	Steel ribbed sheet	35	2,8	40
CH80020	1	m2	Compression layer	4,8	0,46	20
			TOTAL	127,94	11,86	18

m2 INTERMEDIATE FLOOR SLAB

Intermediate floor slab made up of IPE 240 beams IPE 120 joists with screwed joints and cement mortar vaults with 30% recycled polypropylene. Compression layer using 40% recycled steel corrugated sheet with 20% recycled material mortar infill and Ø16 steel 275S reinforcement.

MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
CA01300	1	UD	IPE 240 steel beams	44,29	4,37	0
CA01500	1	UD	IPE 120 steel joists	41,5	4	0
CB00600	1	UD	Cement mortar blocks with recycled pp	2,35	0,23	30
CA00700	1	m2	Greyed sheet metal	35	2,8	40
CH80020	1	m2	Compression layer	4,8	0,46	20
			TOTAL	127,94	11,86	18

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m2 ROOF SLAB						
Roof slab made up of IPE 240 beams IPE 120 joists with screwed joints and cement mortar vaults with 30% recycled polypropylene. Compression layer using 40% recycled steel corrugated sheet with 20% recycled material mortar infill and Ø16 steel 275S reinforcement.						
MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
CA01300	1	UD	IPE 240 steel beams	44,29	4,37	0
CA01500	1	UD	IPE 120 steel joists	41,5	4	0
CB00600	1	UD	Cement mortar blocks with recycled pp	2,35	0,23	30
CA00700	1	m2	Greyed sheet metal	35	2,8	40
CH80020	1	m2	Compression layer	4,8	0,46	20
			TOTAL	127,94	11,86	18

m2 FLAT ROOF ON TANGANILLOS						
Flat roof walkable by means of, slope formation formed by lightened concrete with recycled crushed polypropylene (PP), material compressive strength: 11.9 MPa, material density = 1618 kg/m³. Thermal insulation by means of recycled extruded polystyrene sheets (XPS), type "Foamular" e=5cm. Waterproofing layer: Recycled PVC sheet type Danopol HS 1.2 light grey, Danosa. Thickness = 1.2mm. Non-woven geotextile separating layer for protection of the waterproofing sheet, type danofelt PP 125, Danosa. Rolls: 100x2'25m. WPC tiles with recycled Polypropylene (PP) for roofing. Tile dimensions 14'5x390x3cm. Qualita 020C" type, flexural strength: 35 MPa. EcoMark" label Floating floor support system type "SC 750" (Cáviti), made of polyolefin omo and copolymer with mineral filler. Supports ø90mm and ø150mm.						
MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
CÓDIGO	1	m2	Slope formation by means of lightweight concrete	4,8	0,46	30
CÓDIGO	1	m2	XPS thermal insulation	117	17,3	0
CÓDIGO	1	m2	Geotextile	16,16	2,38	0
CÓDIGO	1	m2	Waterproofing - PVC film	64	14,43	0
CÓDIGO	1	UD	Floating floor support	45	32,05	0
CH80200A	1	m2	WPC tile flooring with recycled PP	2,5	0,18	20
			TOTAL	249,46	66,8	8,33

m2 INTERIOR FLOORING WITH WOODEN DECKING						
Interior flooring using DPL type wood flooring, size 120x30 cm (EPD Certification - EPD-EPL-20150021-CBE-EN. On wooden battens.						
MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
RT01800A	1	m2	Wooden platform type DPL. Dimension 120x30 cm.	24,07	6,69	0
WW00400A	1	m2	Wooden rails for wooden decking supports	10,8	3,59	0
			TOTAL	34,87	10,28	0

m PYL PARTITION WALL						
Partition wall using 15 mm thick laminated plasterboard and 37 mm thick mineral wool, consisting of a supporting structure of metal profiles formed by uprights and channels to which a PLACO SAINT-GOBAIN BA 15 laminated plasterboard is screwed.						
MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
RT02000A	1	m2	Gypsum plasterboard and metal structure	140	20,66	0
			TOTAL	140	20,66	0

m2 FALSE PLASTER CEILING						
Continuous false ceiling with smooth plaster panels of e=2cm and painted with smooth plastic paint. Including anchoring of false ceiling to slab by means of screwed aluminium profiles.						
MATERIALS				MJ/KG	$KgCO_2/kg$	%Recycling
RT02000	1	m2	False plasterboard ceiling	68,72	3,93	0
RT04000	1	m2	Aluminium structure for false ceiling	19,08	1,07	0
			TOTAL	87,8	5	0

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4. ACCESS TO THE INFORMATION

CircularBIM tool is an educational developed for CircularBIM project in order to calculate environmental impacts (carbon footprint, energy envoided and recyclability) for building.

All the information related to environment database and BIM objects will be allocated here:

https://circularbim.eu/es/productos-circularbim/

Platform (OER), which it contents visual examples and other training materials for a better understanding of LCA for building materials, for students, teachers and professional of AEC (Architecture, Engineering, Construction). It can be downloaded from here:

https://circularbim.eu/es/oer/

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