

INTED **2016**

10th International
Technology, Education and
Development Conference

7-9 March, 2016
Valencia (Spain)

CONFERENCE PROCEEDINGS



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Published by
IATED Academy
iated.org

INTED2016 Proceedings
10th International Technology, Education and Development Conference
March 7th-9th, 2016 — Valencia, Spain

Edited by
L. Gómez Chova, A. López Martínez, I. Candel Torres
IATED Academy

ISBN: 978-84-608-5617-7
ISSN: 2340-1079
Depósito Legal: V-337-2016

Book cover designed by
J.L. Bernat

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BUILDING INFORMATION MODELING: A NEW TOOL TO USE IN THE CONSTRUCTION FIELD

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Abstract

The use of BIM technology (Building Information Modeling) in the architectural field is assuming a very important qualitative professional momentum by using specific constructive databases associated with conventional drawings from different perspectives at every construction level.

One of the most demanded technical requirements within the building area today is the use of 3D drawing programs, which become an indispensable training for students versus traditional design. Thus, the main objective of this proposal is to show the constructive application of this tool for teaching construction systems at the University of Alicante, providing an interesting working tool currently used in many architectural companies and building firms. The methodology and contents taught in the course consider a practical development so that the topics are gradually and successively explained, being a good opportunity to implement the study of new technologies related to construction.

In conclusion, the use of BIM tools enriches students' skills (improving their expertise in the field of design and expanding their capacity for spatial vision) and faces the growing business needs in the construction field with indispensable qualities in the architectural practice.

Keywords: training, BIM, parametric objects, university, Revit.

1 INTRODUCTION

For every degree, the university should be able to offer new competencies complementing the specialized training of their graduates to improve their relationship with the business and social environment. Due to several changes raised in the construction industry in recent years [1], we need to pursue new ways of learning/planning new teaching methodologies to enhance the capabilities of students, preparing them for the professional world related to the construction field [2]. Moreover, at present time there have been countless advances in the use of information technologies for both to make graphic surveys and to recognize our immediate environment (using tools such as ICT, SIG, MAPS, etc.). These technologies induce, increasingly, the employ of new data and complementary tools applied to construction projects [3].

In the last decades, the use of CAD drawings has gained great importance in the field of architecture and engineering, generating a radical change of system that can have direct confrontation of many professional critics. However, if the process is proposed as a continued change (step by step since the beginning of project) planning design has to be redirected by assimilating those changes. Despite the existence of some opposing to the use of new tools, it is necessary to break the homogeneity created so far with CAD systems (increasingly obsolete) and to establish dynamic progresses and continuous sustainable improvements to generate new workflows in the professional constructive environment.

Therefore, considering that one of the most demanded technical requirements in the building field is the use of architectural programs for representation and integrated 3D design [4], it is indispensable to reach specific training that includes multiple spatial possibilities beyond conventional orthographic projections (plants or sections). Thus, the use of BIM technology (Building Information Modeling) in the field of architectural projects is assuming a very important qualitative professional momentum by using specific databases associated with conventional drawings from different perspectives such as materials, constructive systems, dimensions, spatial conditions, etc., providing greater accuracy to the project.

2 OBJECTIVES

In our opinion, university teaching in the field of construction must commit daily specialization, training future professionals from a multidisciplinary perspective and giving them new curricular competencies to be applied in a worldwide business environment [5]. This global approach is widely offered by BIM applications, which propose different objectives compared to traditional CAD, considering parametric data coupled to each building system used in the project (new physical and dimensional properties are added to the vector lines comprising the conventional pattern in two or three dimensions). In all, this process of constructive modeling provides a better understanding of the physics of materials, constructive parts and building systems used in architectural projects [6, 7].

In today's competitive business environment, it is important to seek new ways and new working methods that allow external openness to European and international labour market for construction professionals trained in our universities, where this type of advanced BIM technologies are widely used for years [8,9]. This process is applied in the present study for the field of teaching at the University of Alicante.

3 MATERIALS AND METHODS

As mentioned before, the BIM technology is a new evolution in the architectural design process compared to traditional CAD tools that allows including specific information from a three-dimensional database into the material properties of the buildings. This instrument also provides the generation of 3D rendered views from the initial phase of the project, ensuring continuous and immediate global update of changes in real time of every partial data in the building.

Taking advantage of the above cited characteristics, a supplementary training course in the field of construction, architecture and design is supplied, aimed to building professionals such as students of various degrees (Building Engineers, Architects or Engineers interested in the subject). The course's main objective is to initiate each user in REVIT ARCHITECTURE 2015 program, assuming an opportunity to implement the study of new technologies and to manage an interesting working tool currently deployed in many architectural firms.

The main objective of the proposed activity focuses on maximizing this tool based on the use of objects with different characteristics than traditional CAD. In BIM programs, 2D or 3D entities are accompanied by new parameters that allow manipulating and adapting different physical properties of building elements only by changing their basic characteristics without altering the source file in each case [10].

The proposed methodology is based on the development of real examples in different professional environments (rehabilitation projects, new constructions or opening projects). This practical application ensures active participation and time savings for the future professional design, which may be generated, moved or virtually tested [11].

4 RESULTS

With the above assumptions, the course is divided into five practical sessions (4h each), including the following main contents (Fig. 1):

- 1 Interface, basic concepts and model initiation.
- 2 Modeling: definition of constructive elements and lifting the building.
- 3 Modeling nested elements: families, basic creation and modification.
- 4 Advanced modeling of building systems.
- 5 Composition and layout of the project.

<p>SESIÓN 1</p> <p>1. PRELIMINARES</p> <p>1.1 Presentación del curso. 1.2 Entrega de materiales.</p> <p>2. INTERFAZ, CONCEPTOS BÁSICOS Y MODELADOS DE INICIACIÓN</p> <p>2.1 Conceptos básicos. BIM y parámetros. 2.2 Categorías, familias y tipos. Propiedades de ejemplar y de tipo. 2.3 Interfaz del usuario. Cinta de opciones, personalización grupos y cambiar visualización. 2.4 Menú Revit. Extensiones de archivos rvt (proyecto), rfa (familias), rte, etc. 2.5 Navegador de proyectos. Vistas, familias, grupos y vínculos. 2.6 Datos generales. Información de proyecto. El proceso de diseño: niveles y rejillas, importación de datos y masas. 2.7 Herramientas de visualización. Rangos de vista. 2.8 Dibujo en dos dimensiones. Líneas de referencia. Importación dwg. 2.9 Modelado de un sólido de diseño. Incorporación de un diseño propio en el proyecto.</p> <p>SESIÓN 2</p> <p>3. MODELADO. DEFINICIÓN DE ELEMENTOS CONSTRUCTIVOS Y LEVANTAMIENTO DEL EDIFICIO.</p> <p>3.1 Creación de superficies topográficas y plataforma de explanación. Importación de terrenos desde Cad. 3.2 Ceramientos y divisiones interiores. Operaciones con muros: propiedades, creación y modificación. 3.3 Estructura y cimentación: básico. 3.4 Cubiertas (planas, inclinadas), suelos y falsos techos.</p>	<p>SESIÓN 3</p> <p>1. MODELADO DE ELEMENTOS ANIDADOS: FAMILIAS, CREACIÓN BÁSICA Y MODIFICACIÓN.</p> <p>1.1 Puertas y ventanas. Edición básica de familias. 1.2 Muros cortina. 1.3 Rampas y escaleras. 1.4 Mobiliario e iluminación. 1.5 Personas y árboles (rpc).</p> <p>SESIÓN 4</p> <p>2. MODELADO AVANZADO DE ELEMENTOS CONSTRUCTIVOS.</p> <p>2.1 Puertas y ventanas. Edición avanzada de familias. 2.2 Muros cortina. Edición de rejilla de muro y modificación de paneles. 2.3 Rampas y escaleras. 2.4 Iluminación. 2.5 Renderizado de las escenas de proyecto.</p> <p>SESIÓN 5</p> <p>3. COMPOSICIÓN Y MAQUETACIÓN DE PROYECTO.</p> <p>3.1 Cotas. Acotación de elementos y configuración. Estilos. Cotas de trabajo (restricciones). 3.2 Textos y etiquetas (superficies automáticas, etc.). 3.3 Tablas: mediciones, cuadros de superficies, etc. 3.4 Conceptos generales de renderización y materiales con Revit. 3.5 Creación e impresión de planos. Escalas. 3.6 Cartelas y marcos: creación de familias en un único archivo. 3.7 Impresión por lotes y/o conjuntos de vistas.</p>
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Fig 1. Contents of the five sessions in the course.

Considering this, it is crucial to know the different levels of prior knowledge of the students in the area (in many cases users part of a very low level or even from scratch); practices are designed so that the knowledge gained would be gradual and by successive application. Thus, among all the contents, best valued exercises by students, are the following:

4.1 Obtaining details from a previous model

This tool is one of the most identifying in the Revit program and represents a great improvement over CAD tools (Fig. 2) because, after making a model, students can select any representative area (a specific detail) where they can place more information in a 2D level.

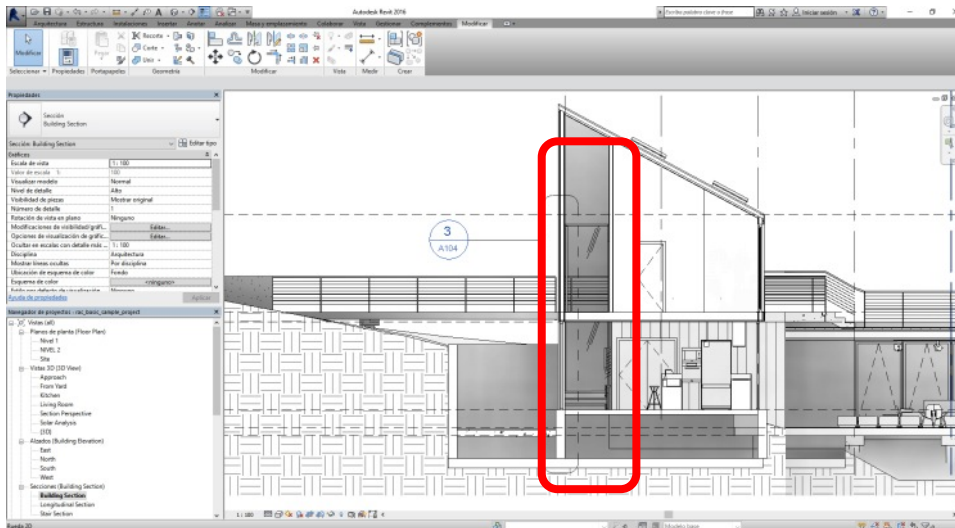


Fig 2. General section of the building with additional information recorded in the Revit database.

Thus, the system provides a great advantage over traditional CAD drawing tools, since each of the drawn elements and its information is recorded in the Revit database, allowing adding labels or to obtain any specific data from an existing representation, even offering the ability to create tables with additional information (Fig. 3).

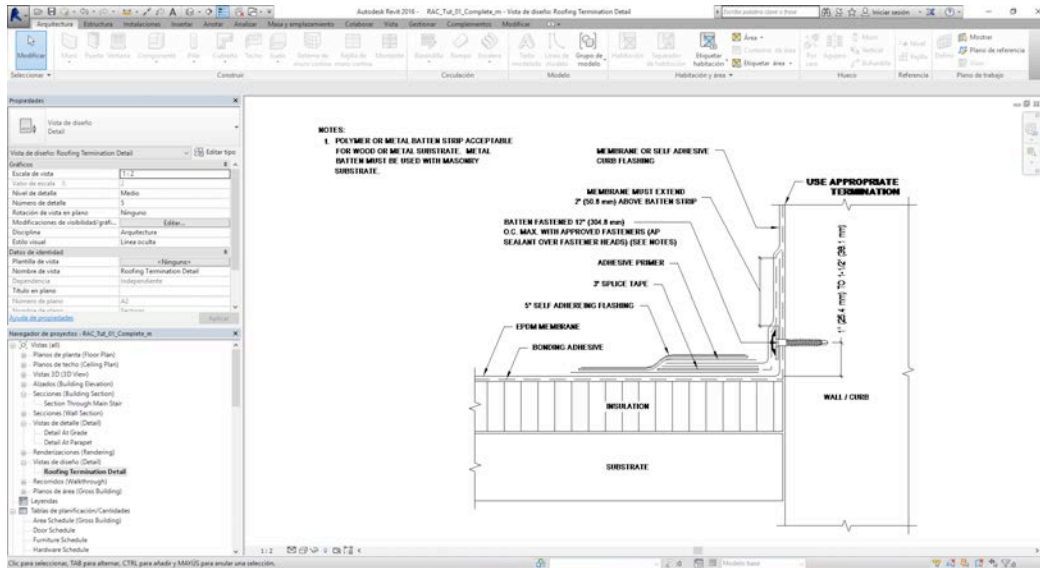


Fig 3. Section of a specific detail, obtained directly from the overview from existing records in the Revit database.

4.2 Direct obtainment of any data of the built model.

In this exercise students work on how to build the three-dimensional model with elements that contain additional information and thanks to these data it is possible to obtain directly, at any time, complex plans, information tables or schedules with little effort.

It is important to mention that all the information contained in each element of the model is scalable and can add other specificities (prices, technical data, etc.) at any time during the project's design or the project's performance (Fig. 4).

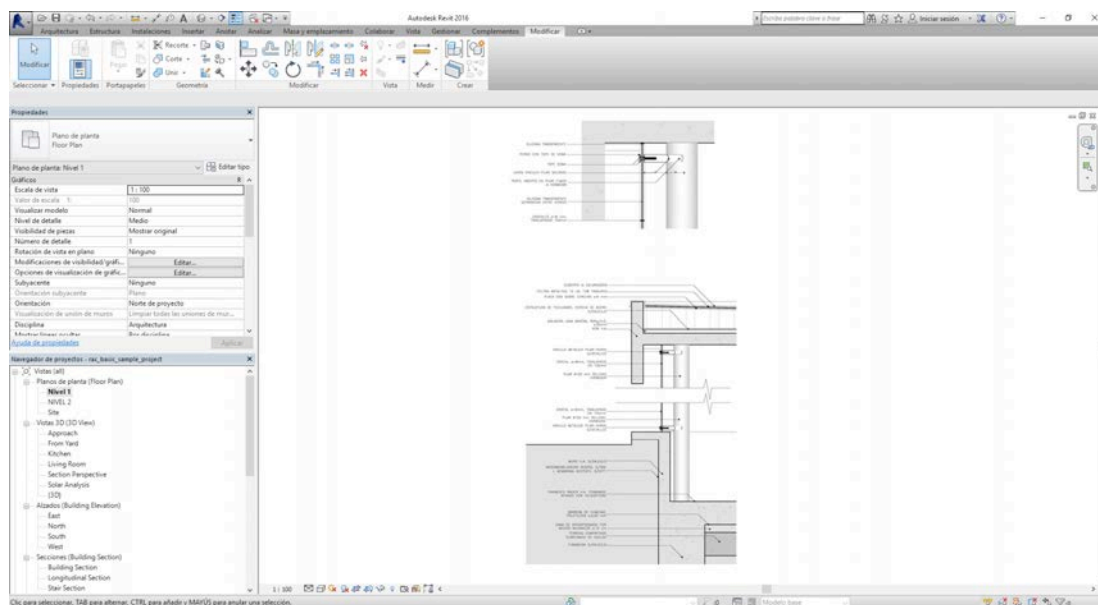


Fig 4. Obtaining specific project data.

4.3 Creation of topographic surfaces

The third exercise rated shows how, compared to traditional CAD programs, the creation of topographic surfaces in Revit is simplified in a surprising way, since students can create outlines of land from points strategically placed at the appropriate high in the model, creating a continuous surface between them (Fig. 5). Another possible option is to draw surfaces from flat contours imported

directly from CAD or even overturn topographic data obtained with different types of software used in civil engineering.

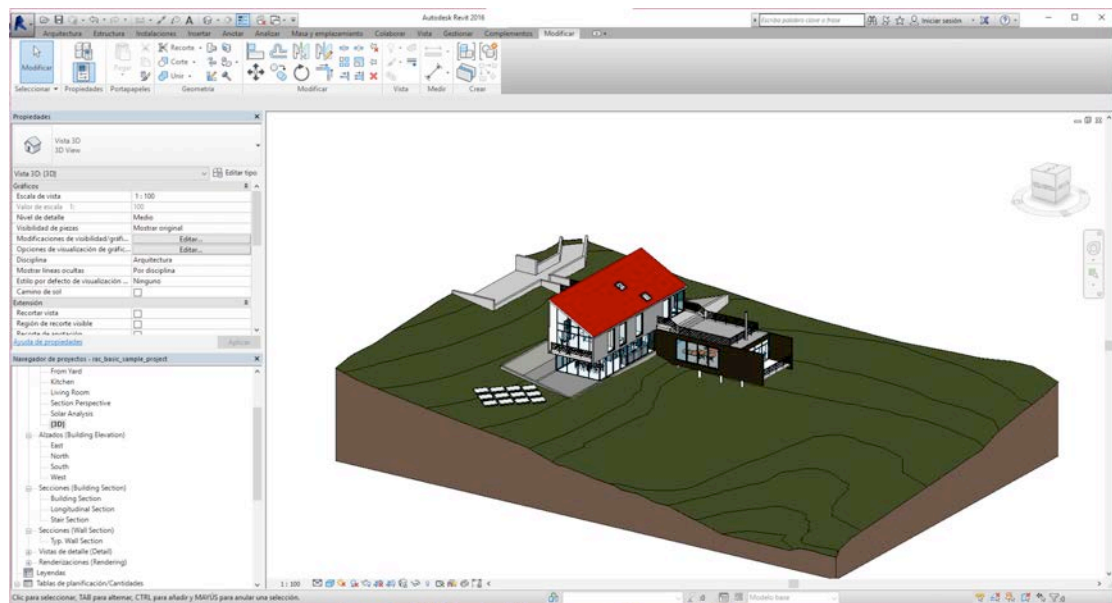


Fig 5. Toposurface around a building.

4.4 Direct creation of sections

In this activity students see how Revit, once built the model, can define section planes directly tracing the line that defines this plane, obtaining a sectional elevational immediately. In addition, the program also has tools to three-dimensionally section the previously constructed model (Fig. 6 and 7).

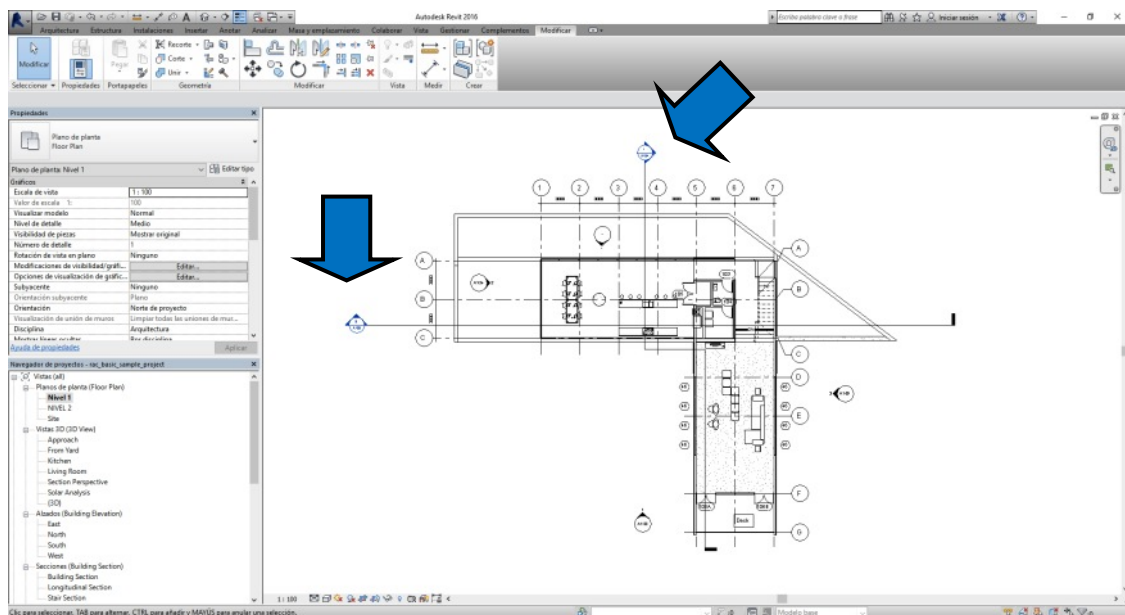


Fig 6. Floor plan where the chosen section plane is identified.

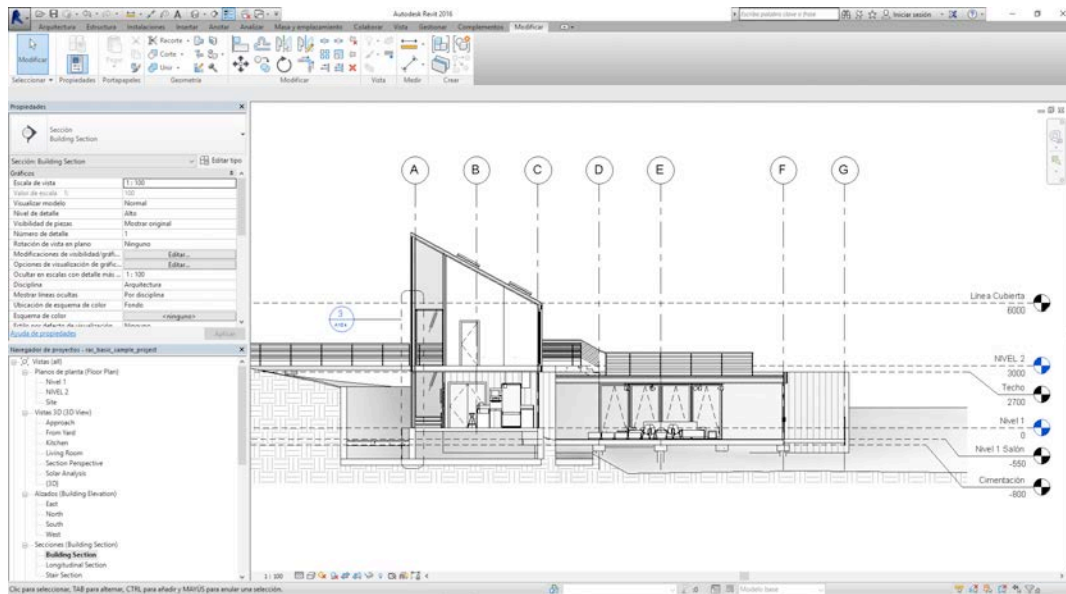


Fig 7. Section immediately generated from indications on the ground pattern.

5 CONCLUSIONS

On the one hand, in the vertiginous and continuous evolution of the information society, the constant changes (both in terms of hardware and software) have allowed assessing the significance of data storage and information management. The different software currently working under the BIM area allows incorporating specific design tools for modeling various building elements (as columns, beams, slabs, foundations, roofs, etc.) that can be simply used and at the same time provides a complex result through complementary data for each of the phases that make up a building. Thus, the system considers the whole project in a global and comprehensive way.

Moreover, these exercises allow college students managing an interesting program for design in three dimensions, presenting the basic principles of accurate and easy drawing. In that way, students have found that, by using simple tools, this program allows employees to produce a three-dimensional architectural project very quickly, generating easily modifiable views with all kinds of additional information (Fig. 8).



Fig 8. Section immediately generated from a display in the plant model.

In conclusion, the proposed course meets the growing needs of qualified teaching to improve the professional skills required in the construction area, while it enriches the expertise of students by improving their knowledge in the field of design and expanding their capacity for spatial vision; both indispensable qualities in architectural practice.

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