PAPER • OPEN ACCESS

A Study of BIM Combined with ETABS in Reinforced Concrete Structure Analysis

To cite this article: Ren-Jwo Tsay 2019 IOP Conf. Ser.: Earth Environ. Sci. 233 022024

View the article online for updates and enhancements.

You may also like

- <u>An automation tool for exporting structure</u> <u>models from Revit to Tekla Structure</u> Jie Ma, Siwen Ding, Dehai Zhang et al.
- Implementation of Building Information Modelling (BIM) Revit to meet the needs of the construction industry F N Aryanti, R R T Busono and S Siswoyo
- <u>Research on Data Fusion Method of Revit</u> and Non-BIM Software in Complex <u>Shaped Buildings</u> Chao Gao, Shengting Li and Zhenkai Wang





DISCOVER how sustainability intersects with electrochemistry & solid state science research



This content was downloaded from IP address 3.141.152.173 on 28/04/2024 at 23:35

doi:10.1088/1755-1315/233/2/022024

A Study of BIM Combined with ETABS in Reinforced Concrete Structure Analysis

Ren-Jwo Tsay¹

¹Departments of Civil Engineering, University of Vanung 312, Taiwan

* Corresponding Author: Ren-Jwo Tsay; email:trj@vnu.edu.tw..; phone:.886-3-45158112 ext 54619.; fax:.886-3-4517602.

Abstract: For many structural analysis software which used to establish a simplified element analysis model based on the concept of finite element method. However, there is a certain gap in the actual behavioral effects for simplifying the model so the analysis results will different with real condition such as RC section reinforcement steel layout. So how to describe the real condition for RC detail section is an important problem for engineering. Building information modeling (BIM) software combined with APP program which will establish the actual section and reinforcement effect of three-dimensional member model. In this paper we applied BIM software AutoDesk Revit program to build a structural model including geometry and reinforcement in RC system and then convert it into ETABS analysis software and obtain regional structure behavior and explore real structural security.

1. Introduction

For structural analysis, how to clearly define the material cross-section behavior of each member will help to analyze the accuracy of the results. For a long time, the structural engineer analysis tools have analyzed the structural system in a simplified mode, although it has the convenience of being numerical. In the actual design, such as the design of the steel reinforcement, the design of the reinforcement is often based on the experience of the designer, resulting in actual construction or the difficulty of the joint reinforcement is required to be changed again, which will have an impact on the design results. For this, Paola et al. [1] and Wang et al [2] proposed how to establish a drawing method for building systems. Li Yuxi [3] analyzed the effect of energy loss after establishing the Revit building model. For RC building the rebar system is complex in real construction. How to get the detail to numerical model for analysis was an important problem to get real behavior. In this paper we applied Revit program APP to prescribe detail rebar system in RC building then export to ETABS program to get a exact numerical model for numerical analysis.

2. Revit Building Modeling and ETABS Program Application

2.1. Revit RC Building Modelling

AutoDesk Revit model is built on the concept of "layer" and "grid" to prescribe the beam-column geometry system. In addition to the size of the elements, the expansion function can also be used to describe its details such as steel number and connection method. So we can get more precise way to describe the actual construction process, which can reduce the difficulty of the interface construction caused by the unclear 2D graph. For the RC structure modeling, in addition to setting the section size of the element (as shown in Figure 1), it is also necessary to set the reinforcement configuration to an-

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI. Published under licence by IOP Publishing Ltd 1

alyze its behavior. In Revit program have provide simple steel bar reinforce model but is not clearly prescribe the connection link method between 2 element.



Figure 1. Revit concrete structure system setup

2.2. Reinforcement in Revit and ETABS data connection

2.2.1. Reinforcement App extension function

After the completion of the structural model, the reinforcement expansion APP function (as Figure 2) is used to set the reinforcement structure of the structural beam, column, and foundation plate for the reinforcement.

Reinforcement
Automatic Reinforcement Generation
Beams
0 Columns
Continuous Footings
Interferences of Reinforcing Bars
Parapets
Pile Caps
Piles
Retaining Walls
Slab Corners
Slab Openings

Figure 2. Revit Reinforcement expansion main board

2.2.2. Reinforcement for building

User can select beam and column sections to enter the reinforce type and set the parameters related to the beam and column reinforcement (Figure 3).

File Help Image construction See + Sing Symp See + Sing Symp Additional to bits Construction Book 1: Book 1: See + Sing Symp Motional to bits Construction Book 1: See + Sing Symp Book 1: <th>Reinforcement of beams</th> <th>New York Concession</th> <th></th> <th>Reinforcement of columns</th> <th></th> <th>×</th>	Reinforcement of beams	New York Concession		Reinforcement of columns		×
Build or a conset granting of the constant of	File Islp File Constry Constry Constry Constry Constry Construct C	Disrup permeter Disrup By: 1.04 * Metaola (Ref):: 1.12 mm Metaola (Ref):: 1.12 mm Book: (Ref):: 1.12 mm Book: <td< th=""><th>Add-detablege nationenessed Add-detablege nationenessed Add-detablege nationenessed Monessi Monessi Detablemessi Detablemessi Add-detablege nationenessed Add-detablege nationenessed</th><th>File Help Sconstry Bas Strings Strings Dowels Reinforcement areas</th><th>$\label{eq:second} \begin{array}{ c c c c } \hline \hline$</th><th></th></td<>	Add-detablege nationenessed Add-detablege nationenessed Add-detablege nationenessed Monessi Monessi Detablemessi Detablemessi Add-detablege nationenessed Add-detablege nationenessed	File Help Sconstry Bas Strings Strings Dowels Reinforcement areas	$\label{eq:second} \begin{array}{ c c c c } \hline \hline$	
President residence and generation VL Cancel	Without relations	5 527 I Dynamic model update	905	Without reinforcement generation	Ber bundles a connex Humber of barr.	OK Concel

(a) Beam reinforcement

(b) Column reinforcement

Figure 3. Beam coulum reinforcement function in reinforcement extionsion

2.2.3. Transport Revit model to ETABS program

We applied "Export to ETABS" to export Revit model as "e2k" file then we can import the system to ETABS program (as Figure 4)



Figure 4. Revit exchange EABS file extension function

and E	TABS No	onlinear	v9.5.0 - ci	irve wall	-201710	28						
Eile	e <u>E</u> dit	<u>V</u> iew	<u>D</u> efine	D <u>r</u> aw	<u>S</u> elect	<u>A</u> ssign	A <u>n</u>	alyze	Dis <u>p</u> lay	Design	<u>O</u> ptio	ons
	<u>N</u> ew Mo	odel				Ctrl+I	N	۾	€ € €	3	-d Pla (el\$ Cl
2	Open					Ctrl+(0	10-1	H % ■	. M	v. S	2 🖄
	<u>Save</u>					Ctrl+	s					
	Save <u>A</u> s						_ 1					
	Import						•	ET	AB <u>S</u> .e2k Te	ext File		
	<u>E</u> xport						•	ETA	ABS <u>6</u> Text F	ile		
	<u>C</u> reate \	/ideo					Þ	EŢ	ABS .edb Fi	le		
	Print Set	tup						DX	(F File of <u>A</u> r	chitectura	al Grid	
	Print Pre	view for	Graphics.					DX	(F <u>F</u> loor Pla	n		
9	Print Gra	aphics				Ctrl+	Ρ	DX	(F File of <u>3</u> D	Model		
	Print Ta	oles					•	IFC	.ifc File			
	Capture	Enhanc	ed <u>M</u> etafi	le				I <u>G</u> E	S .igs File			
	Capture	DXF File	•				•	<u>C</u> IS	3/2 .stp File.			
	Capture	Picture					•	Re	vit Structure	e .exr File		
	Modify/	Show Pr	oject <u>I</u> nfo	rmation.				Pro	Steel .mdb	File		
	<u>U</u> ser Co	mments	and Sessi	on Log				Fra	meworks <u>P</u>	lus .sfc Fil	e	
	Last Ana	alysis Ru	n Log					ST	RUDL/STA4	AD .gti/.st	<u>d</u> File	
	Display	Input/O	utput Text	<u>F</u> iles			_					
_	<u>D</u> elete A	Analysis I	Files									
	<u>1</u> D:\\d	curve wa	II-201710	28.EDB								
	<u>2</u> F:\E2K	\curve w	all-20171/	028.EDB								
	<u>3</u> D:\\r	evit to e	tabs case	1-20171	005.EDB							
	4 C:\Wir	ndows\	.\(Untitled).EDB								

Figure 5. ETABS import e2k file function

3. Numerical Application

In this paper we applied an 1F RC building and define the steel reinforce condition of beam column and independent foundation then we applied uniform load as Figure 5 shown.



Figure 6. 1F independent footing RC building Revit model

After the above process Revit models are imported into ETABS, the structural related parameters can be directly imported without the need for reinforcement and material setting. As Figure 8 we show the of parameter confirmation transform from Revit and the analysis results of deformation and moment of building as Figure 9 and Figure 10. So we can get the real reaction from RC reinforcement detail layout by Revit model.



Figure 7. BIM model import ETABS program results



Figure 8. Revit BIM material import to ETABS results



Figure 9. ETABS analysis deformation result



Figure 10. ETABS analysis moment result

4. Conclusions and Discussions

From this analysis we can found BIM Revit combined with ETABS analysis will provide structural detail analysis results, which will be helpful for the accuracy of structural analysis. So the designer can get the real behavior from Revit reinforce detail layout to avoid the gape from tradition simplified numerical model.

References

- [1] Paola Sanguinetti, Sherif Abdelmohsen, JaeMin Lee, JinKook Lee, Hugo Sheward, and Chuck Eastman ,(2012) General system architecture for BIM: An integrated approach for design and analysis. Advanced Engineering Informatics, 26; 317-333
- [2] Wang, Y., Zhang, J., Yan, G., (2013), "Study on BIM-Based Structural Working Drawing Design System", 30th CIB W78 International Conference - October 9-12, Beijing, China,

http://www.huzhenzhong.net/CIBW78Papers/html/files/5-1pdf/56.pdf.

- [3] Li Yuxi, (2016) Street Miles Square Introducing Revit Energy Analysis in Public Housing Design in Datong District, Taipei City. Master Thesis of Chaoyang University of Science and Technology and Urban Design Institute of Taiwan.
- [4] AutoDesk App store (2018), Revit reinforcement concrete BIM designer 2017<u>https://apps.autodesk.com/RVT/en/Detail/Index?id=5773808811674717142&appLang=</u> en&os=Win64&autostart=true