Role of Building Information Modeling (BIM) in Building Design Industry

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Abstract─**Due to unawareness and non-familiarity with technology among building design industries in Pakistan almost all draftsman are providing their architecture design in AutoCAD which have a lot of flaws. Structural Engineer are preparing structural models for design and analysis based on these drawings. After design draftsman will prepare detailing of design in AutoCAD which may have a lot of mistakes. Then further time are also required for preparing schedules and BOQ which may have possible errors. The Architecture Engineer and Construction(AEC)trades needs such techniques to drop project rate, delivery time and increase quality, efficiency and productivity. Building information modeling is a technique to achieve the above mention parameters. Using BIM technology an accurate model known as building information model is constructed in software which is used for planning, designing and construction of the facility. As BIM create 3D model so this model will then help engineers, architect and constructors to visually observe and built this model in a simulated environment. In this paper BIM tools Revit and Robot are used for design and analysis. Four Storey commercial building design is selected for study. 3D Building information modeling (BIM) model is shaped by Revit then it is pass on to Robot structural analysis professional software for analysis and design. This building is also analyzed and designed in ETABS 9.7.4 for cross check. Drawings and BOQ reports are created at the end.**

Index Terms ---BIM,3D-Modeling, Revit, Robot, ETAB, AEC

I. INTRODUCTION

BuildingInformation Modeling (BIM) is a set of relating strategies, methods and tools making a "policy to accomplish the necessary building plan and project facts in alpha numeric layout during the building's life-cycle". As a basic part in the project development, contractors play a main role in making guaranteed the project will be delivered on time and within the budget. BIM modernize the AEC agency, being not only a revolution among CAD and parametric modeling with 3-D abilities, but a variation of workflows, methods, practice, and associations. Fundamentally it changes the way trade is done throughout the industry. These modifications may appear too ample to be simply recognized by the industry, the paybacks are ample superior, making Building Information Modeling the prospect for the business.

Building Information Modeling (BIM) has lately accomplished well-known consideration in the AEC industry. BIM signifies the change and use of simulated n-Dimension models to put on t he formation, design, creation and task of a facility. It helps AEC to envision whatever is to be built in computer-generated setting and to recognize probable design, structure or operative problems.

Using Building Information Modeling (BIM) helps to characterize the method of improvement and use of a simulated model to put on the planning, design, construction and set-up of a capability as shown in Figure 1. The subsequent model, a BIM, is a data-rich, object oriented, intellectual and parametric ordinal illustration of the aptitude, from where the user can assess the suitable data, desires can be take out and examined to create info that can be helps to make the results and to develop the procedure of conveying the ability (AGC, 2005).

The major alteration stuck between BIM and 2-Dimension CAD is that the second defines a structure by self-determining 2-Dimension views such as plans, cross sections and elevations. If one of these views are edited than all other views should be examined and updated, an error-prone method that is one of the main reasons of bad documentation. Info in these 2-Dimensional drawings are graphical units only, such as semi-circle, lines, and circles, where effects are clear in terms of structural elements

such as walls, spaces, columns and beams a (CRC Construction Innovation, 2007).

A BIM illustrates the geometry, 3-D associations,
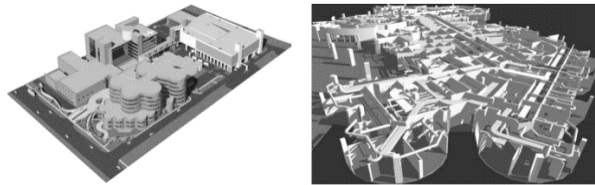
(a) 3D Architectural Model
(b) Integrated Structural and MEP Model

(c) Site Logistic Planning Mode(d) Quantity Estimates
Figure. 1 Different Modules of a BIM
(PCL Construction Services, Orlando, FL)

geographical data, magnitudes and possessions of building basics, rate estimations, solid records and project agenda. This model can be used to establish the whole building life cycle (Bazjanac, 2006). From the result, magnitudes and mutual assets of materials can be freely pull out. Opportunities of work can be simply insulated and well-defined. Classifications, assemblages, and arrangements can be shown in a kin scale with the whole facility or group of facilities. The structure documents like s ubmittal processes, procurement details, drawings and other terms can be simply organized (Khemlani et al., 2006).

II.   MODELING IN REVIT AND ROBOT

This method is totally based on software work. So first an accurate 3D model will be created in software before going to analysis and design. So for this 3D model was created using Revit software and exported this model to Robot structural analysis software for analysis and design. Also ETABS 9.7.4 was used for cross check.
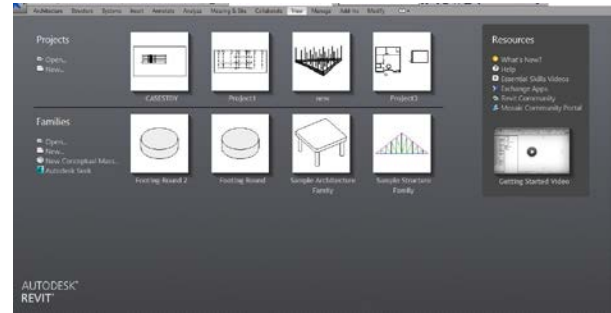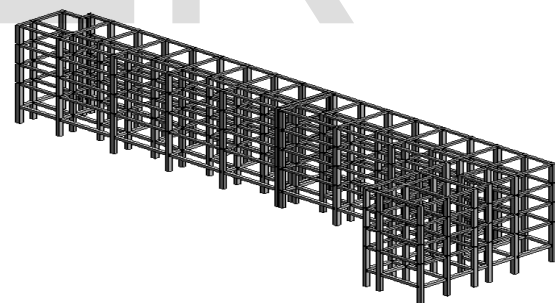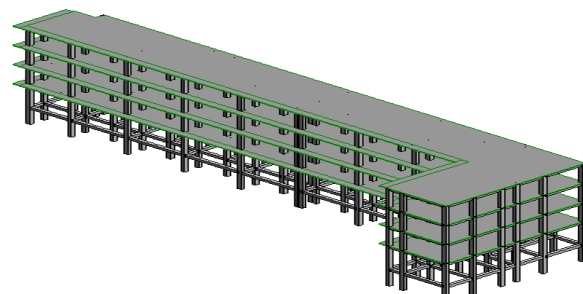

Figure.2 Project Menu
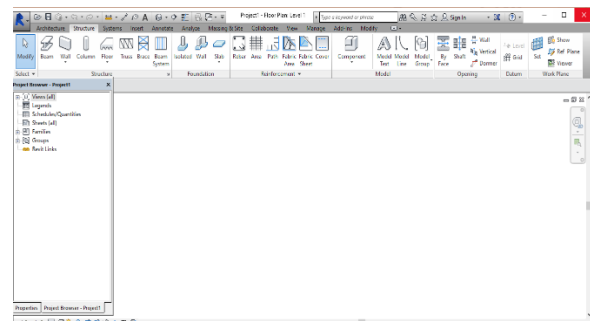
Figure.3Units, Grids and Levels Setting

After starting Revit open project menu to select our required model. After selecting the model the units, grids and levels should be set for further modeling as shown in figure.2 and 3.

Figure.4 3D frames (beams and columns)
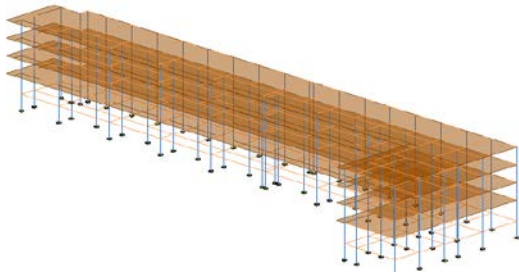

Figure.5 3D frames (beams, columns and slabs)

Figure.6 Analytical View

Simple steps were followed to create a 3D model in which beams, columns and slaps are shown in figure.4 and 5 and analytical view is also shown in figure.6.
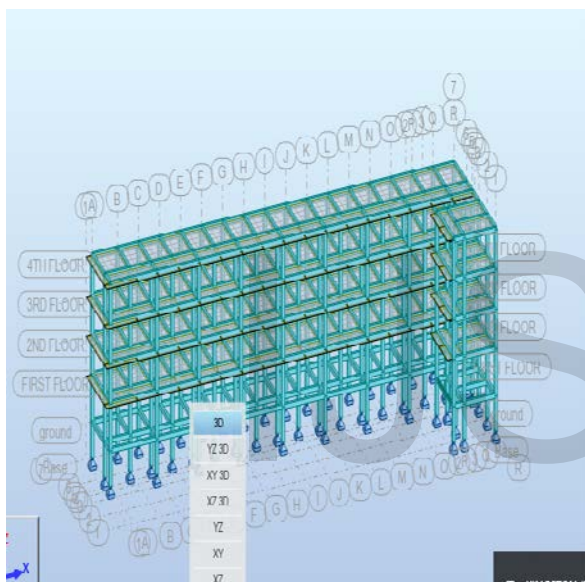

Figure.7 Model in Robot software

Now the model is ready to export to Robot structural analysis software for analysis and design. Minor mistake are noticed and are corrected. Model in Robot structural analysis software is shown in figure.7.
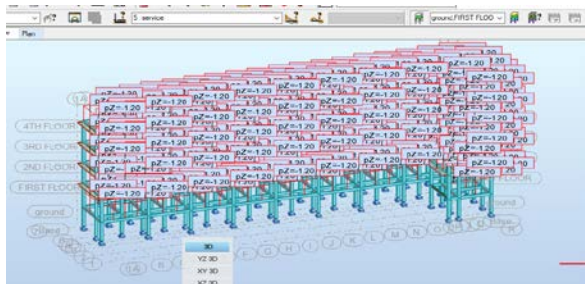

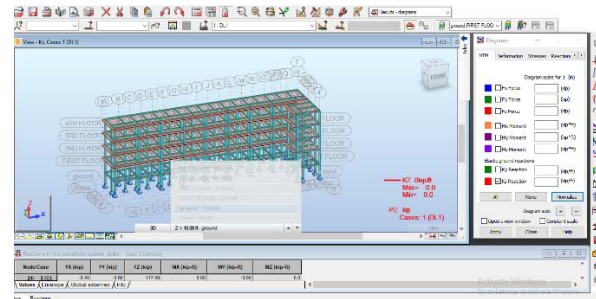**Figure.8 Analysis of structure Mesh**

Figure.9 Analyzing the Model

After exporting the model from Revit to Robot few steps were followed like material are defined in geometry tab and strengths are specified to each material. Also loads are defined in load tab. After defining each material mashed structure are created for exact analysis. Simply the structure is analyzed by clicking on calculation and results which will give the results as shown in figure 8 and 9 respectively.

III. MODELING IN ETABS 9.7.4

For cross checking and Comparison of Robot model, model in ETABS were also created.
The material properties used in the design of structural members are shown in the Table 1:

Material Properties			
1.	Material Description	Material Property	Remarks
2.	Concrete used in Reinforced Concrete Members	Compressive Strength = 3500 psi Modulus of Elasticity = 3368 ksi Poisson's ratio = 0.20	28-days compressive cylinder strength
3.	Reinforcement Steel used in Reinforced Concrete Members	Yield Strength = 60,000 psi Modulus of Elasticity = 29000 ksi Poisson's ratio = 0.30	Grade-60 deformed round bars conforming to ASTM A-615

Table 1: Material Properties

Load applied were consistent with the robot structural analysis model. For modeling beam and column line elements were used and shell elements were used for modeling slab and shear walls.

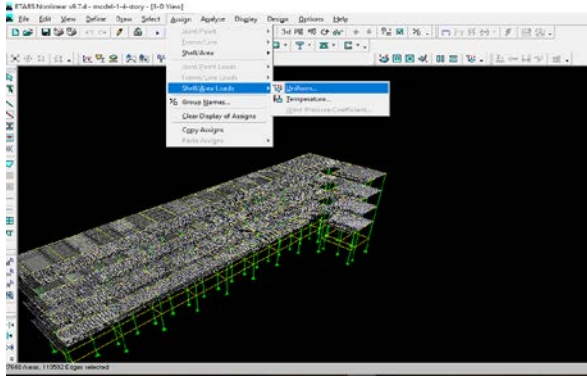The 3D modeling of building in Etab is shown in below figures.
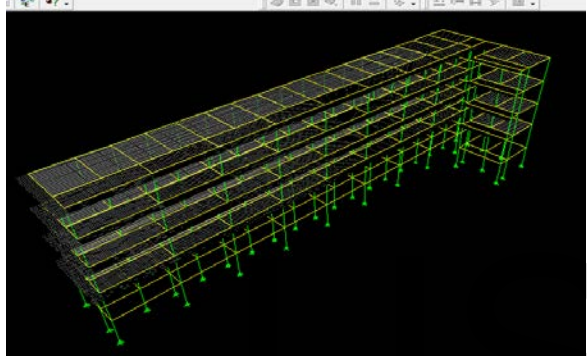

Figure.10 Assign Menu loads

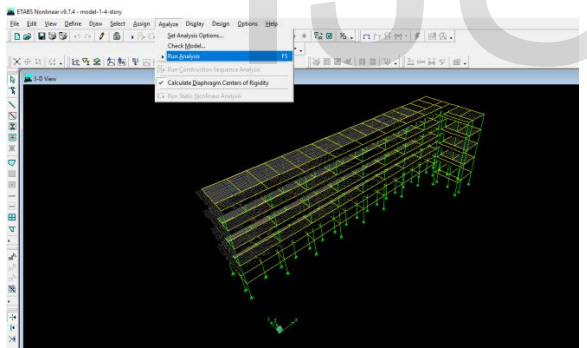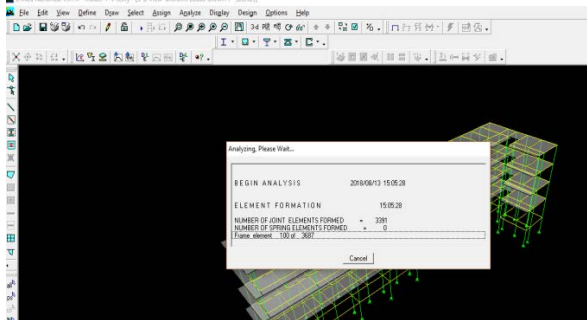**Figure.11 Meshed Structure**

Figure.12 analyzing of model

Figure.13analyzing process

After assigning all loads to each member the model is ready for analyzing which is shown in figure. 12 and 13

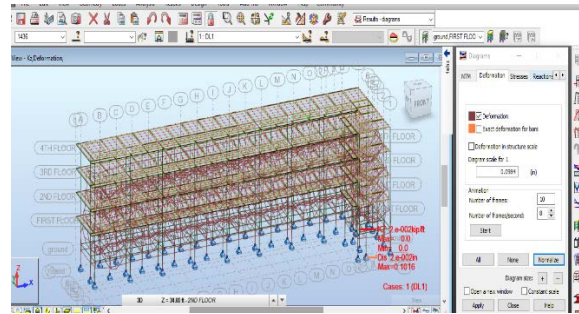## IV. RESULTS AND DISCUSSION
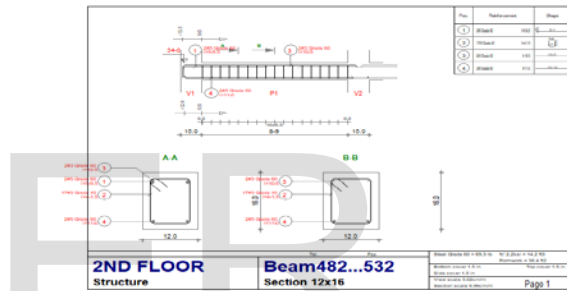### A. ROBOT RESULTS

Figure.14Deflected shape

7**Figure.15 Beam drawing**

Type	Number	Length (ft)	Unit weight (kip/ft)	Bar weight (kip)	Total weight (kip)	Painting area (ft2)
STEEL						
W 16x4	1	20.01	0.04	0.80	1	99.06
Total per						
W 16x4	1	20.01	0.04	0.80	1	99.06
Total					1	99.06
concrete						
B R12x	10	5.02	0.20	1.01	10	234.25
B R12x	50	6.53	0.20	1.31	65	1523.40
B R12x	5	7.78	0.20	1.56	8	181.43
B R12x	185	10.01	0.20	2.01	371	8639.00
B R12x	10	12.01	0.20	2.41	24	560.37
B R12x	105	15.03	0.20	3.01	316	7362.86
B R12x	39	20.01	0.20	4.01	156	3642.39
B R12x	5	22.01	0.20	4.41	22	513.67
C R15x	54	10.01	0.23	2.35	127	2701.77
C R15x	162	11.02	0.23	2.59	419	8929.13
C R15x	54	13.02	0.23	3.06	165	3516.73
Total per						
B R12x	409	4855.15	0.20	972.87	973	22657.37
C R15x	270	3029.53	0.23	711.39	711	15147.64
Total					1684	37805.01

Figure.16a Quantity report

Type	Number	Thickness (in)	Unit weight (kip/ft2)	Area (ft2)	Volume (ft3)	Total weight (kip)
concrete						
TH12	212	5.00	0.06	19180.00	7991.67	1201
Total				19180.00	7991.67	1201

Figure.16b Quantity report
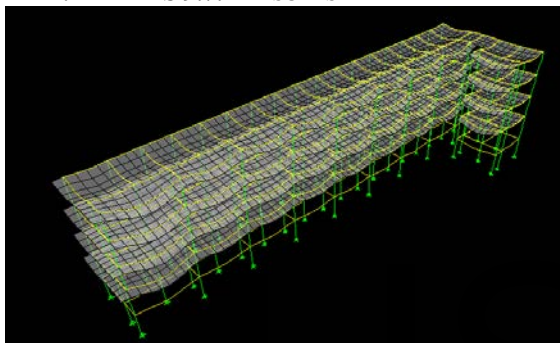
B. ETABS 9.7.4 RESULTS
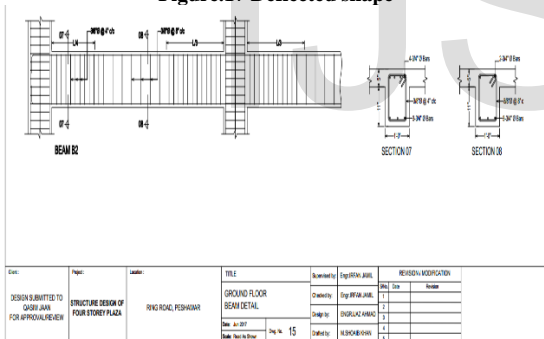

Figure.17 Deflected shape

Figure.18 Beam drawing (In AutoCAD)

V. DISCUSSION

As can be seen from the results, modeling in Robot is very advantageous as it gives all results in one go while in ETABS it requires a lot of work. Robot model after analyzing gives us a very comprehensive structural drawings which ultimately reduce time of construction on site as making drawings in AutoCAD takes a lot of time. Also modeling in REBOT is very simple and easy as compared to ETABS modeling.

VI. CONCLUSIONS AND RECOMMENDATIONS

Following has been concluded after detailed study

1. BIM, being an efficient method of modeling, is becoming crucial for modern age construction.
2. Building information modeling reduces the error and save time.
3. It stores all related data of the building in united, consistent and quickly reachable record.
4. The accessibility of the data facilitates the design analyses.
5. It reduces the chances of user mistakes caused by multiple data entries.
6. Robot as a BIM tool is a well-integrated package for civil engineers of every field.
7. The resulting drawings are fully integrated to the model and any change in the model would subject to change in the drawings.
8. It accurately estimates the bill of quantity and cost of the project. Well documented reports are also generated in Robot for the model.

Following additional research is recommended for future.

1. REBOT analysis results can be compared with other FEM software's to check its reliability.
2. It should be find out whether we can use REBOT for modeling piles and other soil-structure interaction problems.

VII. REFERENCES

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