



AUTODESK UNIVERSITY 2015

RC9940

Scan to BIM for Retrofitting Historical Buildings—Milan's Teatro Lirico Opera House Renovation

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Learning Objectives

- Discover the workflow between ReCap and Revit using point cloud
- Discover the potential of BIM for renovation of ancient buildings
- Discover the advantage of BIM for public project
- Discover the role of public government to support BIM adoption

Description

This session will describe the activity developed for the retrofitting of Teatro Lirico Opera House, a XIX sec. complex building located in the heart of Milan, Italy. For the building's particular shape and complexity, taking advantage of laser scanning, ReCap software, and Revit software was the key to delivering a model faithful to the original, for renovation activity, visualization, and facility management.

Your AU Experts

*Graduated in Civil Engineering with a Structural specialization, after a brief experience in industrial design, **Ilaria Lagazio** worked as Building System Development Manager in the field of building systems industrialization, managing the flow of information from the model of building components to the construction site.*

Her interest in construction site industrialization and the information management brought Ilaria to an experience in the UAE and, since 2008, to Autodesk, where she now holds the position of BIM Senior Technical Specialist.

*Graduated in Economy, after an experience in pre-sales and post-sales service delivery in IT companies, **Davide Rigoldi** joined Autodesk in 2006 covering a Sales position in GIS market in Italy.*

In that market he gained important experience managing public customer and problems that are typically related to Public Administration.

Thanks to the experience gained in past years with important customers in the infrastructure market, he is now responsible for Named Account customers in Utility and Construction

Discover the workflow between ReCap and Revit using point cloud

The workflow

In a traditional approach this is a kind of project that needs a never-ending reality capture work. Very often in areas of ancient heritage drafts coming from very ancient buildings are not available or extremely imprecise.

For the first time in Italy an ancient and famous Public Building renovation project has been approached in a different way.

Laser Scanning and Reality capture tools have been the winning strategy in order to obtain a correct capturing of the building.

This was only the first step of the workflow because the next passage needed to create a very detailed BIM model to be used in the following restoration activity and possibly for future maintenance operations.

Building state of art

The project we are speaking about is called "*Teatro Lirico Internazionale*" (*International Opera House*) and is located in the heart of Milano Historical Center, very close to *Dome* and *La Scala*. The history of the building is very old, starting from 1776, passing through different levels and stages of partial demolitions and renewals, changes in terms of shape and destination, due to different famous Architects activities following each other.

The different layers of history, together with the last partial demolition that happened in this century, left us a very complex situation to recover.

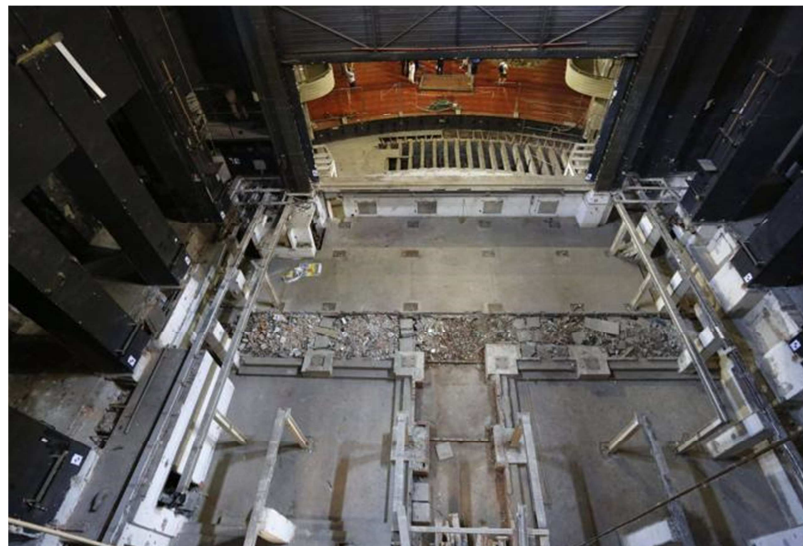


FIGURE 1: A PICTURE OF THE ACTUAL SITUATION



Project Data

The project total surface will be around 10000 SQM for a total of 1500 seats and will cost more than 16million euros.

Reality Capture activity

Scanning the whole building, inclusive of internal and external, took 7 working days and a total of around 6.5 billion points were collected under the shape of point clouds.

The point clouds were scanned with laser scanner Leica P20 by Leica Geosystems Italia, imported and registered through Cyclone, developed by Leica Geosystems and exported in PTG format.

Autodesk Recap was used to imported the PTG and create sets of RCP point clouds, ready for Revit input.



FIGURE 2: LASER SCANNING ACTIVITY

Modeling in Revit 2015

The complexity of the model requested a quite intensive Team Activity. The Team was made of technical people from the customer side and a BIM Manager (Autodesk Consulting).

The whole activity was conducted in Worksharing, with 4-5 people working together on the project.



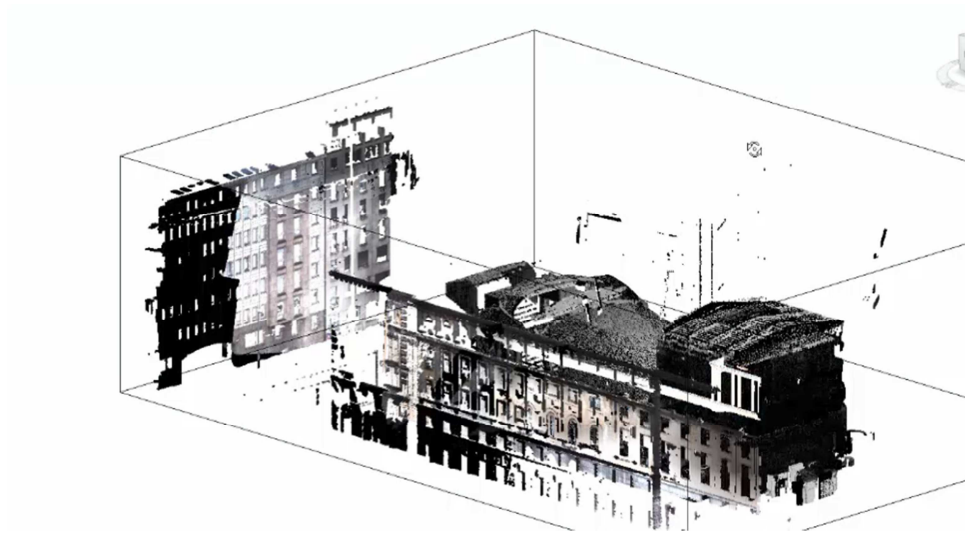


FIGURE 3: A SET OF CLOUD IN REVIT

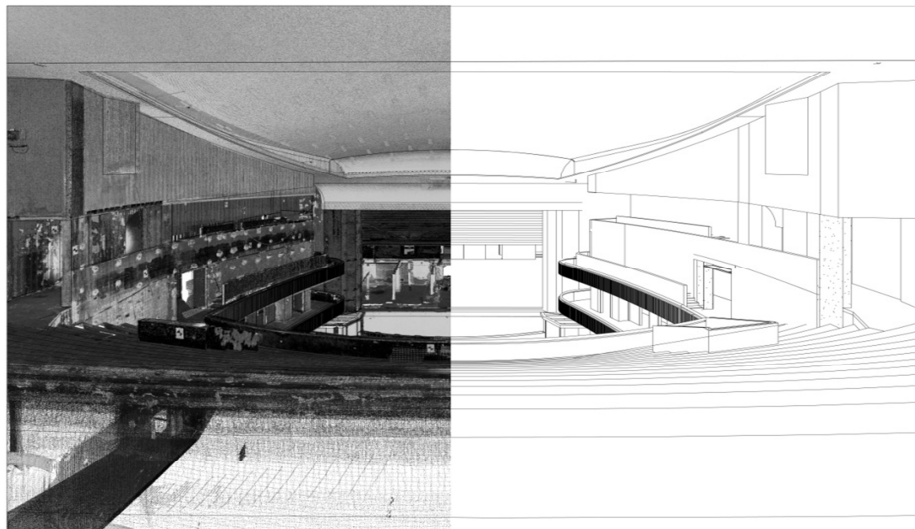


FIGURE 4: PERFECT OVERLAPPING OF POINT CLOUDS AND BIM MODEL

Due to irregular shapes it was very important to base modeling on the shape defined by point clouds, section by section.

In the end, the model could be analyzed and optimized, considering also the different project alternatives that the retrofitting activity offered



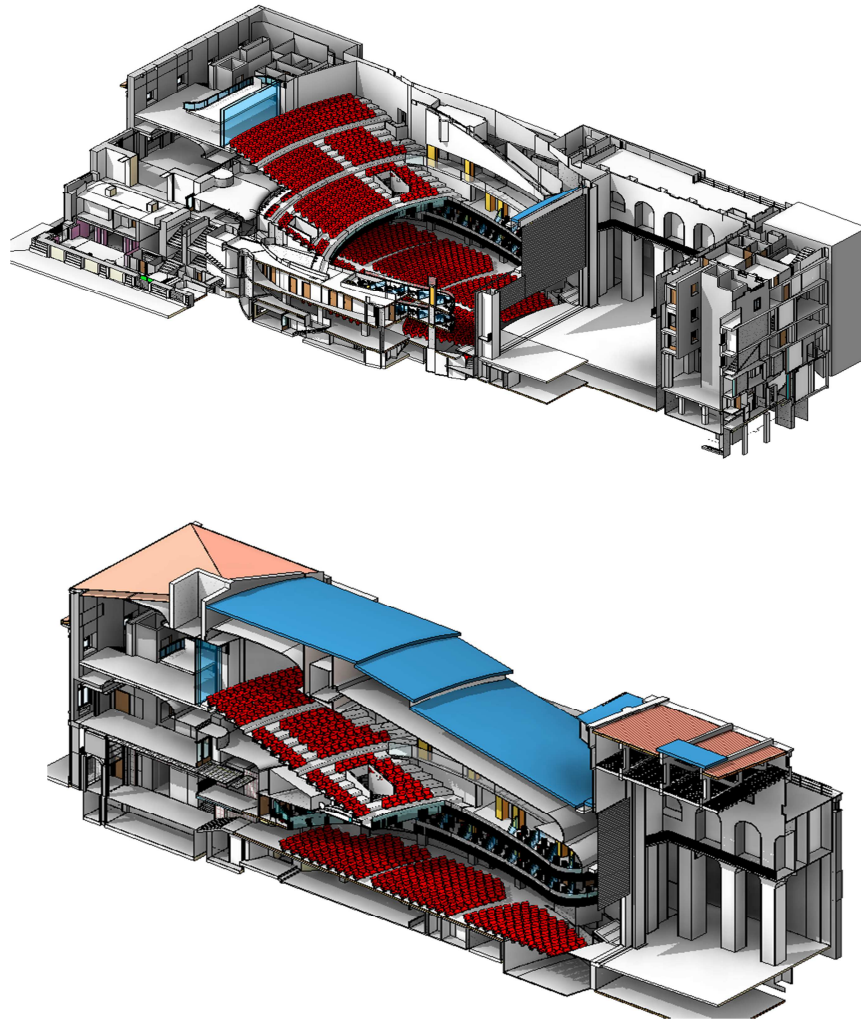


FIGURE 5-6: HANDLING THE MODEL COMPLEXITY



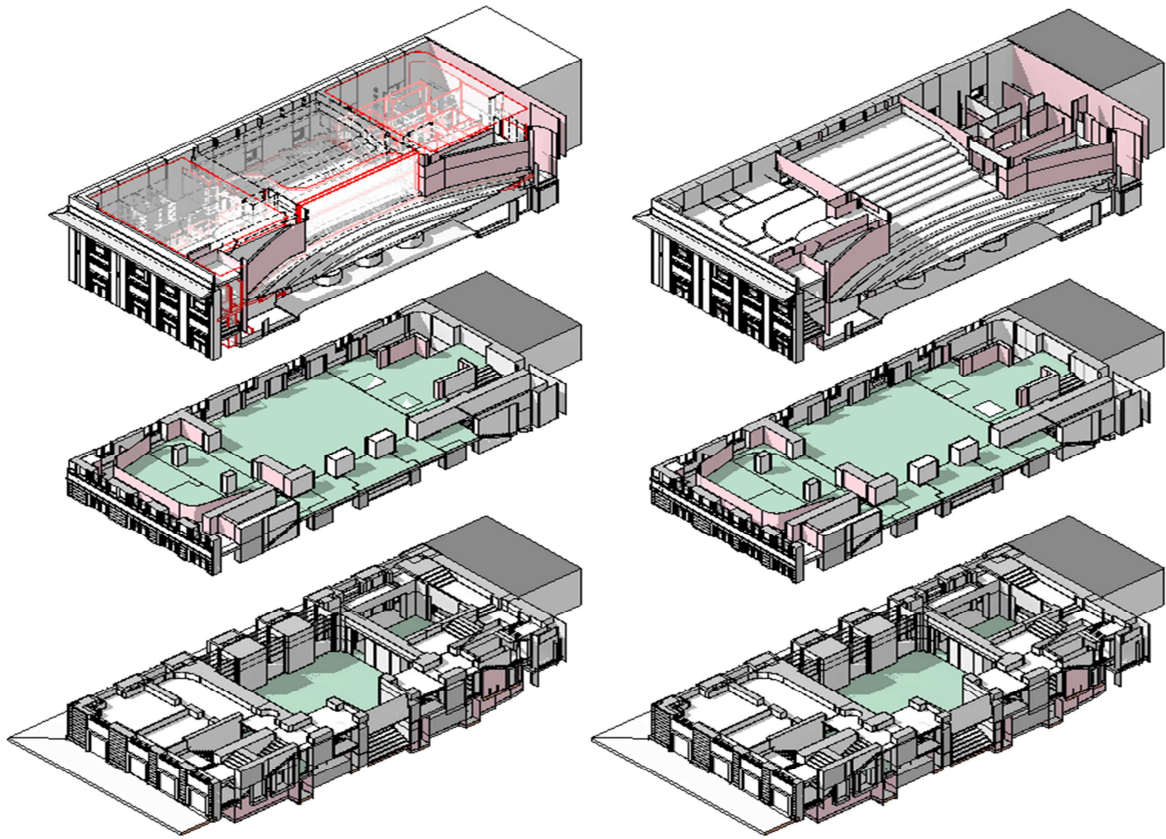


FIGURE 7: PROJECT ALTERNATIVES EVALUATION



Fotorealistic visualization

Considering the fact that Opera House is an important public building the aspects related to fotorealistic visualization have a big importance.

The possibility to import in Autodesk 3D Studio Max software directly the model coming from Revit was certainly very appreciated.



FIGURE 8-9: RENDERING WITH AUTODESK 3D STUDIO MAX



Discover the potential of BIM for renovation of ancient buildings

Precision of the model

Total registration of cloud were done in just 3 days and the tolerance of the point cloud model in Recap is less than 1 mm.

This result, which is extremely valuable itself, is even more interesting if we consider the complexity of the building.

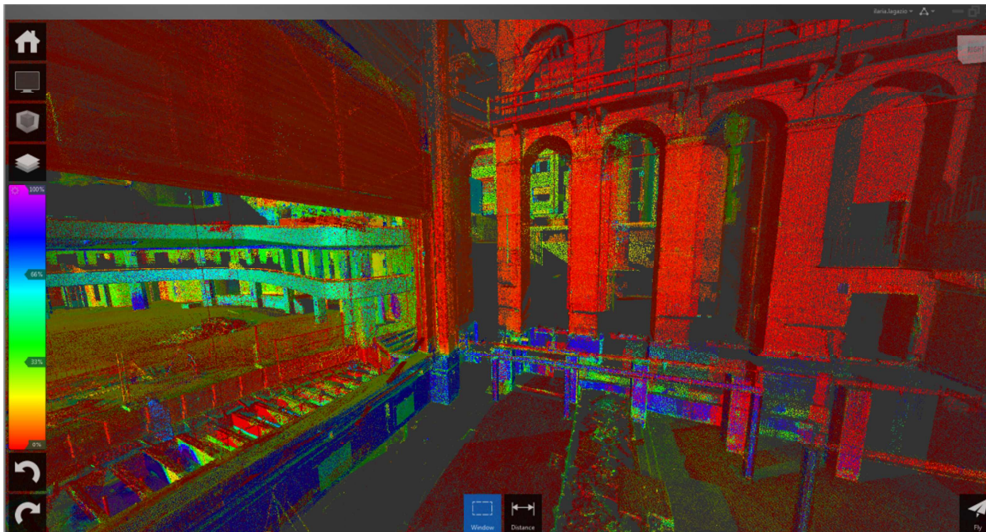


FIGURE 10: MODEL IN AUTODESK RECAP 2015

This aspect has for sure to be taken in consideration as the biggest advantage in ancient buildings, mainly considering that documentation available is old, or not available at all, and many untracked variation can have been occurred after construction in different ages.

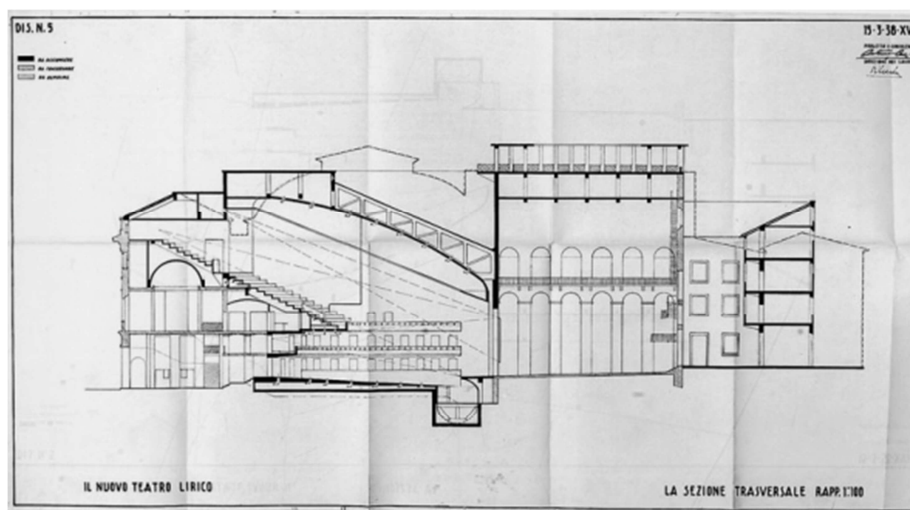


FIGURE 11: THE AVAILABLE DOCUMENTATION, DATED 1938



Discover the advantage of BIM for public project

Time control

Public big projects are always subject to time shifting date.

This is particularly true in case of big complexity, as the unknown is always something that every person involved is the project needs to take care of.

The possibility to control the project in every single part before it starts allows every contractor to have a clear idea about details, simulate work activities and take in consideration all alternatives.

Simulation is a great tool in order to take things under control.

Cost control

Together with time also cost is taken under control by the Owner.

Cost can be controlled directly, with the possibility to use Revit Schedules and Navisworks Quantity Take Off but it is also linked to the saving depending of time control, avoiding extra expenses due to delays and other implications.

Operation and Maintenance

The 3Dmodel will be very useful in the time in order to keep updated the information of the building in terms of Facility Management

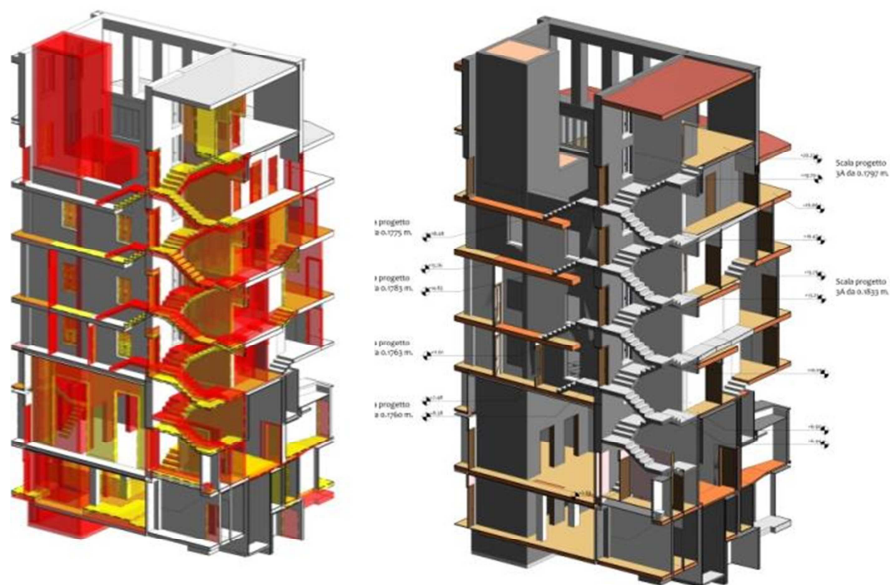


FIGURE 12: USE OF THE 3D MODEL TO CHECK LEVELS AND ANALYZE FIRE EVACUATION WAYS



Discover the role of public government to support BIM adoption

BIM adoption in Public activity

Just consider that BIM is not yet mandatory in this area and there is not a BIM Guide as a reference. The activity of Comune di Milano is for sure much more interesting than for the project itself.

This project had a good media impact and helped to open the road to a new trend in Italy. Today Italian regulations include BIM as a «preferred method», even if not mandatory yet.

In the following projects, also thanks to the experience generated by the “Opera House” activity, the Customer has started to ask to construction companies the BIM format “as built” for every single project they work on.

This is for sure the best result as it does not depend from a mandatory obligation but from the experience of a big advantage and return of investment.

Credits

- Images and Model Courtesy of “**Comune di Milano – Assessorato dei Lavori Pubblici e Arredo Urbano**”
- Special thanks to **Leica Geosystems Italia** for the scanning activity

