

AS125074

Enhanced Coordination and Change Management Using BIM 360 and Collaboration for Revit

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Learning Objectives

- Learn the key benefits of implementing Collaboration for Revit (C4R)
- Learn how BIM360 can be used for efficient change management and unique workflows
- Understand known limitations and workarounds and learn from others' experiences
- Get comfortable working in a cloud based environment and gain a basic understanding of IT requirements

Description

When a progressive health-care client challenged an integrated project delivery team to look for opportunities to enhance collaboration and meet stringent deadlines on a new hospital project in California, the team started investigating several options to enhance coordination among the different teams' model files. After reviewing the available alternatives, and after careful consideration, the team finally selected Collaboration for Revit cloud service. Collaboration for Revit exceeded the expectations of the team members who were not only co-located at a trailer, but were also dispersed in several offices—including overseas. The team was able to work efficiently without restrictions on firewalls, which also enabled for unique workflows between the design and construction teams. In this class, we'll go over this success story while reviewing the key features of Collaboration for Revit, the selection process, setup, tips/tricks, and known limitations. Additionally, we'll look at how BIM 360 software and Collaboration for Revit were used to enhance change management.

Speaker

Sri Vemuri is a Licensed Professional Engineer and works at HGA (an integrated Architectural, Engineering, and Planning firm) as their West Coast Region BIM Manager. In his role, he oversees AEC Technology implementation on several key projects across the country. He is constantly collaborating with cross-functional teams within and across firms in the AEC industry to research, ideate, test, and implement design technology and workflows. After receiving a Master's degree from University of Illinois at Urbana-Champaign, Sri has been working over the past 14 years in various capacities including as a Designer, Project Engineer, BIM Application Specialist, and a BIM Program Manager. During this time, he has worked on a wide variety of projects in Healthcare, Public/Corporate, Education, and Infrastructure projects. He has been actively involved with BIM technology since 2006 and is proficient in several Autodesk BIM tools/platforms including Revit, Navisworks, BIM 360, Collaboration for Revit (C4R).

Introduction

Collaboration for Revit (C4R) has been a tremendous value-add application for several project teams across our firm. In this class we will review how a particular project team in one of our California offices was able to deploy C4R and reap some of the benefits in the pursuit of meeting the project goals. We will also understand the criteria that the team used to make the selection, look at some of the key features of the application, and discuss some known issues and tips and tricks that are useful to be aware of.

Project Information

Unfortunately, due to NDA and the sensitive nature of the project, we are unable to share the name of the client, or the name/specific location of the project at the time of drafting this document. However, we are able to share some of the important project details that are relevant to this class. The project is located in Northern California and includes a new emergency department building and renovation of critical care facilities. This is an IPD project with focus on meeting some stringent goals that could have been achieved only if the team worked together as one collaborative entity.



Aerial Image of the Project

As mentioned in the class description, we had a very smart and sophisticated client team, which was great. They challenged the project team with rigorous and specific goals which included:

- Reducing the Construction Costs by 15% (compared to their prior similar projects); and
- Reducing the project schedule by 12 months

Faced with the above challenging goals, the Project Team immediately started identifying all the crucial areas where they could bring in efficiency that could undeniably impact and improve the project schedule and the bottom line cost.

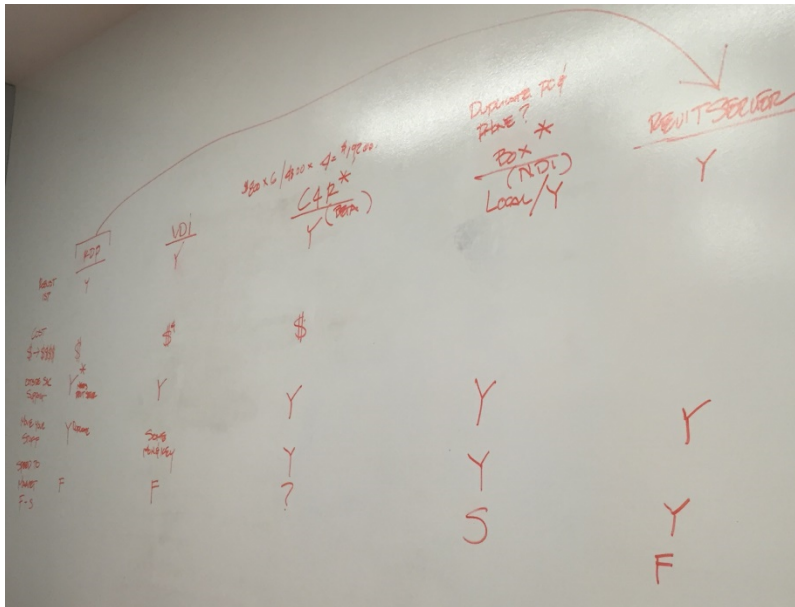
There were several other important strategies in achieving these goals that are not applicable to this presentation. For example: one of them was to schedule specific dates early on to meet with the permit approval agency (OSHPD in this case) and establish an automatic/consistent frequency of sharing information (uploading drawings, specs, calcs, etc.) with the agency. This

meant that the team had to meet those deadlines at any cost, failing which would risk the cost and schedule goals severely. Another strategy was to co-locate the team so that the design team could get input from the construction team early on in the process as well as for the design and construction teams to collectively solve issues quickly as they arose in the field during construction.

However, one of the main concerns that project team had heard from the peers that had worked on similar projects (within and outside of our firm) was that it was nearly impossible to efficiently perform the day-to-day work in the Revit models as well as seamlessly interact and exchange models with external firms without affecting the time and ultimately the project schedule especially given that the team couldn't afford to miss the deadlines with the agency. On top of that, the client had asked that HGA to lead the infrastructure setup process for all the teams since we were the first ones that had to dive into the project.

Criteria for Selection

The project team scheduled a couple of brainstorming sessions to review the available infrastructure options. The sessions included the Design Team Principal, Project Manager, IT Manager, BIM Manager, Design Coordinator to name a few.



Handwritten criteria matrix for Revit server selection. The matrix evaluates various options based on several criteria. The criteria are: Cost, Support, Equipment Relocation, Speed to Market, and Robustness of the tool. The options are: Local, Server, and Cloud. The matrix is as follows:

Criteria	Local	Server	Cloud
Cost	Y	Y	Y
Support	Y	Y	Y
Equipment Relocation	Y	Y	Y
Speed to Market	Y	Y	Y
Robustness of the tool	Y	Y	Y

Additional handwritten notes include: "360 x 6 / 400 = 400 x 1/200", "C4P*", "Y (100%)", "Disparate Revit Files?", "Box * (N/D)", "Local Y", and "REVIT SERVER Y".

Criteria for Selection

As shown in the image above, the criteria that were important to us included the following:

- Robustness of the tool
- Cost
- Support
- Equipment Relocation
- Speed to Market

Once we established the criteria, we then looked at the options available at our disposal. These included:

- RDP
- VDI
- Cloud Solution (C4R)
- Server/Box-on site
- Revit Server

These options are also listed at the top of the image shown previously. Once all the options were listed, all of us added our markups to the best of our understanding. Initially everyone chimed in with their best understanding of the different tools and past experiences. Later, the team substantiated their findings by researching and talking to different users, vendors, and obtaining specific metrics.

The clear winner was Collaboration for Revit. Interestingly, the “Cloud solution” as the team was calling it at that time was included only in the end since not many were unaware of this new alternative solution. When HGA’s BIM team was brought into this discussion only a week before the meeting, we proposed C4R as a potential option to consider. However, we also had some hesitation since the C4R was very new to the market and it was also not yet fully implemented on large scale projects.

Benefits

When comparing the alternatives, C4R came out on top since our primary goal was to make sure that the tool, when deployed, would not only exceed the current workflows of working in a shared Revit environment with minimal “support issues”, but also would give us a sense of true collaboration with teams outside of HGA. The project team was also impressed by the flexibility that C4R offered, i.e. the teams didn’t all have to be in one location since the Co-Lo trailer only had a limited number of desks available. As long as the users had access to the internet and a Revit license, they were able to access or work on the model. In their research, the biggest complaint that the team had heard from the other project teams was the constant lag when saving or updating a model when using tools like Revit Server or RDP. This project team desperately wanted to avoid the several minutes/hours wasted while waiting for a sync to happen or to upload changes. C4R worked exceptionally well and as a service lived up to the expectations.

When considering the speed to market, this was actually the only unknown to us and our IT staff when the question was posed. We weren’t 100% convinced that it would be as easy to set up as it was being advertised. However, we were surprised with the setup process ourselves. Granted, there was some training or understanding involved but once we went through setting up a couple users, all the other users were extremely quick and easy to set up.

As far as the C4R licenses, we had a total of 40 licenses for the entire project team that was working in a Revit environment. Of those, about 28 were being used by HGA which included Architectural and Structural teams. Some firms were still using the old approach of updating a Revit model in their office and uploading but those were for some minor studies and models that didn’t require any collaboration with other disciplines or teams.

IT Requirements

One of the benefits of using Collaboration of Revit is that there is very little IT/infrastructure set up required beyond the usual setup of the workstation and licensing assignments. That said, it would be prudent to make sure that some key IT requirements are considered carefully especially if you plan to work at a Co-Lo Trailer. Some of the major ones include:

- Internet Pipeline
- User workstation
 - hardware requirements
 - software requirements
- Firewall Set up
- Printers

Autodesk updates the minimum system requirements every year for its products. Below is the link for Revit 2018 products: <https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/sfdcarticles/sfdcarticles/System-requirements-for-Autodesk-Revit-2018-products.html>

If you'll scroll down to the Collaboration for Revit section, as shown in the image below, the two main requirements that you will come across are the Disk Space and the Connectivity.

Collaboration for Revit			
Disk Space	Three times (3X) the total disk space consumed by equivalent RVT files for all cloud workshared projects accessed by the user.		
	Minimum	Value	Performance
Connectivity	Internet connection able to deliver symmetrical 5 Mbps connection for each machine on burst transfers.	Internet connection able to deliver symmetrical 10 Mbps for each machine on burst transfers.	Internet connection able to deliver symmetrical 25 Mbps for each machine on burst transfers.

For our project, we provided 1 TB hard disk space on all our Revit users workstations with , and a 100 Mbps connectivity for the overall Co-Lo Trailer. So far this has been working great without any major hurdles even though if you look at the above requirements, it may appear that we were a little short of the needed specs for good performance.

A few other things as noted above were also provided including a branch office VPN tunnel from the firewall at the Co-Lo to the firewall in our office. This was primarily for users to access other (non-Revit) files on their respective project drives.

BIM 360 Team

BIM 360 Team is a separate but related service. When you are provided access to the C4R license, you are automatically granted access to the BIM 360 Team license. However, non-Revit users can also obtain just the BIM 360 Team license which provides access to the model that is published to the cloud. These users (typically Project Managers, Principals, etc.) can login to the BIM 360 Team project hub through any browser, and access the model or the corresponding sheets/views and are able to either review, comment, or simply download the published files.

The screenshot displays the BIM 360 Team Hub interface. At the top, there's a navigation bar with 'Team HGA' and a search icon. Below this, a 'DATA' dropdown is visible. The main area features a table of files and folders. To the right, a 'Details' panel shows project information and a list of 39 project members with their roles.

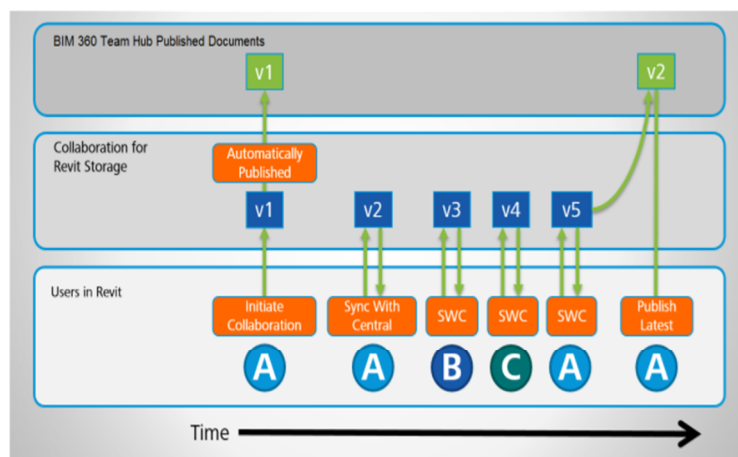
Name	Owner	Type	Size	Last Updated
Apps	Glen Sullivan	Folder		Oct 27, 2016
Architectural	Glen Sullivan	Folder		Jun 29, 2017
Electrical	Glen Sullivan	Folder		Oct 5, 2017
Mechanical & Plumbing	Glen Sullivan	Folder		Nov 3, 2016
Pneumatic Tube	Glen Sullivan	Folder		Jun 30, 2017
Shared Family Files	Glen Sullivan	Folder		Mar 16, 2017
Structural	Glen Sullivan	Folder		Oct 19, 2016
A1	Angela Falla	Cloud Revit m...	74.8 MB	Oct 12, 2017

PROJECT MEMBERS (39)

- HGA Management K.john... (Project Admin)
- Sri Vemuri (Project Admin)
- KURT JOHNSON (Editor)
- Glen Sullivan (Project Admin)
- May Chang (Editor)
- Dang Nguyen (Editor)
- Angela Falla

BIM 360 Team Hub

BIM 360 Team is Autodesk's cloud service that allows access to the published Revit models. However, it is important to note that the actual "real-time" working models are being stored on a separate cloud service which is hosted by Amazon (AWS). This takes a while for people to wrap their heads around, but is really not that hard once you go through the process.



BIM 360 Team (image credit: Autodesk)

As you can see in the above image, here are a few things that can help assist with understanding the difference:

- The BIM 360 Team Hub only stores documents that you deliberately publish. A new version is created each time you hit publish models in Revit (for example, the top row v1 and v2). This involves an additional step of selecting which views to publish although the 3D view is published to the team hub by default.
- The C4R models that are being worked on a real-time basis create different versions every time these models are being synced with central (for example, the second row with v1, v2, v3, etc.) A new version is created each time you hit Sync to Central in Revit.
- The very first time you create a model these two versions will be the same.

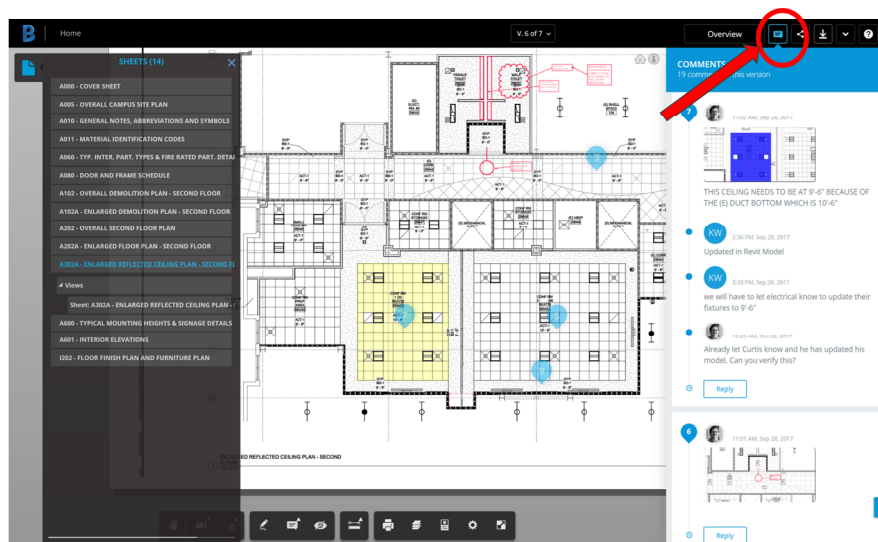
BIM 360 Team – Change Management

BIM 360 Team can be used to capture the changes in a very simplistic yet effective manner. To be honest, we didn't make as much use of this tool as we probably should have. BIM 360 Team provides a couple different options to keep track of and manage the changes that may happen during the project design and construction:

- Markups
- Compare Versions

Markups

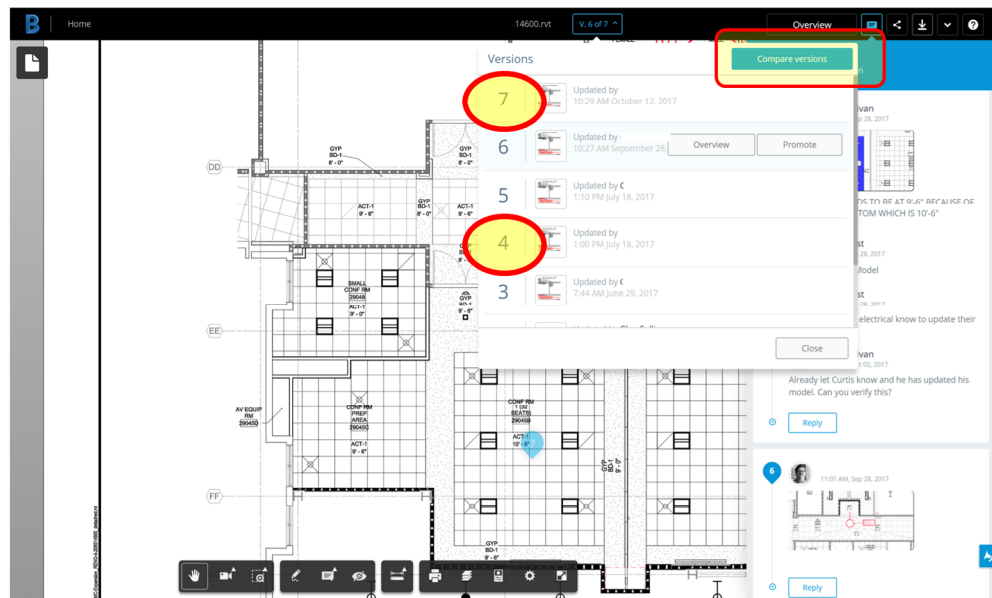
There are several markup tools available in the BIM 360 Team environment. As shown in the image below, you not only have the ability to add markups but also have the ability to comment and keep track of the comments and revisions made to specific areas or elements in the model. This is not only a simple tool to use but effective in keeping a trail of changes. Please note that this will definitely require the project team to think and adopt a slightly different approach to markups since the teams may traditionally be familiar with marking and commenting on PDFs or on paper. However, BIM 360 Team provides a more enhanced way of tracking and managing the markups and comments.



BIM 360 Team - Markups

Compare Versions

Another powerful hidden feature of BIM 360 Team is the Compare versions option. As seen in the image below, you are able to compare the different versions of a specific view, sheet or a model, and graphically visualize the specific items that are different. These changes are grouped into 3 categories and color coded which include “Added”, “Removed”, and “Modified”. You can also use the explode tool that will allow to isolate and identify the changes. This is another effective change management tool that can replace some of the existing workflows to enhance efficiency.



BIM 360 Team – Compare Versions



BIM 360 Team – Compare Versions

Feedback from the Team:

Since C4R was relatively new when we started implementing it, we made it a point to constantly solicit feedback from the project team throughout the duration of the project at least for the first few months. We wanted to make sure that the decision of moving forward with C4R was indeed paying off and was working as expected.

We were extremely happy to learn that the team project team stayed ahead of the proposed schedule and beat all of the increment submittal deadlines. The most recent one by one whole month!

Not surprisingly, the feedback from the team was extremely positive. The Project Manager viewed this as a great success not only because we are on target to achieving the goals but he also mentioned that this allowed the team an opportunity to innovate on other items. In the following sections we will review some limitations and suggestions to improve the implementation process.

Known Limitations and Resolutions

Below are some of the known issues that we have come across during the implementation of C4R on this project and also corresponding resolutions. We don't consider any of them as critical or negative but just items that are good to be aware of, to make your implementation that much more seamless. Please note that we are still using Revit 2016 on this project. Both C4R as well as Revit have only been getting better with each version.

- Service Outages – The main concern about using an external cloud based service is that these services require maintenance and you may experience some service outages. That said, this project Team experienced only 1 MAJOR outage that affected production time – 4 hours in more than 1.5 years since the implementation.
- Linking non-Revit files – as the name suggests, C4R is a service for Revit so you don't have the ability to link non-Revit files through the C4R. However, there are several different options that one can work around this issue. See the link below for more information: <https://knowledge.autodesk.com/support/revit-products/troubleshooting/caas/sfdcarticles/sfdcarticles/C4R-Non-Revit-file-link-with-Collaboration-for-Revit.html>
- User Access – This was a little bit of a concern initially. All the users had write access. However, for a collaborative IPD Team, this is not much of an issue. Also C4R has the ability to “force” relinquishment.
- The “local files” are automatically saved to a hidden location on the C drive. This is not a big issue unless you don't have enough capacity on your C drives. As mentioned earlier, one of the system requirements is to have enough hard drive space.
- Local cache file corruption – This was the most common issue faced by the team and all it required was to manually clearing the local cache.
- When opening files from Revit, one can't sort or check the file size or the last saved date. Not a huge issue in most cases.
- When opening files from Revit, all the project files are displayed in one location, even though they are all organized into separate folders in the BIM 360 Team hub.

- Can't detach from Central from within Revit. You will have to download separately and detach a file that is on BIM 360. However, you need to make sure to publish before downloading from the hub if you are trying to open a detached version of the latest file.
- No ability to link IFC files.
- Replacing or Renaming Files can be tricky especially if the files/models are linked into one another. Make sure to plan naming of the files well in advance and try to stick to the naming through the end of the project.
- Inserting Views from File that is on BIM360 is not available. This is similar to the Revit Server workflow.
- Backup files – In case of corruption or other similar issue, we can only roll back to a certain backup file, so active archiving required. Additionally, only models that are published can be rolled back to.
- Sometimes there may be corruptions because of unknown add-ins. Make sure to run it by a BIM Manager or a BIM Lead before installing applications.
- Users that didn't access the model in a long time (2 months) had to clear local cache before restarting their work. This should be instituted as a best practice anyway.
- BIM 360 Team converts all fonts to Arial. We used Arial Narrow for our annotations in Revit and sometimes this was an issue when viewing the sheets in BIM 360 Team hub.
- Time to open the file the first time – takes lot longer to open files for the first time since the cache is being created. But the successive opening times are significantly faster.

Tips/Tricks and Recommendations:

In addition to the above mentioned resolutions, below are some of the tips and tricks that we wanted to share. These are in no particular order, so make sure to review all the items and use as needed:

- Understand the true benefits and limitations and set the right expectations.
- Institute consistent publishing of the models to the team hub.
- Document C4R workflows in the BIM Execution Plan.
- Early education and Training really helps get everyone up to speed.
- Local Cache – this may not be very obvious but the “local file” is saved in a hidden location which is: `%LOCALAPPDATA%\Autodesk\Revit\Autodesk Revit 20XX\CollaborationCache`
- Mouse zoom direction – In the BIM360 Team hub environment, the default mouse zoom direction is the opposite of the Revit environment. This can be easily adjusted in the settings of the BIM 360 Team.
- Including software version in the file naming really helps.
- Licenses – Our recommendation is to have a dedicated C4R licensed assigned for your in house BIM support team member.
- Just to reiterate, the files on BIM360 Team are not the same as that in C4R (except the very first time the model is uploaded). Understand the difference early on.
- Publishing a model to the cloud will publish all sheets and the default 3d view by default. Make sure to select only the sheets you would like the rest of the team to see before publishing.
- Live Review – This is something we didn't share earlier, but there is a very quick way to your screen using the Live Review option in the BIM 360 Team environment – as long as

there is access to internet, you can simply send a hyperlink and have your project team members access your screen, even via a smart phone or tablet

- Communicator – may be used more often – may be because of Skype and Co-Lo
- Interoperability – getting comfortable in the BIM 360 environment helped our users to efficiently use BIM 360 Glue that the Construction Team was using for their coordination.
- Model access issues – some model access issues were resolved by logging out and logging back in to A360
- Downloading Files – when downloading files from the hub, all the linked Revit files also download with the file.
- Everyone in the team needs to be on the same version of collaboration – Our Team used Revit 2016 and v7 of C4R
- Identify tools that work for specific needs – BIM 360 Team, C4R in combination with BIM 360 Glue

Collaborative Spirit

In conclusion, C4R was an extremely successful solution for this project. We attribute this to careful planning, identifying the criteria early on, setting the right expectations, providing the necessary training, understanding current workflows, and last but not least, fostering a collaborative spirit. Once these aspects are taken into consideration, any team can truly reap the benefits that C4R and other related tools have to offer.

We not only had a great BIM kickoff meeting, coordination meetings, and training sessions, but also continue to have on-going team building events. Below are some of the images taken during some of these meetings and events. Hope you enjoy the process as much as we did. Good luck with your implementation!



Resources:

- <https://knowledge.autodesk.com/support/a360/troubleshooting/caas/sfdcarticles/sfdcarticles/A360-Team-Downloading-Revit-file-includes-host-and-linked-files.html>
- Revit Ideas - <https://forums.autodesk.com/t5/revit-ideas/idb-p/302/tab/most-recent>
- <https://www.autodesk.com/products/collaboration-for-revit/overview>
- <https://forums.autodesk.com/t5/revit-collaboration-forum/bd-p/163>