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Automatic BIM Standards Checking in BIM360

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Learning Objectives

Learning Objective 1: Identify Innovative workflow for Automatic BIM standard checking in BIM360

Learning Objective 2: Visualize how BIM standards can be checked through a set of Computer programs instead of manual checking

Learning Objective 3: Enable better collaboration across disciplines and roles; including design professionals, MEP engineers, and others

Learning Objective 4: Describe best practices in BIM Standard

Description

A valuable class for BIM Designers & Managers, Project Managers, and the likes who design the building & ensure it's designed as per BIM building standards to automate the process of this checking and reduce manual dependency as well as time.

Speaker

Varun Bhartiya, CEO, and Co-founder at nCircle Tech.

Varun established this company to enable passionate innovators in the AEC and Manufacturing industry to create impactful 3D engineering & construction solutions. Leveraging nCircle's domain expertise in CAD-BIM, the organization provides solutions that reduce time to market and meet business goals. Each of the company's CAD and BIM Software solutions is meant to provide you ease, convenience, time and cost-saving so that you can focus on things that matter more.

Audience Definition: BIM Designers and BIM Managers

Audience Description: BIM Designers & Managers who need to design the building & ensure it's designed as per BIM building standards

Audience Occupations: Architect, BIM/VDC Manager, Building Owner, Construction Manager, Design Engineer

The Story Behind BIM Standards Checking

Every company has BIM Standards defined for their workflows. However, it is a very very tedious process to ensure that these standards are correctly followed in the organization. Manual checking is also error-prone. When the timelines are very tight, BIM Standards Checking is the first process that breaks and eventually shrinks to only the most important rules while many other rules are ignored. However, it is integral to perform these checks.

Why Should BIM Standards Be Checked

We all know why Model checks, BIM standards checks, and Code compliance checks are important.

Common benefits are:

- **Reduce the iteration time**
When the standards are checked and complied with, it ensures that unnecessary iterations are avoided. It also means that the designer attempts to design adhering to the standards.
- **Reduce rework**
Since the model design is checked at every level itself, it implies that the teams who build further on the design like the MEPs, etc, develop further over the design on the correct one. Since there are dependencies, if the design is corrected at every level, the rework of other dependants is avoided.
- **Better collaboration**
All the teams right from the designs to MEPs, HVACs, General Contractors, and others collaborate as well as work to develop and further build on the standards checked design.
- **More money in your pockets**
The costs of rework on a construction site surmount to millions of dollars. When this money is saved since rework has been moderated, imagine the money you will save and add to your revenue and profits!

The BIG Challenge

Despite these huge benefits, you all struggle with the problem of *“How do I implement these in my company?”*

It is an impending overhead and people don't like this work. Especially when the timelines are tight, this is the first process to break – most fragile and susceptible.

Thoughts of the Change Maker

What if these checks happened automatically?

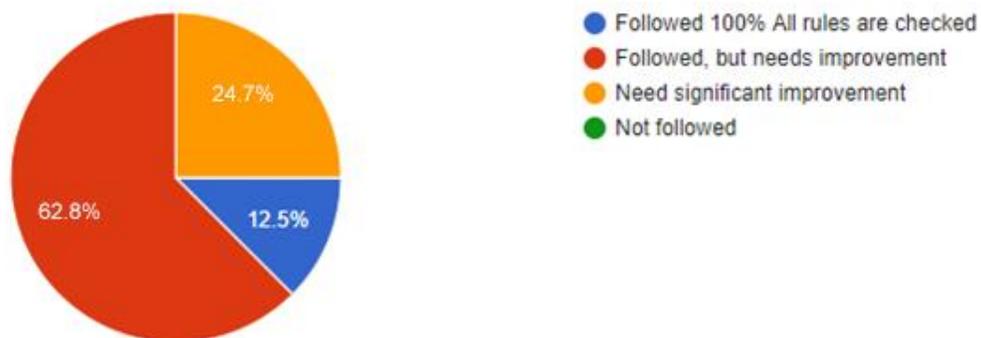
What if you don't ask people to do anything extra?

How can you make the team realize the benefit without any overhead?

Observations from Industry Veterans

We will learn this in 4 parts, broken down into 4 learning objectives to help you get a good headstart on understanding and implementing the tool and technology. Before we move to that, let's look at some data we gathered from a survey we conducted asking professionals to share their practices and observations on the following questions.

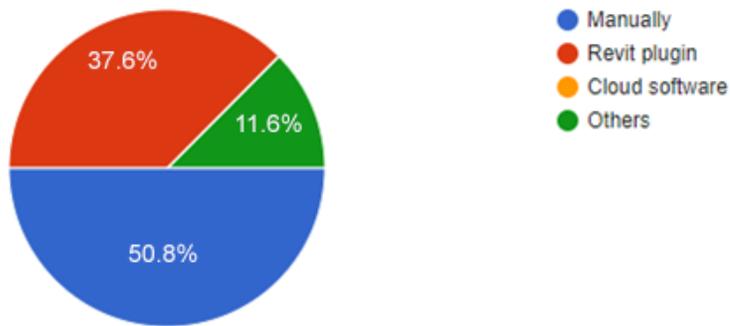
To what extent are BIM Standards being followed and implemented in your projects?



Overall 87.5% of people think that it needs improvement.

Within this, interestingly, about 25% of people said that it needs significant improvement.

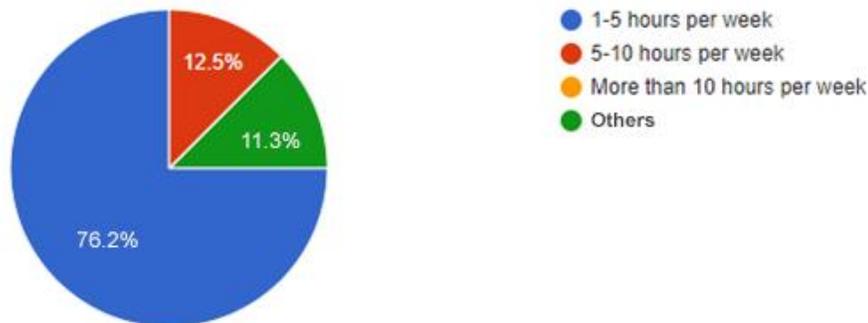
How are you checking these standards currently?



About 51% of the checking is still being done manually. How awful is that?

This leaves a lot of room for error and makes it a very tedious process to implement.

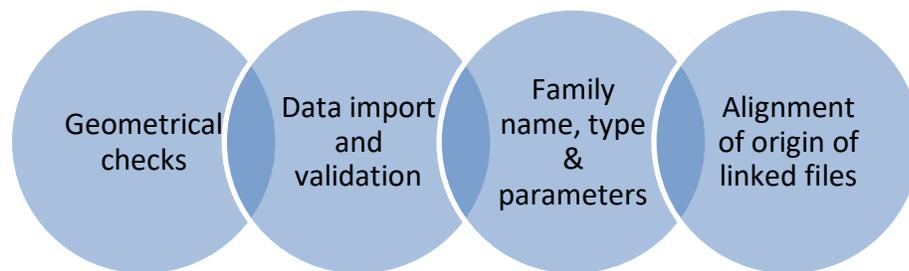
How much time is spent on an average on BIM Standards Checking by a company?



76% of people are spending 1-5 hours per week on model rule checking.

On average, if we consider 2.5 hours per week, 10 hours per month, If we can save it, do you realize that means 15 additional holidays every year!

Which are some of the most time-consuming checks that while checking BIM standards?



The BIG Idea

In software development, there is something called CI (Continuous Integration) and CD (Continuous Development). What these processes follow is that as soon as any line of code is changed, there are a series of checks that run on the entire application, to check for any regressions, code quality, unit test, integration test, etc. This mechanism enables even 1000s of software developers to work on the same development simultaneously.

I thought, why can't we apply the same concept in construction designing!

Great innovations happen when you take ideas from one domain and apply it creatively in another domain!

We have done just this.

What We Did

Learning Objective 1: Discovering innovative workflows for automatic BIM standard checking in BIM360

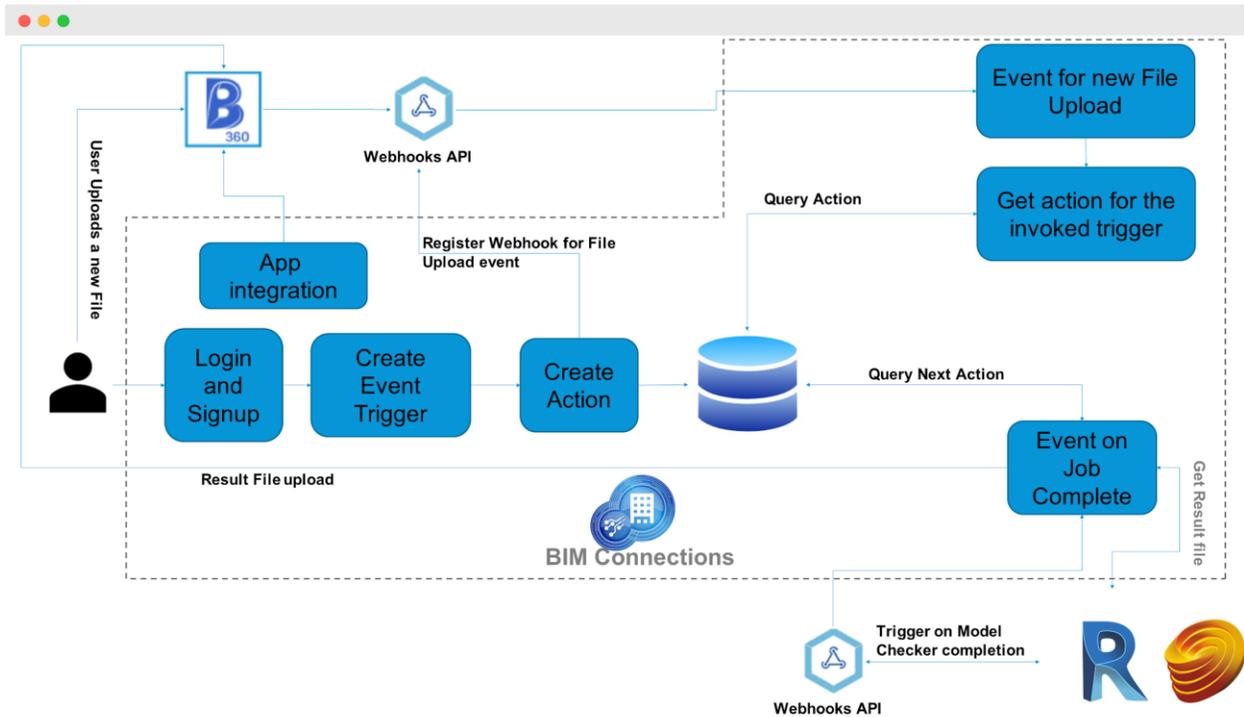
We have automated the process of checking BIM standards in the building design within BIM360 software.

This solution enables you to perform automatic rule checks in the building design each time the building design file is either uploaded or modified in BIM360. Once the checks are done, a summary of the check results is automatically sent over the email.

You can also open the file in Forge viewer to check the issues.

The Architecture

The below diagram is a workflow that explains the entire working of this system.



- We create a user when you Login into BIM360
- We created an App in BIM360 which will help us monitor any activity here; after a Login or Sign Up
- Once done, you Create an Event Trigger here. This means any file uploaded in BIM360
- Simultaneously, you also Create an Action which you would like to take when the above-chosen event is triggered
- A Webhook is registered for the file upload event to help us identify that when this particular event is triggered, a certain action is expected to be performed
- On the other hand, our program is also configured to continuously monitor all the jobs in the cue 'Query next Action' and take action 'Event on Job Complete' whenever the server is free. This is cyclic. Once one action's trigger is performed; it will fetch the next trigger and produce the output on its action
- Here, our results are reproduced on a Forge server. All our files are sent to the Forge server for checking. Once the job here is complete, with the help of Webhooks, the prompt of 'Event on Job Complete' is administered through the code

- As soon as the job here is complete, the result file is uploaded back into BIM360
- All these automation right from the Upload of a File to creating an Event for File Upload, followed by its set Trigger-based Action; further allowing Query Action and giving results from Forge back into BIM360 happens on our platform BIM Connections

So all in all you are expected to perform 3 primary steps:

- ✓ Login / Sign Up on BIM Connections
- ✓ Create Event Trigger
- ✓ Create Action

And then watch the magic unfold in your inbox as an email alert.

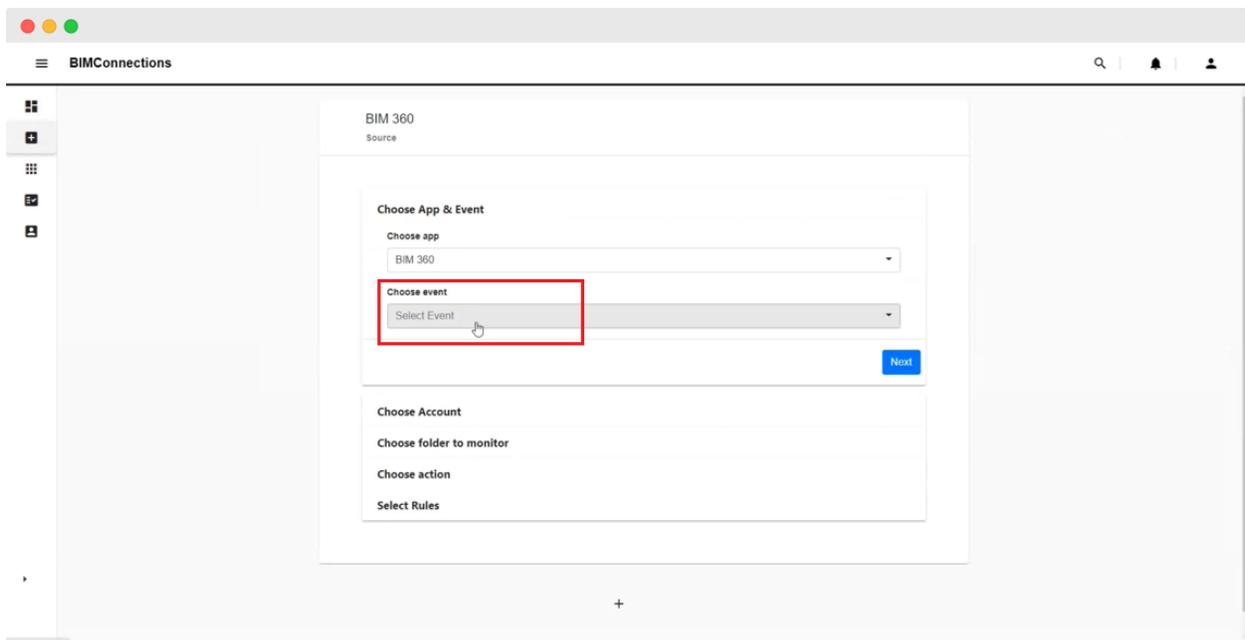
Watch the Class video for an extensive understanding of this workflow.

Learning Objective 2: Visualize how BIM standards can be checked through a set of Computer programs instead of manual checking

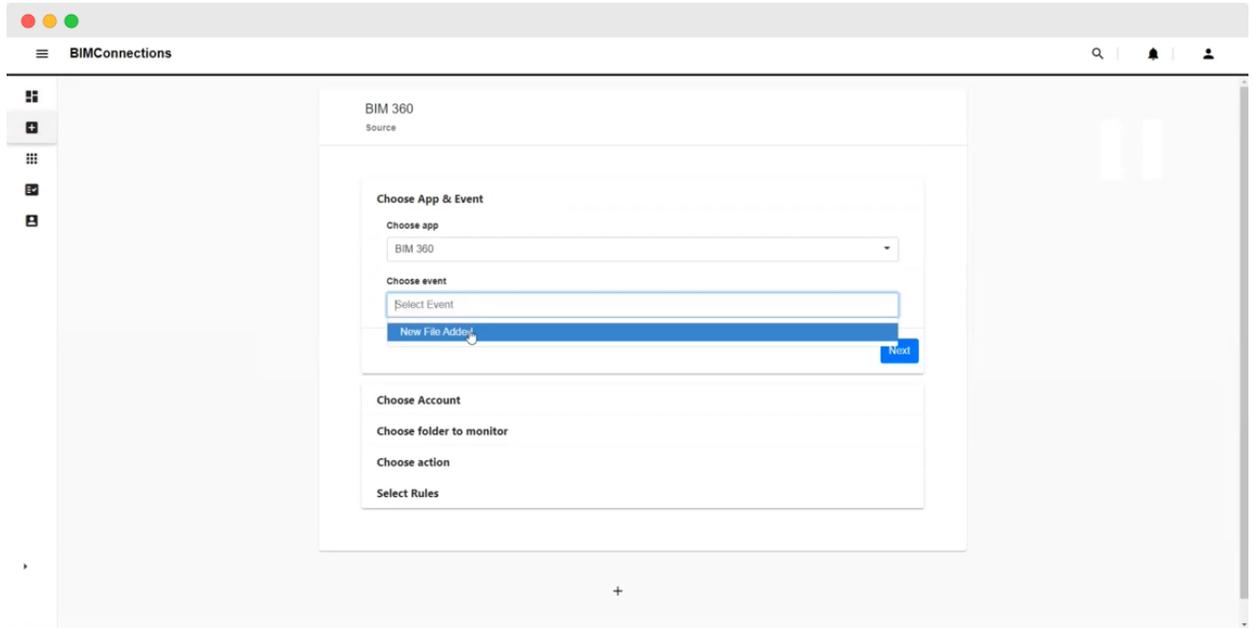
The Virtual Tour

Now that you have understood the working at the backend, let's look at the user workflow step by step

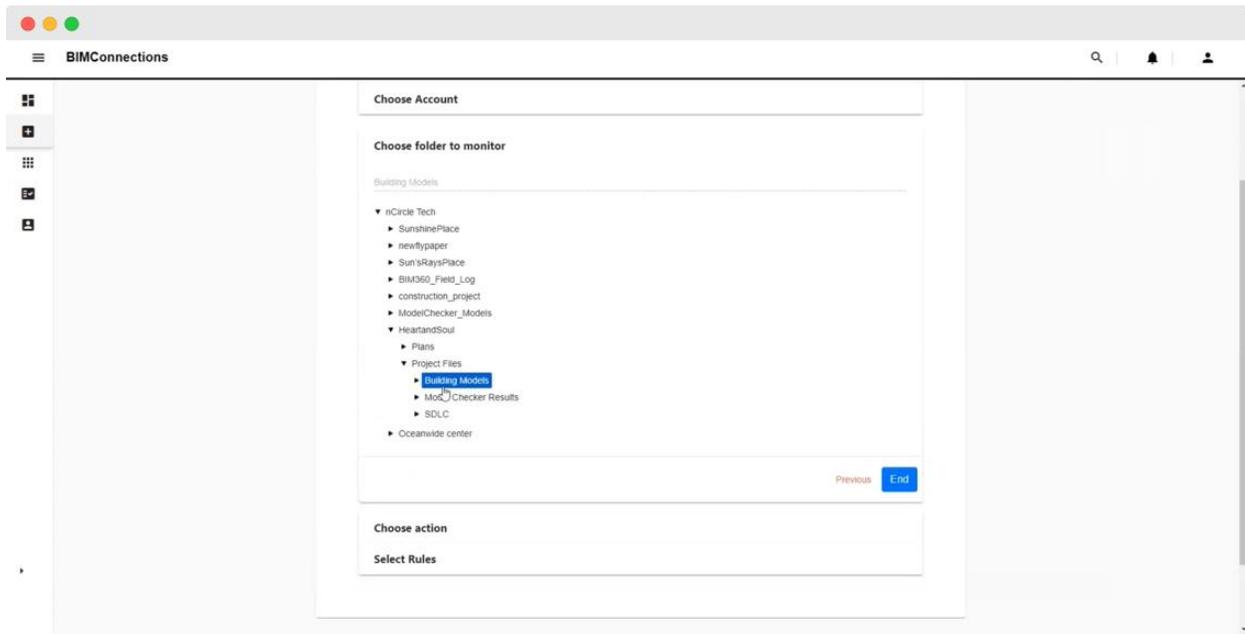
1. The user will log in to the BIM Connections platform and choose the *App* from where the Event Trigger is to be captured. In this case, it is *BIM360*.



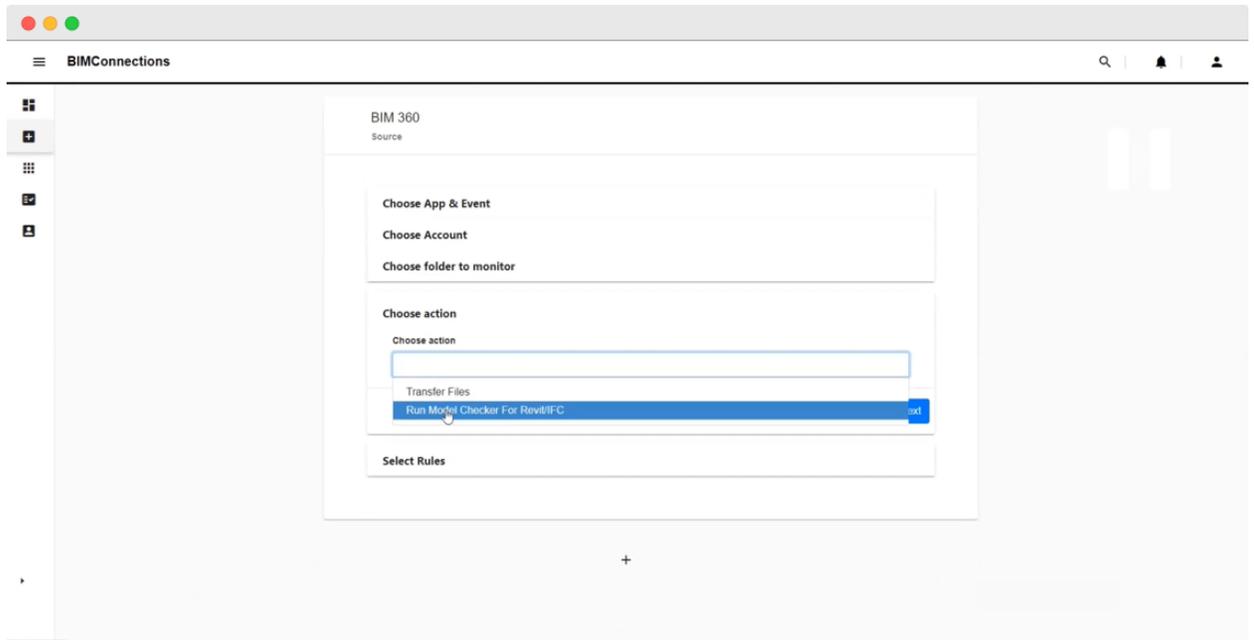
2. Now choose the Event trigger that you would like to perform. We choose *New File Added*



3. Under *Choose Account* you must provide your regular credentials where you would like BIM360 to be configured. All of this is well protected with BIM 360 defined protocols, so your data is very secure.
4. Next, we *Choose a Folder to Monitor*. We have chosen the Building Model folder here. This implies that the system will constantly monitor the folder 'Building Model' for the action 'New File Uploaded'.



5. Moving on, we *Choose specific Actions* to be performed. In this case, we are choosing *Run Model Checker for Revit and IFC files*

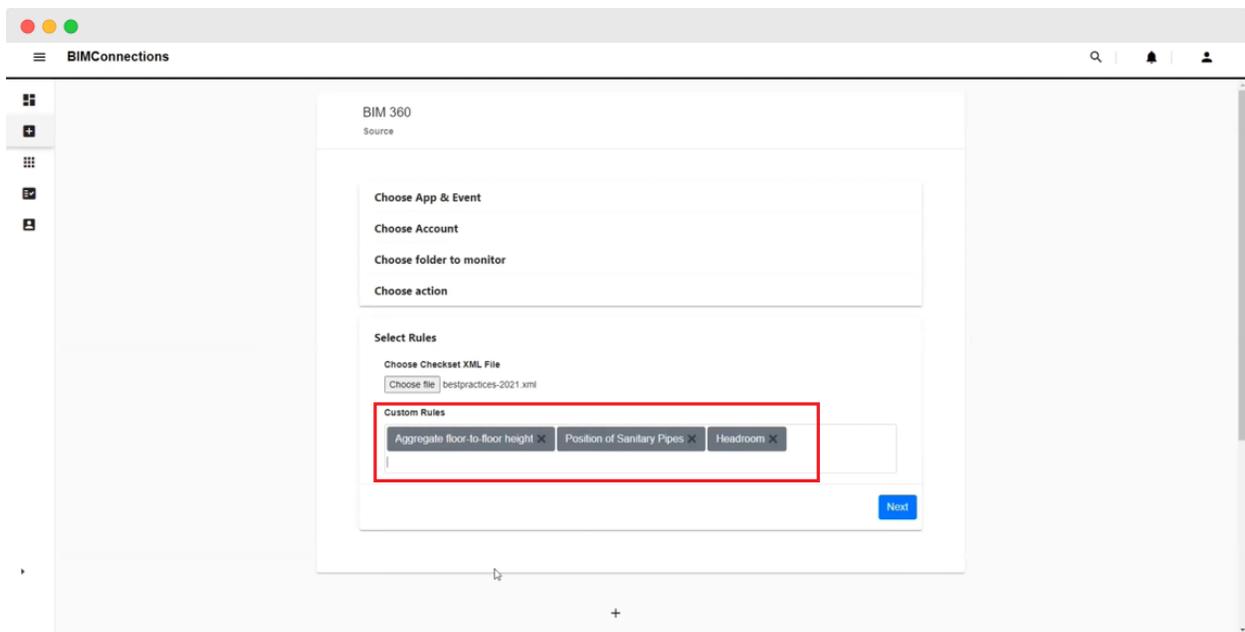


We are internally using already AutoDesk Model Rule Checker. It takes process based on files, more rules can be created. These simple rules are typed like 'fail if certain entities are found', 'pass if certain entities are found', 'count the number of entities', 'list down the number of entities, file size', few other sets of such checks which are all already provided by Autodesk.

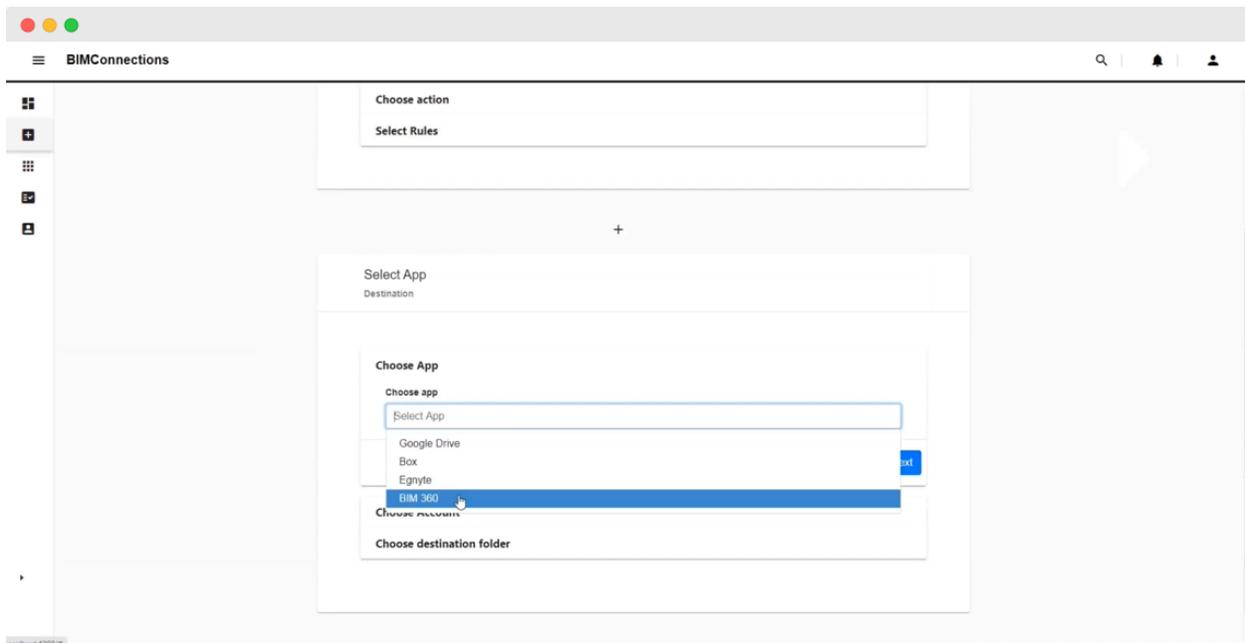
We re-used all those checks, but these also important to know this plugin cannot perform many Geometrical Checks that are required often for code compliance and building approval.

6. In our next step, we use an XML file but we also implemented geometrical checks which are not available out of the regular Autodesk provided model rule checkers. Examples of these are
 - slopes of pipe - very important to check in many cases
 - Aggregate floor to floor height
 - Earthwork within the setback area
 - Vehicular accessibility to refuse room (NEA)
 - Reinforcement of structural elements
 - Sanitary connections
 - Position of sanitary pipes etc

We pick a few of them here

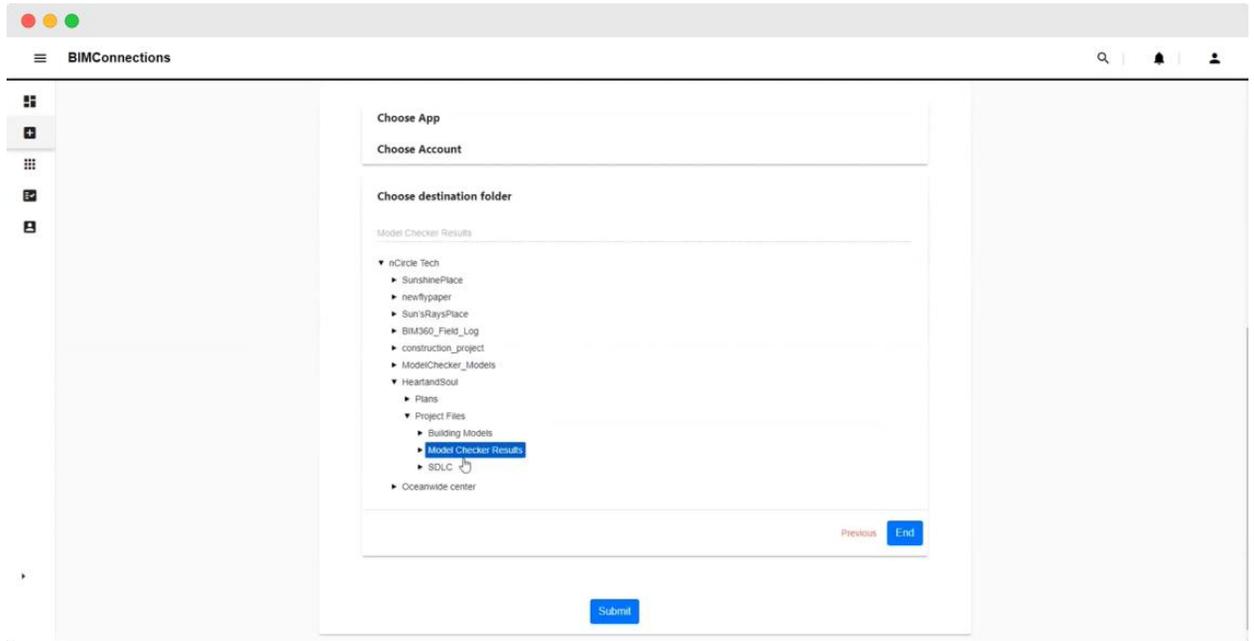


7. Now we *Choose the destination App*, which again for us is *BIM360*

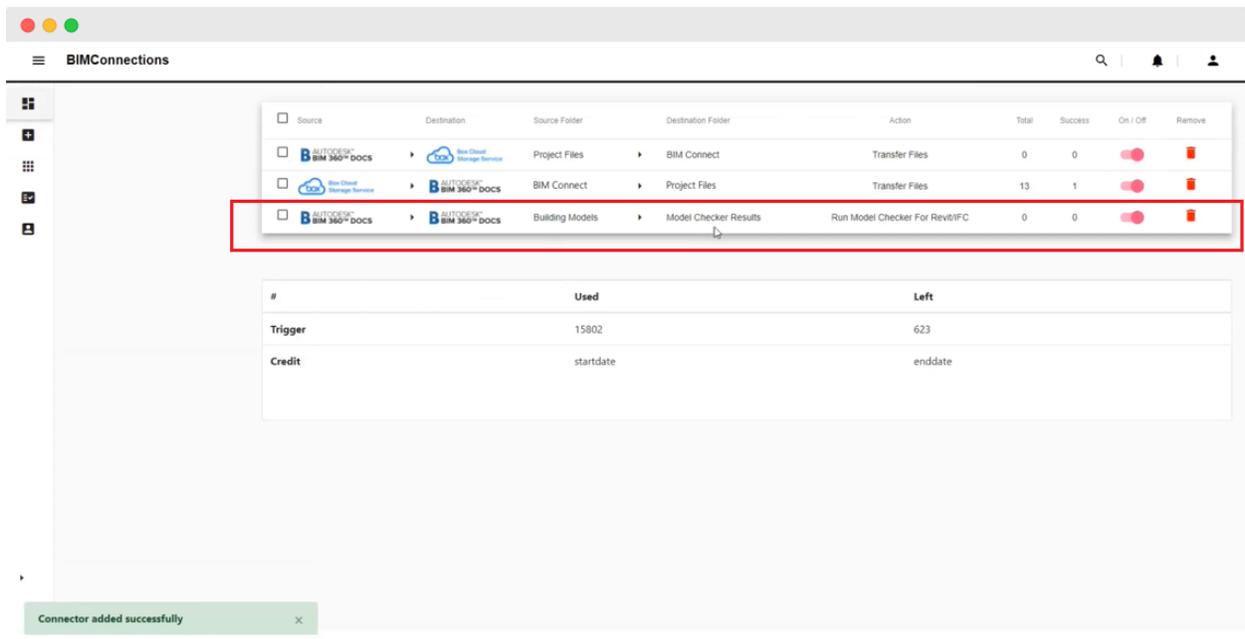


8. Next, *Choose the Account* where you would like to receive the updates (preferably your register email account)

9. Now finally *Choose the Destination Folder*. We have chosen a file named *Model Checker Results* under a project named *HeartandSoul* and click on *Submit*.



10. Now your connection is configured!



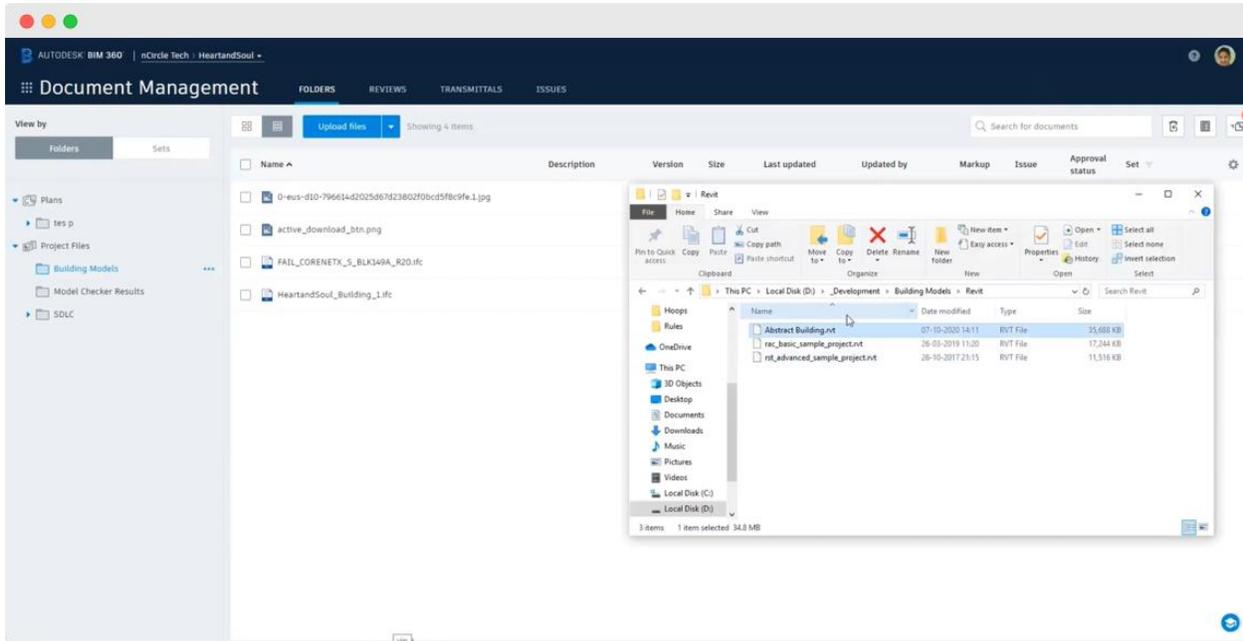
As you can see now, our system is going to read data from BIM360, perform the rule checking on Revit and IFC files, and save the data back into BIM360. The total number of triggers and actions you have right now is Zero.

The way the entire mechanism has been designed is minimally invisible. So we don't ask our users to change any of their processes once this is configured. You can even forget about the

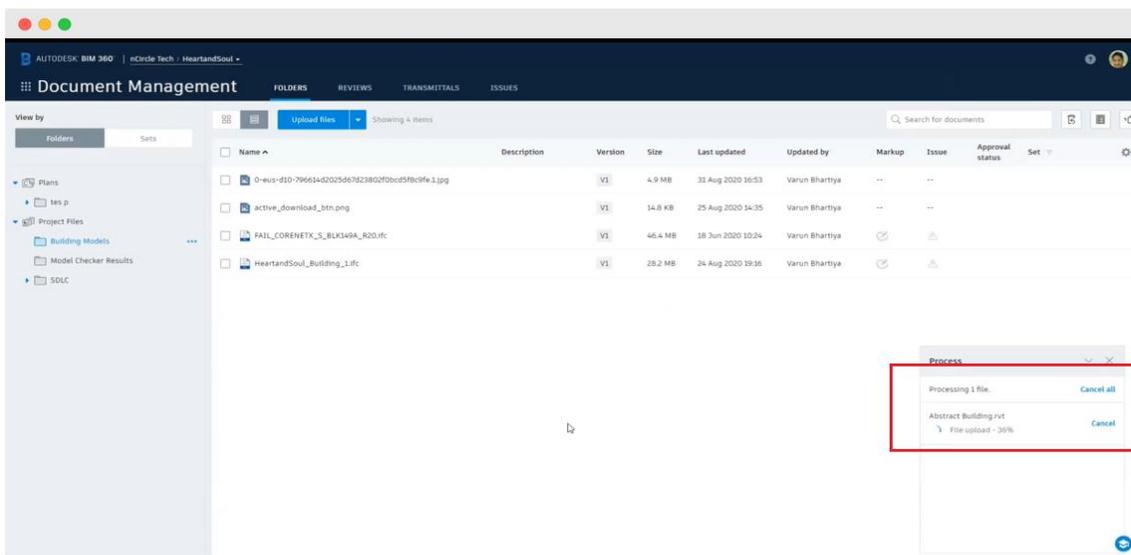
BIM Connection platform. The regular approach is to upload the file in BIM360 and then est happens through automation.

11. Now, let's upload a Revit file named *Abstract Building* into BIM360 with the drag and drop method

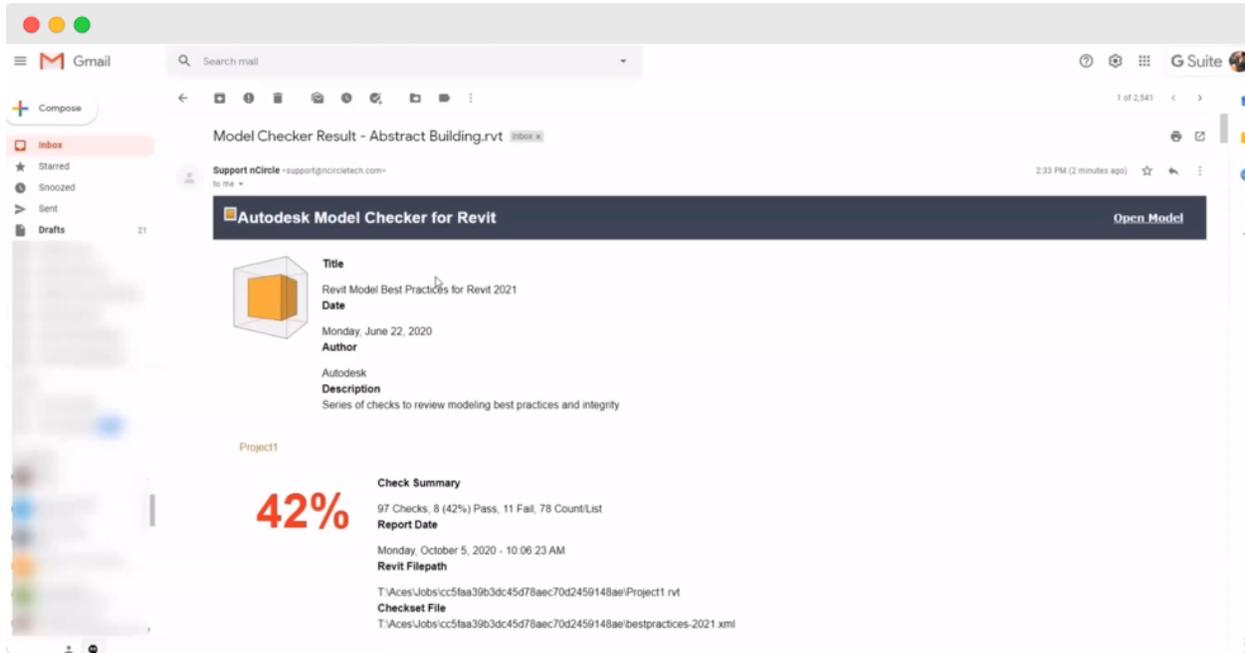
12.



13. As soon as the file is uploaded, the system starts processing the checks on the file



14. Even before the processing on the entire file is complete, a report is generated and sent to your Inbox via an email to show all the rule checks that have been performed on the file



Here we use the Autodesk Model Checker for Revit provided by Autodesk. Many checks can be performed. In this case, 97 checks are performed. (8+11) 19 are Pass/Fail checks and 78 are Check for count and list.

42% passed in total.

If you scroll down further, a more detailed report is available. Here are a few screenshots to exhibit the same.

In this case, 97 checks were performed. 42% are passed, more checkers like file size, count model growth project location, etc.

Grids : Type : 6.5mm Bubble

Wrong Elements on Shared Levels and Grids
 COUNT and LIST of all elements in the model that are on the 'Shared Levels and Grids' workset that are not levels or grids. Note that the 'Shared Levels and Grids' workset must have both 'level' and 'grid' (case insensitive) in the name in order to be recognized.
Result: 'Not Workshared'

Levels and Grids on Wrong Workset
 PASS/FAIL check to determine if any levels or grids are not on the Shared Levels and Grids workset. Will Fail if any are found.
These levels and grids are not on the Shared Levels and Grids workset
 Count: 28

Category	Type	Name	ID
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	586905
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	586912
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	586898
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	586919
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	586933
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	587186
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	587670
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	588097
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	588237
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	588409
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	588773
Grids	6.5mm Bubble	Grids : 6.5mm Bubble	588903

Rooms 4 Checks, 2 (67%) Pass, 1 Fail, 1 Count/List

Survey Point Coordinate 0 E/W | 0 N/S
 Survey Point Elevation 0

Project Location - Latitude
 PASS/FAIL check to determine if Latitude value is correct for the project location. Provide degree value in radians (1 deg = 0.0174533 rad). Value is defined by User Input.
The Latitude value is incorrect for Project Location.
 Count: 1

Category	Type	Name	ID
Location Data	Location Data	Location Data : Type : Location Data	21747

Project Location - Longitude
 PASS/FAIL check to determine if Longitude value is correct for the project location. Provide degree value in radians (1 deg = 0.0174533 rad). Value is defined by User Input.
The Longitude value is incorrect for Project Location.
 Count: 1

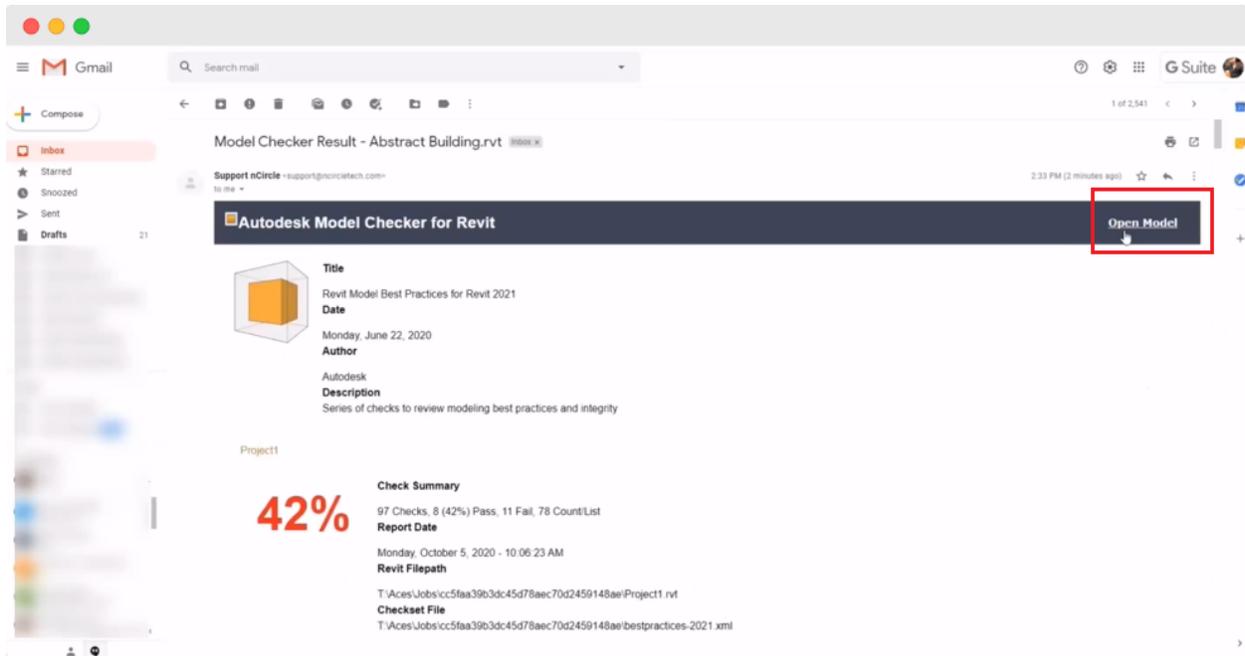
Category	Type	Name	ID
Location Data	Location Data	Location Data : Type : Location Data	21747

Project Location - Project Base Point
 PASS/FAIL check to determine if the Project Base Point is at the designated file origin. Provide input numbers as decimal value up to the nearest 0.00001. Value is defined by User Input.
The Project Base Point is not at the designated file origin.
 Count: 1

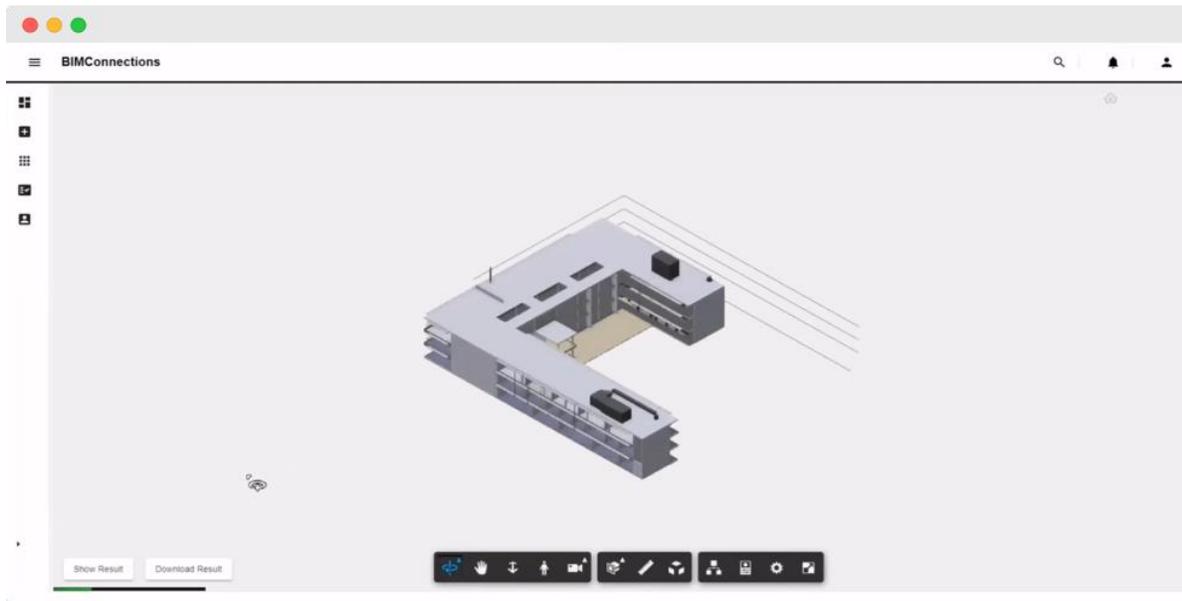
Category	Name	ID
Project Base Point	Project Base Point :	584700

Many more such checks can be configured and executed easily.

15. You can view the same checks using the *Open Model* option in the email on the right corner



It is easy to view and visualize your model as well as the results of the checking under this mode.



16. Click on *Show Results* in the bottom left corner of the screen

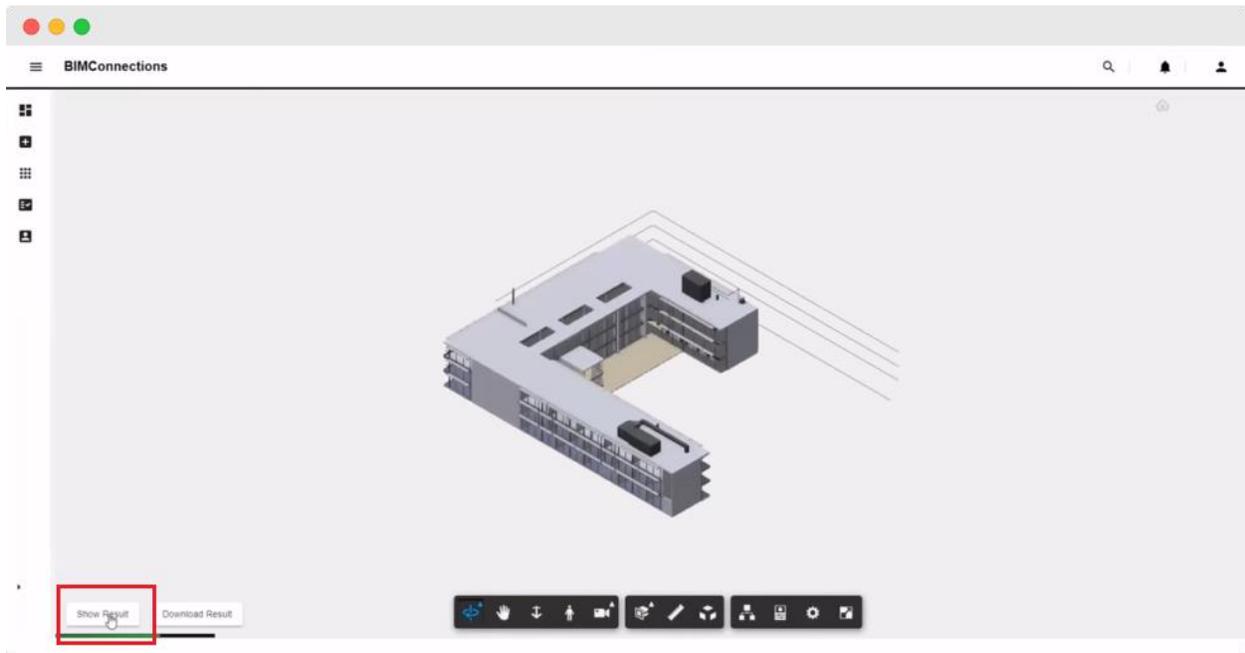
So once you have followed the above steps, you will observe that it is very easy to perform automated Model Checks with an innovative workflow like this. As soon as the file is uploaded the model check happens automatically.

The platform – BIM Connections and its system is designed to not wait for any human to trigger model checks and it is done by the machine each time, every time. In totality too,

- ✓ It requires lesser time
- ✓ Accuracy in check is higher
- ✓ You don't have to worry about errors in checking
- ✓ No manual dependency
- ✓

And very imperatively, there is no change of environment, no change of process. All the magic happens with a one-time configuration.

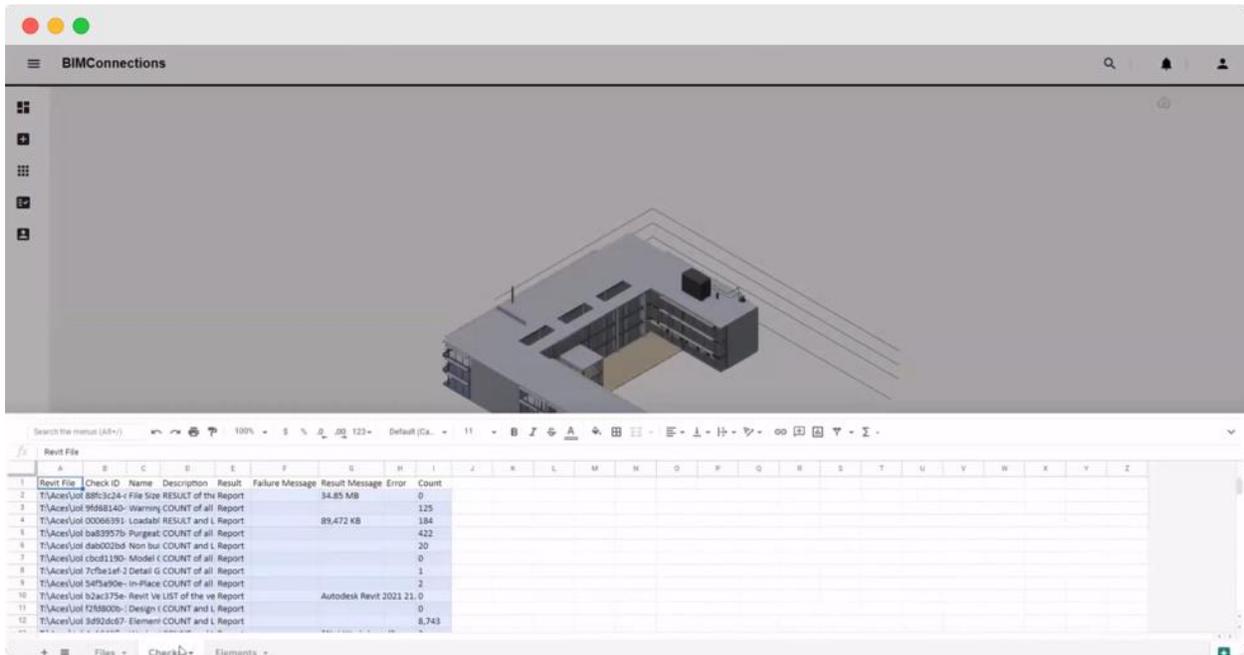
This makes work so much simpler, error-free, dependency-free, and cost-effective for you. Also, can you imagine the number of cost-overruns due to rework you will save!



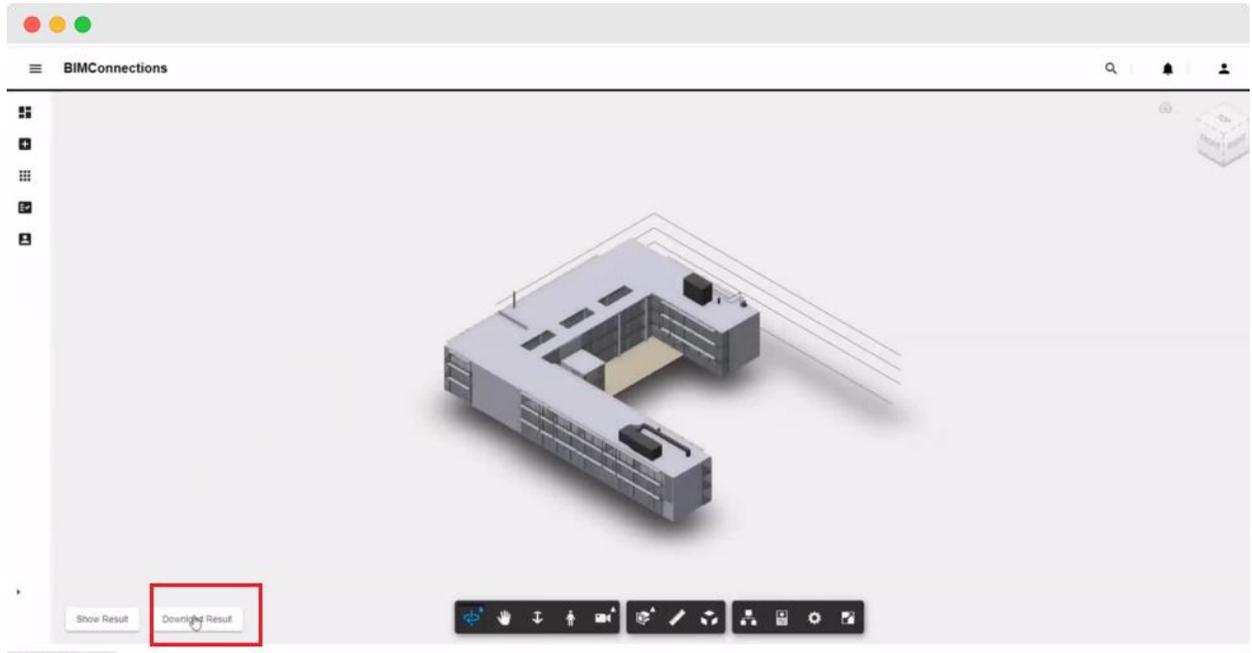
It will open a nice interface where all the data is available in a tabular format like in the excel sheet. It would have listed all the various kinds of checks that have been performed and the various elements linked to all these checks.

Many more checks can be configured if you wish to.

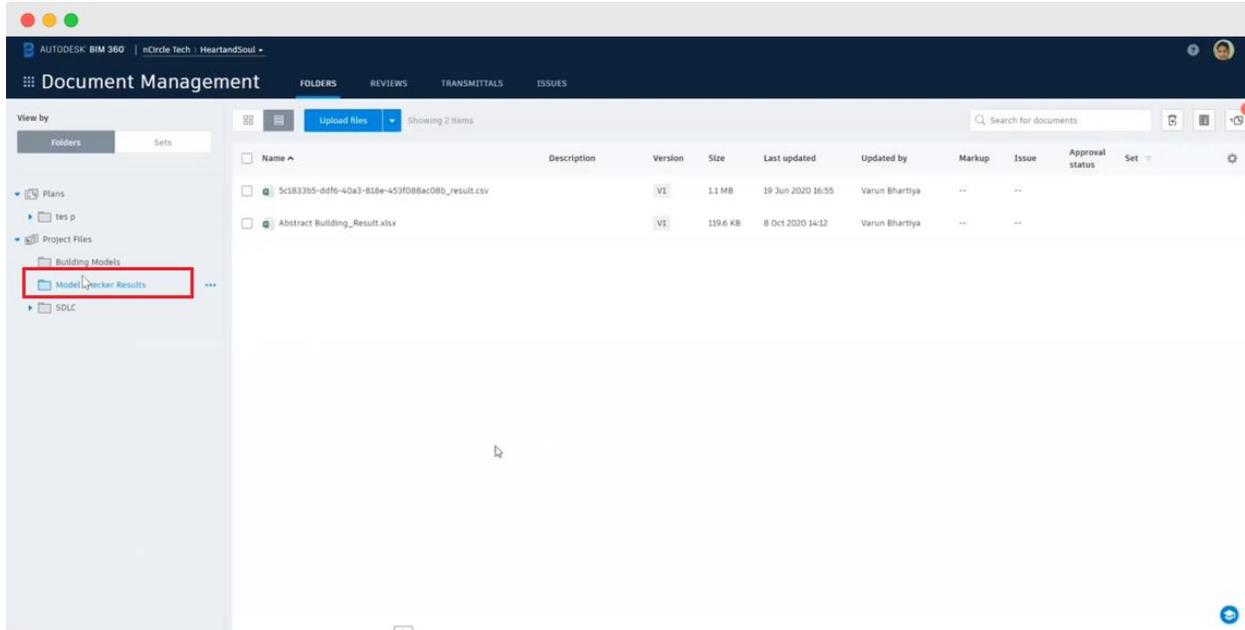
When you click the *Show Results* button, it will show a nice interface and all the data is available in tabular format in the excel sheet. This sheet lists down all the performed checks and the elements related to these checks.



17. We can also *Download Results* from this interface



18. This data is also available in the results folder



If you remember, at the beginning we had also configured the *Results Folder* i.e. where you would want the results of action and trigger be produced once the checks are run on it.

Delight Point: The entire process takes only about a few minutes from the time you upload to the time the file is made available for you to view the check results. In the video demonstration, we uploaded a file at 14.14 hours and the result file was available at 14.15 hours along with the email in the inbox!

Note: This time also is dependent on the size of the file uploaded and the number as well as the complexity of the rules to be checked

All kinds of tracking about how many times the check was performed are available on the BIM Connections platform.

Very similar to the Revit files, the system can process the IFC file also.

19. You can use the Open Model option and view the model in 3D. This can give you visibility into the Success and Failure cases as well as the rate of your Model design.

20. Here, your sanitary pipe is running over the drinking water tank and that can be a problem hence this check has failed to adhere to the BIM standards and needs design revision



21. This showcases that the design has complied with the standards protocol and is depicted by being highlighted in Green



Learning Objective 3: Learning about better collaboration across disciplines and roles, including design professionals, MEP engineers, and others

Better Collaboration entails Better collaboration protocols.

When the design meets protocols, it implies a Design that complies with the BIM Standards.

Let's understand this with the help of an example.

If an architect designs a Bathroom, without considering the accessibility requirements, All other trades will design based on a faulty design. When 1 wall of the bathroom is to be extended to ensure accessibility, everyone has to update their design to accommodate the extension. If such a check happened automatically, right on the day when the designer created the first version of the bathroom, it would save time for everyone downstream.

Learning Objective 4: Describe best practices in BIM Standard

From the perspective of a software developer, the best practices should include the following when you are considering model rule checking:

- ✓ Check frequently
- ✓ Check automatically
- ✓ Report immediately
- ✓ Correct immediately

Who should run the rule checker?

Everyone. For their own set of changes.

Note: Identify rules that can be machine-checked and cannot be machine checked.

Automated checks are still just a mechanism to assist designers. They do not take liability for incorrect results. So you may have to manually review the results before approving and signing the dotted line.

“Automation is to your time what compound interest is to your money.” – Rory Vaden.

So embrace Automation and make it count.