



Quality Control for Autodesk® Revit® MEP Models

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MP3620 Now that your Autodesk Revit software implementation is progressing nicely, have you considered what your next step will be? What about quality control checks of the Revit model itself? No, we're not talking about validating design—we're talking about the quality of the model itself. Are the elements correct? Are your company's standards being followed? This class will demonstrate approaches to checking a model for quality that can be used in any company and using the Autodesk® Revit® Model Review plug-in for more automated checking. We will also open up a discussion with the audience to generate ideas for quality control checklists.

Learning Objectives

At the end of this class, you will be able to:

- Use Filters for QC of Worksets
- Resolve Common Modeling Mistakes Using Filters
- Resolve Common Modeling Mistakes Using Model Review
- Create a QC Checklist

About the Speaker

Robert is the Design Technology Manager for Sparling, a specialty electrical engineering and technology consulting firm in the United States, headquartered in Seattle Washington. He provides strategic direction, technical oversight, and high-level support for Sparling's enterprise design and production technology systems. He is instrumental in positioning Sparling as an industry and client leader in leveraging technology in virtual building and design. Robert has been in the MEP industry for over 25 years and has used every release of Revit MEP (including the initial beta of Revit Systems.) Robert is a frequent speaker at RTC and Autodesk University, and has written many articles regarding Revit MEP and AutoCAD.
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Introduction

When I offered, on LinkedIn, to provide Sparling's Revit QC Checklist I was surprised at the amount of response to the offer. It seems that QC has started making its way into the processes of firms with experience in Revit. The scramble just to produce a model has given way to considerations of how to improve the model.

This is a good thing for the industry and I'm encouraged that many firms are beginning to tackle this issue. This class is about techniques to improve the QC process for Revit models.

Use Filters for QC of Worksets

Filters can often be used to help with quality control. It is often best to combine the filter with a single view dedicated to a specific QC test.

Shared Levels and Grids Workset

Level and grid elements are automatically moved to the Shared Levels and Grids workset when a model is first saved with worksharing enabled. This behavior is most welcome for projects with linked models because the level elements that must be copy/monitored (and to a lesser extent the grid elements) need to be turned off in the linked models.

However, as the modeling progresses, it is far too easy for these elements to wind up on the wrong workset when new elements are added. There are several techniques that can be used to QC this issue.

Also, in the USA Pacific Northwest it is becoming more common that most reference planes be placed in the Shared Levels and Grids workset. Why? Because most experience Revit teams are already used to turning off that workset already and a linked model's reference planes are rarely useful to the host model.

Do grid elements need to be copy/monitored into the host model? I argue that, although this leads to extra coordination review items, the entire design team needs the warning that grid elements have changed.

Worksharing Display Settings

This feature was introduced in Revit 2012 and can help you visually distinguish worksets. On the View Control Bar, click the Worksharing Display button and select the Worksets item.

You can assign a specific color to the Shared Levels and Grids and then visually scan to see if any of the level or grid elements are on the wrong workset.



Figure 1 Worksharing Display

Creating Specific QC Views for Shared Levels and Grids Workset

It may be preferable to create specific views that always display the target elements in wrong worksets by an override rather than use the worksharing display settings. Worksharing display

settings are a toggle and random in color assignment. If you prefer to have a bit more control, you can take the following approach.

Once worksets are enabled create the following views:

1. Plan view named Grids
2. Plan view named Reference Planes
3. 3D view named MEP Elements
4. Elevation view named Levels

Grids View

Change the Visibility/Graphic Overrides for the view to turn off all model categories, all annotation categories except for Grids, and then go to the Filters tab.

Create a new filter called “Grids/Levels Not on Shared”.

Assign categories Grids and Levels.

Assign the filter rule to filter by “Workset does not equal Shared Levels and Grids”.

Add the filter and override the properties as desired.

Use this view to immediately see if any grids are assigned to the wrong workset. It is then very simple to correct the offending elements.

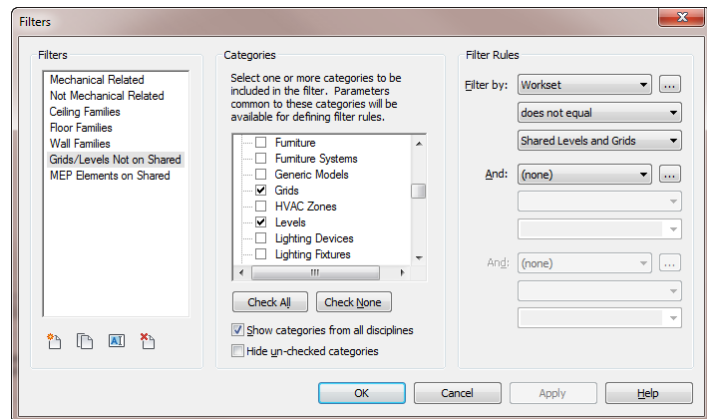


Figure 2 Grids/Levels Not on Shared Filter Settings

Reference Planes View

Change the Visibility/Graphic Overrides for the view to turn off all model categories, all annotation categories except for Reference Planes, and then go to the Worksets tab.

Hide the Shared Levels and Grids workset.

Use this view to immediately see if any reference planes are assigned to the wrong workset. Any visible in this view would be in an incorrect workset. It is then very simple to correct the offending

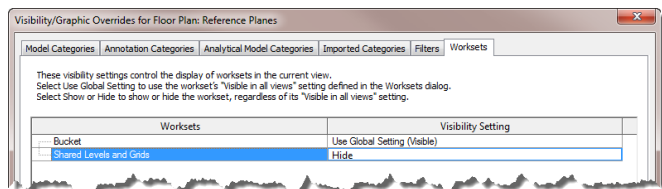


Figure 3 Hiding the Workset

elements.

MEP Elements View

A 3D view is used so that the models of the elements are visible and therefore making it easy to override their properties. If you were to use a plan view then any families that use nested plan symbols would not be overridden.

Change the view to Wireframe.

Change the Visibility/Graphic Overrides for the view to turn off all model categories that you do not need to check, all annotation categories, and then go to the Filters tab.

Create a new filter called “MEP Elements on Shared”.

Assign categories to match the selected model categories.

Assign the filter rule to filter by Workset equals Shared Levels and Grids.

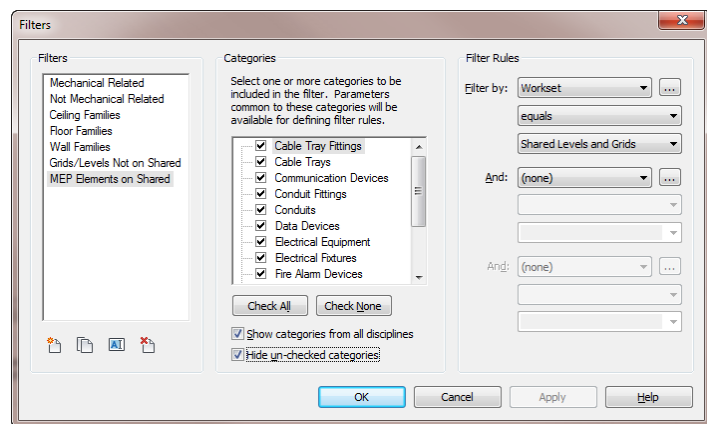


Figure 4 MEP Elements on Shared Filter Settings

Add the filter and override the properties as desired.

Use this view to immediately see if any elements are assigned to the wrong workset. It is then very simple to correct the offending elements. Note that if your model uses several worksets where MEP elements do *not* belong then you can create additional filters and add them to apply overrides.

Levels View

Change the Visibility/Graphic Overrides for the view to turn off all model categories, all annotation categories except for Levels, and then go to the Filters tab.

Add the “Grids/Levels Not on Shared” filter and override the properties as desired.

Use this view to immediately see if any levels are assigned to the wrong workset. It is then very simple to correct the offending elements.

Use the Model Review Add-In

The Model Review add-in makes it possible to scan the model for issues and (even better) automatically correct some of the discovered issues. It is possible to run the Model Review add-in and test for grid and level elements that are not in the Shared Levels and Grids workset.

Unfortunately, the process of configuring the criteria for this specific test is a bit too manual. The add-in does have an API that can allow you to write a plug-in to make the test much more reliable, but that discussion is beyond the scope of this class.

Resolve Common Modeling Mistakes Using Filters

It is common to see schedules or color schemes used to QC a model but, unfortunately, those don't cover some basic modeling mistakes. Because Revit MEP does not expose the Elevation parameter to tagging and schedules we need to rely on other approaches to check the model.

Ceiling Mounted Elements Hosted to Floors

This modeling mistake happens too often. It is also difficult to catch when most of the time is spent looking at floor plan views. This issue can be caught by using QC elevation views that can filter out non-ceiling elements. This takes a bit of family planning. If all your ceiling-mounted families have the word "ceiling" in the family name then you can create a filter for those families.

Use the filter to change the color of ceiling mounted elements to be distinct from floor mounted or wall mounted elements. Turn off all non-MEP model categories to simplify the QC view to just what is needed to be checked. Levels should be displayed, but make them halftone to help "pop" the MEP elements. Depending on the amount of placed elements, you may desire to combine the QC for ceiling and floor mounted elements and change the color of the floor mounted elements to a different color from the ceiling mounted elements. Elements on the wrong host will still be very evident.

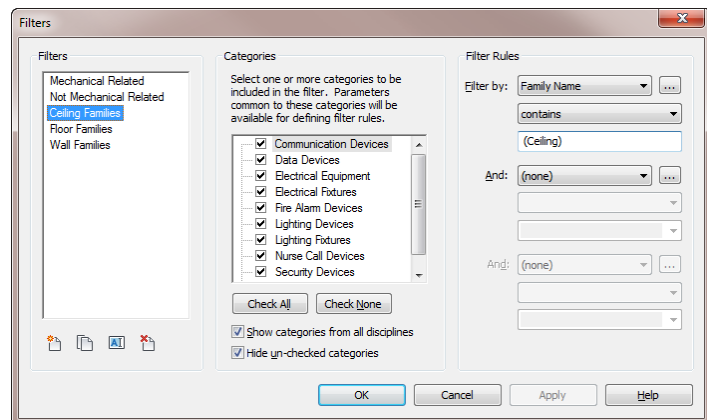


Figure 5 Ceiling Families Filter Settings

Wall Mounted Elements with no Elevation or Hosted to Floors/Ceilings

Many wall-mounted elements are not mounted directly on the corner of the wall and floor. Therefore, it is useful to have a way to check wall-mounted families for elevation. Because you cannot create a schedule using the Elevation parameter, you must use other methods to check the model.

The same approach can be taken for floor mounted elements.

Another issue is that a lazy designer may simply place a wall-mounted element on the floor or ceiling because they didn't want to wait for a true floor/ceiling mounted family to be created.

Once again, a bit of family planning can help. If all ceiling and floor mounted families have names that indicate such, then it can be assumed that families without those words are wall mounted. Or the word “Wall” can be explicitly added to wall mounted families.

Either approach will give you the ability to create a filter to change the color of wall mounted elements. Model object categories not related to MEP should be turned off except for floors and ceilings. Make floors and ceiling halftone to help the MEP elements “pop” in the QC view. Leave levels on but change them to halftone also.

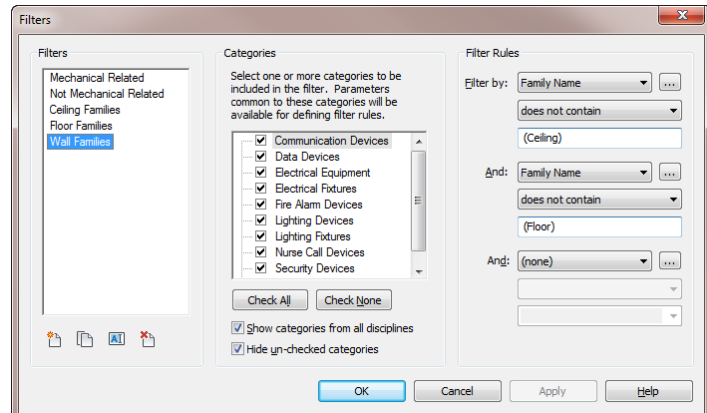


Figure 6 Wall Families Filter Settings

Resolve Common Modeling Mistakes Using Model Review

The Model Review add-in does expose the Elevation parameter and the hosting element. This makes it possible to check the model for elements with the correct elevation or the correct host.

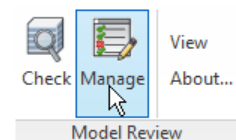
In order to check elements that are supposed to be on the wall the family name needs to indicate that it belongs on a wall. This can be done either by explicitly adding “Wall” to the family name or implicitly by adding “Ceiling” or “Floor” to the appropriate families consistently.

Once this is done then creating the required test in the Model Review add-in becomes possible.

When creating a new check file for the Model Review add-in you should run Revit as an administrator. The reason for this is that adding a check file to the list of available checks modifies a file that is located in %ProgramFiles% (or %ProgramFiles(x86)% on 64-bit operating systems). This location is read-only to many users. Once the check file has been added the test can be run when Revit is launched normally.

Creating a Model Review Check for Elevation

On the Ribbon select the Add-Ins tab > Model Review panel > Manage tool.



In the Autodesk Revit Model Review dialog, on the menu select Check > Add > Standards > Parameter Requirements. This creates a new check type in the dialog.

Figure 7

On the Basic Info tab, change the following items:

Name: Elevation of Electrical Fixtures for Walls

Allow Correction: unselected

On the Details tab, change the following items:

Element Type(s): Family Instance

Built In: Elevation (INSTANCE_ELEVATION_PARAM)

Must Exist: selected

Must Be: selected

Please specify one or more values or ranges: 1-7.5

On the Filter tab, add the following filters:

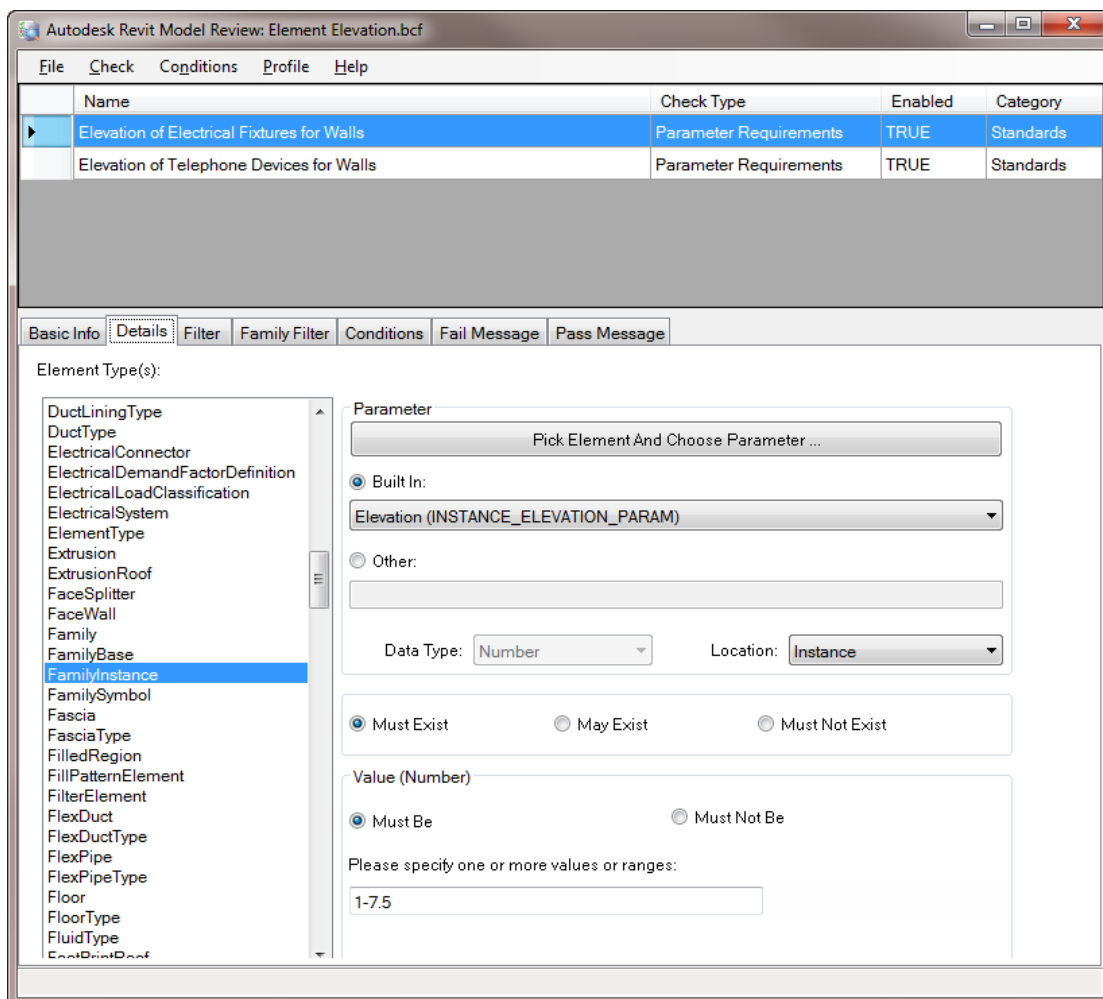


Figure 8 Details for Elevation Check

Parameter: Family Name (SYMBOL_FAMILY_NAME_PARAM) ~= ^((?!Ceiling|Floor)).*\$
Category = Electrical Fixtures

Save the file to My Documents, named as “Element Elevations”.

On the menu select Profile > Edit.

In the Autodesk Revit Model Review Profile Editor dialog select the Standards tab and then the Add button.

In the Check File Add/Edit dialog change the following items:

Description: QC Elevations

Filename: use the ... button to select the Element Elevations.bcf file in My Documents.

Running a Model Review Check

On the Ribbon select the Add-Ins tab > Model Review panel > Check tool.

In the Autodesk Revit Model Review dialog, select the desired check file in the drop-down list. Make sure the Current Model is selected (not Current Model and Linked Models). Select the OK button.

The Autodesk Revit Model Review Results dialog will appear. The results for each test as listed at the top of the dialog and the specific results for the selected test are displayed in the lower half of the dialog box.

You can select the Items tab and double-click on one of the listed elements to have Revit zoom to the offending element.

Creating a Model Review Check for Host Element

On the Ribbon select the Add-Ins tab > Model Review panel > Manage tool.

In the Autodesk Revit Model Review dialog, on the menu select Check > Add > Standards > Parameter Requirements. This creates a new check type in the dialog.

On the Basic Info tab, change the following items:

Name: Host of Electrical Fixtures for Walls

Allow Correction: unselected

On the Details tab, change the following items:

Element Type(s): Family Instance

Built In: Host (INSTANCE_FREE_HOST_PARAM)

Must Exist: selected

Must Match: selected

Regular Expressions: selected

Please specify one or more Regex: ^.*Wall.*\$

On the Filter tab, add the following filters:

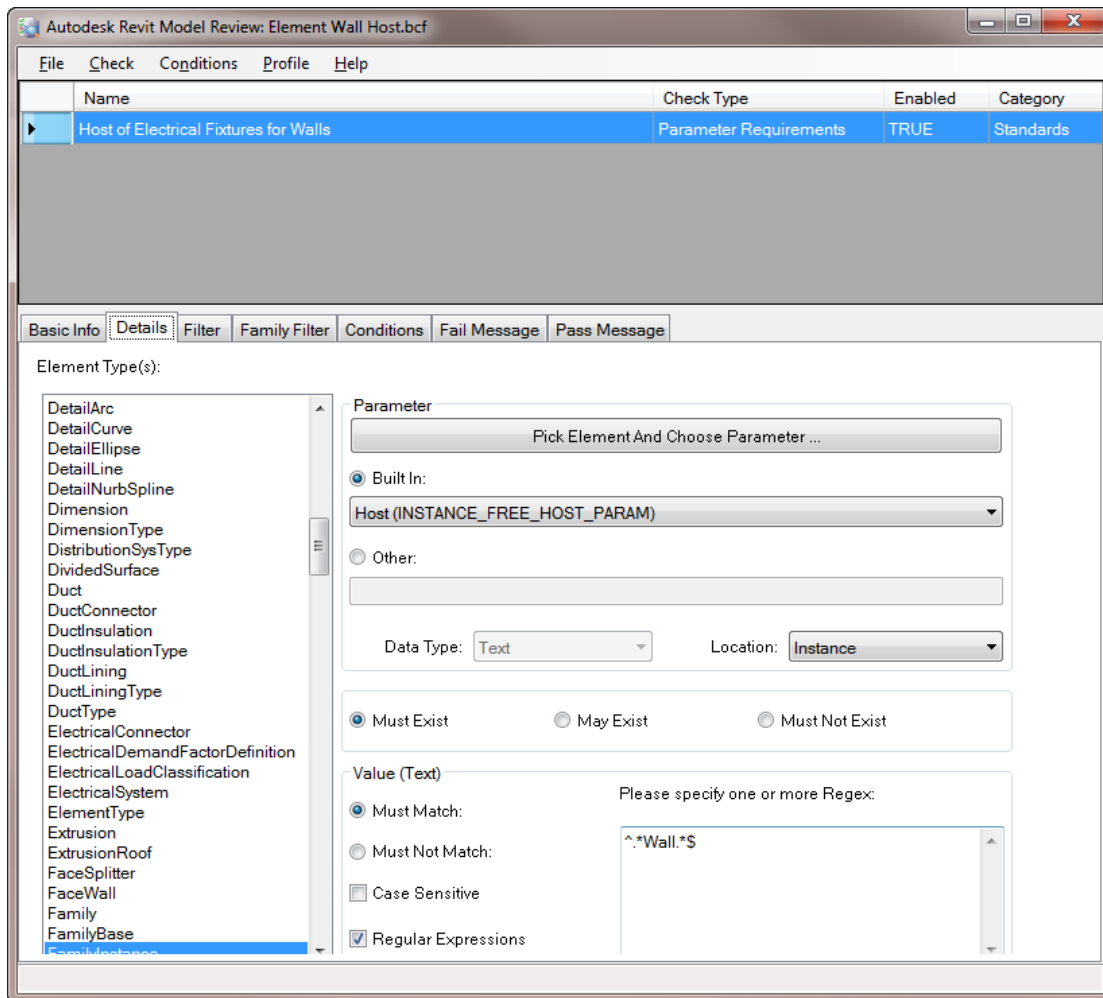


Figure 9 Details for Wall Host Check

Parameter: Family Name (SYMBOL_FAMILY_NAME_PARAM) ~= ^((?!Ceiling|Floor)).*\$
Category = Electrical Fixtures

Save the file to My Documents, named as “Element Hosts”.

On the menu select Profile > Edit.

In the Autodesk Revit Model Review Profile Editor dialog select the Standards tab and then the Add button.

In the Check File Add/Edit dialog change the following items:

Description: QC Hosts

Filename: use the ... button to select the Element Hosts.bcf file in My Documents.

Execute the check in a manner similar to the QC Elevations check.

Create a QC Checklist

In the appendix is the QC Checklist that Sparling uses. Note that this checklist undergoes frequent updates as Sparling uncovers areas where modeling runs into issues. Most of the QC is related to project setup items but also has items related to the other material presented in this handout.

All questions are formed so that an answer of “Yes” means the model passed that particular QC item. Any checkmarks in the “No” column means that the model needs to be corrected. This can make it a bit tricky sometimes when forming the question but it pays off by having an easy-to-understand pass/fail.

Appendix

The next page has a version of Sparling’s QC Checklist.

Sparling Revit Model QC Checklist
Project Number and Name

General Project Information		
Item	Yes	No
1. Is the BIM Kick-Off Meeting FAQ completed and located in Project Masters?		
2. Is the Revit Project Description starting view up to date?		
3. Was Sparling's project information filled out completely?		
4. Was project information transferred from the architect's model? (Check project address, Angle from Project North to True North, and Report Shared Coordinates of Level 1's Elevation and grids.)		
Files and Links		
Item	Yes	No
5. Do all the central Revit model filenames match the Sparling standard?		
6. Are all linked files linked to the project folder on the network?		
7. Are all models in the project folder central files to the project folder? (Was the update procedure followed?)		
8. Are all linked files using the relative path type?		
9. Are all the linked files loaded?		
10. Are non-Architectural/Structural linked Revit models in each their own workset?		
11. Are the correct models set to room bounding in its Type Properties? (See FAQ for required models.)		
12. Are all Revit links given a meaningful name in its Instance Properties?		
13. Are all DWG links in worksets to control loading of the DWG links?		
14. Are all linked models pinned or in a design option?		
Linked File Coordination		
Item	Yes	No
15. Has the model had a recent coordination review, i.e. there are no coordination items?		
16. Is the Shared Levels and Grids workset closed on all linked models?		
17. Are all the grids copied and monitored?		
18. Are all the required levels copied and monitored? (Note: some levels may not be needed for Sparling's work.)		
19. Are all the host model's grids and levels in the Shared Levels and Grids workset?		
20. Are all the host model's reference planes in the Shared Levels and Grids workset?		
21. Are there <i>no</i> room elements (placed or unplaced)?		
22. Have all duplicated spaces been removed?		
23. If spaces are required, are all spaces placed?		
24. If spaces are required, are all spaces bounded?		
25. If spaces are required, are all spaces' upper bounds set correctly?		
26. If spaces are required, are space numbers and names coordinated with room numbers and names?		
General Model Integrity		
Item	Yes	No
27. Do all levels have Computation Height set to 0' 0" (or appropriate documented offset)?		
28. Do all wall-mounted elements have elevations other than floor or ceiling?		
29. Are all ceiling-mounted elements on the ceiling (i.e. not floating in space or on the floor)?		
30. Are all floor-mounted elements on the floor (i.e. not floating in space or on the ceiling)?		
31. Are all electrical elements connected to power systems?		
32. Are all warnings resolved in the model? (Duplicate type marks are permitted for lighting		

Sparling Revit Model QC Checklist
Project Number and Name

fixtures.)		
Project Browser Issues		
Item	Yes	No
33. Are match-lined views, e.g. Area A and Area B, created as dependent views?		
34. Are all views categorized, e.g. no “???” groups in the project browser?		
35. Are all sheets categorized, e.g. no “???” groups in the project browser?		
36. Are all view names in Title Case?		
Plot View Issues		
Item	Yes	No
37. Do all plotting views have an assigned view template?		
38. (Prior to 2013) Does applying a plotting view’s view template maintain the same view appearance, i.e. there are no view-specific overrides?		
39. Are the grid bubbles on the outside of the building turned on?		
40. Are the grid bubbles inside the building turned off?		
41. Are all areas on plan sheets showing Sparling room or space tags?		
42. Are all room or space tags within their boundary or showing a leader to within the boundary?		
43. Are all revisions in the revision block actual Revit revisions and not static text?		
44. Are all circuit annotations tags?		
45. Are all switch leg annotations tags?		
46. Are all mounting height annotations tags?		
Clash Detection		
Item	Yes	No
47. Are there no unresolved clash items within Sparling’s own model?		
48. Are there no unresolved clash items against the architectural model(s)?		
49. Are there no unresolved clash items against the structural model?		
50. Are there no unresolved clash items against the MEP model(s)?		
Linked Model Cleanup (Optional)		
Item	Yes	No
51. Have all groups been deleted?		
52. Are all non-sheet views deleted?		
53. Are all non-plan sheets deleted?		
54. Has the file been purged?		

Additional comments:

1.