Trimble Connect AR System

USER GUIDE

Trimble

Legal Information

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Release Notice

This is the June 2023 release (Revision A) of the Trimble Connect AR System User Guide. It applies to version 1.30 of the Trimble Connect AR system.

Contents

Trimble Connect AR System Overview

Trimble® Connect® AR is an augmented reality system that is ideal for indoor use. It enables you to interact with your spatial data in the context of the real world. You can visualize and measure positions using LiDAR (supported devices only) and Augmented Reality technology as you explore the project site.

The Connect AR app is supported on BYO devices:

- powered by the Android™ operating system version 9.0 and later, that are supported by the Google AR technology
- powered by iOS 13 and later, from iPhone 6s and later and iPad (2017) and later

The Connect AR system is an augmented reality solution that works with Google Play Services for AR technology or the Apple ARKit technology, and is comprised of:

- the Connect AR app running on a user-supplied Android or iOS device
- cloud services (Trimble Connect)

For a list of recommended mobile devices, see Connect AR System Requirements, page 9.

To begin to use the system you will need a model that you want to visualize.

| **NOTE** – A sample model is included when you install the app, so that you can explore the app's features.

The Connect AR app supports a wide range of common Building Information Modeling (BIM) formats. View models ranging from early architectural concepts right through to LOD400 fabrication models. It also supports the visualization of 2D PDF plans.

The models can be created with a range of Trimble applications or many third party packages such as AutoCAD, Autodesk Revit, and ArchiCAD.

Before you start

Before you start you will need:

- A device which meets the following:
  - powered by Android 9.0 or later that is supported by the Google AR technology
  - powered by iOS 13 and later, from iPhone 6s and later and iPad (2017) and later, that is supported by the Apple ARKit technology
- The app downloaded to the device
- A Trimble Identity to be able to log into the app
- A current subscription
- A model to view. Alternatively, you can create a workspace in the field or use the sample model included when you install the app.

Using your Trimble ID

To use the Connect AR system you will need a Trimble Identity to log in to Connect AR, Trimble Connect, or any other Trimble system.

- If you have an existing Trimble ID you will be able to use it for all Connect AR related services.
- If you are a new Trimble user, go to the Trimble ID signup page to create a Trimble ID.

The Trimble ID allows you to log into the Connect AR system and Trimble Connect with the same username and password.

Deleting your Trimble ID account

If you want to delete your Trimble ID account, go to **Menu / Tools / About / Account**. You will be redirected to your **My Trimble account** page, where you can delete your account.

Obtaining a Connect AR Subscription

Contact your Authorized Trimble Distributor or Trimble sales representative to purchase a subscription to the Connect AR services. When you contact your distributor you will need to provide the email address that you use for your Trimble ID. Your distributor will assign the license to your Trimble ID.

Then proceed to download the Connect AR app from the Google Play Store or Apple App Store.

Downloading Trimble Connect AR

1. Go to the Google Play Store or Apple App Store and search for **Trimble Connect AR**.
2. Download and install the app.
3. Run the Trimble Connect AR app on your mobile device.
4. To get started, accept the End User License Agreement and then enter your Trimble ID username and password.

About Trimble Connect

Trimble Connect is a cloud-based data management and collaboration platform that allows you to view, share, and access project information over the internet from anywhere at any time. Trimble Connect stores the 2D and 3D models, prepared in your office software, that are to be viewed in Connect AR.

The subscription for Trimble Connect is included with your Connect AR subscription. If you have separate users who will only be doing data preparation you can purchase separate standalone subscriptions for just Trimble Connect for them.

To get started with Trimble Connect, go to the Trimble Connect website.

About Google AR Technology and Apple ARKit Technology

Google and Apple have developed services for building augmented reality experiences. The service enables your mobile device to sense its environment, understand the world and interact with information.

To learn more about Google AR technology, go to the Google ARCore website.

To learn more about Apple ARKit technology, go to the Apple AR website.

Operational Safety

Connect AR is frequently used on construction sites. Make sure you follow the recommended safety procedures for your work environment.

> **CAUTION** – Because it mixes the real and digital worlds, Connect AR can impair the operator's field of vision and hide obstructions that may cause harm.
>
> - Use Connect AR in environments where it is safe to do so.
> - Always be aware of your surroundings.

> **CAUTION** – Trimble recommends that before you use Connect AR in the field, you:
>
> - Plan a path of travel and areas of interest.
> - Identify and either minimize or eliminate potential hazards.
> - Ensure others on site know that the device is in use.
> - Follow all work site health and safety requirements, including personal protection equipment.
>
> Additionally, during use:
>
> - Remain aware of your surroundings.
> - Keep a note of physical object vs Augmented Objects.
> - Stop and look rather than walk and look.
> - Be aware of machinery, site exclusion zones, site vehicles and identified hazards.

> **CAUTION** – A hazard spotter is recommended to watch the user who is operating Connect AR in case of unexpected dangers on the work site.

Getting Started

This section takes you through the following:

- Connect AR System Requirements, page 9
- Installing the Connect AR Software, page 9
- Getting Started with the Connect AR Software, page 10

Connect AR System Requirements

Mobile Devices

Trimble Connect AR runs on Android and iOS devices, as follows:

- any Apple device powered by iOS 13 and later, from iPhone 6s and later and iPad (2017) and later, that is supported by the Apple ARKit technology.
- and device powered by the Android operating system version 9.0 and later, that is supported by the Google AR technology. There are over 400 devices which are Google AR Services compatible. Refer to the list that Google maintains to check if your device is supported:

  https://developers.google.com/ar/devices

For best results, Trimble recommends using a device with the highest spec possible.

Internet Connectivity

You must have an internet connection to download models from Trimble Connect. You can operate Connect AR without an internet connection but with the following limitations:

- You must have logged into Connect AR on the device previously.
- To use a model (or models) from Trimble Connect, you must have already downloaded it / them from Trimble Connect while connected to the internet. You can access previously downloaded models from the **Quick Access** list (see Loading a Model, page 33).
- You cannot save ToDos, or sync measured data to Trimble Connect until you are back online.

Installing the Connect AR Software

Installing on an Android device

To install the Connect AR app on your Android device:

1. On your device go to the Google Play Store and search for **Trimble Connect AR**.
2. Download and install the software from Google Play Store.

> **NOTE** – You will also be prompted to download and install Google Play Services for AR if not previously installed on your Android device. This must be installed on your device for Connect AR to function correctly. Trimble recommends that you configure your device to allow automatic updates of these applications.

Installing on an iOS device

To install the Connect AR app on your iOS device:

1. On your device go to the Apple App Store and search for **Trimble Connect AR**.

2. Download and install the software from Apple App Store.

Getting Started with the Connect AR Software

Below are some Connect AR basics to get you started.

Launching Connect AR

1. Tap on your device.

2. When prompted sign into Connect AR using your Trimble ID.

3. You must agree to the End User License Agreement before you are permitted to use the application, and accept the Health and Safety Warning.

4. And finally, you are prompted to **Go to Menu and load a model**.

> **TIP** – When working in Connect AR, various prompt messages appear across the screen. You can
>
> minimize these messages to give you a clearer view of the screen—tap .

> **NOTE** – A sample model is included in the Connect AR app, so that you can explore Connect AR's features.
>
> **NOTE** – If you want to visualize your data in Connect AR, you must first load it either to Trimble Connect into a project, or pre-process data directly loaded onto your device (see Loading a Model, page 33 for the different available options).
>
> **NOTE** – To be able to access the data from Trimble Connect the Connect AR user must either be the project owner, or be invited to the Trimble Connect project as a part of the project Team, under the same Trimble ID that you use to log into Connect AR. If the data has been uploaded by another person they must invite you—using the email address of your Trimble ID—to the Project team before you can access the data with Connect AR.

Working with model data

To work with data in the field, Connect AR provides the following options:

*   Load data from the cloud; you must first upload it to Trimble Connect. To use this option, use **Load Model / Trimble Connect**.

*   Load a model by scanning a Marker. This will load the Trimble Connect model the Marker is associated with. To use the option, use **Load Model / Marker**.

*   Create data in the field using the Connect AR apps. To use this option, do one of the following:

    *   use **Load Model**, select **Trimble Connect** then tap to create a new model in Trimble Connect.

    *   use **Load Model**, then tap to create a new model locally.

*   Load data locally from the device. This must be model data that you have already, or that is manually copied to your device after processing your model data via Trimble Business Center, Trimble Connect for

Windows, or other Trimble products that produce the TRB file format (see To load a model from a file storage location, page 34). To use this option, tap **Load Model / My Files**.

- Load data you have previously downloaded and viewed already; use **Load Model / Quick Access**.

  If you are offline, you may not be loading the latest model if the data has been updated on Trimble Connect since you loaded it from Trimble Connect; you will be loading a local copy of the model file.

  If you are online, for any model that you select to load that is sourced from Trimble Connect, the app checks with Trimble Connect for an updated version and downloads it. This ensures you are loading the latest version.

  While online, you can also sync all or selected models before you load a model.

  - To check all models for updated versions and download the latest versions from Trimble Connect, tap in the top right of the **Quick Access** screen.

  - To check selected models for updated versions and download the latest versions from Trimble Connect, tap-hold a model to select it, then tap any other models you want to sync, then tap in the top right of the **Quick Access** screen.

See Loading a Model, page 33 for information on each of these options.

TIP – Go to the Trimble Connect website or Trimble Mixed Reality Youtube channel for more information and tips specific to Trimble Connect.

Tools, Settings, Configuration Options

Tap ▤ / ⚒ **Tools** to configure the following:

- ⚙ **Display Settings**. See Using the Display Settings, page 40.

- ☰ **Configuration**: tap to access the following -

  - **Units**: set your preferred Distance measurement unit (Metric, International Feet, US Survey Feet).

  - **Language**: Select the language you want the application to run in.

Tap **About** to view the Privacy Policy, Terms of Service, Version of the software, Subscription expiry date, and to access **Support**.

Preparing Your Data

Good data preparation is the essence of great visualization. As the Connect AR system supports a wide range of data types for a wide range of users, this section describes a range of typical workflows and discusses the benefits and limitations of different types of data and data preparation.

## About model complexity and size

Connect AR features a powerful 3D visualization engine that allows it to load and display large and complex models, reducing the burden in terms of data preparation. This reduces the likelihood you will need to section your models into smaller pieces before loading into the application.

> **NOTE** – Depending on your use case you may still prefer to organize your data by sectioning it—for example, by floor. As there is no way to occlude the display of data behind physical walls / floors, it can be confusing to see data from the level above or below. Conversely, this can also be very helpful if you want to visualize a services riser traveling up through multiple levels, or to see what is behind a wall.

There are still limitations on how much data can be rendered at any given time; this limit is dependent on the device you are using. The more modern a device is, and especially the quantity of RAM, will be the governing factor.

One of the methods Connect AR uses to improve performance is to hide any small objects that are more than 8 m (24 ft) away from the current viewing position within the model. These small objects are typically bolts, or other physically small objects, which due to their size are difficult to see from a distance. Moving around within the model dynamically redraws these small objects so you will always see them in your vicinity so that you always see all your model content within 8 m (24 ft).

In some extreme cases, typically very complex and dense models, and especially if running on an older device, Connect AR may not be able to render all the objects within 8 m (24 ft). In this situation the following banner message displays notifying you that some objects may be missing from the visualization.
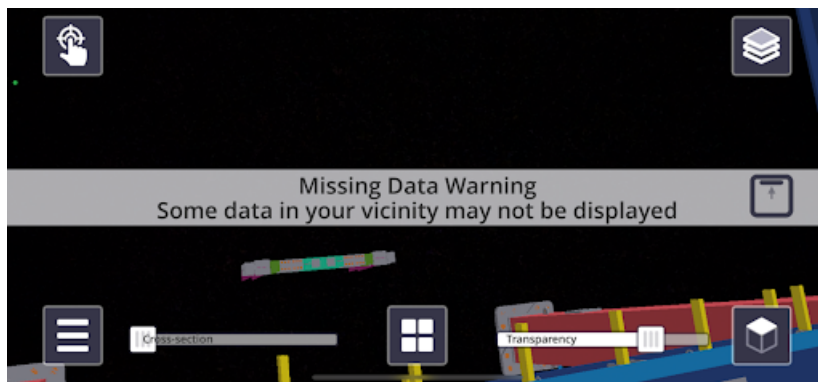
To manage this you can turn off unnecessary model data from the layers menu. As you disable each layer, Connect AR will reoptimize the visualization and once sufficient layers have been turned off that all data can be displayed, the banner message will disappear.

Connect AR has a maximum rendering distance limit. Only data within 10 km (approximately 6 miles) is displayed; data beyond this distance is not visible.

Supported 3D file formats

- IFC (2x3, MVD EM.11)
- IFC ZIP (.ifcZIP)
- IFC XML (.ifcXML)
- DWG (dwg - AutoCAD 2013 and later)
- TRB
- SKP
- RVT (Revit 2019 and later)*
- Tekla (.tekla)
- NWC
- NWD
- TFLX (Trimble FieldLink), page 25

* Revit files can be added to the project on the project page in Trimble Connect for Windows, or using the Trimble Connect for Revit add-in. Note that the Trimble Connect for Revit add-in gives you more control over the views and other upload settings.

IFC (2x3, MVD EM.11)

The IFC file extension is an Industry Foundation Classes file. The IFC-SPF file format is:

- developed by the buildingSMART organization, a worldwide not-for-profit organization driving change in the Building Construction industry.
- used by Building Information Modeling (BIM) programs to exchange models and designs of facilities, buildings, and other infrastructure.

IFC exports are available from most leading CAD / Modeling software such as SketchUp, Revit, AutoCAD, AECOsim Building Designer, and Tekla.

- When preparing your IFC file, consider the layering system you use. When an IFC model is exported from a model authoring package it will contain layers. Connect AR will sort model elements into layers based on the IfcPresentationLayerAssignment entity.
- It is important to define the correct mapping settings within your authoring package before performing the IFC export or these layers may not contain useful information.
- When exporting from Autodesk Advance Steel, Trimble recommends using IFC MVD EM.11.

DWG (AutoCAD)

DWG is a proprietary binary file format used for storing 2D and 3D design data. It is the native format for several CAD packages notably AutoCAD (and its variants). In addition, DWG is supported non-natively by many other CAD applications.

- Connect AR supports DWG versions up to version DWG 2018.
- Connect AR does not support DWG Civil extensions.
- Connect AR has very limited support of geometry generated using ARX extenders and it is suggested to avoid using them in the import model if at all possible.
- To ensure correct model scaling, you should define the INSUNITS parameter in the DWG file to specify the intended unit dimensions.

- If the Trimble Connect import fails, the DWG file might be corrupted. Try running the AUDIT command in AutoCAD to detect and fix any errors.

TRB (TrimBIM)

TrimBIM (.trb) is a Trimble proprietary file format for efficiently storing 3D BIM geometry and attributes with in-memory fast random access. It is not a replacement for IFC or any other formats, but a more intelligent way to access model data. TrimBIM speeds up BIM processes significantly.

There are several ways to convert your model to .trb format:

- From Trimble Connect Desktop
- From Trimble Quadri

See below for details on each of these options.

Converting data from Trimble Connect Desktop

For data on Trimble Connect, the Trimble Connect Desktop application can be used to generate a .trb file.

> **TIP** – By selecting and viewing multiple models, this workflow can also be used to combine these models into a single TRB file. Additionally, any filters you apply within Trimble Connect Desktop will be preserved during this export. This allows you to export a specific subset of model elements based on the embedded model attributes.

1. Load your model in Trimble Connect Desktop.
2. In the **MODELS** panel on the right, click the **Export current 3D view as TrimBIM model** button (highlighted below).
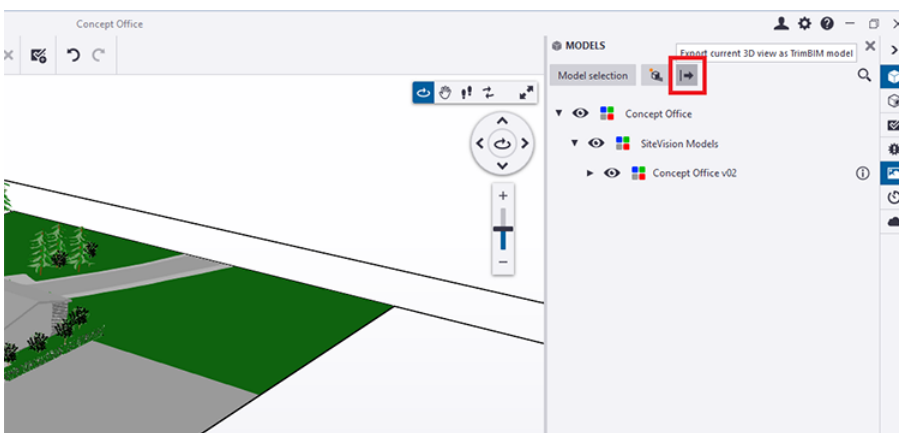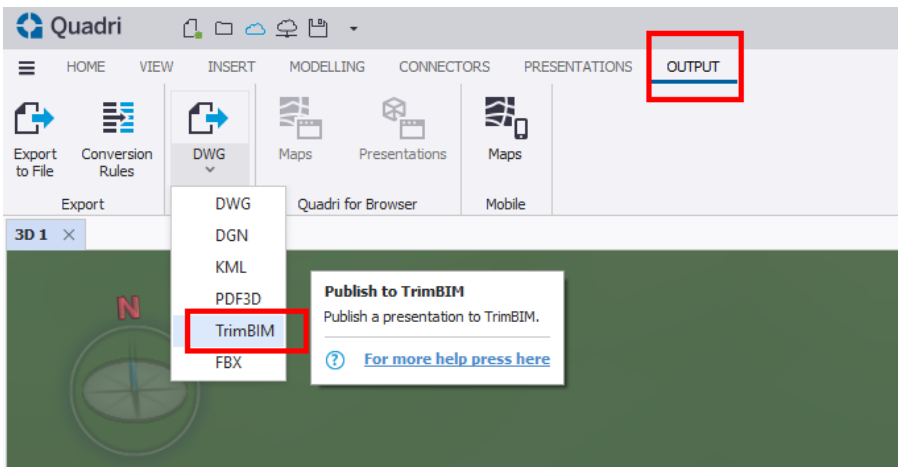

3. Copy the .trb file to your device. You can then load it with the **My Files** workflow.

Converting data from Quadri

For data on Quadri, a .trb can be generated as an output from any 3D Presentation Task.

1. Create a 3D Presentation Task containing the model data you require.
2. Select the **Output** tab of the 3D Presentation task, then from the **Publish** ribbon select the **TrimBIM** option.

3. Confirm the settings, select your preferred output location from the list of options in the **External Delivery** dropdown, then click **Finish**.
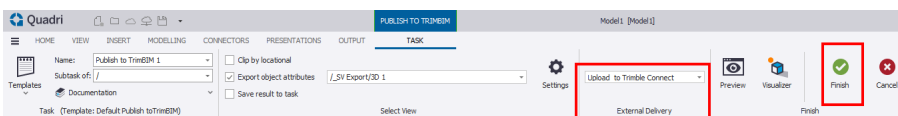
4. Copy the .trb file to your device. You can then load it with the **My Files** workflow.

SKP (SketchUp)

Trimble SketchUp is a highly versatile 3D modeling software that generates 3D models in the .SKP format. When preparing your SketchUp models for use with Connect AR, note the following:

- For best visualization in Connect AR apply material textures to individual object faces.

- Do not create multiple surfaces at the same location, such as two different faces on a wall. When models with two surfaces in the same location are drawn by Connect AR the display engine will try to draw both surfaces and their assigned colors which will result in flickering of the model in the area of that surface.

- Organize your model by using components. You can create a component by selecting an object and right-clicking to access the **Create Component** function. Organize your components by Tags to allow simpler selection / viewing in Connect AR. Connect AR will sort model elements into layers based on the SketchUp Tag.

- To display attributes you must be using SketchUp Pro. From the Components created right-click on your component and select **Dynamic Components\Component attributes**. Then add the attributes as required.

RVT (Revit)

To publish native Revit RVT model files to Trimble Connect, you must use either the Trimble Connect Desktop application, or the Trimble Connect Revit Add-in (recommended).

The Revit Add-In is used within the native Revit program. The Revit Add-In allows for the uploading of .RVT files directly from the Revit program to the Trimble Connect platform and features useful content filtering and coordinate management options.

Download the Trimble Connect for Revit Add-In

The Revit Add-In for Trimble Connect must first be installed. Log in into Trimble Connect Web and click the **Applications** button (top right of the screen).
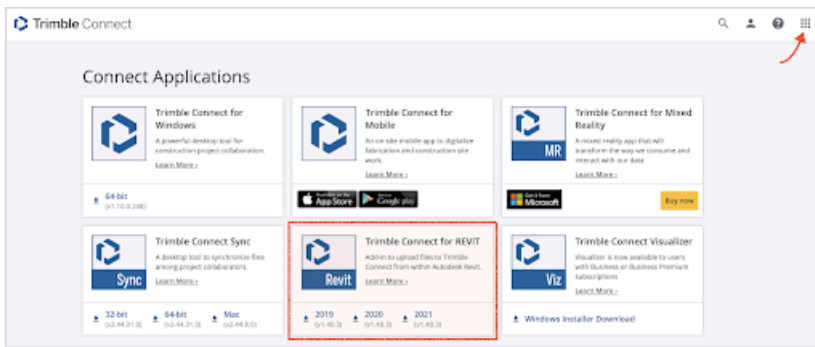
Install the Trimble Connect for Revit Add-In

1. Launch the setup.exe file in the folder where you saved the Revit Add-In.

2. Once setup is launched, proceed with the installation process.

3. Once you have finished installing the Revit Add-In, you'll be able to log in using a username and password.

4. When installed, the Add-In can be found in the Add-Ins ribbon within Revit.
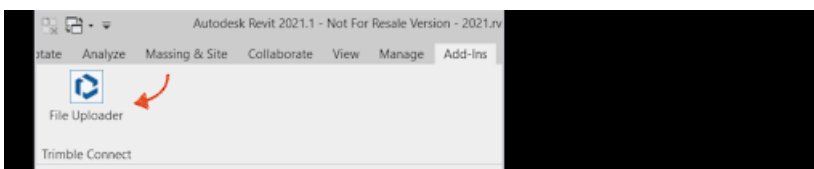

Upload from Revit to Trimble Connect

1. Create a Project in Trimble Connect Browser or Windows.

2. Start Revit.

3. Open the model.

4. Start the File Uploader Add-In.

5. Sign in with your Trimble Connect account. Select **Stay signed in** to automatically log in the next time you use the Add-In.

   The Revit Add-In will then load the Trimble Connect project directory listing.
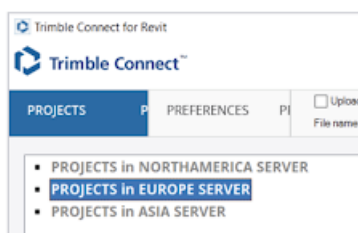
6. Double-click the project and double-click the folder that you want to upload the Revit file to.
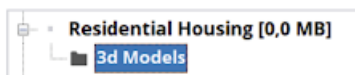
7. Select **Upload** once the folder has been selected and the uploading process will begin.

8. A message appears about the used Coordinate System. Click **OK** to continue.

   Trimble Connect automatically uploads the Revit model, and makes a viewable model by also creating an IFC model in the background, while maintaining the original filename for reference purposes.

9. Click **Close** when the process has been completed. You can now go back to the Trimble Connect platform and view the .RVT file.

Default 3D View

By default the Add-In will search for a 3D-view called **Trimble Connect**. This view is used to determine the visibility of the Viewable Model within Trimble Connect.

This behavior can be overridden by selecting **Upload model in current 3D view** before uploading:
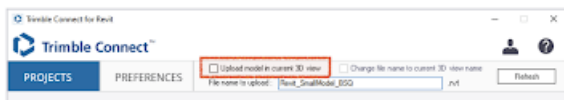

Exporting a Custom View

A custom view can also be created and uploaded to Trimble Connect. To do this, simply create / select a custom view in Revit from the **Project Browser** palette and select the **Upload model in current 3D view** option.
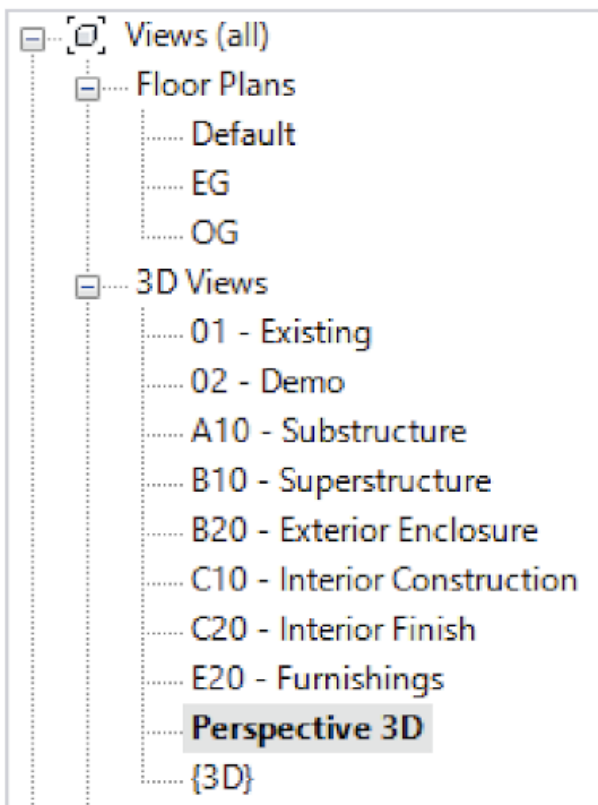
Upload Settings - Shared Coordinates

The Revit Add-In supports shared coordinates, which is enabled by default. You can change this setting from within the Revit Add-In.

1. Click the **Preferences** link (bottom left) in the Revit Add-In.

   You can also access **Preferences** after you have logged in to the Add-In.

2. On the **Preferences** screen, click **Upload Settings**.

3. Make the necessary changes.

4. Click **Save**.
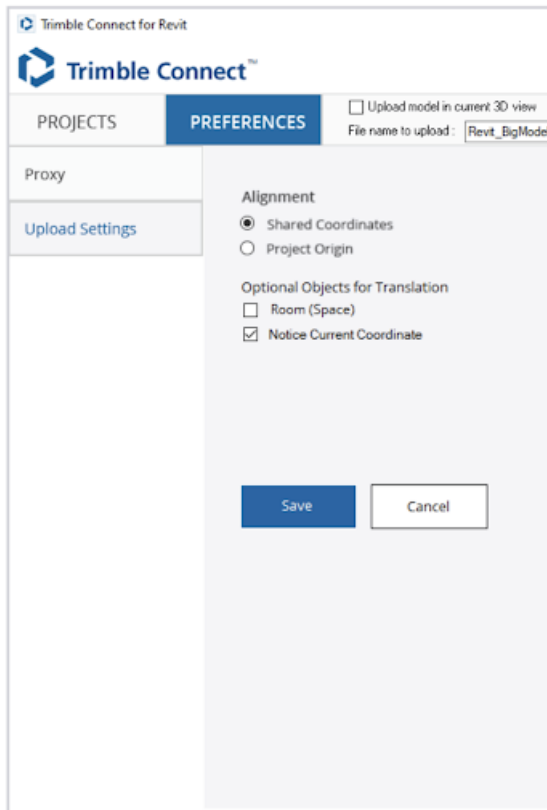
Upload Revit Files with Trimble Connect for Windows

To upload a Revit file:

1. Download the latest version of Trimble Connect for Windows from the Trimble Connect App Store and install it on your computer.

   > **NOTE** – If you already have Trimble Connect for Windows on your computer, verify you are using the latest version. Update if necessary. Version 1.9 or later is required.

2. Sign in to Trimble Connect.

3. Open your project.

4. Click **Add file** (or drag-drop) an .RVT file from Windows Explorer.
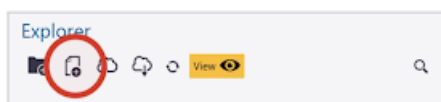
   The Revit file is added and begins assimilation in the Windows application.

Once your file has finished processing, you can then upload it to the server where it can be viewed in the Browser application.

Default 3D View

A Revit file can have multiple views in it. Trimble Connect for Windows uses the following rules to determine which view gets selected for rendering.

1. The rules are evaluated in numerical order:
2. If a 3D View called **Publish** is found, it is selected;
3. If the current **Starting View** is 3D view, it is selected;
4. If there is a 3D view matching for name {3D}, it is selected;
5. The first 3D view found is selected;
6. The **Starting View** is selected (not 3D, the same that is shown when the model is loaded to the Revit application).

.tekla (Tekla)

You can upload the current Tekla Structures model to a Trimble Connect project folder as a read-only .tekla file. The .tekla file can then be used as a lightweight reference model with Tekla Structures or any Trimble Connect product. The .tekla reference models list and visualize model objects, parts, rebars, bolts, assemblies, and grids.

Before you upload your model to Trimble Connect, note that:

- Welds and surface treatments are not included in the .tekla reference model.
- Profiles are exported with normal solid accuracy, so corner roundings are not included.
- Object colors in the .tekla reference model might be different than in the Tekla Structures model.
- To include pours and pour units in the .tekla reference model instead of cast units and cast unit parts, you need to enable pour management.

  To disable pours and include cast units and cast unit parts:

  1. Go to ...\Environments\common\system\UploadToConnect\.
  2. Copy the conf.json file to the \attributes sub-folder under the model folder.
  3. Open the conf.json file in a text editor.
  4. Change "pours" : "model" to "pours" : "false".
  5. Save the conf.json file.

In the following image, the connection on the right has been exported as an IFC reference model using Trimble Connector. The connection looks the same as in the Tekla Structures model.

The connection on the left has been uploaded to Trimble Connect as a .tekla reference model. The colors are different, and the radiuses of profiles and welds are missing.
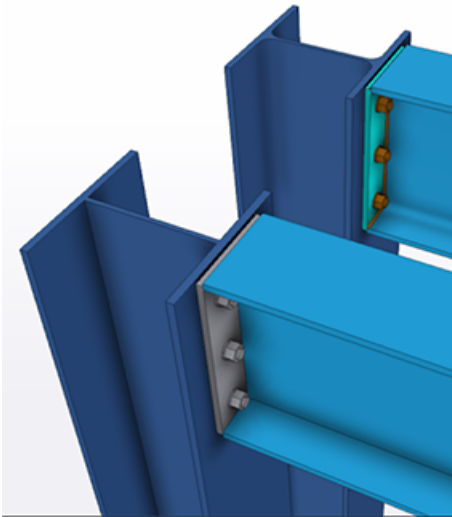
1. Select **File / Settings / Advanced options**.

2. In the **Advanced Options** dialog, find the XS_CONNECT_UPLOAD_MODEL_FOLDER option.

3. Type or paste a file path to the Trimble Connect folder where you want to upload the Tekla Structures model. The default file path is Structural\Tekla models.

4. Click **OK** to save the folder path.

5. If necessary, define which template attributes and user-defined attributes are uploaded with the model:

   a. Copy the part.epr file from the \TeklaStructures\<version>\Environments\common\system\UploadToConnect folder to the \attributes folder under the current model folder.

   b. Open the part.epr file in a text editor, such as Microsoft Notepad.

   c. For each supported object type, define the template and user-defined attributes using the following syntax:

   {

   "part": ["PART_POS", "NAME", "USERDEFINED.USER_FIELD_1"],

   "assembly": ["ASSEMBLY_POS", "USERDEFINED.PRELIM_ASSEM_MARK"],

   "bolt":

   ["NAME","BOLT_STANDARD", "DIAMETER"],

   "rebar": ["REBAR_POS", "NAME",

   "GRADE", "SIZE", "LENGTH", "WEIGHT"]

   "layer": ["ASSEMBLY_POS"]

   }

   Note that you cannot change the units that are used for attributes.

   d. Save the part.epr file.

6. Go to the Trimble Connect ribbon tab, and click **Upload model**.

7. To confirm saving the model and uploading the entire model folder to the attached Trimble Connect project, click **Save and upload**.

   The Tekla Structures model is uploaded as a .tekla file to the Trimble Connect project folder that you defined. If needed, you can later attach the .tekla file to your model as a Connect overlay model.

Note that if you want to move the model to another folder after uploading it, you need to do so manually in Trimble Connect.

> **NOTES** –
>
> - The **Upload model** button does not upload shared models to Trimble Connect. Instead, you can use the XS_UPLOAD_SHARED_MODEL_TO_CONNECT advanced option to select if and when a shared model is uploaded to a Trimble Connect project folder.
> - In the **Advanced Options** dialog, set the value of XS_UPLOAD_SHARED_MODEL_TO_CONNECT to one of the following:
>   - BASELINE = The shared model is automatically uploaded to the set Trimble Connect project folder each time a user creates a new baseline.
>   - WRITEOUT = The shared model is automatically uploaded to the set Trimble Connect project folder after each successful write out.
> - If you do not want to upload the model to a Trimble Connect project folder, clear the **Value** field.

NWD/NWC (Navisworks)

Navisworks NWD/NWC is a popular file format for the exchange of 3D model data.

- Developed by Autodesk
- Used by Building Information Modeling (BIM) programs primarily for design review and collaboration

> **NOTE** – Trimble Connect does not yet support web-based assimilation of NWD/NWC files. This requires NWD/NWC files to be uploaded and assimilated to Trimble Connect via the Trimble Connect for Windows desktop application.

Upload Your Navisworks File to Trimble Connect

1. Download the latest version of Trimble Connect for Windows (version 1.11 or newer) from the Trimble Connect App Store and install it on your computer.
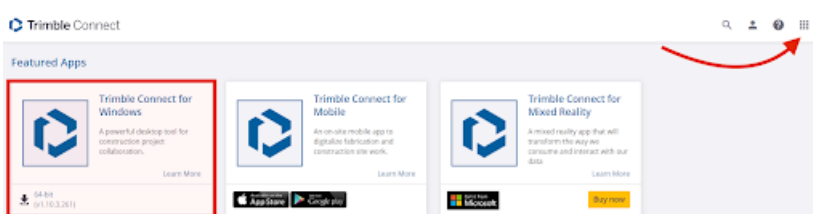
> **NOTE** – If you already have Trimble Connect for Windows on your computer, verify you are using the latest version. Update if necessary. Version 1.11 or later is required.

2. Sign in to Trimble Connect.
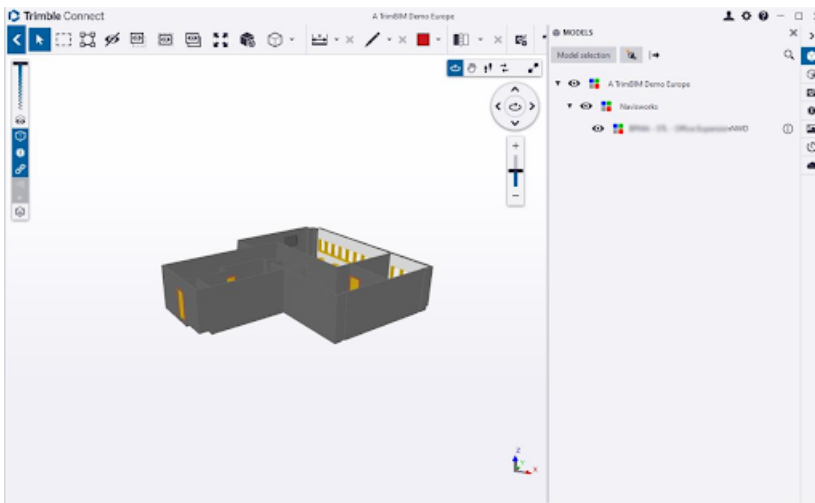
3. Open your project.
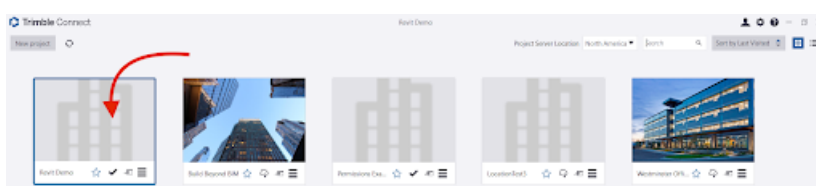
4. Click **Add file**.
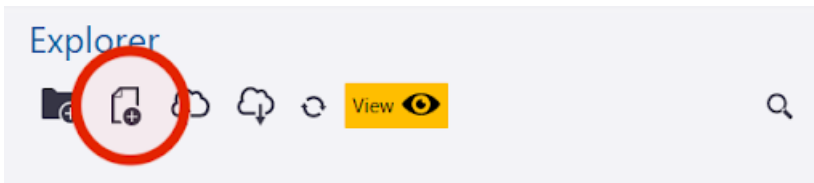
Alternatively, drag-drop an .NWD or .NWC file from Windows Explorer.
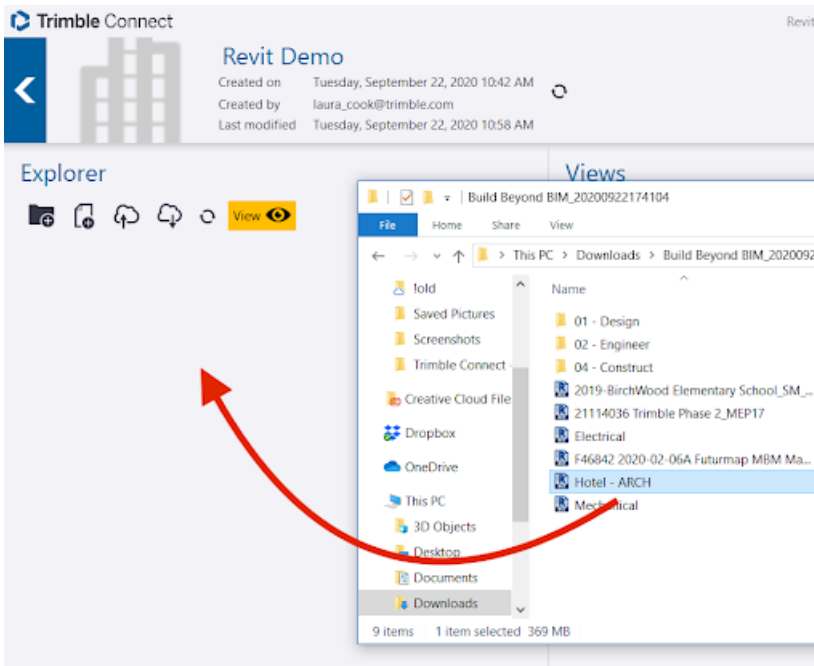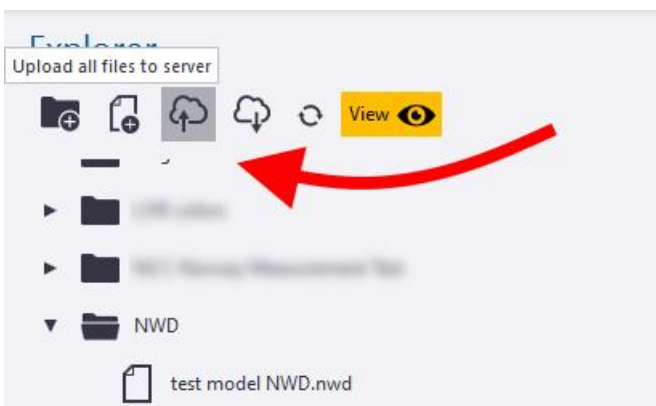

5. Using the file explorer, navigate to a Navisworks (.NWD or .NWC) file and select it.

6. Click the **View** button.

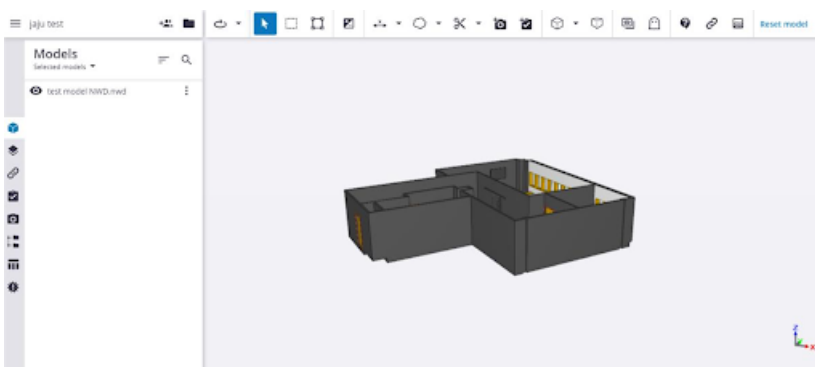7. Once the file has been processed, it appears in the 3D view.

8. Upload the file to the cloud.

View the File on the Web

1. Go to the Connect for Browser 3D Viewer in https://3d.connect.trimble.com

2. Select a model file by clicking it in the **Models** panel.

3. To view the file, click the **Load model** icon.

> **NOTE** – If the download is complete but you are not seeing your model, it may be because of the zoom level. In the **Overflow** menu, select the option **Fit to View**.
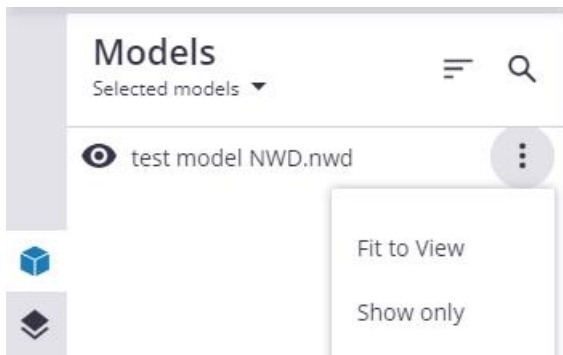
TFLX (Trimble FieldLink)

TFLX is the Trimble FieldLink project format and can contain a range of data including points, lines and arcs. These points can represent design, control, or staked points including if the point has been staked in or out of tolerance.

Connect AR supports visualization of the following categories of TFLX points:

- Points
- Lines
- Arcs

Points can be a range of types and are visually represented with the following icons depending on their type:

Visual Classification	Point Type	Image
Control	Control	⬆
Design	Design	⬤
Stake in tolerance	Design / Control	✓
Stake out tolerance	Design / Control	✕
Plane level in tolerance	Design	■
Plane level low tolerance	Design	▲
Plane level high tolerance	Design	▼

Establishing a QR Marker Network

A key workflow to enable quick and accurate placement of models on-site is to establish a QR Marker network. These markers provide a link between a known location in the model and the real world. Digital representations of the Markers are created within the model, a PDF printout of each Marker is downloaded, then installed in the corresponding real world location.

The Connect AR application has been developed with the intent that a network of Markers is established around the construction site. Once this network is established, any field user can easily use the app and position the model without requiring extensive training.

Marker placement guidelines

For best performance, Trimble recommends installing markers on a flat, vertical surface such as a wall or column. Sloping or horizontal placement of markers is supported, however a lot more care is required when installing a sloping or horizontal marker to ensure the marker alignment is accurate.

- The markers should be flat, and securely fastened on all four corners. Any wrinkles or curvature of the marker may adversely impact model alignment.
- The markers can be laminated to provide protection from water / dampness.
- To ensure optimal performance, Trimble recommend placing Markers with as much clear, flat space around them as possible, as opposed to right at the edge or corner of a surface.

Immediately after scanning a Marker to place a model, the model should be very well aligned and accurately located. However as you move around, and the further away from the marker you get, you will see the digital model will drift out of alignment with the real world. This is completely normal, and reflects the present limitations of this type of visualization technology. The extent of this drift will vary depending on the device you are using—the more recent the device model, the less drift you should expect to see.

To manage this drift, it is recommended to establish a network of Markers around your jobsite. These can be placed in critical locations, service risers, plant rooms, or more generally around the jobsite depending on your needs. As a general guideline Trimble recommends operating within 5 to 10 meters (5.5 to 11 yards) of a Marker, so Markers placed every 10 - 15 meters (11 - 16.5 yards) should prove sufficient.
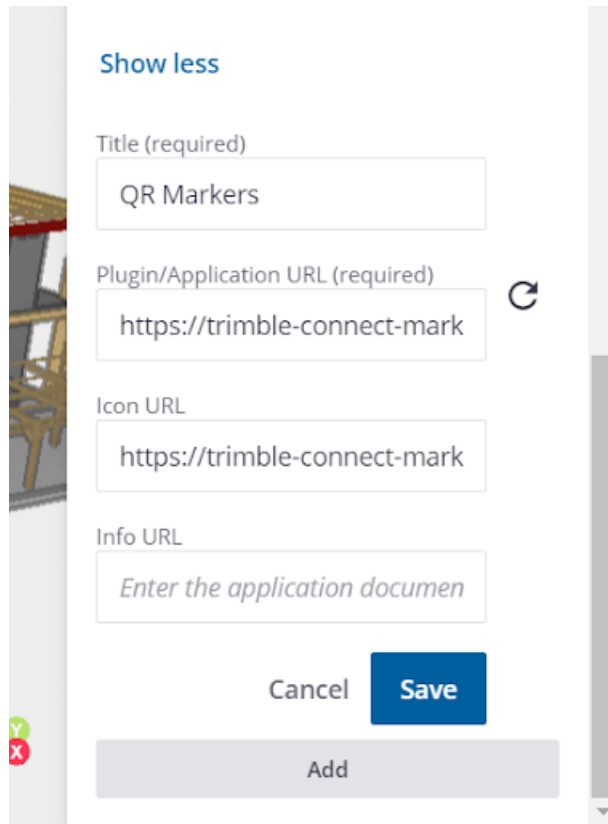
Installing the Trimble Connect Marker Extension

Markers are created and managed within Trimble Connect Web, using the Trimble Connect Marker extension. Whoever is responsible for creating and managing the Marker network will need to install the Trimble Connect Marker extension.

1. Load your 3D model in Trimble Connect.
2. From the right end of the ribbon menu, select **Settings / Extensions**.
3. Click **Add**.
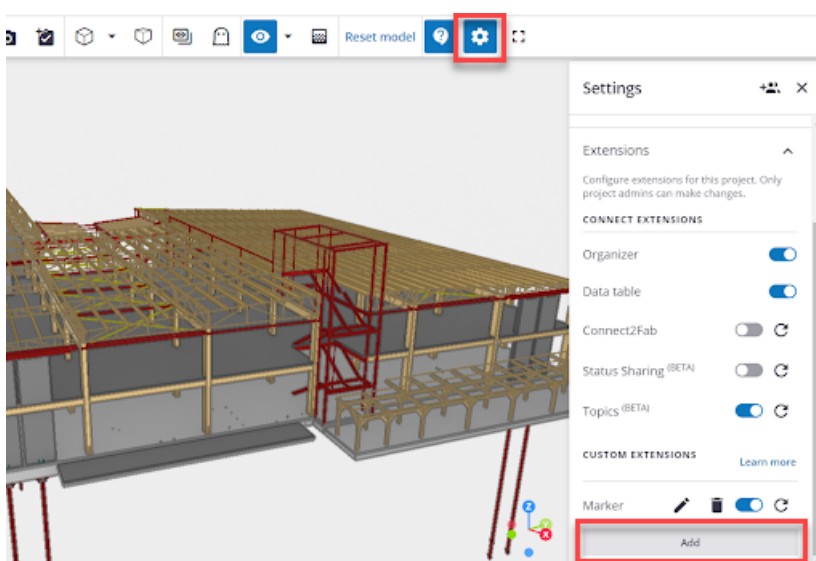
4. Click **Advanced** to open the additional input fields, and enter the following:

- **Title**: QR Markers
- **Plugin/Application URL**: https://trimble-connect-marker-authoring.trimble.com/
- **Icon URL**: https://trimble-connect-marker-authoring.trimble.com/markerextension.png

5. Click **Add** to complete the extension installation.

Creating Markers

Once the Trimble Connect Marker extension is installed, it will be available within Trimble Connect Web when any 3D model is loaded.

1. Load your 3D model in Trimble Connect.

2. From the left panel, click the Trimble Connect Marker extension icon:
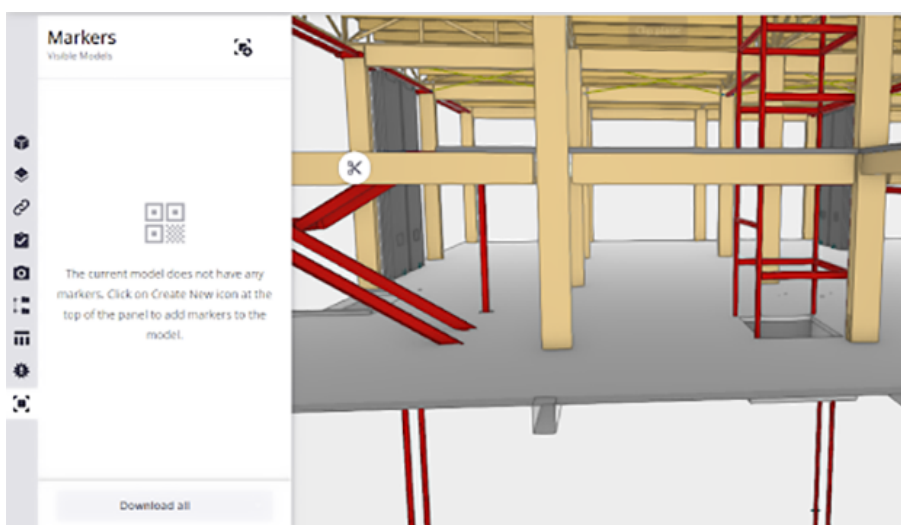
3. Navigate in the 3D view to where you want to create your Marker.

> **TIP** – It can be helpful to use the Clip Plane feature of Trimble Connect to expose interior sections of the model.

4. Click **Create New Marker** to create a Marker, then click the desired location in the model. The location you click will correspond to the **bottom left corner** of the QR code portion of the Marker.

   The created Marker appears in the 3D view, and the Marker management pane is opened automatically.
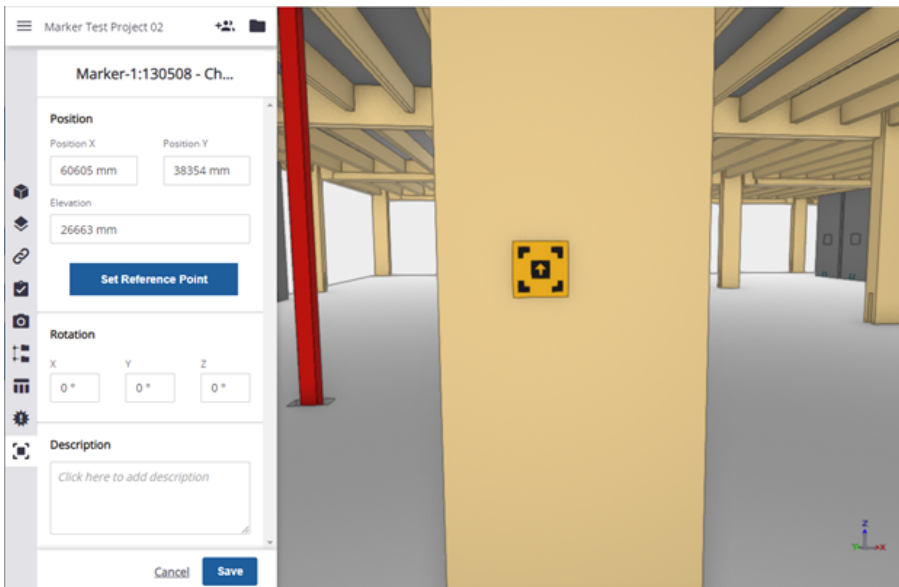
5. Here you can make adjustments to the **X** and **Y** positions or **Elevation** of the Marker in terms of your model coordinate system.

> **TIP** – Use this approach to reference known survey control points on your jobsite.

   You can also use the **Set Reference Point** feature to reference other model components to assist with accurate positioning of the Marker. When you click **Set Reference Point**, you are prompted to select a point within the 3D view; the X, Y, and Z Reference Offset values are then displayed. Manually editing these values will adjust the location of the Marker while keeping the reference point fixed. You can click **Redo Reference Point** to select an alternative reference point if required.
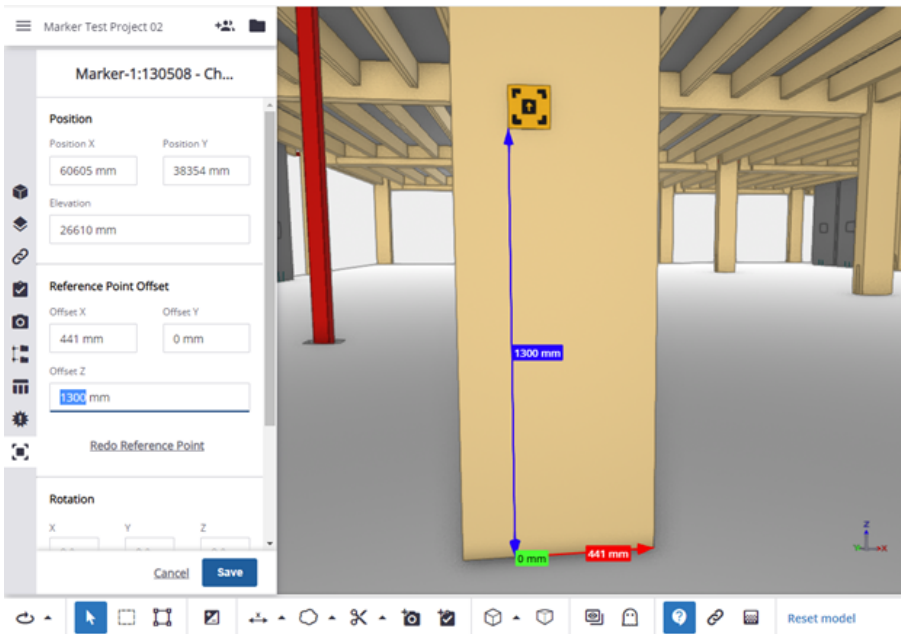
> **TIP** – Use this approach to accurately place Markers with a tape measure at standard heights / offsets to allow for easy setting out in the field.

6. Click **Save** to confirm the creation of your Marker, and return to the Marker list.
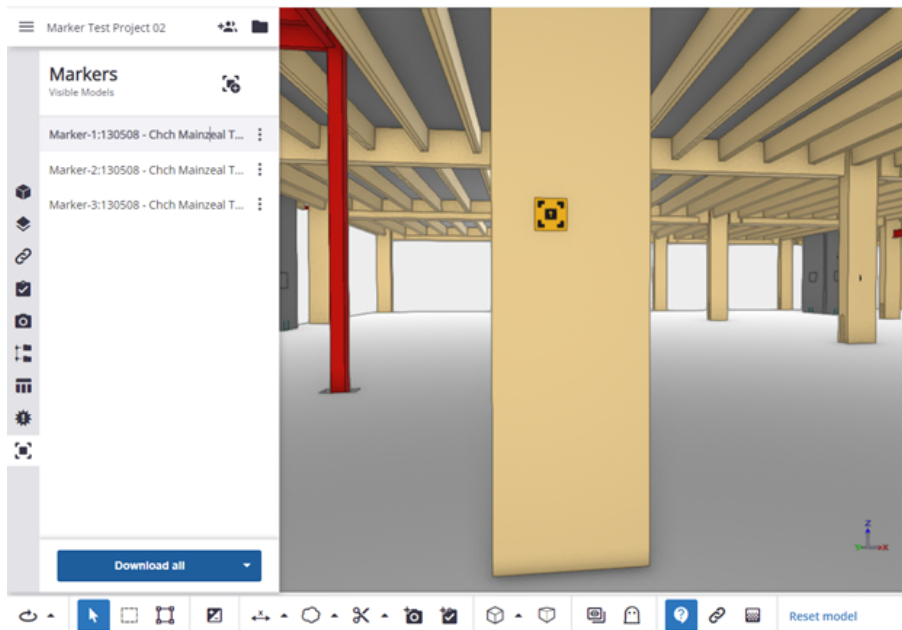

Clicking ⋮ next to the Marker enables you to Edit, Delete, or Download the Marker as a PDF.

Installing Markers in the Field

When you have created all the Markers you require in Trimble Connect, you must install the Markers in the field.

1. Download and print the Marker PDFs. The **Download all** button is a useful shortcut if you are managing a large number of Markers.

   IMPORTANT - Ensure when you print the markers that there is no page scaling applied. The Markers must be printed at 100% size.
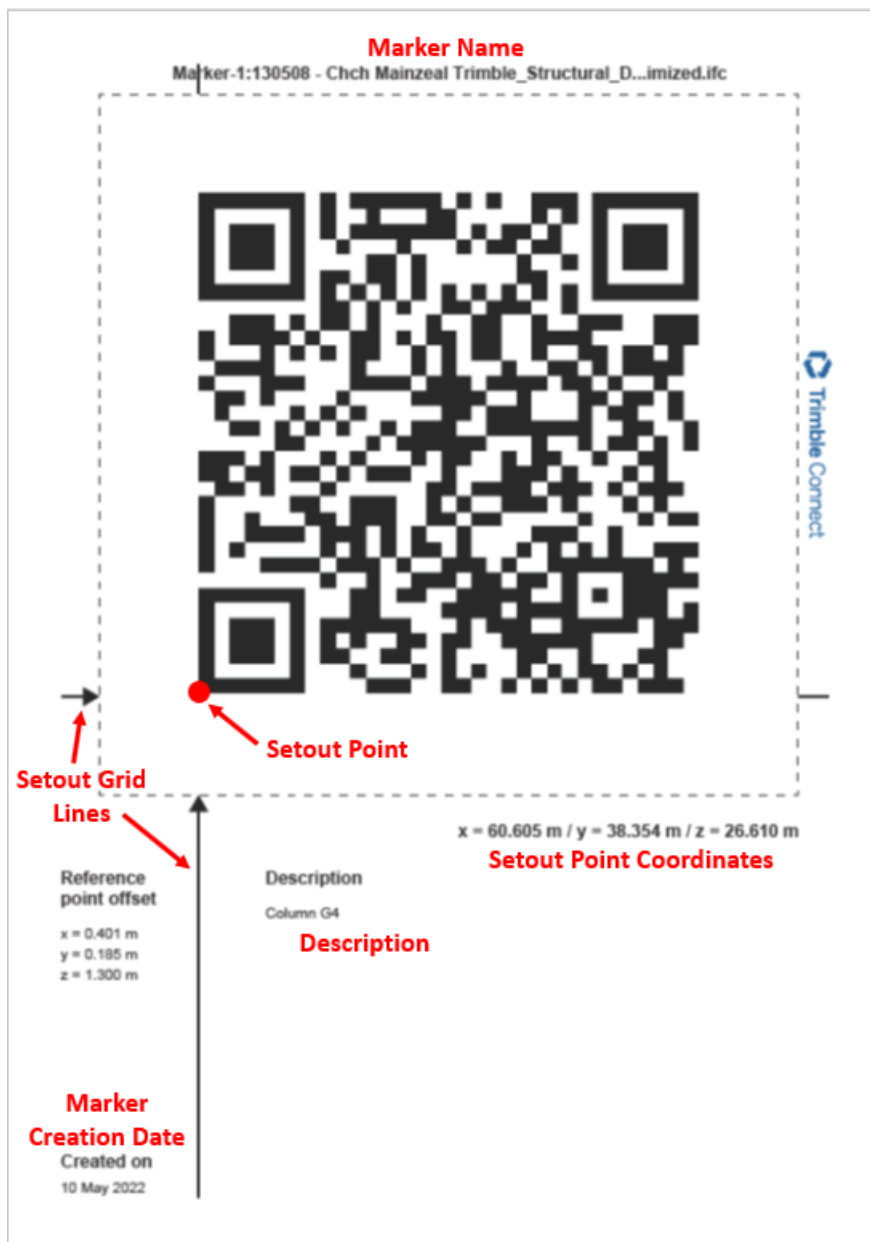
   The Marker printout contains **Setout Point** coordinates which correspond to the location of the lower left corner of the QR code. These coordinates are expressed in terms of the parent model coordinate system. The Marker printout also features **Setout Guide Lines** to assist with aligning the Marker on site. The **Reference Point Offsets** and **Marker Creation** data are also displayed.

2. Install the Marker on-site either with a tape measure, or by keying in the **Setout Point** coordinate to a Robotic Total Station or similar setout tool. Make sure the Marker is securely fastened on all four corners and sits flat on the surface.

> **TIP** – There is also an option to download a .CSV file containing all of the Marker Setout Point coordinates. This .CSV file is formatted to be imported directly into Trimble Field Points, which is used in conjunction with Trimble Robotic Total Stations to accurately position setout points with a visible laser.

Once your Markers are installed on-site, any Connect AR user with access to the project will be able to use the Markers to place any model within the project. This is important to understand as Markers are most frequently installed using structural models. As long as your other project models (such as Mechanical, Electrical, etc.) all share the same coordinate system, they will be able to be positioned using the same set of project Markers.

Markers can also be used to load the model within the Connect AR app. This is especially useful where a single federated model is being used, and enables field users to easily load the correct model without having to locate this in Trimble Connect.

> **NOTE** – When loading a model using Markers in this way, Connect AR always attempts to load the latest revision of the model (assuming it is online).

For further information on loading and placing your models using Markers within the app, see Placing a model: Marker Placement, page 36.

Using Connect AR in the Field

Before using Connect AR in the field make sure that:

1. **Your data preparation is complete**.

   > **TIP** – Before you go on-site, if you require a model that is on Trimble Connect, confirm you can access the required model by using the **Trimble Connect** option from the **Load Model** menu option. If you want to view the model while in the office, use the **Place Model / Manual Placement** option to view the model indoors. See Placing a Model, page 35 for more information.

2. **You have internet connectivity**.

   > **NOTE** – You can operate Connect AR without an internet connection but with the following limitations:
   >
   > - You must have logged into Connect AR on the device previously, while online.
   > - You must have already downloaded your model(s) from Trimble Connect while connected to the internet. See Loading a Model, page 33 for more information on these options.

Health and Safety

> **WARNING** – Viewing a screen while walking can be dangerous on any project site. Only use Connect AR in environments where it is safe to do so. Maintain awareness of the existing surroundings at all times. Failure to do so may put the operator's safety at risk.

> **CAUTION** – A hazard spotter is recommended to watch the user who is operating Connect AR in case of unexpected dangers on the work site.

As a reminder, each time you launch Connect AR you will be prompted with a Health and Safety Warning. You must tap **Accept** before using the application.

Warning

Only use this system in environments where it is safe to do so

You are responsible for maintaining awareness of your surroundings

Failure to do so may put your safety at risk

Accept
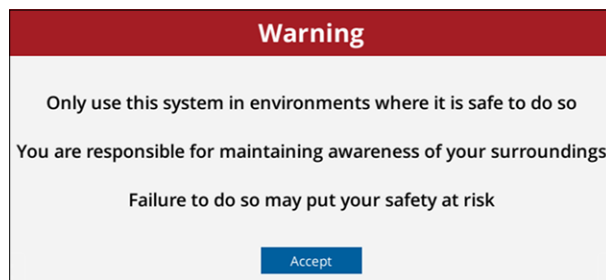
Loading a Model

In Connect AR in the field, you can:

- load a model from Trimble Connect
- load a model from a file storage location
- create a model in the field
- load a model that you have previously loaded or created on your device

> **TIP** – When working in Connect AR, various prompt messages appear across the screen. You can minimize these messages to give you a clearer view of the screen—tap 🔼.

About Trimble Connect

Trimble Connect is a cloud-based data management and collaboration platform that allows you to view, share, and access project information over the internet from anywhere at any time. Trimble Connect stores the 2D and 3D models, prepared in your office software, that are to be viewed in Connect AR.

The subscription for Trimble Connect Business is included with your Connect AR subscription. If you have separate users who will only be doing data preparation you can purchase separate standalone subscriptions for just Trimble Connect for them.

To get started with Trimble Connect, go to the Trimble Connect website.

To load a model from Trimble Connect

If you have data stored elsewhere that you want to visualize in Connect AR in the field, you must upload it to Trimble Connect:

1. Go to connect.trimble.com
2. Sign in using your Trimble ID.
3. Confirm which server you want to store your data on.
4. Create a new project for your Project Site, or select an existing project.
5. Create a new folder to store your 2D and 3D models.

> **NOTE** – You cannot upload folders to Trimble Connect from within Connect AR; you will need to upload your data to Trimble Connect via the Trimble Connect web or desktop applications.

6. Upload your models to Trimble Connect.

To load the data in Connect AR, do one of the following:

- To select the model from **Trimble Connect**:

  a. Tap ☰ / 🔷 **Load Model** / 🔃 **Trimble Connect** and select the required project folder.

  b. Find the model you want to visualize, select it and tap 👁.

  > **TIP** – In Trimble Connect, your files can be on different regional servers. The North America server is the default. Tap the menu icon in the top left of the Project Menu window to select a different server.

- If you have created Markers for a model (see Establishing a QR Marker Network, page 25) you can scan these Markers to load a model. This is particularly useful if it is not easy to locate where the model may be stored in the folder structure in Trimble Connect .

  a. Tap ☰ / ◈ **Load Model** / ⬚ **Marker**.

  b. Scan the Marker. The Trimble Connect browser opens in the app and takes you to the location where the associated model is; it is selected by default.

  > **NOTE** – If you are offline, and you had already downloaded the model in a previous session while online, Connect AR will instead take you to the model in **Quick Access**; it is selected by default.

  c. Click ⬚👁 to download the model to Connect AR.

To load a model from a file storage location

You can load a model that is stored in a number of different file storage sources, such as iCloud Drive, Google Drive, DropBox, OneDrive etc.

To use this option, you must:

- have the model stored in the TrimBIM (.trb) format. TrimBIM (.trb) is a Trimble proprietary file format for efficiently storing 3D BIM/Civil geometry and attributes with in-memory fast random access. It is not a replacement for IFC or any other formats, but a more intelligent way to access model data. TrimBIM speeds up BIM processes significantly.

- on your device, have added the required file storage source(s) to the device's File Management app so that Connect AR can access the file storage source(s).

1. Tap ☰ / ◈ **Load Model** / ▱ **My Files**.

2. Navigate to where the model is stored.

3. Tap to select the model that you want to load then tap it.

4. Tap ⬚👁 to visualize it.

To create a blank model directly in Connect AR in the field

This option may be useful for visualization or simple data collection.

> **NOTE** – **You must have an internet connection to create a new model in the field in Trimble Connect.**

1. Tap ☰ / ◈ **Load Model**, then do one of the following:

    - select **Trimble Connect** then select a Trimble Connect project. Tap ＋ to create a new model under the selected project in Trimble Connect.

    - tap ＋ to create a new model locally.

2. Enter a name for the model and tap **New**.

Models that you create in the field are automatically saved in a new folder, under the selected project; the folder name is the same as the model name that you entered when you created the model.

Connect AR creates a localized projection around you, with coordinates of 0,0,0.

You can sync data and measurements that you collect in the model to the project in Trimble Connect.

To load a model that you have previously loaded or created on your device

All models you load or create in Connect AR are available from **Quick Access**. You can see models that only you have previously loaded or created, and not models loaded or created by a different user.

Quick Access stores a local copy of model files sourced from Trimble Connect that enables you load and work with the model offline. If you are offline, you may not be loading the latest model if the data has been updated on Trimble Connect since you loaded it from Trimble Connect.

> **TIP** – This option is useful if you do not have data connectivity out in the field, or if you want to save on cellular data usage. You can download the data in the office on Wi-Fi prior to heading out to site.

1. Tap / **Load Model**.

2. If you are online, for any model that you select to load that is sourced from Trimble Connect, the app checks with Trimble Connect for an updated version and downloads it. This ensures you are loading the latest version.

3. While online, you can also sync all or selected models before you load a model.

   - To check all models for updated versions and download the latest versions from Trimble Connect, tap

      in the top right of the **Quick Access** screen.

   - To check selected models for updated versions and download the latest versions from Trimble

     Connect, tap-hold a model to select it, then tap any other models you want to sync, then tap in the top right of the **Quick Access** screen.

4. Find the model you want to visualize, select it and tap .

> **NOTE** – Under **Quick Access**, you can delete any models you no longer need to see listed here. To delete a model, tap to select it then tap . To delete multiple models, tap-hold a model to select it, then tap other models to select them and tap .

Placing a Model

In Connect AR, there are three ways to position a model on site:

- **Marker**. This is the recommended method for model placement. It requires QR Markers to be created within the digital model at known locations. Physical printouts of the Markers are then placed in the corresponding real world location. Once this Marker network is established, the model can be accurately positioned by simply scanning the nearest Marker.

  See Placing a model: Marker Placement, page 36

- **Manual**. Placement is by using gestures on the screen and the augmented reality technology on your mobile device.

  See Placing a model: Manual Placement, page 37.

- **Component**. A placement method designed for fabricators working on construction components in a workshop environment. This method includes a search feature to isolate a specific assembly or spool,

along with a 3-point placement workflow to align the model to the physical component.

See Placing a model: Component Placement, page 37.

Placing a model: Marker Placement

Using Markers is the recommended way to place your model on site. Before you can use this workflow you must have created at least one Marker in your project, and installed the physical Marker printout in the corresponding location on site. See Establishing a QR Marker Network, page 25 for more information.

1. Load the required model (see Loading a Model, page 33), then tap ▤ / ⊕ **Place Model** / 🖳 **Marker** to start the Marker Placement process.

2. For best performance, it is recommended to spend a few seconds moving around your working environment, scanning the area with the camera. This will help Connect AR learn the local environment and will improve the visualization stability.

> **TIP** – For best results when scanning your working area, look at the areas of interest with the camera, then back to the Marker, and toward any other nearby Markers you are likely to use.

3. Approach and scan the Marker. When you are close enough, the progress circle appears. Complete the progress circle by shifting side to side to view the Marker from a range of angles.

> **TIP** – When completing the progress circle, the objective is to view the Marker from a range of angles. The animation below the progress circle shows how to best do this by orbiting around the Marker from side to side, keeping the camera pointed at the Marker.

Scanning additional Markers

When you have used a Marker to place a model, you can tap the 🖳 icon to go back to Marker scanning mode. This allows you to scan additional Markers as you move into new areas of the job site, or to rescan and update Markers you have already scanned if you find the visualization has drifted.

1. Tap 🖳 in the top left of the screen.

2. Approach the Marker to be added or rescanned, complete the progress circle by shifting side to side to view the Marker from a range of angles.

Canceling a Marker Placement

When you have used a Marker to place a model, the 🖳 icon shows in the top left of the screen, indicating that you have performed a Marker placement. To cancel the Marker placement:

1. Tap-hold 🖳 in the top left of the screen.

2. You are prompted to confirm Do you want to remove your Marker Placement?. Tap **Continue** to cancel the placement.

> **NOTE** – When using Marker placement, the first Marker you scan relies on the flatness of the Marker and the surrounding surface to provide an accurate orientation. When a second Marker is scanned, the physical separation between the Markers is used to provide a more accurate orientation. However this can be adversely impacted by the visualization drift; for the best possible two-Marker placement, keep your motion between scanning your two Markers to a minimum.

Placing a model: Manual Placement

1. When you have loaded the required model (see Loading a Model, page 33), tap ▤ / ⊕ **Place Model** / 👆 **Manual** to start the Manual Placement process.

2. Navigate the plan view of your model to get the approximate location and correct orientation for the model placement.

3. Adjust the position of the model:

   - Drag two fingers on the screen to make large adjustments, and one finger to make small, fine adjustments to the model placement

   - Use the adjustment tools on the right of the screen to align the model correctly with the real world:

     ↱ **Vertical**

     ↰ **Horizontal**

     ↺ **Rotate**

   - View the model from a number of different perspectives / angles while making small adjustments to fine-tune the model's placement.

     > **NOTE** – When there is a horizontal plane within 50 cm (20 in) of the ground, a yellow icon 🔼 is visible. Tapping this icon will align the horizontal plane in the model to the ground in the real world; the icon changes to green 🔽.

4. When the model is correctly placed, tap **Finish**.

When you have manually placed a model, the 👆 icon shows, indicating that you have performed a manual placement.

Canceling a Manual Placement

To cancel the Manual Placement:

1. Tap-hold 👆 in the top corner of the screen.

2. Connect AR prompts Do you want to remove your Manual Placement?". Tap **Continue** to cancel the Manual Placement.

> **TIP** – If you have already performed a Marker-based placement, you can use the Manual Placement workflow to access the fine-tune adjustment controls. This is helpful if you have moved away from your Markers and have experienced some drift.

Placing a model: Component Placement

Component Placement is specifically designed for use by fabricators in a workshop environment. This feature includes a search to quickly isolate a specific assembly or spool, along with a placement workflow to easily align the model with the physical component regardless of its orientation.

1. When you have loaded the required model (see Loading a Model, page 33), tap ▤ / ⊕ **Place Model /** ⊕ **Component** to start the Component Placement process.

2. Search for and isolate the component you want to place by entering the associated assembly or spool ID. If more than one result is found, use the arrows to move through the different components to review the results. Tap **Next** to confirm your component selection.

   > **NOTE** – Connect AR will search all the associated attribute data in the model for an **exact match** of the ID you have entered, including any special characters. It will not show any results for partial matches.

   Once you have isolated a component from the rest of the model, Connect AR will show the component as an individual layer (see below). Use the visibility icon 👁 to make the model visible again as needed.
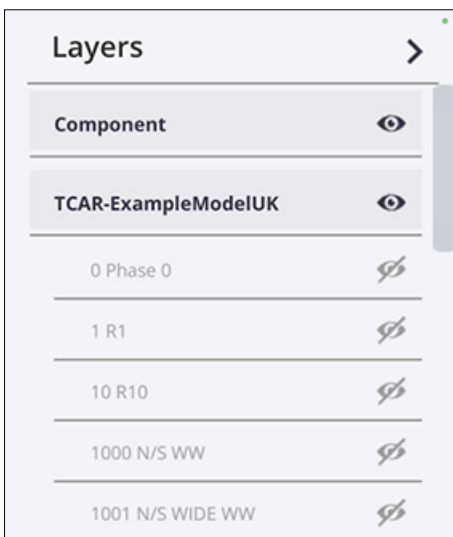
   > **NOTE** – Search uses the Trimble Connect Assembly Mode. This is applied to the highest level assemblies within your model's data structure and will group objects based on a universal assembly property. If you experience difficulty isolating components, it is likely because this assembly level information is not present in your model data. Modeling applications and formats can behave quite differently. For example, Trimble has found that Autodesk Advance Steel requires IFCs to be exported using the MVD EM.11 schema in order to capture this assembly level information.

3. If the isolated component includes a Marker within its bounds, this is detected and you are asked if you want to place the component using the Marker.
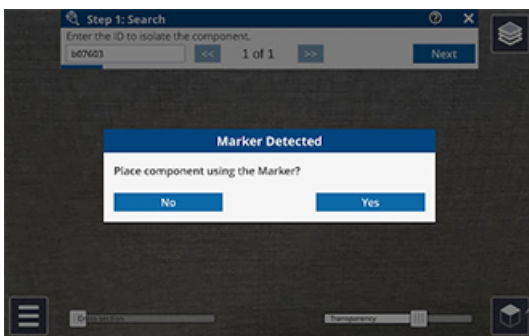
- If you tap **Yes**, you are prompted to scan the Marker; see Placing a model: Marker Placement, page 36 for instructions on how to scan a Marker.

- If you tap **No**, you are prompted to orient the model to match the physical component.

    - Drag two fingers on the screen to make large adjustments, and one finger to make small, fine adjustments to the model placement

    - Use the adjustment tools on the right of the screen to align the model correctly with the real world:

        - Vertical

        - Horizontal

        - Rotate

    - To change the orientation of the model, double-tap on the face of the bounding box. This will roll the component by 90°, towards the ground.

        You can unselect a face at any time by tapping outside of the bounding box.

4. Do one of the following:

    - If you are satisfied with the placement, tap to exit the workflow.

    - If you are not satisfied with the placement, tap **Next** to perform a **Three Point Alignment**, where you will measure three pairs of points, matching the points on the model to the points in the real world.

        a. Measure the first point on the real world component; tap the crosshairs or to measure the point. You can remeasure the point to ensure you get the correct position. Tap **Next** to confirm your real world point measurement.

        b. Measure the same point on the model. Your camera feed will switch off during this step and you will only be able to see your model.

        > **TIP** – Measurements are the most accurate when taken on a wider plane, for example the face of a beam rather than the edge. This is due to how depth is measured, and is most accurate when there is a significant surface to "see".

        c. Repeat steps **a** and **b** for the second and third sets of points, and then tap **Finish** to complete the placement.

        > **NOTE** – You can remeasure real world points after your placement is complete; tap the misaligned red point you want to remeasure.

        > **TIP** – For best results, measure the first two pairs of points along the length of the component, and the third pair across the width. Measure real world points on flat surfaces, and look at the point from different angles to confirm your point is in the correct position.

To remove the placement, tap-hold in the top left corner of the screen. This will revert the Search feature as well, so your model visibility will return to default.

Viewing a Model

Using the Display Settings

Use the **Display Settings** to interact with and view your model in different ways.

Tap ☰ / ✖ **Tools** / ⚙ **Display Settings** and use the checkboxes to show or hide the **Display Settings** tools on the main screen.

- **2D / 3D View**. When selected, the **2D / 3D View** 📦 displays in the bottom right corner of the screen. Tap to switch between views.

- **Layers** enable you to manage which details of the model you want to view at any given time.

  When selected, the **Layers** icon 📚 displays in the top right corner of the screen.

  - To show / hide any layers in your model, tap 📚 then tap the required layer(s) to show or hide them.

  - To isolate a single layer and hide all other layers, long-tap on the required layer.

> **TIP** – If you have a lot of layers you can turn them all on/off by taping the model name at the top of the layer list.

> **TIP** – You can also hide selected data in a layer; these will show as 👁 in the **Layers** manager. See Interacting with a Model's Features, page 42.

> **NOTE** – When you have an active Component Placement, your isolated component will be visible under **Component**. All of the other model layers will be turned off when using this placement method.

When you record measurements in the field, Connect AR creates a layer, under a User Measurements layer, for each app that you use. Any measurements from previous sessions of Connect AR— Points, Lines & Area, and Grade & Distance only—are also stored under a **Prior User Measurements** layer. This enables user-created data to be hidden or displayed in the 2D or 3D view of data.

- **Pit View** is an important tool to improve the visualization of subsurface models, such as utility data, or data below the floor surface—to remove the perception of the data floating. Using Pit View you can set the Pit position to fixed or movable, change its diameter, depth, and shape, and choose options to view subsurface data (round, half round, surface only).

  By default, the Pit displays 1.5 m (5 ft) below the device camera.

  When selected, the **Pit View** information displays on the right side of the screen:

> **TIP** – Use the following gestures to adjust the diameter and depth of the Pit: pinch to expand / reduce the radius of the pit, and use a two-finger swipe up / down on the screen to change the depth of the pit.

  The lines on the Pit View wall are displayed at the following distances, depending on the Distance measurements units you set:

  - Metric - thick line interval = 1 m, thin line interval = 10 cm.
  - International Feet - thick line interval = 1 ft, thin line interval = 1 in.
  - US Survey Feet - thick line interval = 1 ft, thin line interval = 0.1 ft.

- The **Transparency Slider** enables you to change the opacity level of the model, allowing you to compare design to existing.

- The **Cross-section Slider** enables you to section through your data from your current position, to the extents of your data. This is useful for visualizing inside of large structures such as buildings or houses, as well as comparing designs to the existing ground. The cross-section is always perpendicular to the direction in which you are looking.

- The **View Distance Slider** enables you to section through your data from the furthest extent of your data, back to where you are currently standing. This is useful for visualizing large models where objects at a distance can cause confusion and it is helpful to remove those portions from view by reducing the viewing distance. Using the View Distance Slider to turn off information that is outside the area of interest can also improve the responsiveness of the system by eliminating the need to draw items that are outside of the area of interest.

- Using the **Overlay Lines** option, you can choose **None**, **Grid Lines**, or **Contours** to improve the display of model objects in 3D view. The lines are displayed at the following distances, depending on the Distance measurements units you set:

  - **Grid Lines**:
    - Metric - grid size = 1 m.
    - International or US Survey Feet - grid size = 3 ft.
  - **Contours**:
    - Metric - thick line (major contours) interval = 1 m, thin line (minor contours) interval = 10 cm.
    - International Feet - thick line (major contours) interval = 3 ft, thin line (minor contours) interval = 3 in.
    - US Survey Feet - thick line (major contours) interval = 3 ft, thin line (minor contours) interval = 0.3 ft.

- **Plan View Background**: You can change the Plan View (2D View) background color to either: None, Black, Grey, or White according to your preference. This can be particularly helpful if you receive a model where some data is in either black or white, and may be invisible against the background you have set.

- **Line Width**: Use the **Line Width** tool, to choose how lines are displayed:

  > **NOTE** – This line thickness is not applied to lines in NWD / NWC, SKP, and RVT file formatted data

    - select **World Scale** to view a line with real-world perspective; the line thickness is adjusted as it 'moves' into the distance, by the unit value entered
    - Select **Screen Size** to display a line at a constant thickness (i.e. without real-world perspective) according to the **Pixels** value entered for the line thickness (height and width).

## Interacting with a Model's Features

On the main screen, you can interact directly with a model and view the following:

- **Attributes**: You can view attribute information when in 2D or 3D View, by tapping on a part of the model you are interested in. The attributes available are a function of your model and how it is prepared.

  > **TIP** – The layer that the selected data is in is also displayed at the top of the **Attributes** window.

  When you tap a part of a model, it is highlighted to emphasize it . This may be useful when creating ToDos.

  3D View:
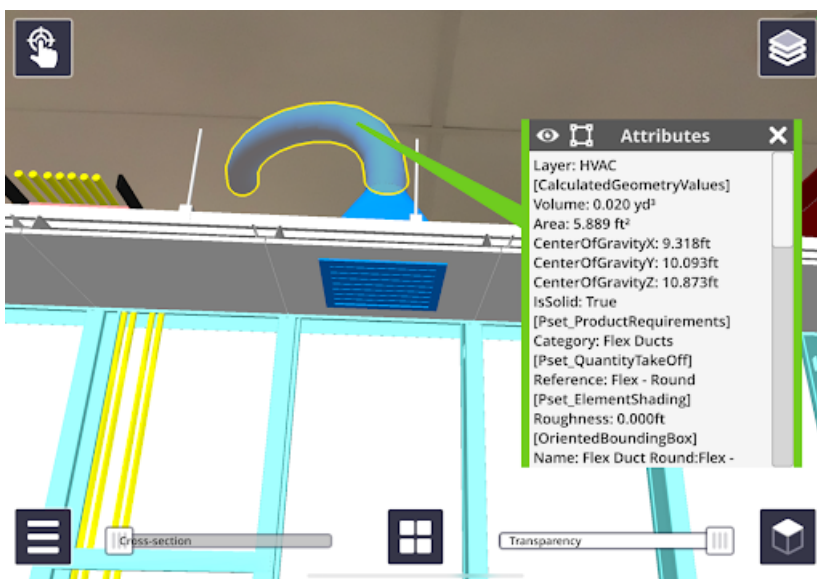
The 2D View shows attribute information, as well as your current location and orientation.

At the top of the **Attributes** window, you can use the ![eye] icon to hide a selected object. This is useful to hide data to see what is behind it.

Long-tapping ![eye] will isolate the selected object. This hides all the surrounding data leaving only the selected object visible.

When selected data is hidden within a layer, the **Layers** window shows the layer and the data that is partially hidden with ![icon] . Use the **Layers** window to turn back on hidden data.

> **NOTE** – This is not supported for any user measurements.

- **Assemblies**: If a selected object is part of an Assembly or System level hierarchy, this is indicated by the icon ⊡ at the top of the **Attributes** window. Tapping ⊡ expands the object selection to include the entire assembly or system.

> **TIP** – When viewing an assembly, the displayed attributes will also be updated to display the assembly or system level attributes.

- **Textures**: If your data model includes textures you can visualize them in Connect AR.

  > **NOTE** – Textures are not available for all data types. Their availability is determined by what the authoring software supports on export.
  >
  > - Data from SketchUp and Novapoint support textures.
  > - Data from Trimble Business Center supports textures applied through the Site and Material Manager.

Using the Apps: Reporting and Measurement Tools

Connect AR provides a number of tools that can be used alone or together in the field, to achieve things such as measuring a point, or measuring surface areas.

All measurements and design data are recorded in a .csv, with all of the positions, angles, distances, accuracy estimates, etc., and are associated with the model loaded at the time these measurements or designs are made.

NOTES –

- Any placed PDFs, or measurements using the Points, Grade & Distance, and Lines & Area apps are preserved from earlier sessions; these are stored under a **Prior User Measurements** layer.

- You cannot use the measurement tools if you have 2D model data loaded.

Before you start using the apps:

- See About Measurement Modes, page 46 for more information.

- For information on using each of the apps, see the links in Accessing the apps, below.

When you record measurements in the field, Connect AR creates a layer for each app under a User Measurements layer. This enables user-created data to be hidden or displayed in the 2D or 3D view of data. To hide / display any layers, tap then tap the required layer(s) to hide or display them. See Viewing a Model, page 40 for more information on layers.

Accessing the apps

To access the apps, tap or swipe-up the App icon (center of the main screen). The Apps carousel displays the available apps:

ToDo / Screensnap	Measure Point	Measure Grade & Distance	Measure Lines & Area	PDF
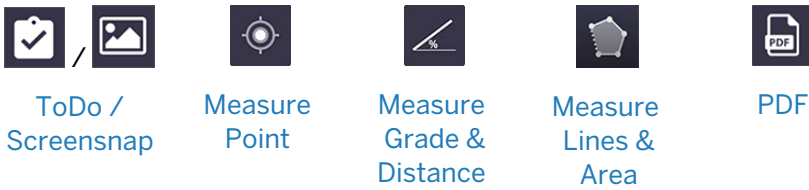
To use one of the apps, tap its icon from the carousel; it becomes the active app and is displayed in the center of the screen, replacing the icon.

> **TIP** – To select a different app, tap-hold or swipe upwards on the current active icon. All the available apps are redisplayed on the Apps carousel.

Each of the apps can be used in some or all of the following measurement modes:

- **LiDAR** or **Camera** based measurements to the Real World

- **Model** measurements to the Digital Model

See About Measurement Modes, page 46 for more information.

The active measurement mode is indicated on the active app icon, as a border around the button. For example, the Measure Point app using LiDAR based measurements will show as .

To select a different measurement mode tap the arrow to the left of the active app icon. The available modes (shown here with Measure Point + LiDAR as the active app) show as:
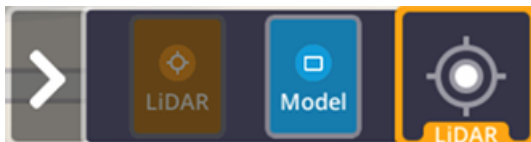
Tap the required measurement mode; the active app icon is updated showing the new measurement mode.

About Measurement Modes

The Connect AR system supports measurements between the real world and the digital model using two types of measurement modes:

- Recording Measurements to the Real World
- Recording Measurements to the Digital Model

Recording Measurements to the Real World

Real World measurement mode is shown in orange.

Real World measurements measure a point in the real world, captured in the coordinate system of the model you have loaded. The measurements are based on the technology of the device being used. For most devices this is based on visual odometry, calculating distances using camera images and sophisticated algorithms. Some more modern devices include a LiDAR sensor, which allows for much more reliable and accurate measurements. However even with LiDAR, the range tends to be limited to approximately 5 meters (5.5 yards). Connect AR will automatically detect and use the best available Real World measurement method.

> **NOTE** – Due to the limited inherent accuracy of these measurements it is not advised to use these measurements for purposes that require high levels of accuracy.

To initiate Real World measurements, tap the active measurement app (bottom center of the screen), or tap the cross-hairs.

- The cross-hairs appear as red or white, as follows:

the cross-hairs are red when...	Connect AR is unable to return a valid distance measurement (e.g. if pointing to the sky, or to some surfaces that it can't easily measure to, such as plain vertical walls with no defining features, or glass / reflective surfaces).
the cross-hairs are white when...	a valid distance measurement is able to be returned (edges of objects, or patterned surfaces will provide more reliable results for Camera based measurements. LiDAR enabled devices should perform well in most circumstances).

- Both Camera and LiDAR measurements have a limited range of approximately 5 meters (5.5 yards). Beyond these ranges it becomes very difficult to achieve a valid measurement.

Recording Measurements to the Digital Model

Model-based measurements use the Google AR or Apple ARKit functionality to measure to a point directly within the 3D visualization.

To initiate Model measurements, point the cross-hairs at the point in the model you want to measure to, then tap the active measurement app (bottom center of the screen), or tap the cross-hairs.

> **WARNING** – Due to limitations of the AR technology, positions measured with Connect AR are not warranted for survey or safety purposes. Use survey grade equipment with appropriately trained professionals if certified accuracy is required for remote measurements.

Using the ToDo ☑ / Screensnap 🖼 app

If you loaded a model from a file storage location, the Screensnap 🖼 app is available. Tap it to take a screensnap.

If you loaded a model from Trimble Connect, the ToDo app is available ☑ . A ToDo is a reporting mechanism which enables you to take and send augmented reality screensnaps and notes to a project member. When you have selected the ToDo tool, ☑ shows as the active app icon.

> **TIP** – Tap it to take a photo, or double-tap to take a photo with the Connect AR user interface.

Completing the ToDo details

- The system automatically names the ToDo but you can edit this to suit.
- You can enter a description of the task by typing it or, if supported by your device model / configuration, record using voice.
- You can assign a priority level, a classification (Type), and a due date. The classifications available are:
  - Issue
  - Clash
  - Comment
  - Request
  - Solution
  - Remark
  - Undefined
  - Fault
  - Inquiry
- The Trimble Connect user that the ToDo is assigned to can receive an email notification with the details and associated link.

  > **TIP** – Project members must be set up in the Trimble Connect project to enable ToDos to be assigned to them.

- You can take and add more photos from the details window by tapping 📷 on the right (above the **Save** button).
- The photos come through in the ToDo in Trimble Connect as attachments.

Photos taken with ToDos

To capture a photo with the AR content that is displayed during operation, the ToDo function captures images by doing a screen capture. This limits the resolution of the images to the native screen resolution of the device. Connect AR stores the following information in the image as meta data:

- What model the image is from
- The orientation

The images stored include the composite image of the AR and real world, together with the accurate position and orientation of the image, using the industry standards.

The images are stored in your device's file system and are available through your device's photo management app.

Using the Measure Point app ◉

Measure Point is used to record the coordinates of a single position. The point name, code, and coordinate information is recorded.

You can record points using Real World (Camera / LiDAR) or Model (Model) based measurements.

A measured point is shown as a blue sphere in Connect AR.

To measure a point, tap the Measure Point active app icon. The **Point Details** window displays, where you can:

- edit a point's details.

- remove a point; tap 🗑 in the bottom right corner of the **Point Details** window.

Measured points are stored as a .csv file.

Tap **Sync** to sync the .csv file to Trimble Connect or to share using third party applications (depending on how you loaded the model). See Syncing Measurements for Sharing in the Office, page 52.

Using the Measure Grade & Distance app ◢

Measure Grade & Distance requires two points to be measured, creating a line. The name, code, grade, calculated distance, horizontal distance, and vertical distance are recorded. A line is shown in yellow with the two measured points shown as blue spheres.

You can record points using Real World (Camera / LiDAR) or Model (Model) based measurements.

> **TIP** – In the **Grade & Distance Details** window, you can delete a measurement; tap 🗑 in the bottom right corner of the window.

Tap **Sync** to sync to Trimble Connect or to share using third party applications (depending on how you loaded the model). See Syncing Measurements for Sharing in the Office, page 52.

Using the Measure Lines & Area app ⬠

Measure Lines & Area is used to measure lengths and surface areas. Each measurement shows the length, total length, and surface area of the measured region. Measurements are saved in a .csv file.

You can measure areas using Real World (Camera / LiDAR) or Model (Model) based measurements.

To measure a line or area:

1. Measure the first point.

    When measuring points for a line or area, they are shown as a blue sphere.

2. Measure the second point. The yellow line is shown between the two points.

   The length between the points appears in a panel on the left of the screen, along with the current surface area defined by the measured points (0 m^2 for a straight line).

3. Continue to measure required points.

   As you measure more points, the measurements shown on the left of the screen show the length between the last 2 points, and also the total length from the first measured point to the last point and the area defined by the measured points.

   The surface area is displayed in purple.

   > **TIPS** –
   >
   > • If required, you can delete any point by double-tapping it.
   >
   > • If you need to insert a point after any previously measured point, tap the previously measured point to 'activate' it, then measure your new point. The new point is inserted after the 'activated' point.

4. When you have measured an area, tap ✅ and give the measured area a name. Tap **Finish** to save it.

   > **TIP** – To cancel the entire current line or area you are measuring, double-tap ⬟.

5. Tap **Sync** to sync to Trimble Connect or to share using third party applications (depending on how you loaded the model). See Syncing Measurements for Sharing in the Office, page 52.

Using the PDF app 📄

The **PDF tool** allows you to visualize a PDF plan or JPG, TIF, or PNG image alongside an existing 3D model or the real world. The workflow for PDFs and images is the same. The JPG, TIF, and PNG image formats can be imported, scaled, and viewed in Connect AR in exactly the same way as PDF plans.

To position and correctly scale a PDF plan or image file you will need to identify two known points in the real world that correspond to the PDF plan / image.

> **TIP** – By tapping on a PDF or image file either on your device or as an email attachment, you will have the option to **Open with Trimble Connect AR**; this automatically imports the file into the app, and adds it to the **Document Library**, ready to visualize.

1. Tap the 📄 app icon.

   • If the file you want is not already loaded into the Connect AR app, you will need to import it. You can select a file to import from Trimble Connect, your device, or some other file storage location such as

     or iCloud Drive, Google Drive, DropBox, OneDrive etc. Tap Trimble Connect or 🗁 **My Files** from the side panel to navigate to the file you want to import.

     > **NOTE** – To select a file from a file storage location, you must have added the required file storage source(s) to your device's File Management app so that Connect AR can access the storage source(s).

- If you have imported PDF or image files into Connect AR already, you can select them from the **Document Library**.

  While you are online, to ensure all data is up to date, tap ⟳ in the top right of the screen to sync all files from this **Document Library** with Trimble Connect. Alternatively, tap-hold a file to select it, then tap other files to select them, then tap ⟳ to sync just the selected files.

  > **NOTE** – The **Document Library** shows all the files imported to the device, including from previous sessions.

2. Tap 👁 to continue.

   > **NOTE** – When you select a file to place, and that file is from Trimble Connect, if you are online the file is synced automatically with the latest on Trimble Connect.

3. Scroll through the page preview and tap to select the specific page you want to visualize.

4. Select the first known point on your plan by zooming and panning to position the crosshairs at the correct location. Tap **Select** to confirm the point selection.
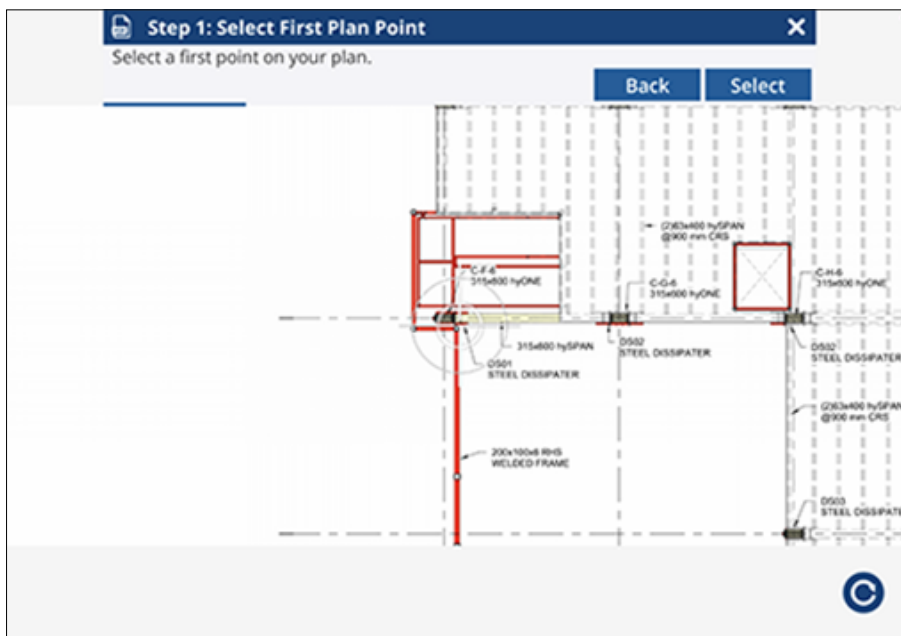
> **TIP** – The ↻ button in the lower right corner will rotate the file if it has not been loaded with the correct orientation.

5. Navigate to the first known point. Measure this position using either a Real World (Camera / LiDAR) or Model (Model) based measurement. The height of this first position is used to determine the height at which the file will be placed (the height of the second point that you will measure in the next step is ignored; the file is placed flat / horizontal).

6. Repeat the previous two steps to select and measure a second known point. After measuring the second point the file will be placed in the 3D view at the correct scale and location.
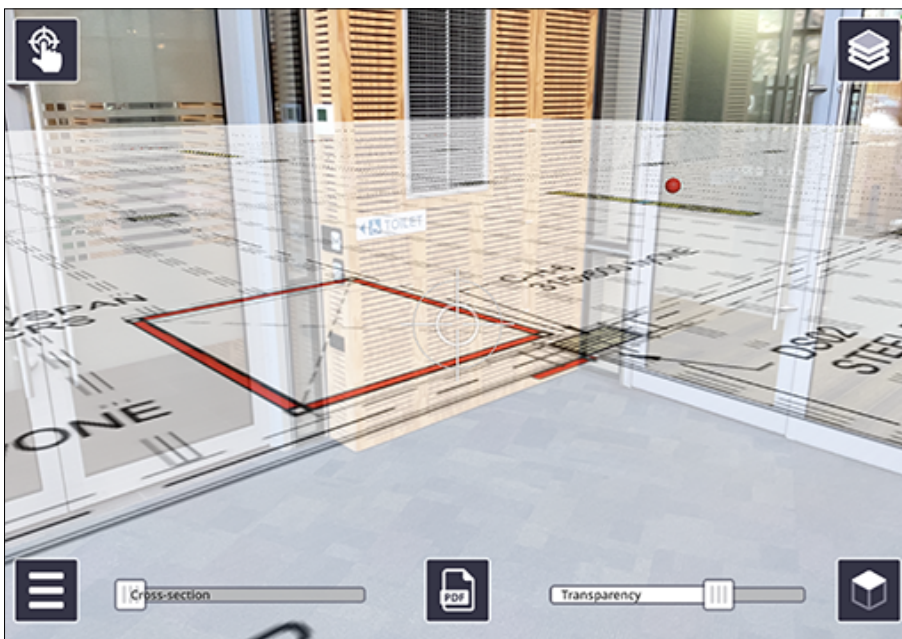
> **TIP** – When selecting two points to use to position the file, Trimble recommends that you select points that are far away from each other to provide a good baseline and ensure accurate positioning and scaling.

Multiple pages from the file can be loaded and displayed in this way. Each page will be displayed within the Connect AR layer manager, and visibility can be toggled like any other layer. Each page is stored as a separate layer—e.g. if you place 3 pages from a single file, 3 separate layers are created, indicated by <PDFname> + (<page number>).

Any placed files from previous sessions of Connect AR are stored under a **Prior User Measurements** layer.

Deleting files from the Document Library

You can delete files from the **Document Library** if required.

- To delete a single file, tap to select it then tap ⬜.

- To delete a number of files, tap-hold a file to select it, then tap other files to select them, then tap ⬜.

Viewing Measurements

After taking measurements, you can view and interact with these in Connect AR.

Any placed PDFs, or measurements using the Points, Grade & Distance, and Lines & Area apps are preserved from earlier sessions; these are stored under a **Prior User Measurements** layer.

- A point measurement is shown as a blue sphere by default.
- A measured area is shown with blue spheres for the measured points, yellow lines for the lengths, and purple for the surface area.
- A measured volume is shown with blue spheres for the measured points, yellow lines for the perimeter, and dark blue for the volume.
- A grade & distance measurement is shown as a yellow line with the two points shown as blue spheres.

> **TIPS** –
>
> - For placed PDFs, Point, Grade & Distance, Lines & Area measurements, tap the measurement on the screen to view its attributes. The **Details** window displays.
>
>   In the **Details** window, you can delete a measurement; tap 🗑 in the bottom right corner of the window.
> - Turn off the layers in the model to view only the measurements.
> - When you record measurements or designs in the field, Connect AR creates a layer for each app under a User Measurements layer. This enables user-created data to be hidden or displayed in the 2D or 3D view of data. To hide / display any layers, tap 📚 then tap the required layer(s) to hide or display them. See Viewing a Model, page 40 for more information on layers.

Syncing Measurements for Sharing in the Office

Connect AR has many apps that generate or record data which you can share for use in the office.

- For data that is measured for models that were loaded from Trimble Connect, the data is synced back to Trimble Connect.
- If you loaded a model using the **Load Model / My Files** option, you cannot sync to Trimble Connect; instead the data is available to share using third party applications such as your email app, Google Drive, iCloud Drive, or any file storage solution you use.

Each time you sync your measurements, files storing the results—whether on Trimble Connect or locally—are updated to the latest version of the files on your device.

> **TIP** – In Trimble Connect, you can see an earlier version of the file using the **History** function.

To sync your measurements once you have completed them:

1. Tap and confirm the name in the **Sync Measurements** window.

2. Tap **Sync**.

> **TIP** – Tap-hold **Sync** to rename the .csv file.

> **NOTE** – Any placed PDFs, or measurements using the Points, Grade & Distance, and Lines & Area apps are preserved from earlier Connect AR sessions; these are stored under a **Prior User Measurements** layer.

Troubleshooting and Tips

Contacting Support: Sending a Connect AR log file

If you need to send a Connect AR log file to the Trimble Connect AR Support team:

1. Tap **Tools** / **About** / **Support**.

2. Enter the required email address to send the log files to. This could be your internal support contact, or local Trimble distributor.

3. Optionally, take a photo of the issue; tap the camera icon, focus the screen, then tap to take the photo.

4. Tap **Send email**. Select the email application to send the log files with, e.g. Gmail. The email application launches with the log files automatically attached as a .ZIP file.

5. Add a detailed description of the issue you are experiencing and then send the email.

Connect AR Camera Tracking Stability

To keep the 3D model visualization aligned with the real world, Connect AR uses visual odometry to calculate the position and orientation of the device. These calculations are not perfect, and over time the model will appear to drift away from the real world.

To minimize the impact of this drift it is helpful to understand the factors and environments that can impact stability performance. Visual odometry requires contrast and definable objects in the camera scene that can be tracked. Any lack of visually distinct features such as pointing at a blue sky, low light, repeated patterns (such as striped carpet), or busy environments with a lot of movement, can cause freezing and / or jumping in the visualization. Note this performance does vary by device make and model; as a general rule, more recent devices deliver better performance, and this continues to improve over time.

To further improve performance of the mobile device's AR system, Connect AR uses visual "anchors" to re-orientate the AR reference frame to reduce the effects of drift. Trimble's experience has been that the "anchoring" technique, while very effective for many applications, is subject to errors from mis-identification of images which results in angular jumps both in the horizontal and vertical axis. These errors tend to occur more frequently in long (more than 30 minute) sessions of continuous tracking with visual odometry.

If the AR system detects a large tracking error in its visual odometry the Connect AR application will advise you.

The recommended workflow of using physical QR Markers as a known reference point provides a quick and easy way for users to not only initially place the model, but also to quickly recalibrate when drift occurs.

Marker-1:Connect AR Sample Model.ifc

Trimble Connect

x = 2.318 m / y = 2.959 m / z = 1.230 m

Description

Print out this Marker and fix it to a wall 4ft / 1.23m above the floor.
Use the Place Model - Marker workflow to quickly position the Connect AR sample model.