BuildingPoint™

Digitization and Connected Construction

Volume Two: The Connected Field Solutions

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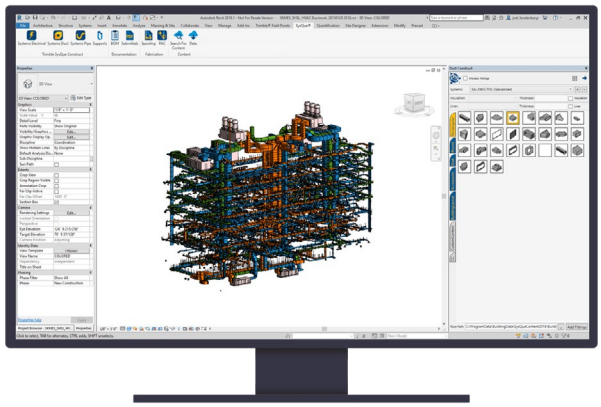
Introduction

The goal of **connected field solutions from Trimble®** is to enable every onsite person, phase, and process in the construction process to work together seamlessly.

Connected field solutions optimize the design, build, and operation lifecycle of a construction project by enabling a connected work environment. They achieve this by providing a common data platform, improving compatibility between tools, equipment, and data sources.

Field Solution Connectivity



Trimble's field equipment includes tools for field layout, 3D capture, extended reality and construction robotics. By design, Trimble's technology platform seamlessly connects all these tools and the workflows they support.

The key to field platform integration is Trimble Connect. It's the backbone, connecting all systems from the building information modelling (BIM) phase to the onsite construction in the field in both directions. Trimble Connect also includes a plug-in to exchange data with Autodesk Revit via SysQue.

Trimble Connect also is very well integrated with Tekla. The integration enables seamless transition from the office to the field and back enabling ongoing analysis of onsite construction progress.

Resolving the 3D/2D Disconnect

We've reached an awkward stage in the evolution of architecture, engineering, and construction (AEC) software tools. We're designing structures using sophisticated 3D digital models.

Then, we communicate with onsite crews by creating 2D DWG files or printing out 2D plans and drawings. Field teams then interpret stacks of 2D documentation to guide the hands-on tasks to erect a three-dimensional structure.

Trimble Connect re-engineers this process by allowing the entire project team to share data in a 3D environment throughout the design, build and operate phases of the construction lifecycle. This enables crews to view sections of the model in context, improving efficiency and accuracy while saving time in the field.

Decision-Making

Trimble Connect transforms decision making by enabling all project stakeholders to share data via Trimble Cloud and view it wherever they're working. They can access the data using a desktop, laptop, smartphone, Trimble XR10 with HoloLens 2, or augmented reality (AR) set.

Accessing data in its design context provides more accurate information, enabling more informed decisions. For example, onsite crews can share scan data they've collected.

Office staff can then bring that data into the Trimble Connect desktop and overlay it onto the project's BIM model. This enables designers and engineers to review as-built data for quality assurance directly from Trimble Connect with their desktop computers.

Similarly, engineers and architects can share their 3D BIM models. Onsite teams can then access that data and overlay point data onto a web-based model in the field.

Account Management

Your company can purchase one full Trimble Connect account to store all project information centrally. You can easily share that data with related companies, contractors and trades by arranging for them to register for free, personal Trimble Connect accounts.

Personal accounts allow users to access up to five projects. They can view BIM data, coordinate tasks, identify design clashes and access any other data your firm hosts about the project at no cost to you or to them.

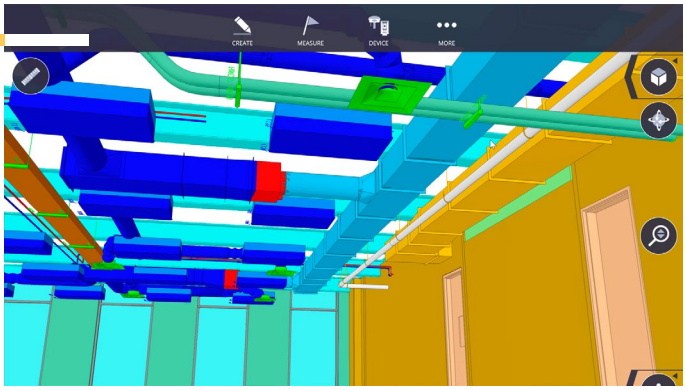
Data Synchronization

Trimble Connect enables everyone involved with a construction project to synchronize data. Information can flow from the office to the field or from the field to the office as required.

FieldLink

Onsite crews use the FieldLink application on their controllers. For example, crews performing layout tasks might be working with a simple model displaying lines and grid spacing points.

Within their application, Trimble Connect is one of the options in FieldLink under the "More" tab. By selecting it, users can access all authorized projects and then synchronize using Trimble Connect.



Crews can download the grid spacing points and the 3D model directly from Trimble Connect. The platform provides a consistent, shared data environment, eliminating the need to share USB thumb drives or send emails back and forth to exchange models and drawings.

Having laid out the required points, field staff can update the information in FieldLink. By selecting Projects>Manage and then clicking on "Save As," they can save their updates via Trimble Connect.

Trimble Connect

Trimble Connect

Trimble Connect will synchronize the update, making it available on the web. Office staff can then access and view the model, complete with the latest updates.

Having selected the model for the project, office staff can use the 3D viewer to inspect it. Using this view, they can assess the project status and determine how far ongoing tasks are from completion.

From the 3D viewer, office staff can then select Projects/Save to upload the updated model to Trimble Connect. Trimble Connect makes the model available for viewing on the web using smartphones, tablets or desktop applications, including the most recent detailed point layout data.

Common Web-Based Platform

This provides a common, web-based platform from which all project stakeholders can monitor progress. The platform enables supervisors to base project management decisions on timely access to accurate information.

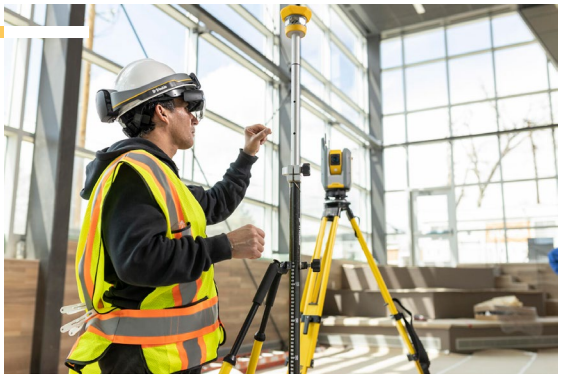
This ability to integrate and overlay 3D BIM models and scan data obtained onsite improves project management both in the field and in the office. Using Trimble Connect to manage these tasks offers a low-cost alternative to standalone review and coordination software applications like Navisworks.

Finally, once all team members have shared project updates from their perspective, they can select the "Model" tab within Trimble Connect. This exports the current view into a single Trimble BIM model.

This step integrates all models into one shared file, combining all updated project layers. Staff can reconcile and section the data to provide a more complete project view and support teams working from the model onsite.

Field Solutions

The connected field solution supports four building construction categories as follows:



- Field Layout
- 3D Scanning
- Augmented Reality (AR) and Mixed Reality (MR)
- Robotics

Field Layout

Field layout solutions involve traditional survey instruments, including:

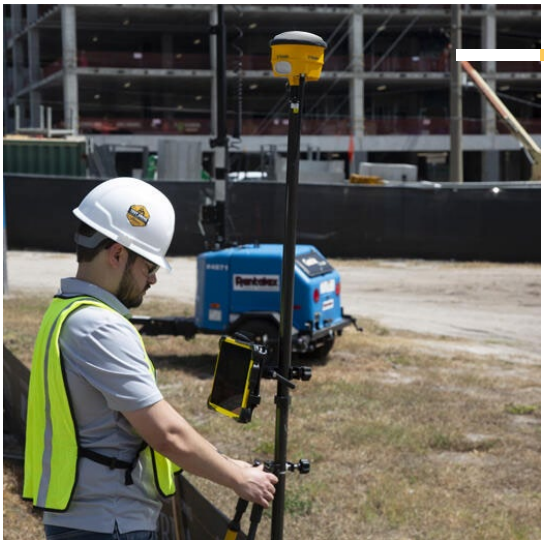
- Robotic Total Stations (RTS)
- Global Navigation Satellite Systems (GNSS)
- Rapid Positioning Tools (RPT)
- Robotic Instruments (Ri)

Robotic Total Station (RTS)

The RTS product line includes the 573, 773, 873 and 771 models. The first three instrument models with designations ending in "3" are 3-second instruments.

All of Trimble's field layout instruments are laser-capable except the 573. For projects requiring the highest levels of precision, the RTS 873 comes equipped with a focusing green laser to improve layout precision at longer ranges.

These RTS instruments support the MT1000 MultiTrack Active Target. With the MT1000, surveyors can select from eight separate radio channels provided by Trimble. Combining traditional visual locks with radio connectivity improves accuracy by reducing errors caused by reflective surfaces like safety vests.



Global Navigation Satellite Systems (GNSS)

GNSS survey instruments include the SPS986 and the R780. These tools can operate, even in remote locations, using a base and rover configuration. Both the base and the rover have a capturing device on top, which Trimble calls an antenna.

The SPS986 and R780 can also support virtual reference station (VRS) connections via Can-Net. Wherever VRS coverage is available, these instruments can deliver wireless network access, which eliminates the need for a second antenna.

VRS systems communicate digitally using cellular/internet protocol (IP) connections. Devices such as field tablets with SIM cards or personal hotpots can provide the VRS connection.

Rapid Positioning Tool (RPT)

The RPT is a relatively new, shorter-range Wi-Fi-based instrument. It performs well on smaller commercial or high-end residential projects.

The RPT is easier to use than precision layout instruments, and it's self-levelling. It can also serve as a complementary total station in cases where surveyors need to stand 150 metres or more away from a tripod-mounted instrument.

Robotic Instrument (Ri)

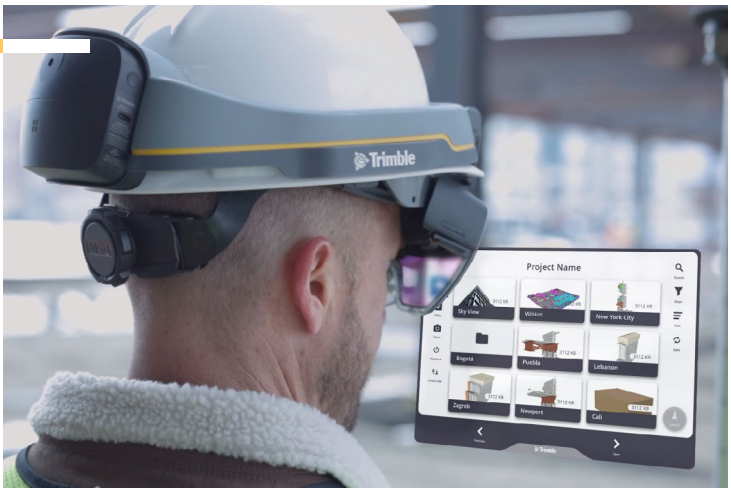
The Trimble Ri represents the next generation in Wi-Fi field location instruments. It has a longer range than the RPT, and it's more flexible and upgradeable.

The Ri makes robotic total station technology more accessible and scalable. These features can make it ideal for general contracting, concrete, and steel applications.

It's also highly scalable and adaptable, with a range of accuracies available as well as a range of upgradeable firmware subscriptions. The Ri has a red focusing laser, which functions similarly to the 873's green focusing laser.

Trimble FieldLink

FieldLink is the software application controlling all of Trimble's field instruments. As mentioned above, FieldLink exchanges data with Trimble Connect to enable the synchronization that drives the connected field solution.



FieldLink can support field layout for most formats of 2D or 3D plans or drawings. It includes plugins to support other Trimble brands, Autodesk, Tekla, and SysQue software files.

Whether your field crews work with advanced BIM or planning, design and construction (PDC) applications, FieldLink can integrate with your team's software. FieldLink is also an essential connection for incorporating RTS instruments and to synchronize data with office staff, as described above.

Field Controllers

Trimble offers two field controller models for managing layout software field data, the Trimble T100 and the Panasonic FZ-M1. The operating system for both devices is Windows 10.

As a result, any task field staff can do with a Windows 10 laptop or desktop, like accessing file sharing services or connecting to hotspots, they can do with either of our field controllers.

The T100 is Trimble's most popular field controller, because of its larger display and larger data capacity. However, the smaller, lighter FZ-M1 with its 7-inch screen can be a better option for working in confined spaces or wherever a smaller, lighter tool is more convenient for workers.

Data Management

Crews can import data into FieldLink from CAD or from digital models such as BWG, IFC or NWD. They can use this data to control layer visualization or to create new layers within models.

They can also create new views or search on model elements. They can also transform models within FieldLink. Staff can enter data from the plan, import digital PDF files or import layout points.

RTS Layout and Collect Layout

FieldLink can also support more complex layout workflows, such as sleeves, anchor bolt templates or other challenging tasks such as trench definitions, hanger runs or other difficult locations tasks.

FieldLink can also work with lines to help crews determine grid lines or stake out grid line offsets, for example. Regardless of your approach to locating onsite points or lines, FieldLink can support your team.

Field crews may collect unexplained or clashing points or set lines onsite. FieldLink can capture very precise coordinates and immediately share that data directly with office staff by synchronizing with Trimble Connect.

Special Tools

FieldLink also supports vertical alignment tasks such as columns or wall transfer points. Onsite crews can use FieldLink to determine if components are plumb or square from very long ranges.

Field workers can also work with reference elevations in FieldLink. Working with cartesian XYZ coordinates, or even using 2D data controllers, teams can set a baseline elevation such as 0 or 100, override initial data settings and transfer elevations from the baseline.

FieldLink includes a range of pattern and grid tools. These can help onsite crews reconcile data discrepancies in coordinates from diverse sources.

Intelligent Features

Connected field solutions enhance intelligent positioning capabilities through visual layout features. In some locations, such as drop ceilings for example, obstacles can obstruct a laser's line-of-sight.

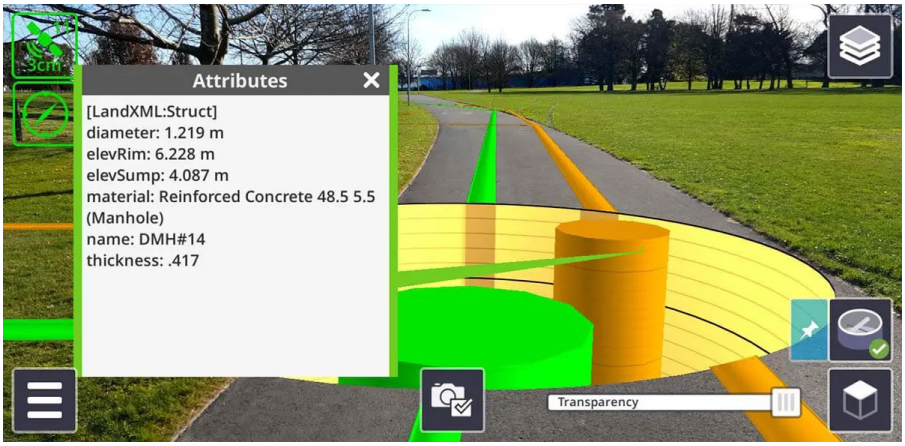
FieldLink can compensate for this by calculating the correct XYZ position based on surface height. This ensures the correct positioning of items such as hangers. FieldLink can help your teams make the most of laser technology's accuracy.

Trimble Vision

Trimble Vision enables onsite staff to work with live videos feeds from a camera on the data collector. It includes precision tools to control and aim the camera accurately.

Operators can acquire a target and simply tap to lock onto it. It also supports a range of zoom levels to help identify targets correctly.

The Trimble Vision system provides point and line overlays, enabling teams to visualize elements like hangar, anchor, or attachment points more accurately. They can capture images automatically or on an as-required basis, including panoramas of site locations.



Comprehensive Reporting

FieldLink provides standard reports that field staff can generate daily at the touch of a button. These can include full deviation reports of specific XYZ coordinates or variance reports of design versus staked positions.

Teams can also run a daily layout summary to document project progress or setup data. They can produce field or surface reports showing discrepancies and even attach photo images to clarify concerns.

Trimble X7

The X7 is Trimble's latest high-speed 3D laser scanning system. The X7 fully supports FieldLink, Perspective, Realworks and CloudEngine software applications.

Using the X7, onsite crews can rapidly capture, manage and view the scan data they collect in the field. Project teams can use this data to generate models and as-built information based on structures in place.

The rapid data collection features can facilitate renovation projects where legacy as-built documentation is obsolete or incomplete. Using the X7, crews can capture more accurate models of a structure's current state.

Scanning System

The X7 supports auto registration and auto calibration. Using a tripod mount, the X7 automatically performs a full 360-degree rotation and captures its surroundings.

Because the X7 automatically registers itself, when crews move it to other positions, it can combine overlapping location data. In some cases, teams have used this feature to combine as many as 40 site scans and then used them to build as-built site models.

This feature ends tedious note-taking and data processing and improves accuracy. Its efficiency has made many new onsite capture tasks both possible and accessible.

The X7 also has automatic calibration and leveling functions. The instrument performs a rapid self-calibration every time it powers on.

The self-calibration ensures grade level compensation and accurate measurement. As a result, scanning and reality capture take place at consistent angles, reducing the need to reconcile data with previous plans and drawings.

The X7's built-in laser pointer delivers visual confirmation of individual onsite points the team needs to measure. This helps project teams integrate onsite data with existing models.

Depending on the accuracy settings required, crews can complete scans in a matter of minutes. The X7 has only one button. Once it powers up, operators manage all scanning functions from FieldLink.

Renovation and Retrofits – Use Cases

Without an instrument like the Trimble X7, renovation projects can be challenging. For example, locating existing electrical or other utilities can involve making and recording multiple measurements by hand.

The X7 captures and records these measurements in minutes at the touch of a button, dismissing any need to scribble figures on walls, for example. It also eliminates costly errors resulting from manual methods. Because of its connectivity with FieldLink, teams can also instantly share measurement data with office staff.

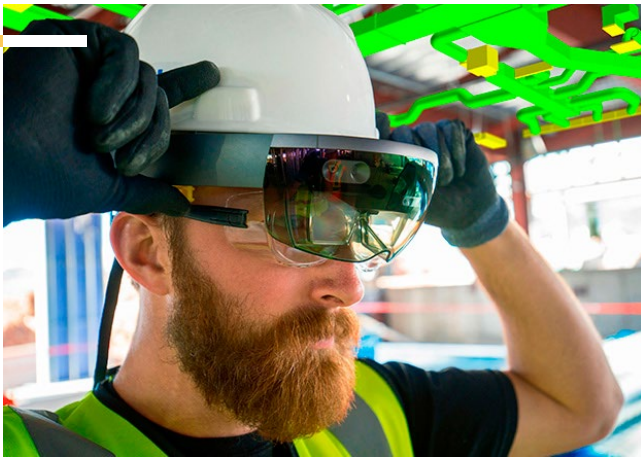
With the X7, teams can automatically capture data and critical dimensions. They can scan specific areas, check heights, verify floor flatness, or uncover any other issues with the existing structure.

Crews can use Trimble CloudEngine to detect data clashes identified by the X7 and FieldLink. This can ensure that project teams make full use of the onsite data they collect.

Extended Reality

Trimble's Extended Reality (ER) platform includes Mixed Reality (MR) and Augmented Reality (AR) tools.

The Trimble XR10 is a joint venture with Microsoft, mounting the Microsoft Hololens 2 securely to a CSA approved hard hat. It delivers real-world context to models with the accuracy of layout instruments like the X7.



Wearing the Trimble XR10 with Hololens 2, field workers can see their point in the real world and simply walk toward it while viewing the model with the HoloLens 2. It provides hands-free, onsite access to the 3D design model.

Instead of flipping through reams of paper plans, operators can see the plans overlaid on the real-world site. Viewers can compare site status to the design model to track process. They can also quickly identify clashes or discrepancies, avoiding costly rework.

FieldLink MR

The XR10 integrates with Trimble's robotic total station platform to deliver maximum accuracy. This provides full control of layout instruments in fully immersive MR.

FieldLink MR enables project managers to make decisions based on timely access to accurate information. It also allows them to proactively detect design errors or clashes and solve them earlier in the construction process.

Trimble Connect AR

Trimble Connect AR enables a "bring your own device" approach for field construction tasks. For example, onsite workers can use tablets or smartphones running either Android or iOS.

Since almost every field worker has a phone in their pocket, Trimble Connect AR is more accessible than the Trimble XR10 with Hololens 2. This enables less frequent users to perform design reviews based on similar extended reality tools.

Trimble Connect AR provides 2D or 3D overlays. Because it's accessible using a wide range of mobile devices, it can facilitate onsite discussions by overlaying design models on real-world views of site conditions for everyone involved.

Connected Field Solutions

Trimble's connected field solutions integrate leading edge instruments and applications. The solutions enable every onsite project team to collaborate more efficiently and share information with office staff in both directions.

These integrated field solutions transform the design, build, and operate lifecycle of construction projects. By supplying a common data environment and ensuring compatibility between tools, equipment and data sources, Trimble is enabling a 21st Century approach to managing onsite construction.

Featured Products:

- Robotic Total Stations: 573, 773, 873 and 771
- GNSS Receivers: Trimble SPS986 and R780
- Trimble Ri
- Trimble X7
- Trimble XR10 with HoloLens 2
- Trimble FieldLink
- Trimble FieldLink MR
- Trimble Connect
- Trimble Connect AR

Contact BuildingPoint Canada today to discuss how the constructible process can help your business deliver construction projects more efficiently, profitably, and accurately.

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