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Trimble Fabrication Workflow

Using SX12 and Trimble Access

Trimble.

Agenda

Market Overview

- **Fabrication** is the process used to manufacture steelwork components that will, when assembled and joined, form a complete frame.
- Applications:
  - Industrial (oil & gas, power & telecommunication)
  - Commercial (malls, food outlets, and retail stores, hotels)
  - Institutional (healthcare and educational)
  - Offices
  - Residential
- Versatility, sustainability, off-site fabrication, speed of construction

Technological Trends

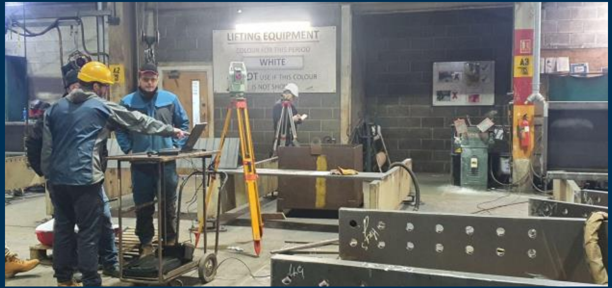
Utilising technology to optimise workflows and increase productivity

- How can they better utilise 3D data in the field
- How they connect office and the field better
- How can they reduce material waste

Process we followed

And we would like to share

1. Voice of Customer
   (Online Interviews & Customer Visits)
2. Define industry requirements & current practice
   (steel, precast, shipbuilding-steel deformation, other)
3. Map Trimble based workflow
   (SX12, Trimble Access, Trimble Connect, Tekla S, TBC)
4. Demo and get feedback from customers
   (in progress..)



Manufacturing

Inspection methods

Manual

Using Specialised Kit

Robots

Overall Observations

Overview of Process Followed

1. Design model: often coordinates are different from where the element will be fabricated.

2. Setting out process to mark locations for assembly process (e.g. location of where plates should be welded for steel, where embeds should be placed for precast, etc.) based on the design model/information.

3. Inspection process to check if all elements are in place or if anything is missing, dimensions, and deformations.

4. Report is generated but the way that this is generated can vary. In some cases it can be a heat map or individual points, or in other cases just a document where the inspector needs to fill in some boxes.

Overall Observations

Challenges of Current Practice

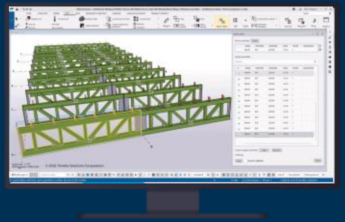
- Time consuming process to get the right data in the field (i.e. extract points and transform coordinates)
- 2D points creates lack of confidence about whether data is right and where it corresponds
- AR for visual inspection but does not offer required mm accuracy
- Many laser scanners do not offer the required data accuracy and point cloud data needs time for processing
- Inspection report (heatmap) is created in the office

Time consuming process without leveraging 3D data in the field!

Trimble Fabrication Workflow

Using SX12 & TA, Tekla S & Trimble Connect

Workflow Overview



1. Prepare your data set

Trimble Connect

Cloud platform for collaborating and sharing across project teams

2. Upload to Connect

3. Launch Trimble Access

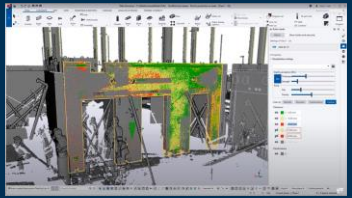
4. Load the model

(place model; establish location & orientation)

5. Visualise and interact with your data…

6. Verify, QA Inspection

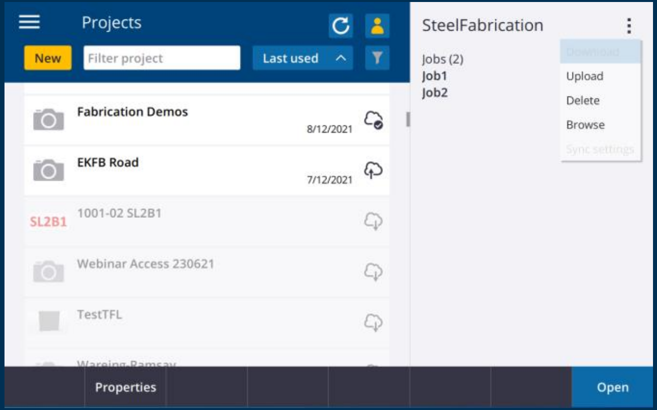
7. Save data to Trimble Connect

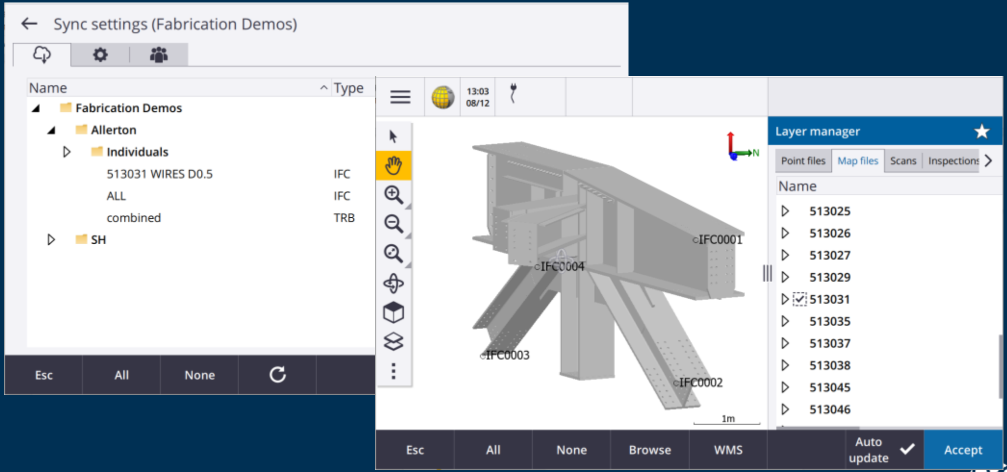


8. Use Data in the office

Loading Data

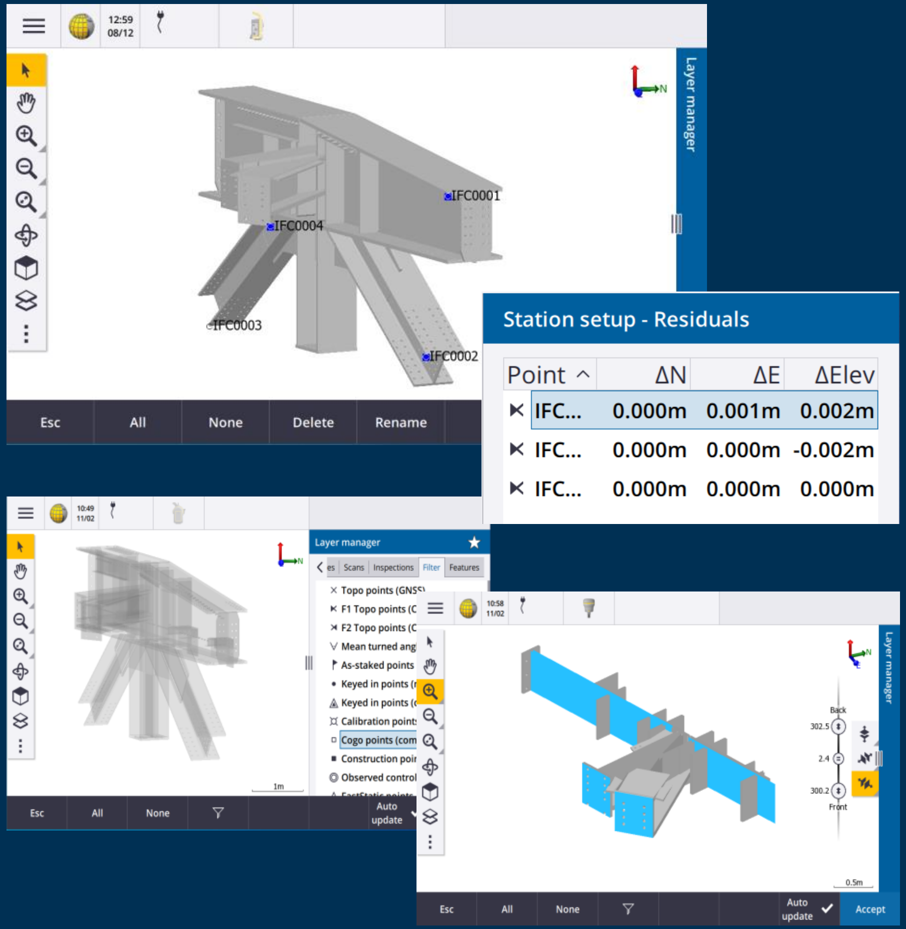
- 3D model and related files to Trimble Connect
- Load data directly on Trimble Access
  - 3D model(s) (with all properties)
  - Annotations
  - Set out points





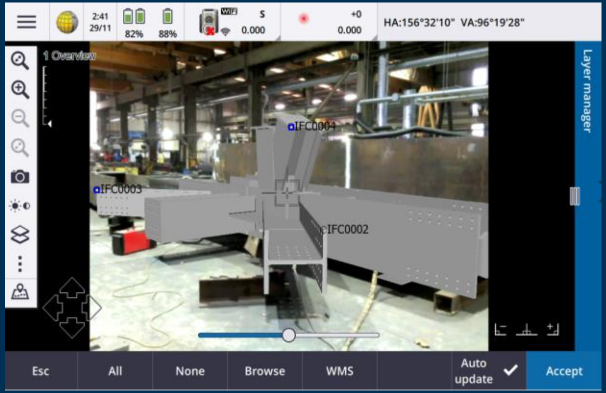
Setting Up

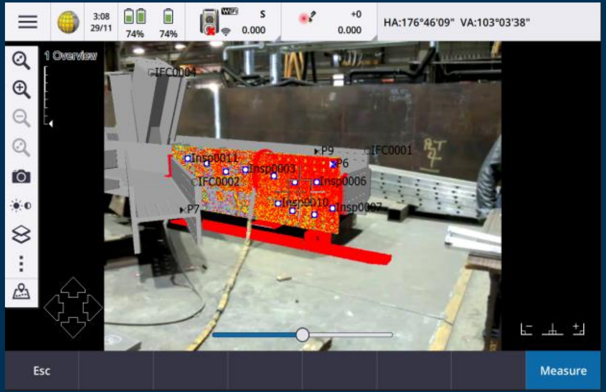
- Arbitrary coordinate system in manufacturing environment
- Object oriented set-up
- (model based registration using 3 points)
- Other capabilities
  - Wireframe
  - Limit box
  - Extract points directly from model



Setting Out and Inspection Process

- Model and instrument are aligned with the physical object
- Inspection
    - mm AR capability for visual inspection and better data interpretation
    - Individual points/scanning and extracted points
    - Prism offsets
    - Area scan
    - In field inspection (scan-to-surface) heat map (in AR too)





Reporting

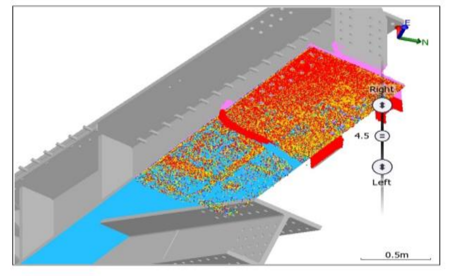
- In-field inspection report (pdf)
  - Header
  - Inspection details
  - Screenshot of the inspected area
  - Selected deviation points
- Customisable report with XML stylesheet generation

Surface Inspection Report - Job1

Operator:

Date: NaN NaN

Instrument: Trimble SX10, Serial number: 30410003



Inspection: Wall5

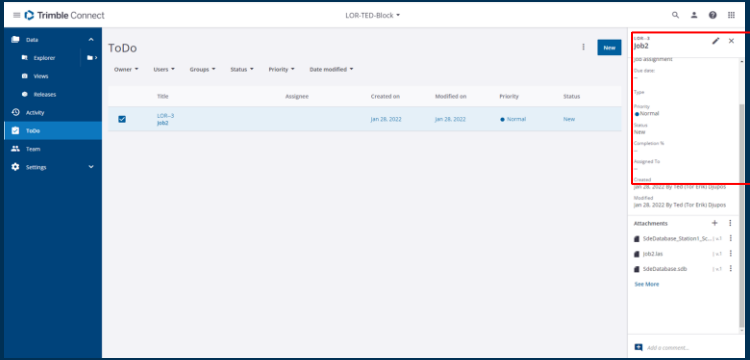
Method	Scan to surface
Reference surface	combined.trb
Selected scans	Wall3
Minimum delta	-0.194
Maximum delta	0.181
Color scale	Rainbow

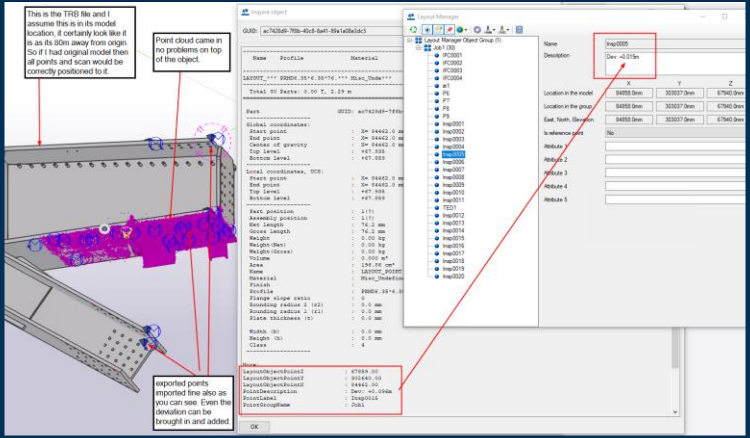
Inspection point deviations for: Wall5

Point name	North	East	Elevation	Deviation	
Insp0012	303.067	85.323	67.942		0.013
Insp0013	303.256	85.230	67.933		0.022
Insp0014	303.468	85.153	67.953		0.002
Insp0015	302.640	84.462	67.859		0.096
Insp0016	303.370	84.474	67.946		0.009
Insp0017	303.020	84.924	67.945		0.010
Insp0018	302.337	83.532	67.946		0.009
Insp0019	302.973	83.346	67.961		-0.006
Insp0020	302.575	83.809	67.940		0.015

Data upload and office processing

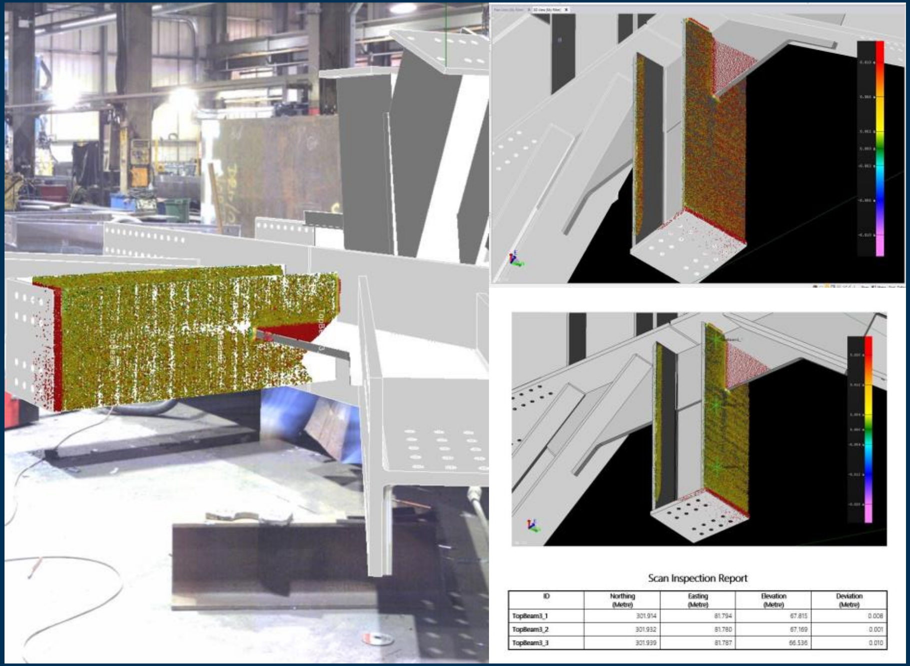
- Data upload to Trimble Connect via ToDo directly from Trimble Access
  - Point cloud
  - Survey points
  - Images
  - Other files (i.e. inspection report)
- Office processing (i.e. Tekla S or Trimble Business Center)





TBC Office Inspection

- Object oriented station set-up
- Scan-scan + Scan-model analysis and reporting
- TA Inspections
  - Reading in heat maps + point clouds regions from Access jobs
- TBC Inspections
  - Scan-scan, Scan-3D objects (IFC, TRB, Meshes and surfaces) comparisons
  - Reporting deviations/deltas



Scan Inspection Report

ID	Northing (Metre)	Easting (Metre)	Elevation (Metre)	Deviation (Metre)
TopBeam3_1	301.914	81.794	67.815	0.008
TopBeam3_2	301.932	81.780	67.169	0.001
TopBeam3_3	301.939	81.787	66.536	0.010

Workflow Advantages

1. 3D Handling and AR capability is unique for a total station! → Less error
2. Layer Handling with 3D data directly in the field → Richness of data
3. Loading data in the field via Trimble Connect → Seamless workflow
4. Tekla model is incorporated in the whole workflow → Trimble Eco System
5. Trimble EcoSystem is seamless → Productivity gain and time efficiency

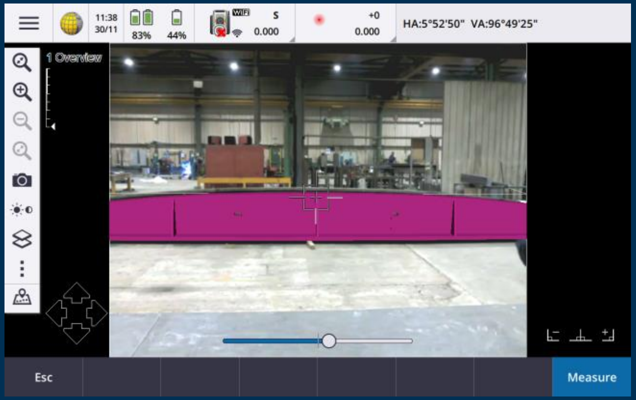
Digital Construction/Manufacturing

Conclusions

Digital Construction using SX12 & TA
Key advantages

Capabilities that facilitate BIM based workflows:

- Cloud Integration for seamless data flow
- Object-Oriented Setup (manufacturing environment/moving platform) for faster set up
- Viewing IFC in 3D viewer for better data understanding and richer data in the field:
  - Access model attributes
  - Layer handling
  - Pick entities in the model/easier stake out
  - Extract line, point and surface information directly from model
  - AR with mm accuracy
- Area Scan for better productivity
- In-field inspection and reporting



Q/A

Next steps...

Thank You

Credits

For Questions
or Feedback
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