SMART & INTELLIGENT EQUIPMENT FOR MODERN AND TOP-QUALITY INFRASTRUCTURE DEVELOPMENTS

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Regional Sales Manager
Geospatial- SAARC

Why Digital Construction?

Digital technologies provide answers to some key industry challenges surrounding complexity, labor, productivity, sustainability and profitability

Complexity

Complex projects; fragmented workflows & supply chain

85% Projects exceed **budget**

63% Projects have **quality** issues

92% Projects exceed **schedule**

40% of jobsite work **unproductive**

People

Skilled labor is a top priority

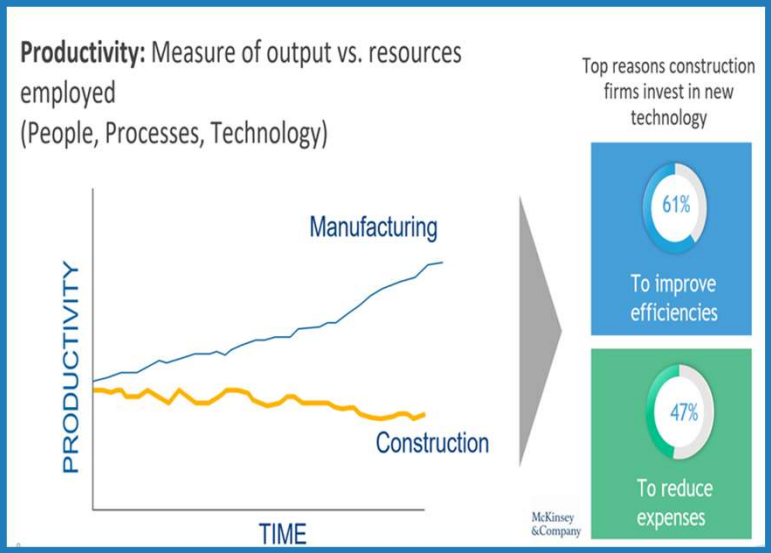
90% Face **Talent** Shortages

30% Decrease in **Workers** Less than 24 Years Old

Profit Fade

Maintaining profitabilty

4-5 % Average project margins



Sources: McKinsey, Dodge Analytics, US Chamber of Commerce Commercial Construction Index, Construction Financial Management Association, IBISWorld, Byggeindustrien Norway. 'Projects' refers to construction projects.

Challenges in Construction

Survey & Design

- Survey Data Acceptance across the lifecycle of Project- Preliminary survey & Detailed Survey
- Survey Data Integrity Issues
- Design facing challenges with accuracy of data
- Using Design data in the field with confidence
- Using data while construction
- Updating Desgin based on changes in the field

- Federated Sites
- Remote Sites

Construction

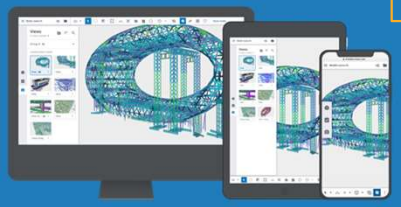
- Quality Challenges with Machines at construction site
- Productivity challenges
- Update of design after actual construction
- Safety of resources on the field
- Positioning data integrity

O&M

- Effective Resource planning
- Scheduling
- Resource management,
- Rising cost,
- Maintenance and operations, Unreliable Predictive indicators

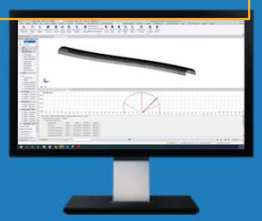
Connecting the field-office-stakeholders

Stakeholder



Data Transfer

Design / Backoffice Team



Trimble Business Center

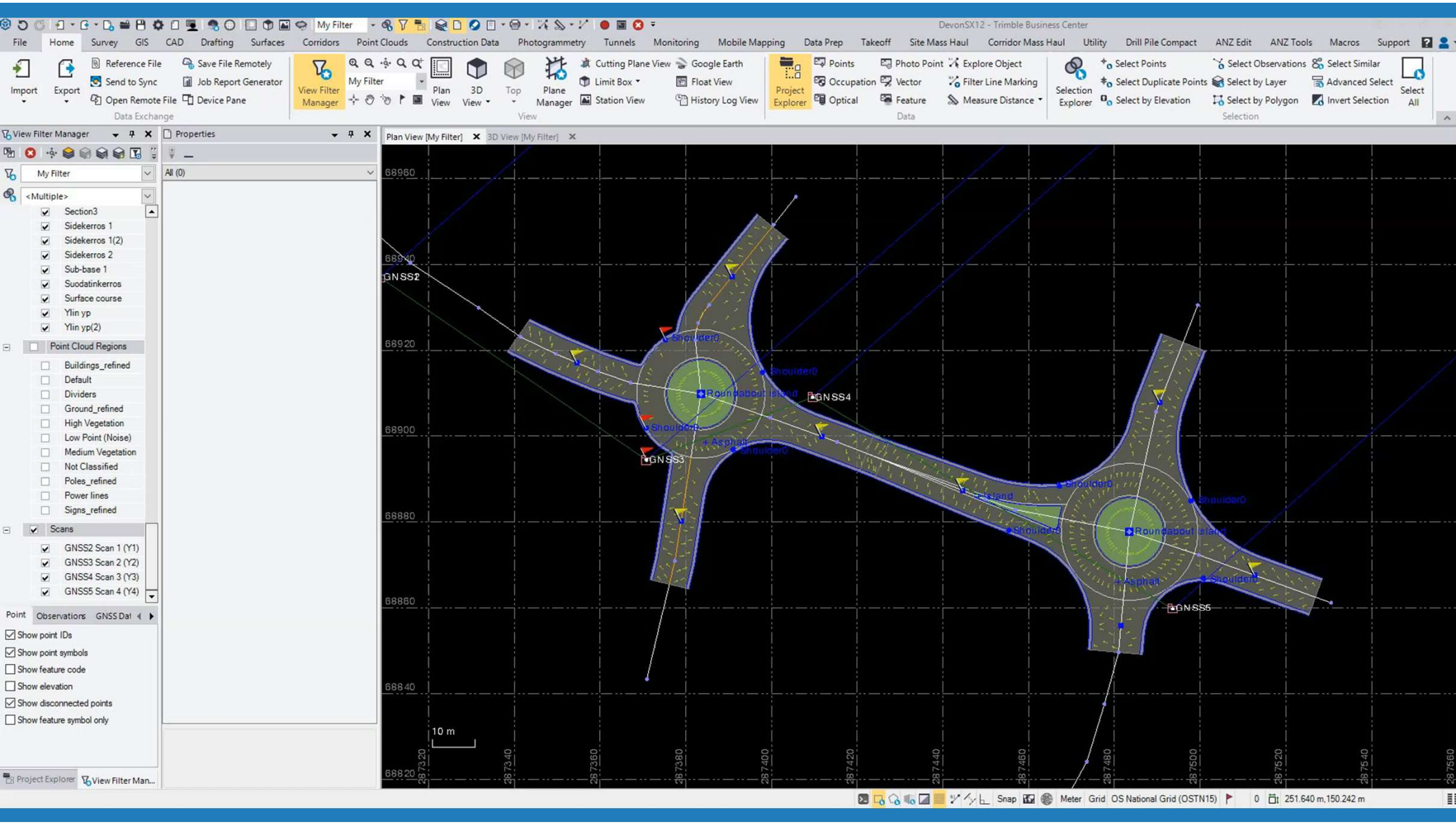
Trimble Connect®

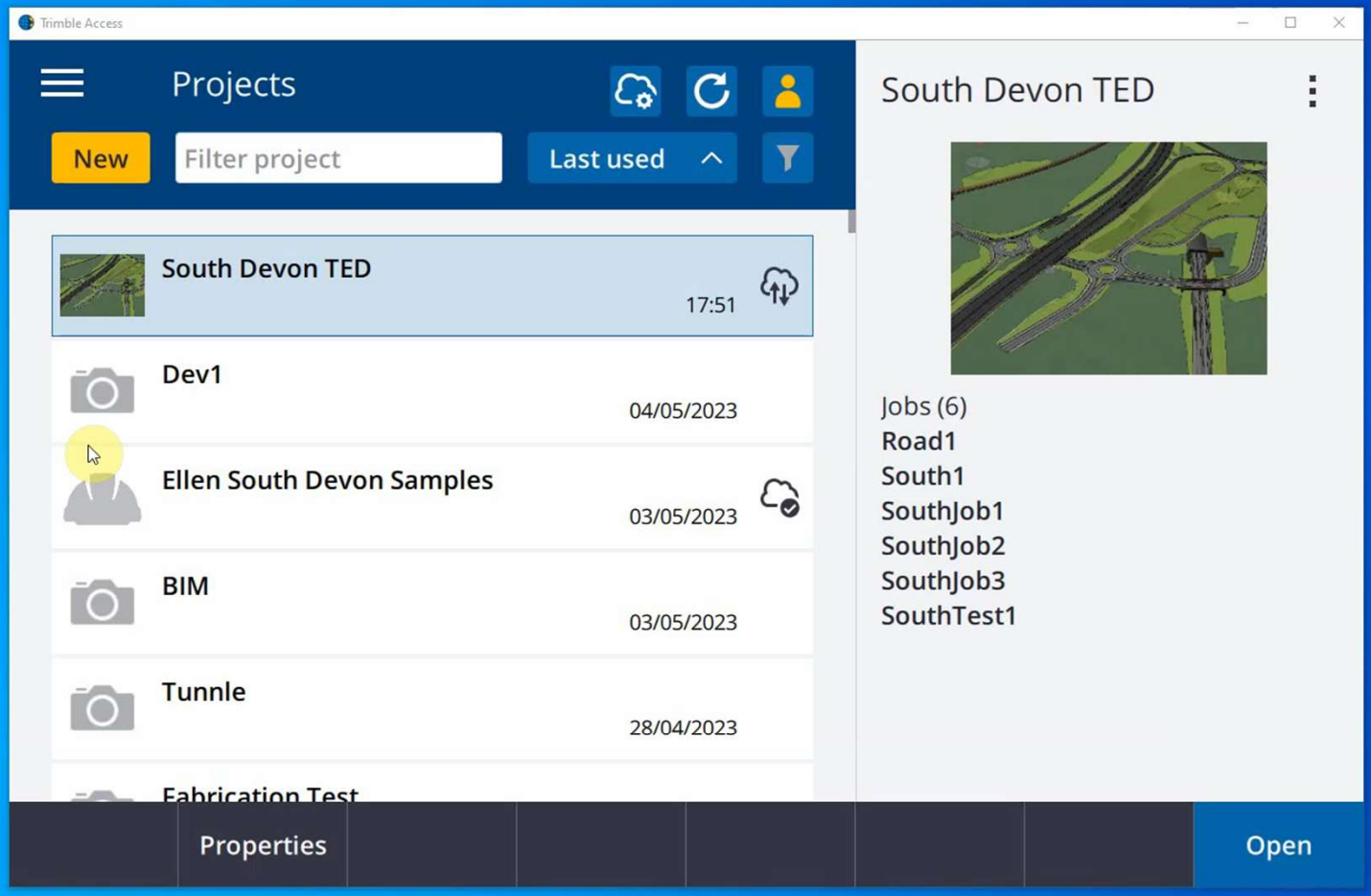
Data Transfer

Survey Field crew

Trimble Access

Field & design data


DevonSX12 - Trimble Business Center
File
Home
Survey
GIS
CAD
Drafting
Surfaces
Corridors
Point Clouds
Construction Data
Photogrammetry
Tunnels
Monitoring
Mobile Mapping
Data Prep
Takeoff
Site Mass Haul
Corridor Mass Haul
Utility
Drill Pile Compact
ANZ Edit
ANZ Tools
Macros
Support
Import
Export
Reference File
Send to Sync
Open Remote File
Save File Remotely
Job Report Generator
Device Pane
Data Exchange
View Filter Manager
My Filter
Plan View
3D View
Top
Plane Manager
Cutting Plane View
Limit Box
Station View
Google Earth
Float View
History Log View
View
Project Explorer
Points
Occupation
Optical
Photo Point
Vector
Feature
Explore Object
Filter Line Marking
Measure Distance
Data
Selection Explorer
Select Points
Select Duplicate Points
Select by Elevation
Select Observations
Select by Layer
Select by Polygon
Select Similar
Advanced Select
Invert Selection
Select All
Selection
View Filter Manager
My Filter
<Multiple>
Section3
Sidekerros 1
Sidekerros 1(2)
Sidekerros 2
Sub-base 1
Suodatinkerros
Surface course
Ylin yp
Ylin yp(2)
Point Cloud Regions
Buildings_refined
Default
Dividers
Ground_refined
High Vegetation
Low Point (Noise)
Medium Vegetation
Not Classified
Poles_refined
Power lines
Signs_refined
Scans
GNSS2 Scan 1 (Y1)
GNSS3 Scan 2 (Y2)
GNSS4 Scan 3 (Y3)
GNSS5 Scan 4 (Y4)
Point
Observations
GNSS Dat
Show point IDs
Show point symbols
Show feature code
Show elevation
Show disconnected points
Show feature symbol only
Properties
All (0)
Plan View [My Filter]
3D View [My Filter]
68960
68940
68920
68900
68880
68860
68840
68820
GNSS2
GNSS3
GNSS4
GNSS5
Shoulder0
Roundabout Island
Asphalt
Island
10 m
Snap
Meter
Grid
OS National Grid (OSTN15)
251.640 m,150.242 m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Projects
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Filter project
Last used
South Devon TED
17:51
Dev1
04/05/2023
Ellen South Devon Samples
03/05/2023
BIM
03/05/2023
Tunnle
28/04/2023
Fabrication Test
South Devon TED
Jobs (6)
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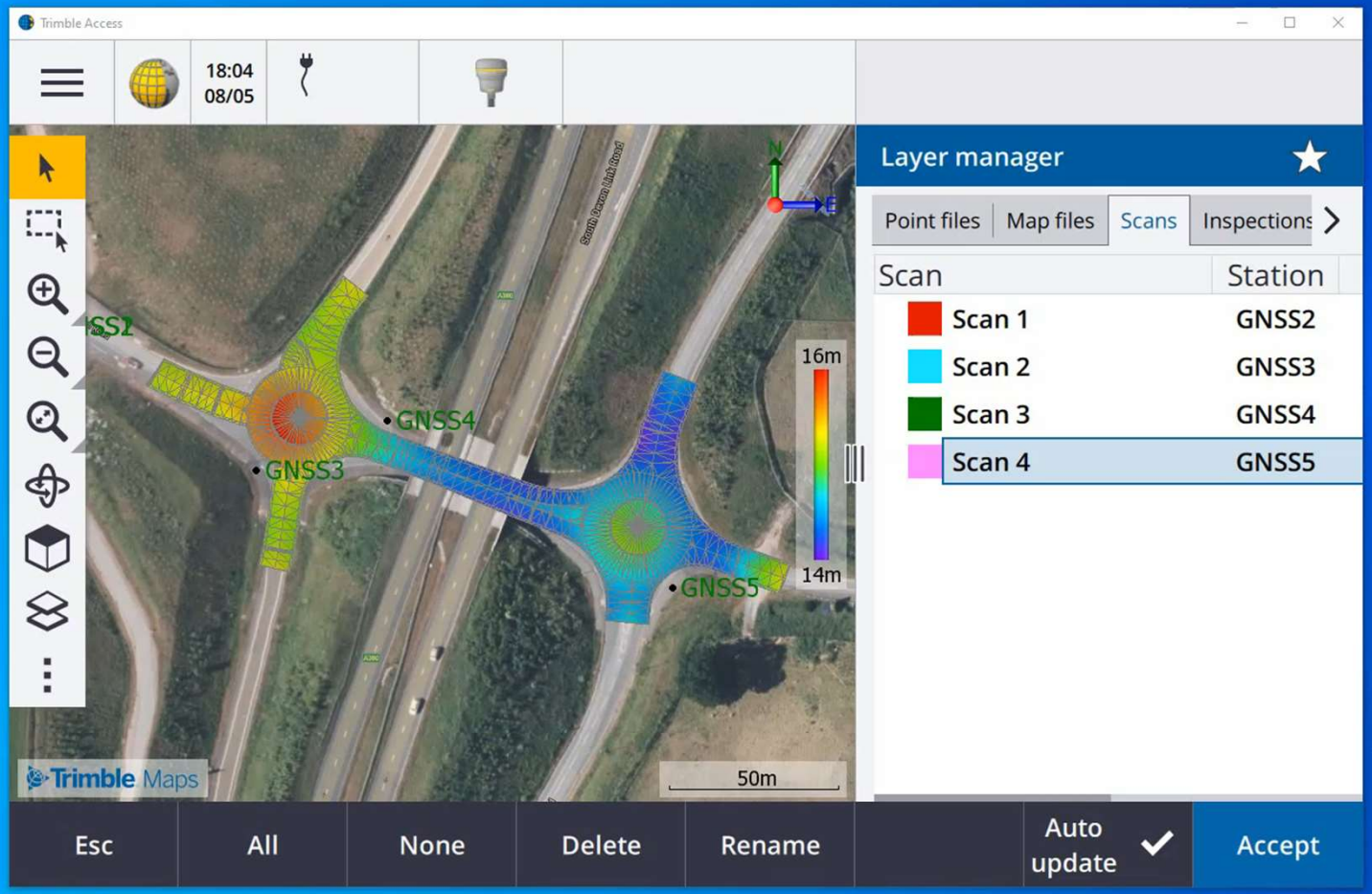
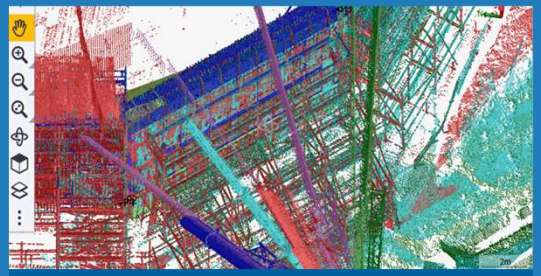
South1
SouthJob1
SouthJob2
SouthJob3
SouthTest1
Properties
Open


Trimble Access
18:04
08/05
Layer manager
Point files
Map files
Scans
Inspections
Scan
Station
Scan 1
GNSS2
Scan 2
GNSS3
Scan 3
GNSS4
Scan 4
GNSS5
16m
14m
GNSS4
GNSS3
GNSS5
Trimble Maps
50m
Esc
All
None
Delete
Rename
Auto update
Accept

Digital Construction

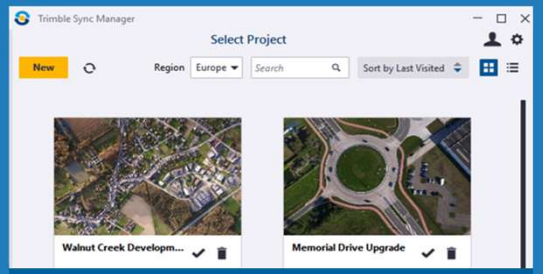
Physical to Digital

Digitization of Existing Conditions through a use of rich survey data.
Efficient feasibility planning, conceptual and detailed design



Digital to Physical

Consistent model use supporting field stakeout, inspection, analysis with connection back to the constructible model



Collaboration and Connectivity

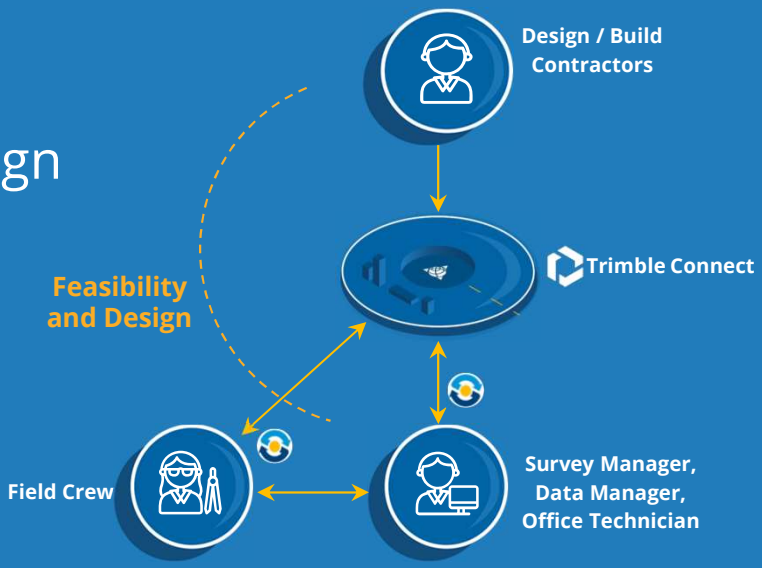
Common data environment to streamline data sharing, collaboration and decision making

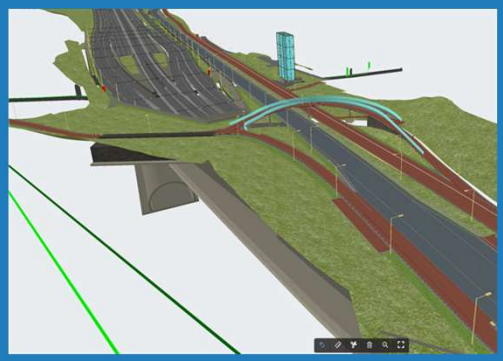
Integrated Vertical Workflows

Physical to Digital

Existing condition data for feasibility and design

- High speed data capture increasing productivity without compromising on accuracy or quality
- Supporting multiple data types (e.g. images, survey data, scan data)
- Reducing traffic management costs and increasing field crew safety
- Efficient and traceable results that deliver confidence you can trust
- Interoperability with CAD and GIS systems for additional data use



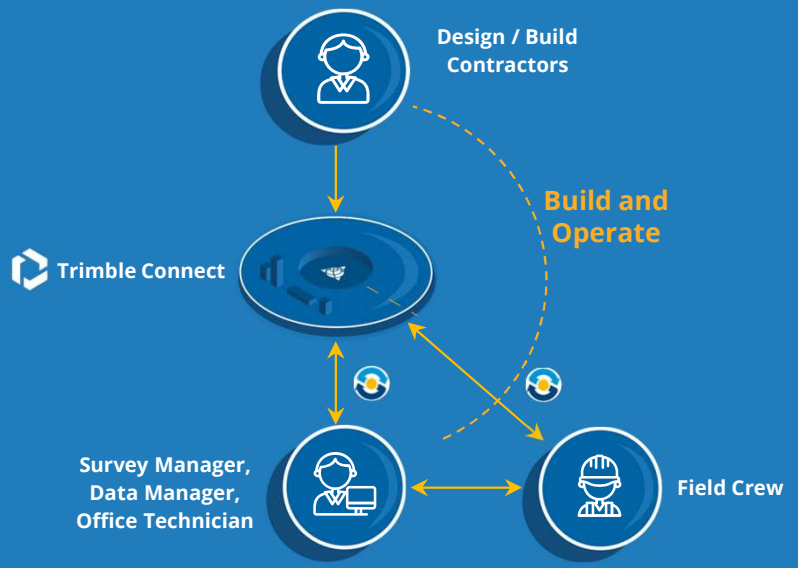


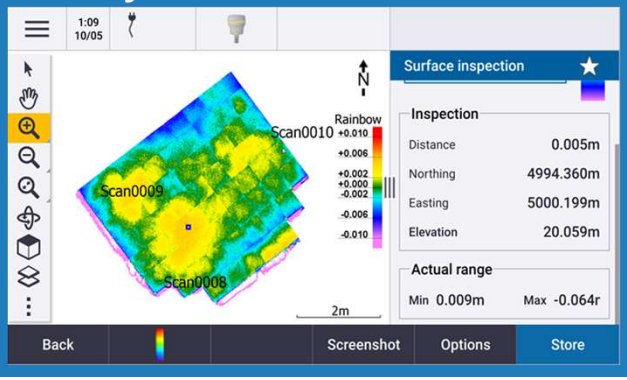
Digital to Physical

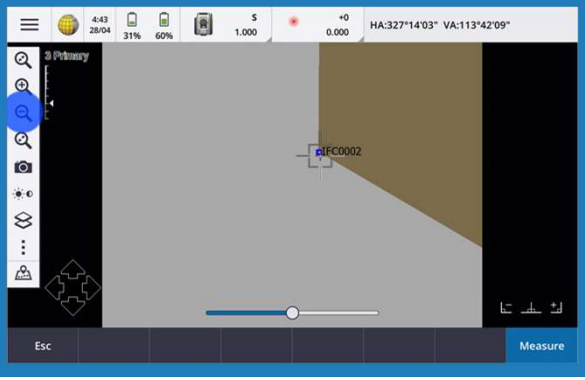
Streamlining design to field workflows

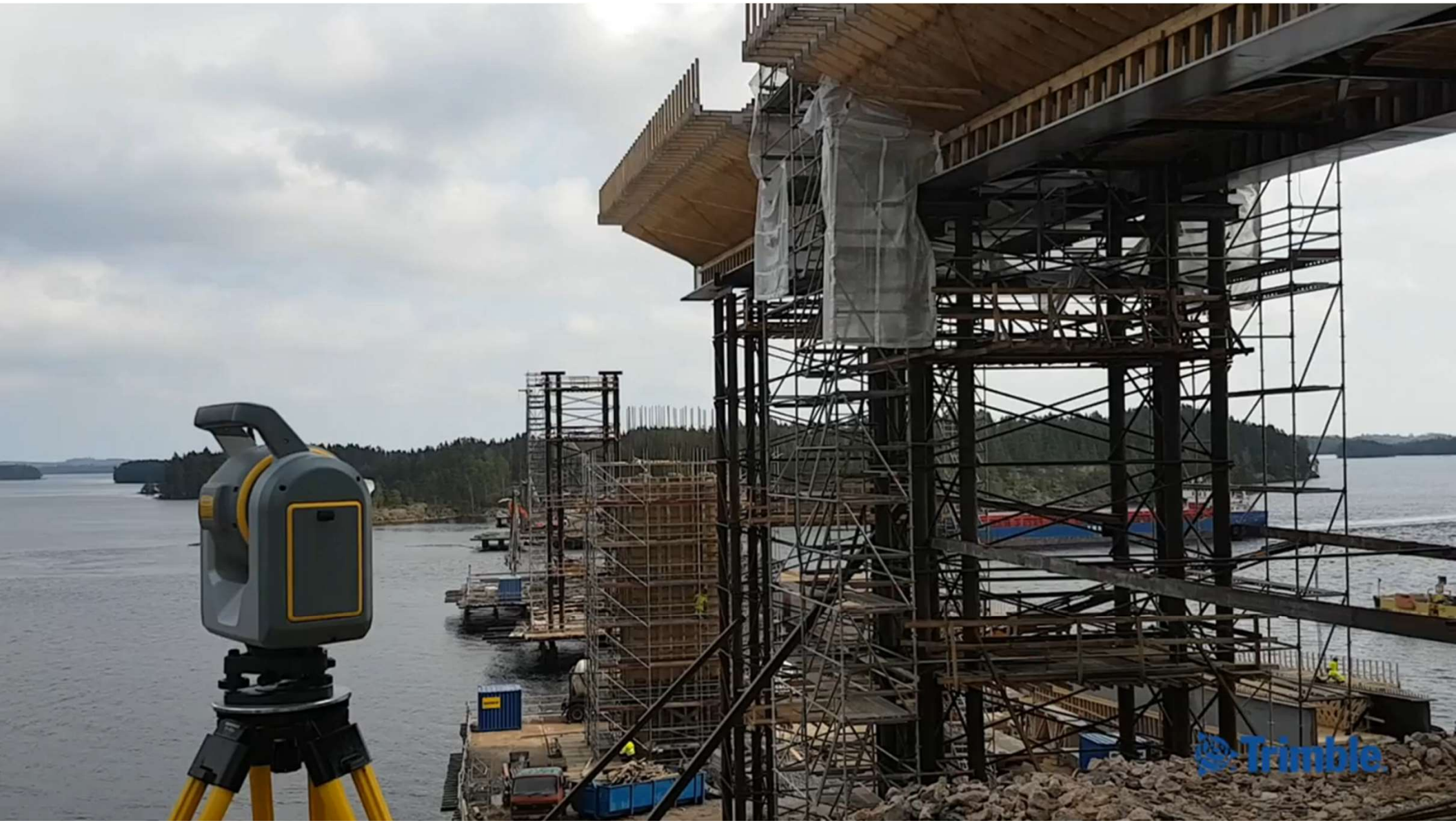
As-built inspection

- Verify construction conformance and enable direct action (e.g. additional shotcrete)
- Direct comparison of design, or prior scans, to standards-based designs (IFC, DXF, LandXML,...)
- 3D design visualization (incl. AR) increases project understanding and productivity
- Inspection workflows integrated with the role of office technicians
  (i.e. TBC, TRW)

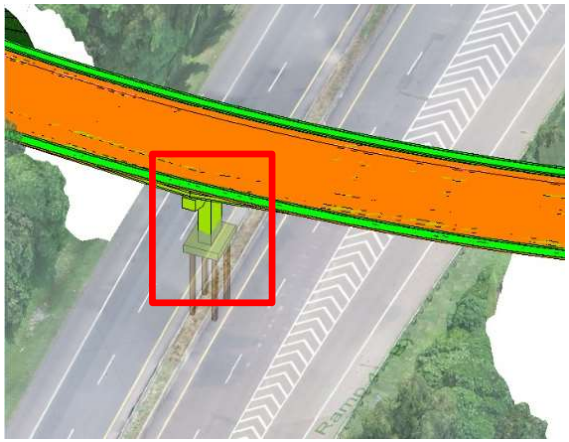




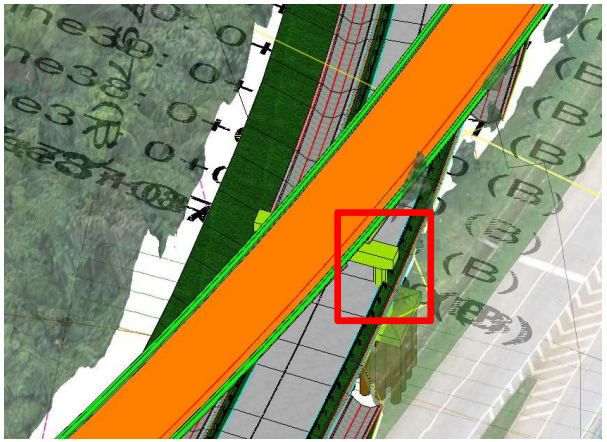



Trimble

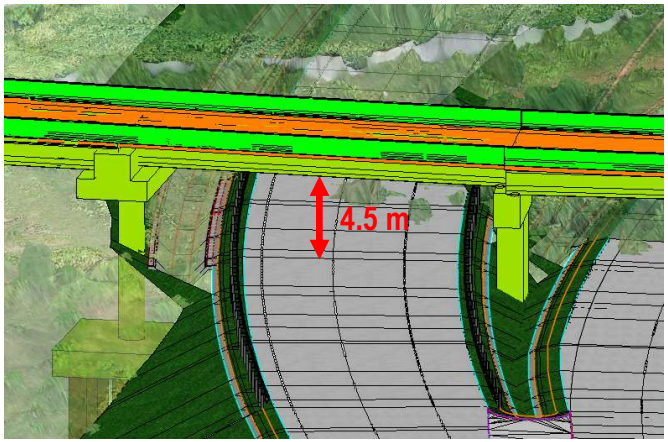
SUPERIMPOSED MODELLING



Pier misplaced on existing road



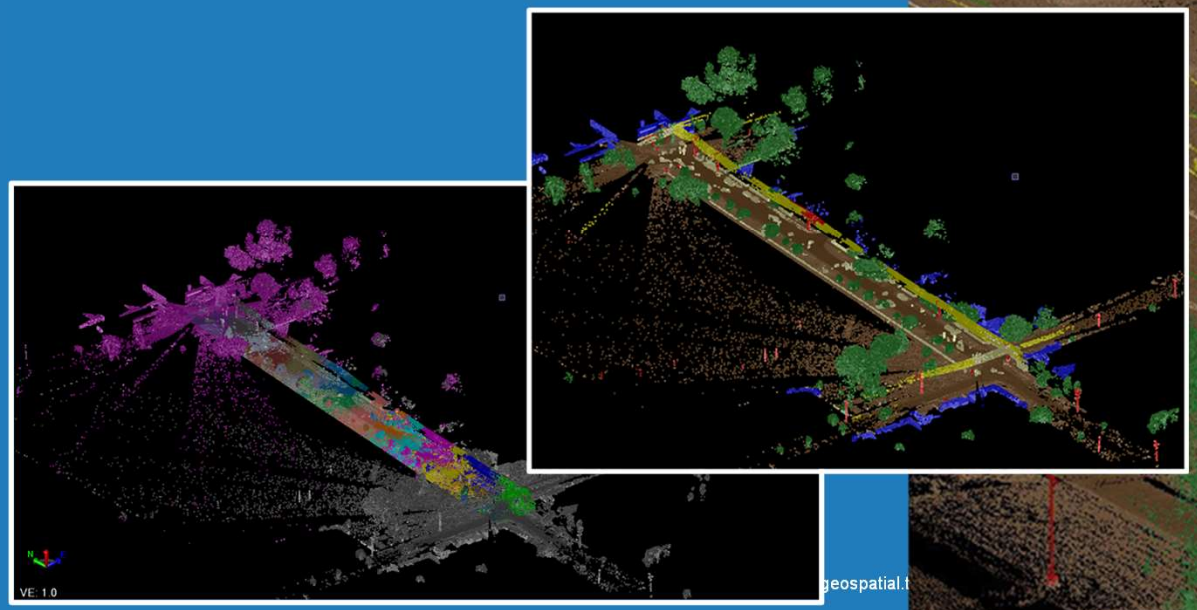
Pier misplaced on ramp

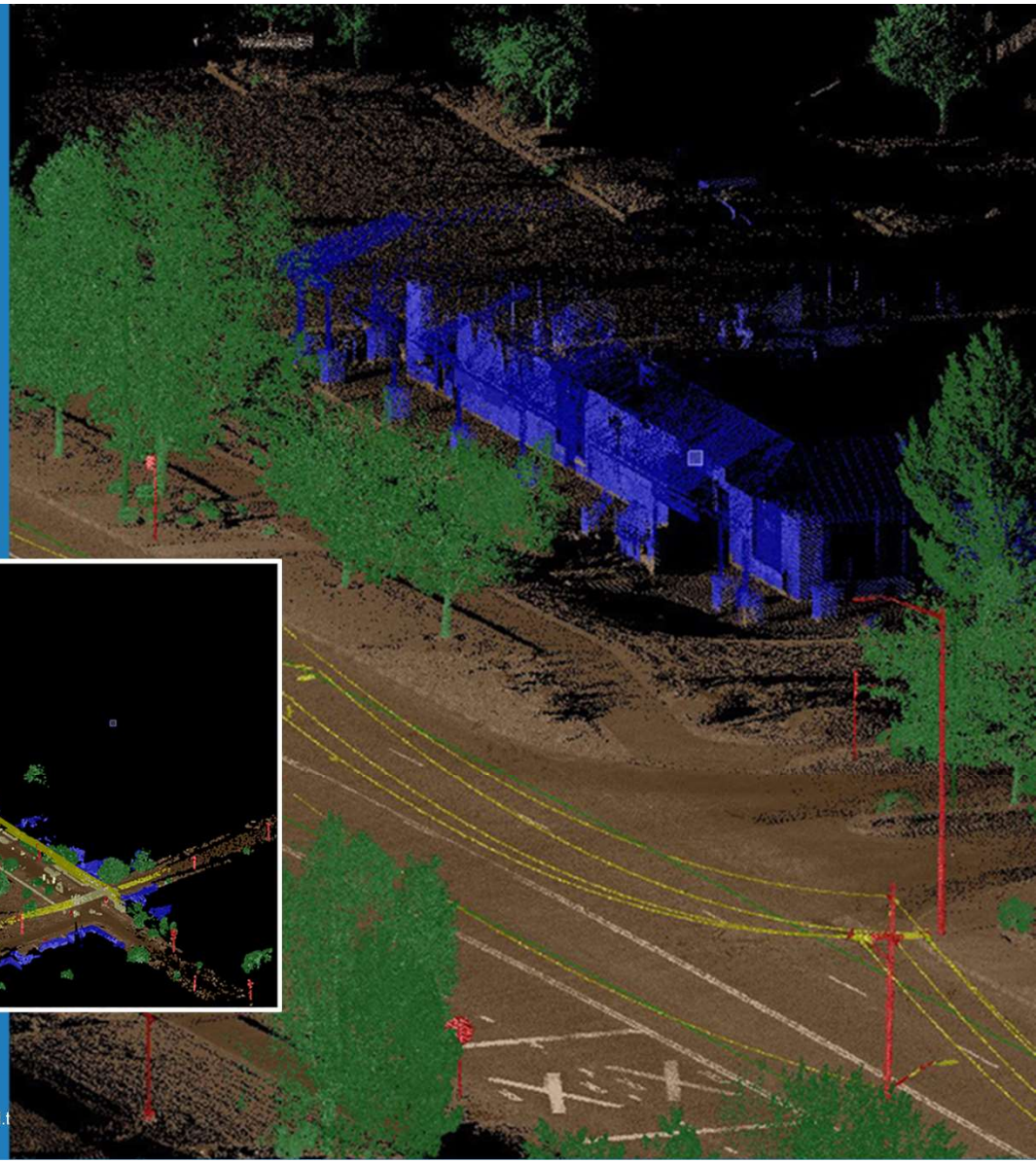


Road clearance doesn't meet the requirement

Automatic Classification

- Buildings
- Ground
- High/Medium Vegetation
- Poles and signs
- Power lines
- Dividers
- Steps





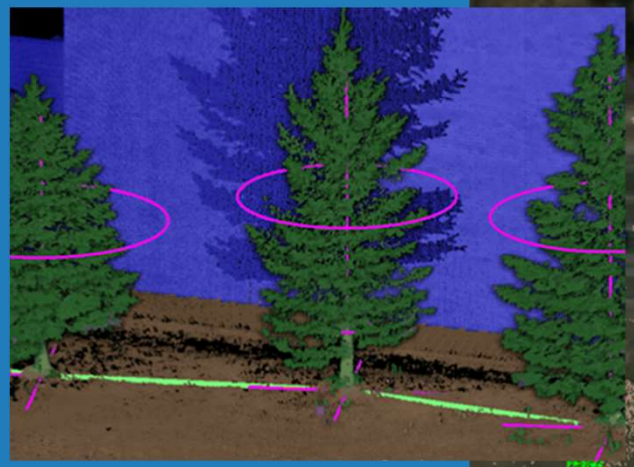
Feature Extraction

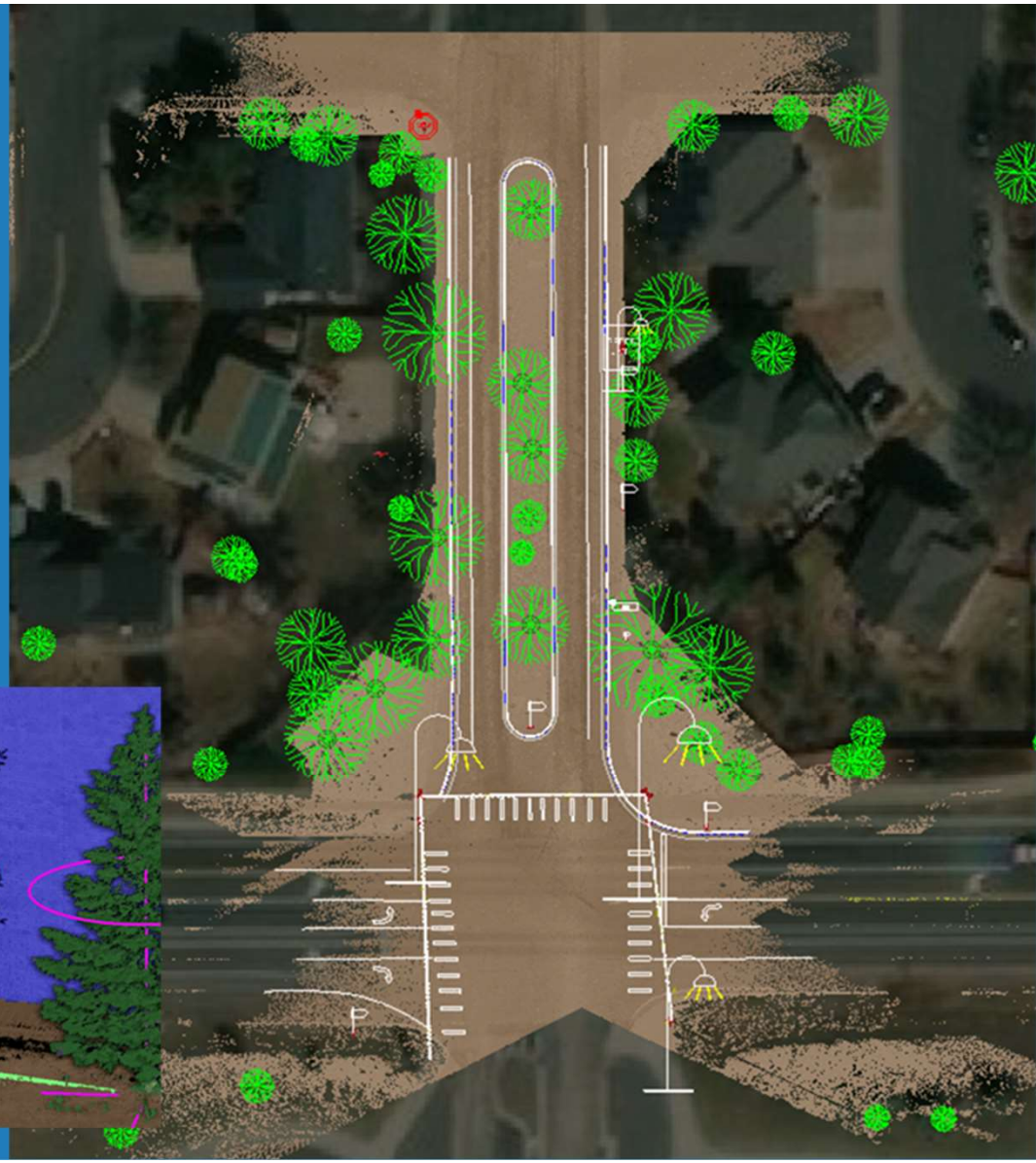
Line Features

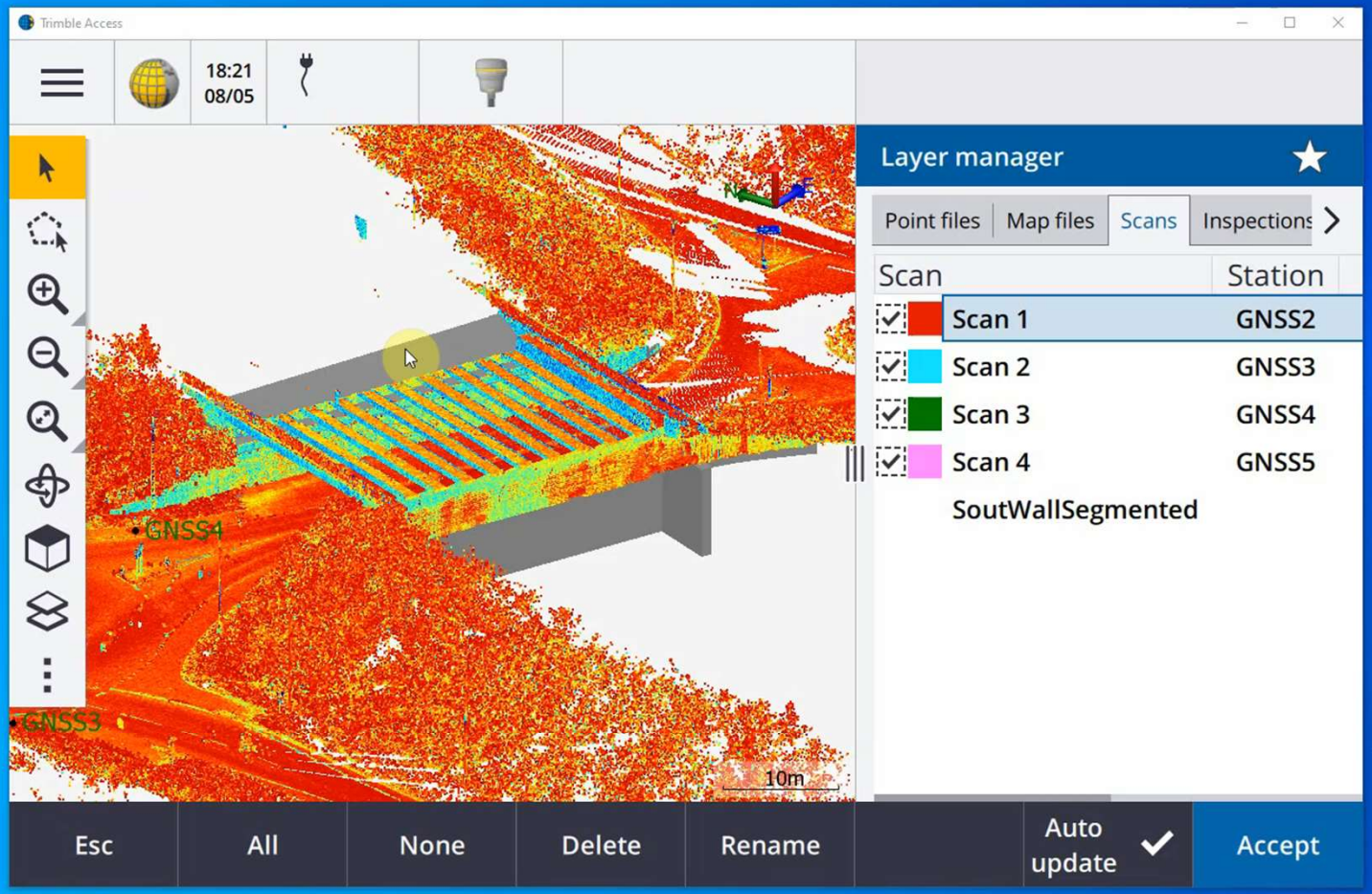
- Overhead Line
- Curb and Gutter
- Lane Lines

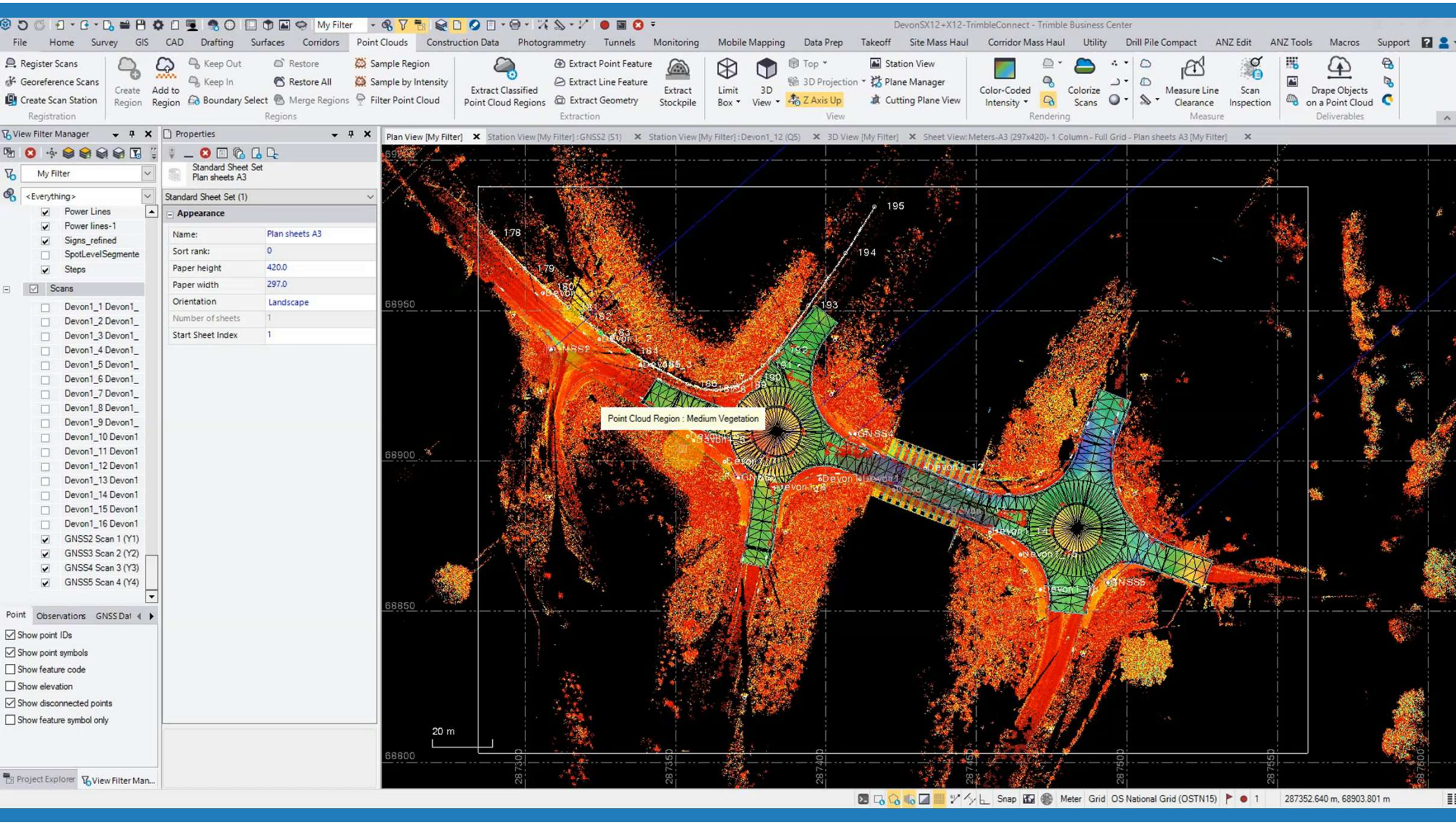
Point Features

- Tree
- Pole
- Sign
- Manholes






Trimble Access
18:21
08/05
Layer manager
Point files
Map files
Scans
Inspections
Scan
Station
Scan 1
GNSS2
Scan 2
GNSS3
Scan 3
GNSS4
Scan 4
GNSS5
SoutWallSegmented
GNSS4
GNSS3
10m
Esc
All
None
Delete
Rename
Auto update
Accept


DevonSX12+X12-TrimbleConnect - Trimble Business Center
File
Home
Survey
GIS
CAD
Drafting
Surfaces
Corridors
Point Clouds
Construction Data
Photogrammetry
Tunnels
Monitoring
Mobile Mapping
Data Prep
Takeoff
Site Mass Haul
Corridor Mass Haul
Utility
Drill Pile Compact
ANZ Edit
ANZ Tools
Macros
Support
Register Scans
Georeference Scans
Create Scan Station
Registration
Create Region
Add to Region
Keep Out
Keep In
Boundary Select
Restore
Restore All
Merge Regions
Regions
Sample Region
Sample by Intensity
Filter Point Cloud
Extract Classified Point Cloud Regions
Extract Point Feature
Extract Line Feature
Extract Geometry
Extract Stockpile
Extraction
Limit Box
3D View
Top
3D Projection
Z Axis Up
Station View
Plane Manager
Cutting Plane View
View
Color-Coded Intensity
Colorize Scans
Rendering
Measure Line Clearance
Measure
Scan Inspection
Drape Objects on a Point Cloud
Deliverables
View Filter Manager
My Filter
<Everything>
Power Lines
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Signs_refined
SpotLevelSegmente
Steps
Scans
Devon1_1 Devon1_
Devon1_2 Devon1_
Devon1_3 Devon1_
Devon1_4 Devon1_
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Devon1_13 Devon1
Devon1_14 Devon1
Devon1_15 Devon1
Devon1_16 Devon1
GNSS2 Scan 1 (Y1)
GNSS3 Scan 2 (Y2)
GNSS4 Scan 3 (Y3)
GNSS5 Scan 4 (Y4)
Point
Observations
GNSS Dat
Show point IDs
Show point symbols
Show feature code
Show elevation
Show disconnected points
Show feature symbol only
Project Explorer
View Filter Man...
Properties
Standard Sheet Set
Plan sheets A3
Standard Sheet Set (1)
Appearance
Name: Plan sheets A3
Sort rank: 0
Paper height 420.0
Paper width 297.0
Orientation Landscape
Number of sheets 1
Start Sheet Index 1
Plan View [My Filter]
Station View [My Filter] :GNSS2 (S1)
Station View [My Filter] :Devon1_12 (Q5)
3D View [My Filter]
Sheet View:Meters-A3 (297x420)- 1 Column - Full Grid - Plan sheets A3 [My Filter]
Point Cloud Region : Medium Vegetation
20 m
68950
68900
68850
68800
287300
287350
287400
287450
287500
287550
287600
Snap
Meter
Grid
OS National Grid (OSTN15)
287352.640 m, 68903.801 m

Real Time Monitoring of Geotechnical / Geodetic & Vibration sensors

Experience of Tapi Bridge, Surat Gujarat

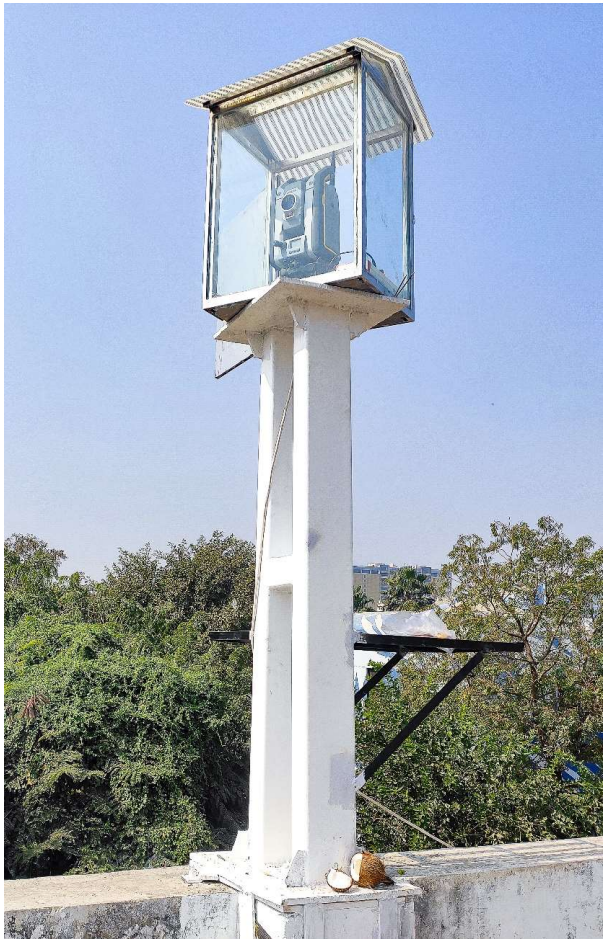
What is Monitoring & Areas of measurement

Monitoring is the process of taking Measurements onto a Structure, over Time, to detect changes in its size, shape or behaviour, to compare those changes to reference values, and to raise an alarm if the measured change exceeds the permissible change.

The instrumentation system can be set up in accordance with the needs of monitored structure.

- ✓ Stress Sensor: Vibrating Wire strain Gauge.
- ✓ EM Sensors & Strand meters
- ✓ Extensometer - Displacement
- ✓ Crack & Convergence monitoring
- ✓ Strong Motion Accelerographs – Blast vibrations
- ✓ Seismographs – Seismic Measurements
- ✓ Weather Data –Rainfall/Wind/Humidity/ Temperature
- ✓ GPS system
- ✓ Automatic Total Stations
- ✓ Long Term Online Monitoring Software & applications using GSM/GPRS Technology.


PROPER TOTAL STATION
HOUSING

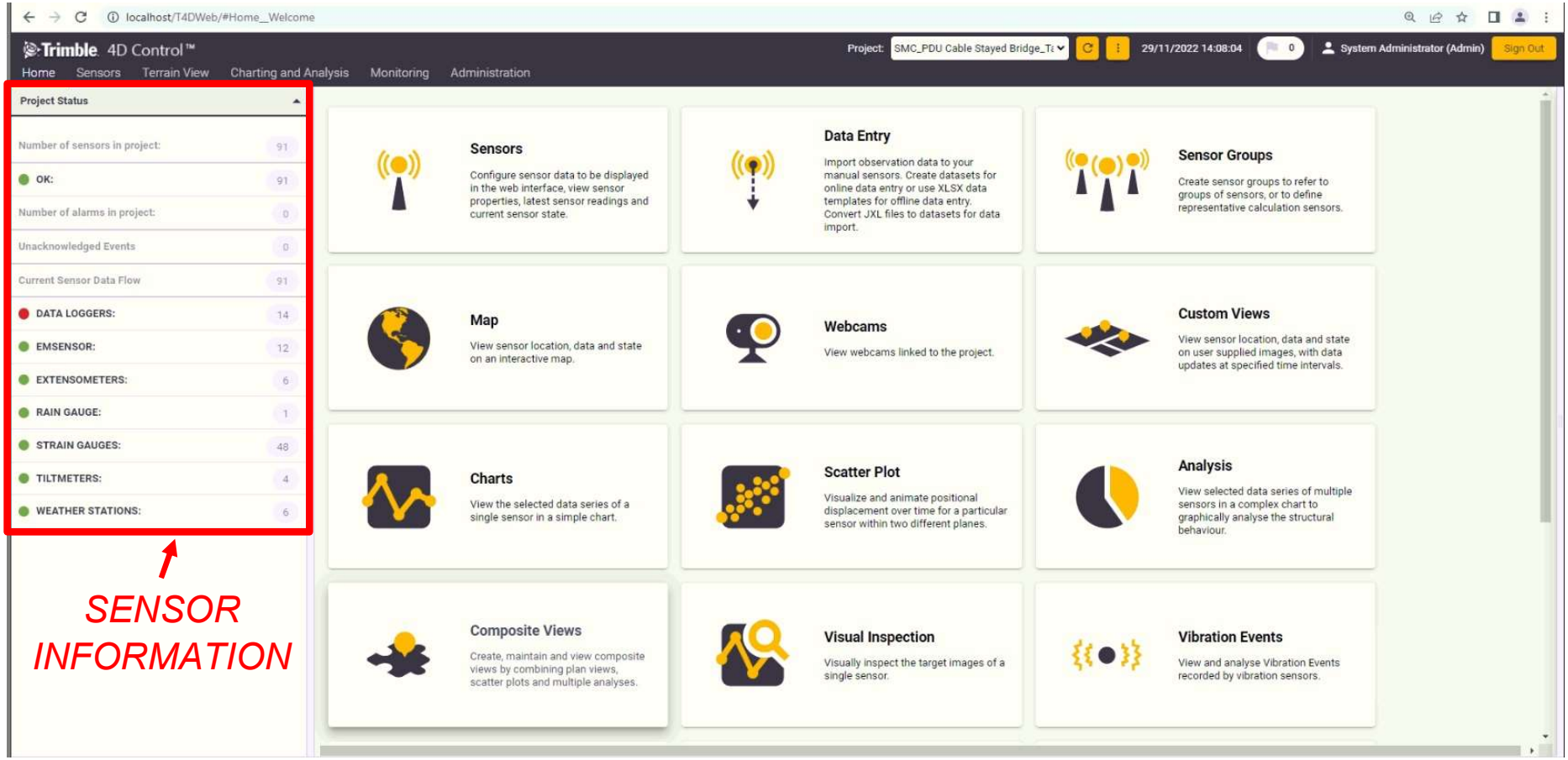


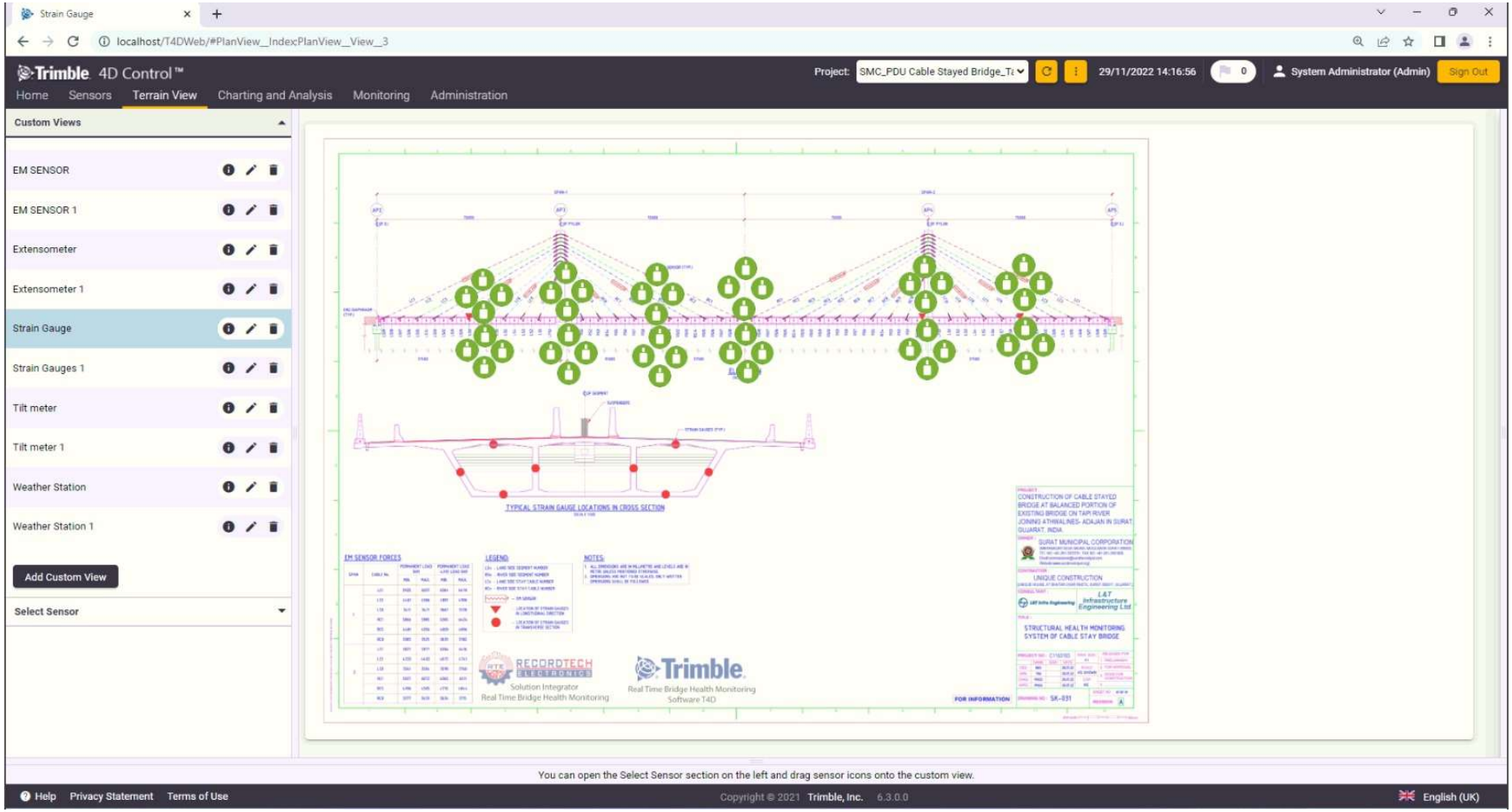
TOTAL STATION VIEW


TRAFFIC & BRIDGE CCTV VIEWS


REAL TIME MONITORING


Trimble 4D Control™
Home
Sensors
Terrain View
Charting and Analysis
Monitoring
Administration
Sensor Groups
Map
Webcams
Custom Views
Charts
Scatter Plot
Analysis
Composite Views
REAL TIME MONITORING SOFTWARE DASHBOARD


localhost/T4DWeb/#Home_Welcome
Trimble 4D Control™
Project: SMC_PDU Cable Stayed Bridge_T
29/11/2022 14:08:04
System Administrator (Admin)
Sign Out
Home
Sensors
Terrain View
Charting and Analysis
Monitoring
Administration
Project Status
Number of sensors in project: 91
OK: 91
Number of alarms in project: 0
Unacknowledged Events 0
Current Sensor Data Flow 91
DATA LOGGERS: 14
EMSENSOR: 12
EXTENSOMETERS: 6
RAIN GAUGE: 1
STRAIN GAUGES: 48
TILTMETERS: 4
WEATHER STATIONS: 6
SENSOR INFORMATION
Sensors
Configure sensor data to be displayed in the web interface, view sensor properties, latest sensor readings and current sensor state.
Data Entry
Import observation data to your manual sensors. Create datasets for online data entry or use XLSX data templates for offline data entry. Convert JXL files to datasets for data import.
Sensor Groups
Create sensor groups to refer to groups of sensors, or to define representative calculation sensors.
Map
View sensor location, data and state on an interactive map.
Webcams
View webcams linked to the project.
Custom Views
View sensor location, data and state on user supplied images, with data updates at specified time intervals.
Charts
View the selected data series of a single sensor in a simple chart.
Scatter Plot
Visualize and animate positional displacement over time for a particular sensor within two different planes.
Analysis
View selected data series of multiple sensors in a complex chart to graphically analyse the structural behaviour.
Composite Views
Create, maintain and view composite views by combining plan views, scatter plots and multiple analyses.
Visual Inspection
Visually inspect the target images of a single sensor.
Vibration Events
View and analyse Vibration Events recorded by vibration sensors.


Strain Gauge
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Trimble 4D Control™
Project: SMC_PDU Cable Stayed Bridge_Ta
29/11/2022 14:16:56
0
System Administrator (Admin)
Sign Out
Home
Sensors
Terrain View
Charting and Analysis
Monitoring
Administration
Custom Views
EM SENSOR
EM SENSOR 1
Extensometer
Extensometer 1
Strain Gauge
Strain Gauges 1
Tilt meter
Tilt meter 1
Weather Station
Weather Station 1
Add Custom View
Select Sensor
TYPICAL STRAIN GAUGE LOCATIONS IN CROSS SECTION
EM SENSOR FORCES
LEGEND
NOTES
CONSTRUCTION OF CABLE STAYED BRIDGE AT BALANCED PORTION OF EXISTING BRIDGE ON TAPI RIVER JOINING ATHWALINES- ADAJAN IN SURAT, GUJARAT, INDIA
SURAT MUNICIPAL CORPORATION
UNIQUE CONSTRUCTION
L&T Infrastructure Engineering Ltd
STRUCTURAL HEALTH MONITORING SYSTEM OF CABLE STAY BRIDGE
RECORDTECH ENGINEERING
Solution Integrator
Real Time Bridge Health Monitoring
Trimble
Real Time Bridge Health Monitoring Software T4D
FOR INFORMATION
You can open the Select Sensor section on the left and drag sensor icons onto the custom view.
Help
Privacy Statement
Terms of Use
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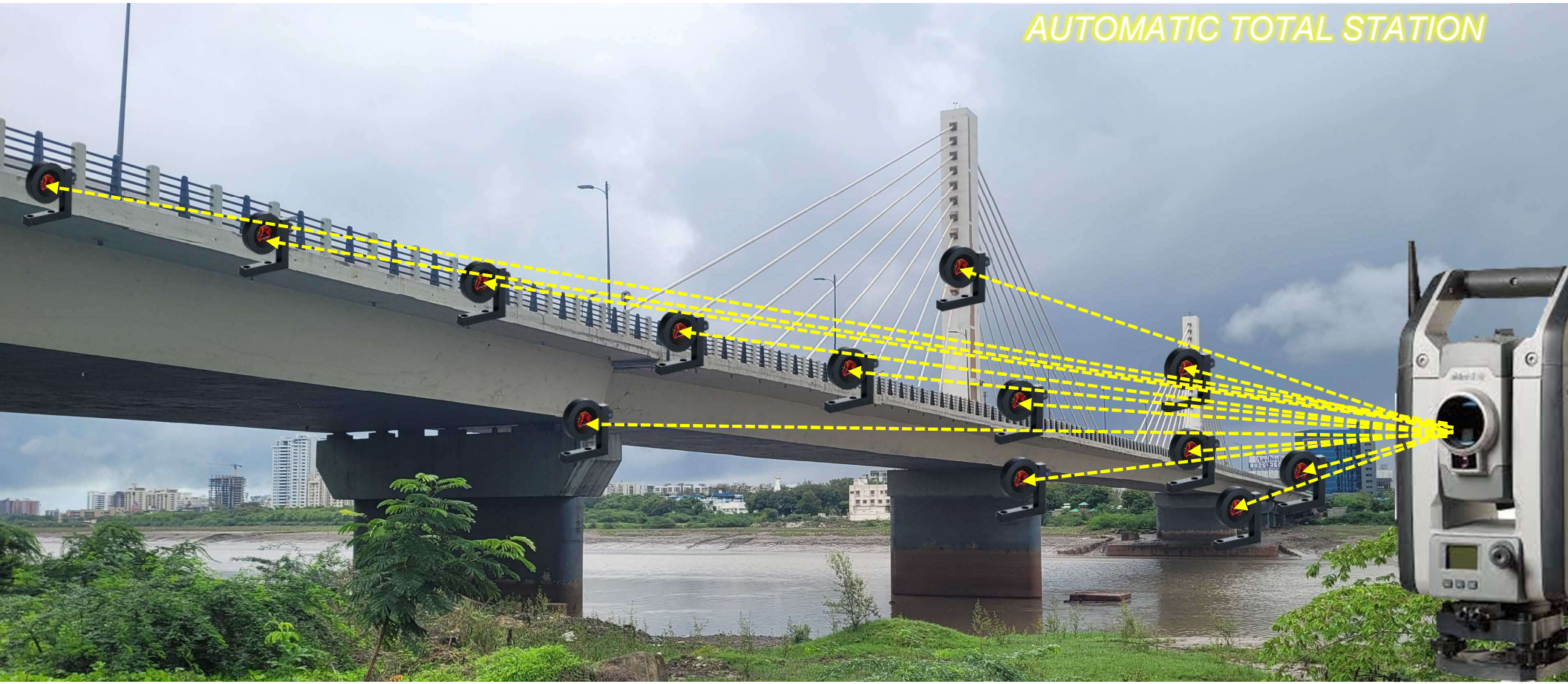
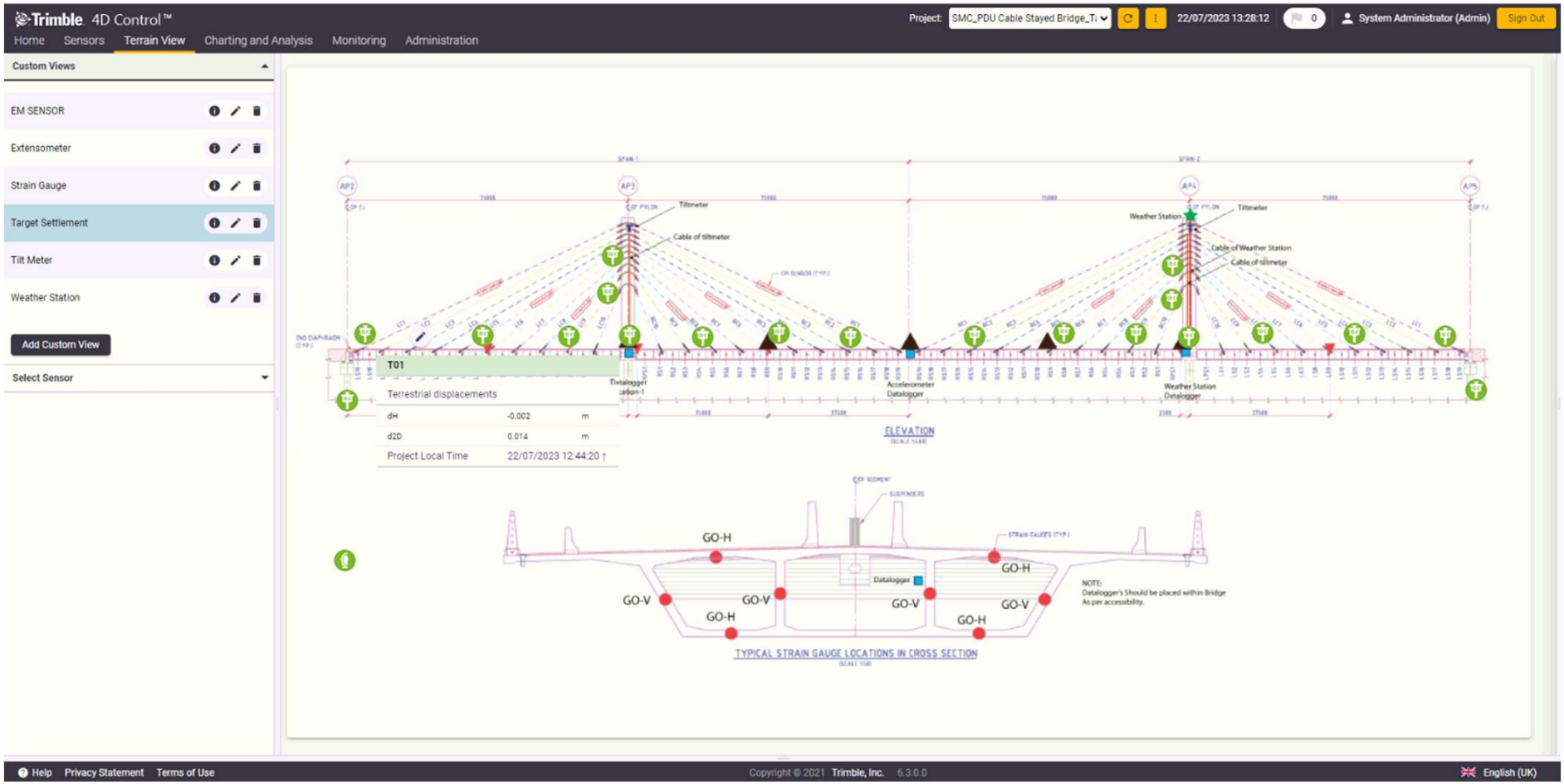
English (UK)


AUTOMATIC TOTAL STATION


Trimble 4D Control™
Project: SMC_PDU Cable Stayed Bridge_Ti
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System Administrator (Admin)
Sign Out
Home
Sensors
Terrain View
Charting and Analysis
Monitoring
Administration
Custom Views
EM SENSOR
Extensometer
Strain Gauge
Target Settlement
Tilt Meter
Weather Station
Add Custom View
Select Sensor
T01
Terrestrial displacements
dH -0.002 m
d2D 0.014 m
Project Local Time 22/07/2023 12:44:20
Tiltmeter
Cable of tiltmeter
Weather Station
Cable of Weather Station
Datalogger
Accelerometer Datalogger
Weather Station Datalogger
ELEVATION
GO-H
GO-V
Datalogger
NOTE:
Datalogger's Should be placed within Bridge As per accessibility.
TYPICAL STRAIN GAUGE LOCATIONS IN CROSS SECTION
Help
Privacy Statement
Terms of Use
Copyright © 2021 Trimble, Inc. 6.3.0.0
English (UK)

Trimble

Connected Construction:

Data driven Digital Construction

Transforming the construction industry again!

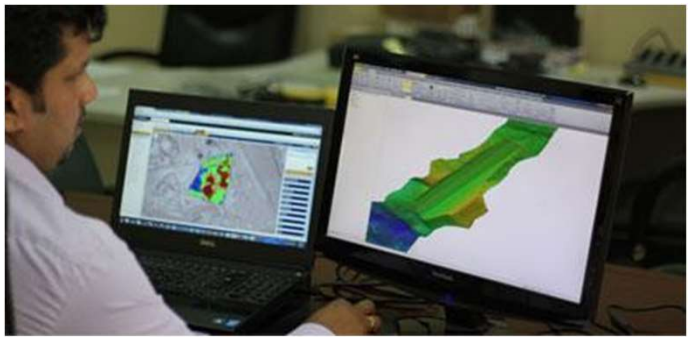
FROM
Conventional Construction

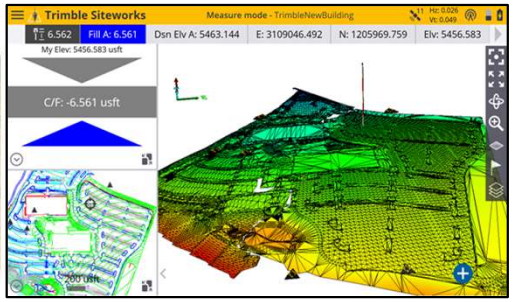
Optimize & Automate Process

- Elimination of Stakes & Strings,
- Eliminate human safety hazards
- Eliminate daylight constraint

TO
Data Driven Digital Construction

SINGLE DIGITAL MODEL FOR ALL





3D Machine Control Technology on Grading Machine

100%+

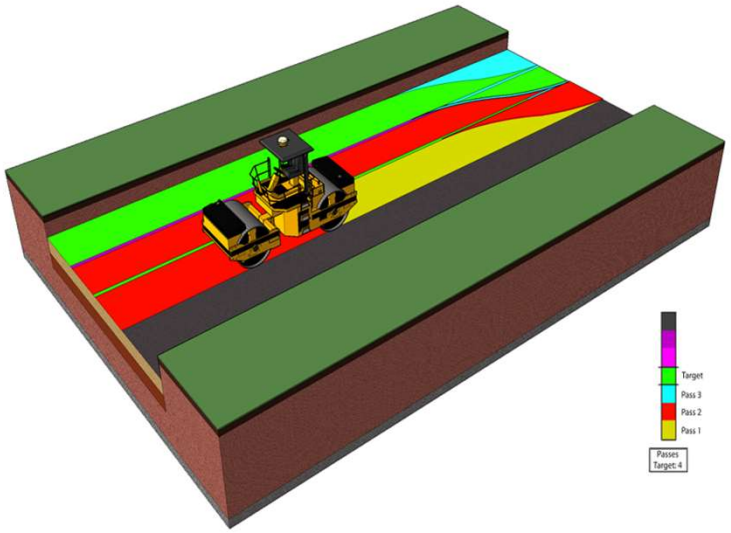
FASTER

- Accurate to Tolerance
- Easy execution of complex design

Night Operation: With high speed and high quality

- Machine Control allows 24x7 operation (day or night)
- With same speed, quality and ease
- No manual guidance required

3D Technology on Compaction and Paving



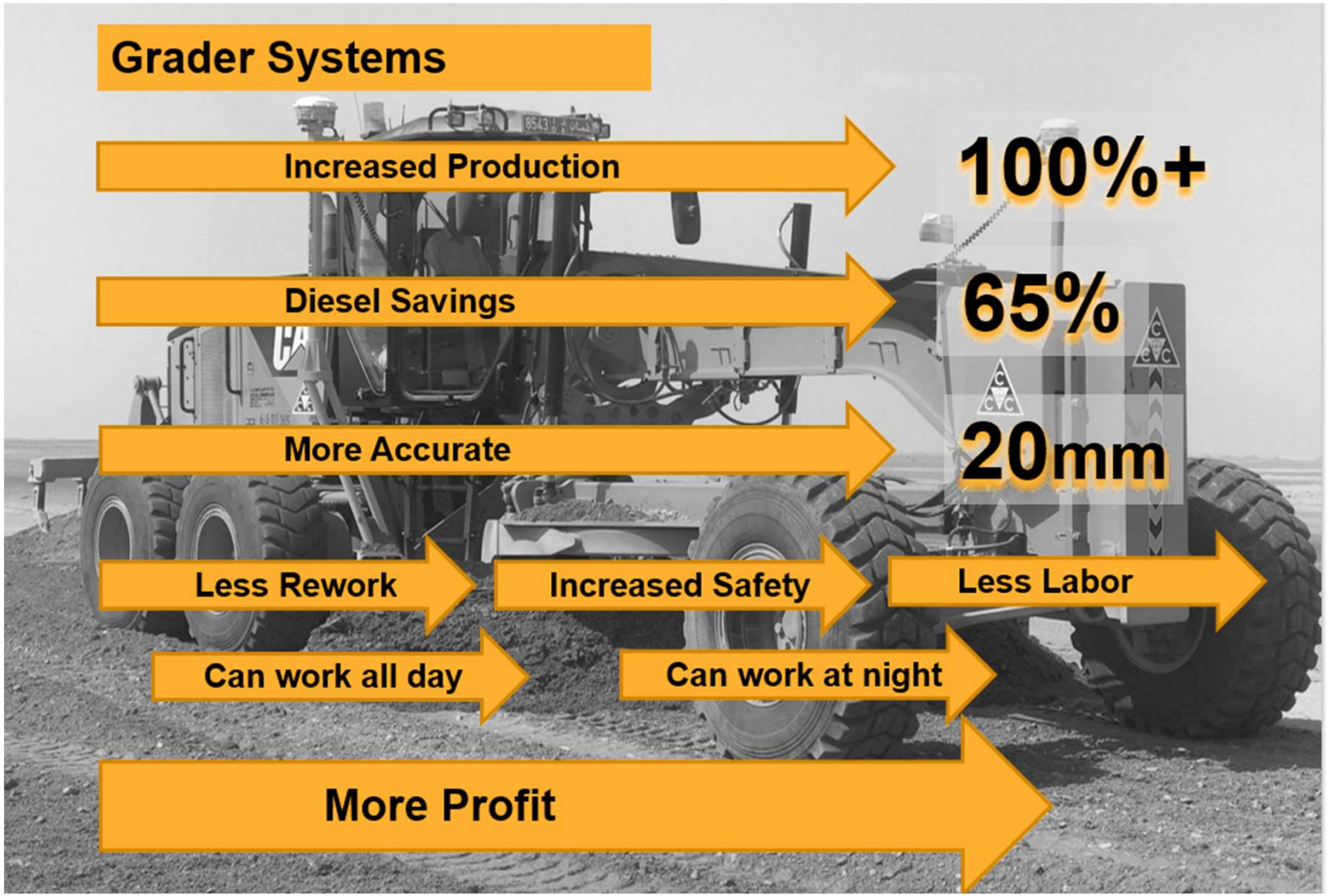
20%
SAVINGS

Assured QUALITY

- Ensures right number of passes
- Avoid over or under compaction
- Realtime Compaction map and measurable records

3D Paving

- Ensures smoothness and rideability
- Eliminate time consuming manual setup and human errors
- Faster paving with better product


Grader Systems
Increased Production
100%+
Diesel Savings
65%
More Accurate
20mm
Less Rework
Increased Safety
Less Labor
Can work all day
Can work at night
More Profit

Productivity Comparison and cost analysis

Cost Components	Conventional Method	Trimble Grade Control Method
Average Productivity Volume / Hour - (in M^3)	107	200
Trimble Grade Control System-Approx. (Cost /hr)		313
Grader-Hire Charges (Cost /hr)	1042	1042
Time in hrs	1	1
Labor Charges (Cost /hr)	625	292
Diesel consumed in liters	14	11
Diesel cost (with rate of INR95/Litre)	1330	1045
Total Cost for Fine grading (Cost /hr)	2997	2691
Total Cost for Fine grading/M^3	₹ 28.01	₹ 13.45

Savings = INR 14.55/ m^3

Percentage of saving in M^3 grading 51.96 %

Saving through Machine control across stages

Earthwork Dozing Compaction Grading Paving

Owner

- Faster and on-time execution
- Reduced Project Cost
- Collaborative Execution of Design
- Higher Quality - smoothness, rideability, compaction
- Digital records for Audit, future planning and expansion

Contractor

- Faster production with high accuracy – Early completion
- Lower Cost of production
- Day/Night all weather operation, higher utilization of machines/assets, higher ROI
- Less rework – First time right
- Less wastage

Trimble Geospatial

GNSS Positioning Services

Survey & Mapping GNSS Systems

High Precision Mixed Reality

Mobile & Cloud "Asset First" Software

Ruggedized & Specialized Handhelds, Controllers, & Tablets

High Precision Optical Positioning & Reality Capture

Mobile Mapping

Thank You

For Queries:
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