Construction Technology Showdown

Does One Reality Capture Solution Rule Them All?

Shane Saltzgiver
CEO & Founder
VEC

Leo Castillo
Director of Construction Technology
VEC

Rob Ohata
VDC & HDS Project Manager
VEC

AUTODESK. UNIVERSITY

About the speakers

Shane Saltzgiver | Founder & CEO

After many years as a Project Engineer and Project Manager in the Construction industry seeing the waste and chaos firsthand, Shane founded Virtual Engineering & Construction with the Vision to Make Construction Easy. In less than 5-years VEC has grown to a 75-person army with offices in California, New York, South America and Eastern Europe. VEC's experience extends to large-scale aviation, transportation, infrastructure, commercial and residential projects ranging from high rises and tunnels in downtown San Francisco to high-end tech projects in Silicon Valley for clients such as Google and Facebook.

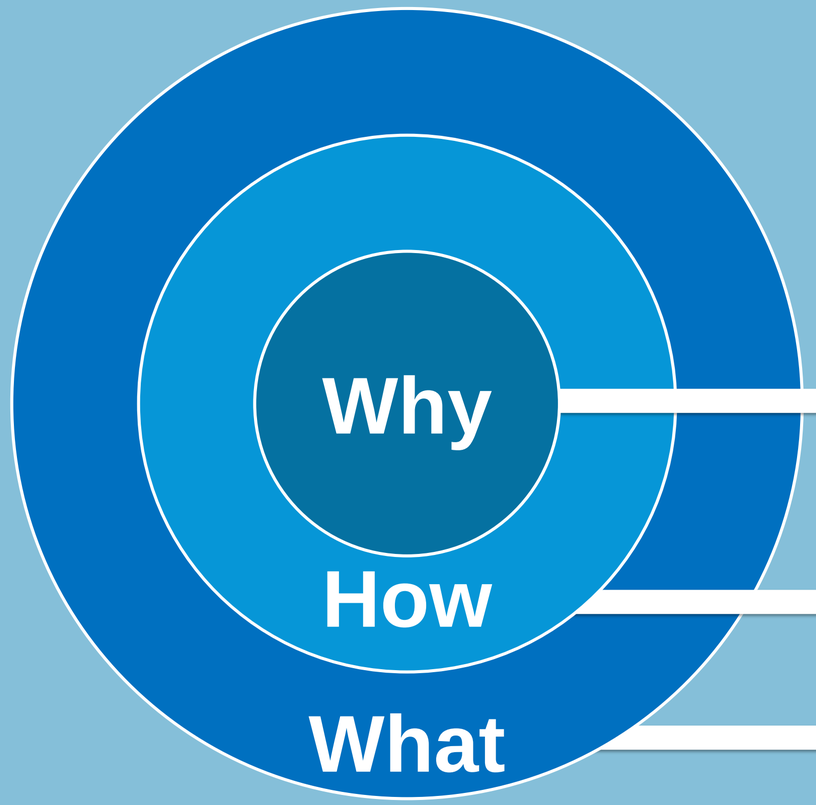
Leo Castillo | Director of Construction Technology

A serial entrepreneur

Co-founded a Civil & Land Development Consulting Company in 2008

Founded a BIM & Scanning Company in 2012 (acquired 2016)

Joined VEC in early 2018 laser-focused on taking 3D tech to the Field



Our Purpose

Our Process

Our Results

Why Did We Want to Do This?

Our Track Record

0

MISSED EMBEDS

0

MISPLACED EMBEDS

0

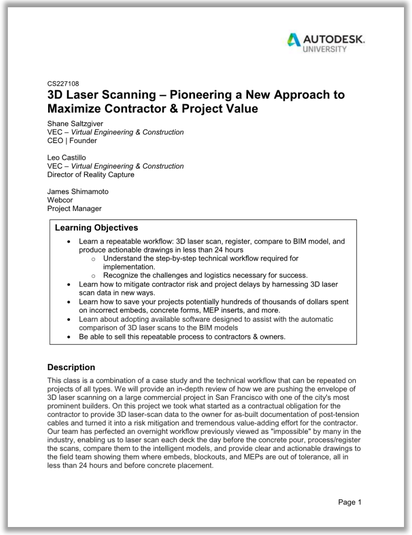
SLAB EDGE ERRORS

0

BLOCKOUT ERRORS

0

TIMES THIS HAPPENED IN WEBCOR HISTORY



AUTODESK. UNIVERSITY

CS227108

3D Laser Scanning – Pioneering a New Approach to Maximize Contractor & Project Value

Shane Saltzgiver
VEC – *Virtual Engineering & Construction*
CEO | Founder

Leo Castillo
VEC – *Virtual Engineering & Construction*
Director of Reality Capture

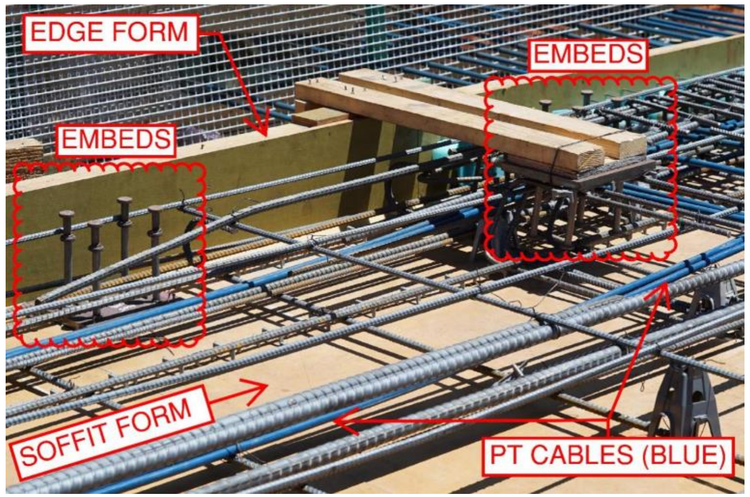
James Shimamoto
Webcor
Project Manager

Learning Objectives

- Learn a repeatable workflow: 3D laser scan, register, compare to BIM model, and produce actionable drawings in less than 24 hours
  - Understand the step-by-step technical workflow required for implementation.
  - Recognize the challenges and logistics necessary for success.
- Learn how to mitigate contractor risk and project delays by harnessing 3D laser scan data in new ways.
- Learn how to save your projects potentially hundreds of thousands of dollars spent on incorrect embeds, concrete forms, MEP inserts, and more.
- Learn about adopting available software designed to assist with the automatic comparison of 3D laser scans to the BIM models
- Be able to sell this repeatable process to contractors & owners.

Description

This class is a combination of a case study and the technical workflow that can be repeated on projects of all types. We will provide an in-depth review of how we are pushing the envelope of 3D laser scanning on a large commercial project in San Francisco with one of the city's most prominent builders. On this project we took what started as a contractual obligation for the contractor to provide 3D laser-scan data to the owner for as-built documentation of post-tension cables and turned it into a risk mitigation and tremendous value-adding effort for the contractor. Our team has perfected an overnight workflow previously viewed as "impossible" by many in the industry, enabling us to laser scan each deck the day before the concrete pour, process/register the scans, compare them to the intelligent models, and provide clear and actionable drawings to the field team showing them where embeds, blockouts, and MEPs are out of tolerance, all in less than 24 hours and before concrete placement.




seco

VEC Tech Magazine Construction Technology Reviewers

To live up to our Vision to “Make Construction Easy” we are constantly testing new Construction Technology hardware, software and workflows. We decided to share our research with our colleagues, customers and enthusiasts for the next reason…

Drink From the Firehose

Construction industry is bombarded with $$$ in advertising for new technology, services, products and workflows. Chasing the next new trend that comes along could cost significantly without any guarantee that it will provide ROI. The most expensive part of anything new is going to be in training your personnel. We decided to help you drink from the Fire Hose.

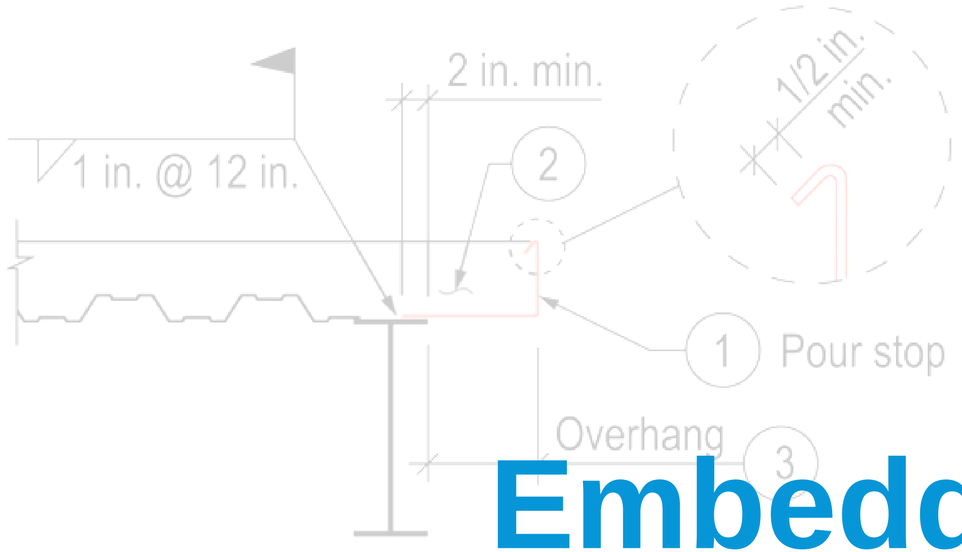
How Did We Evaluate?
How Are We Going to Deliver Results To You?

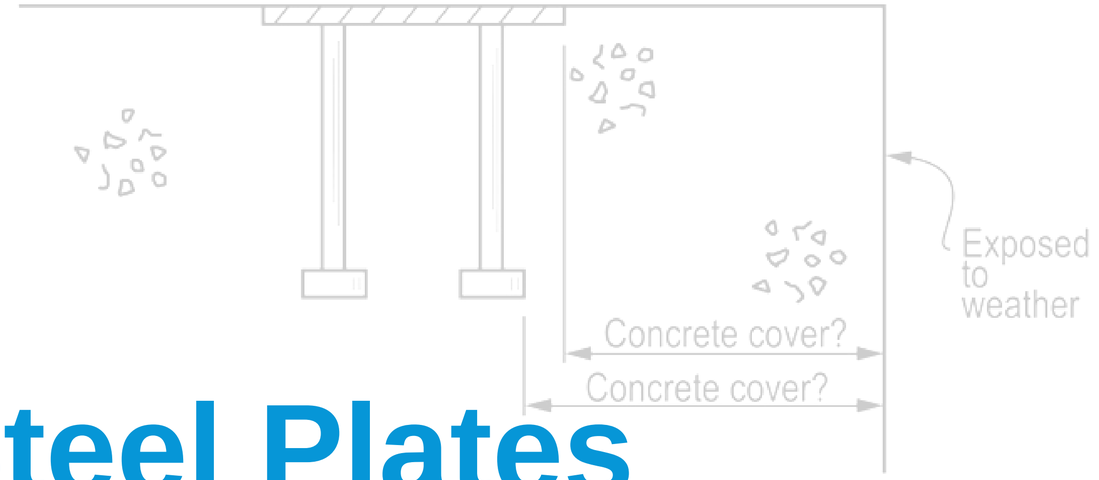

FAA
LICENSED
COMMERCIAL
DRONE PILOT
OBSERVER
FAA
LICENSED
COMMERCIAL
DRONE PILOT
PLEASE DO NOT
DISTURB
YOU

950 Market Street

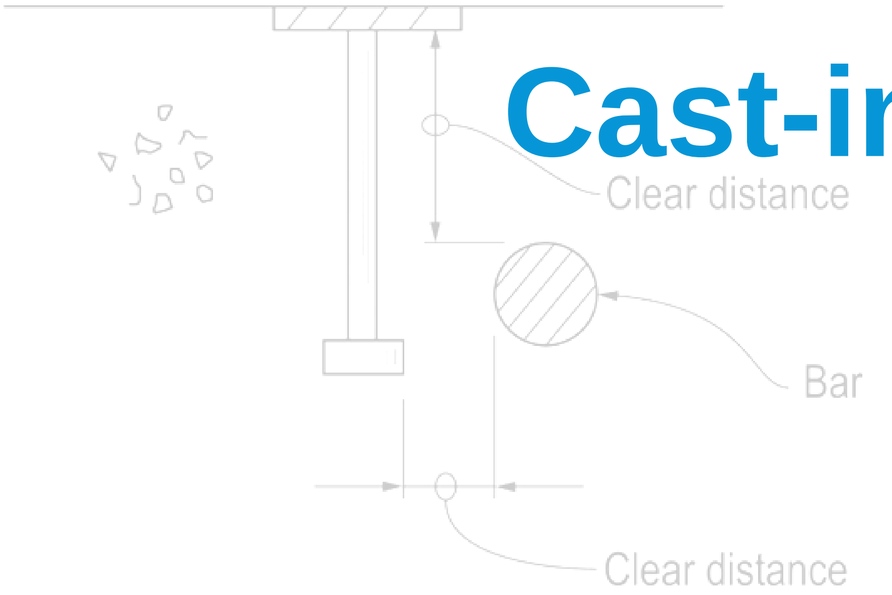
The project will enliven the neighborhood by providing room for a wide range of activities, including a dedicated non-profit space for Magic Theatre at the corner of Turk and Taylor, a community open space on Turk Street, outdoor food and beverage garden, event space, a selection of retailers, and a landscaped rooftop as well as hospitality, housing, and retail space.

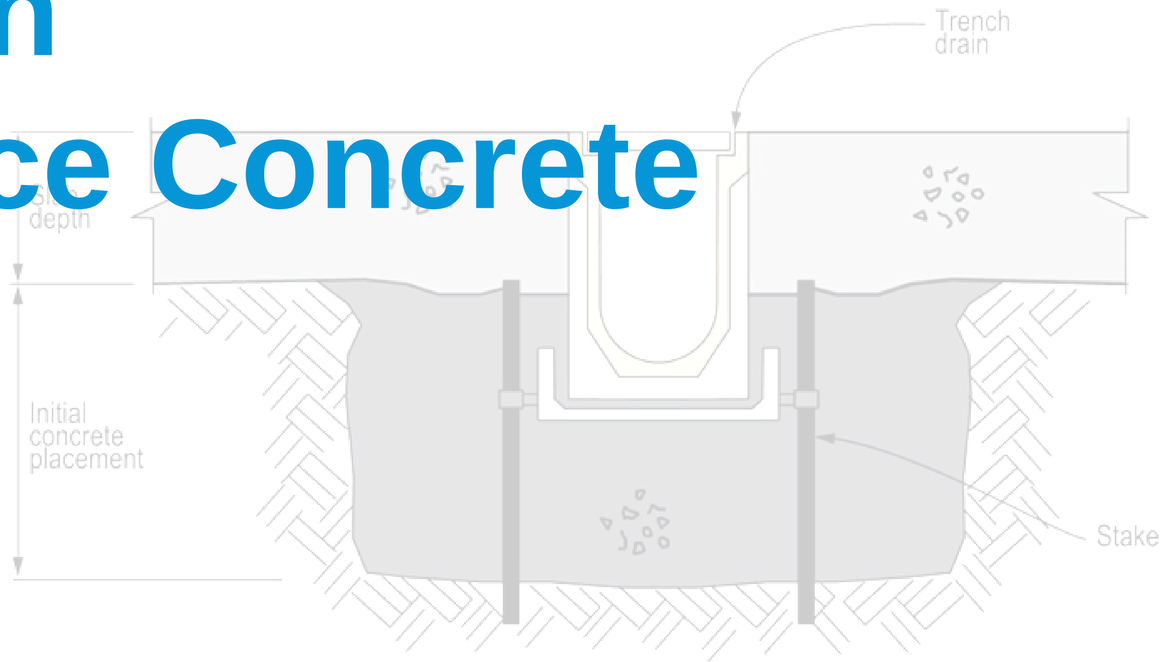
Group i | Handle Architects | Lendlease | Pankow



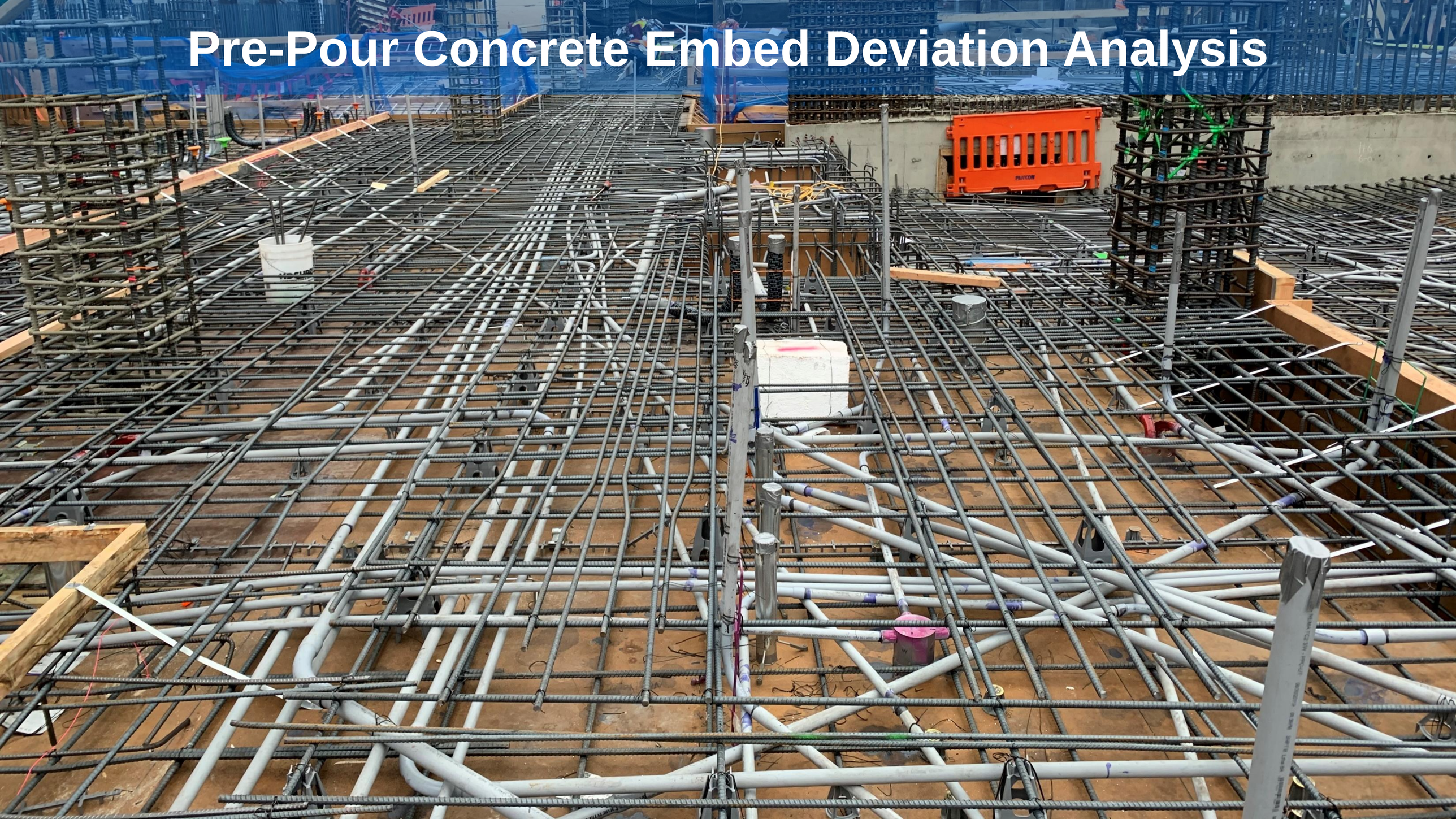


Embedded Steel Plates in Cast-in-Place Concrete





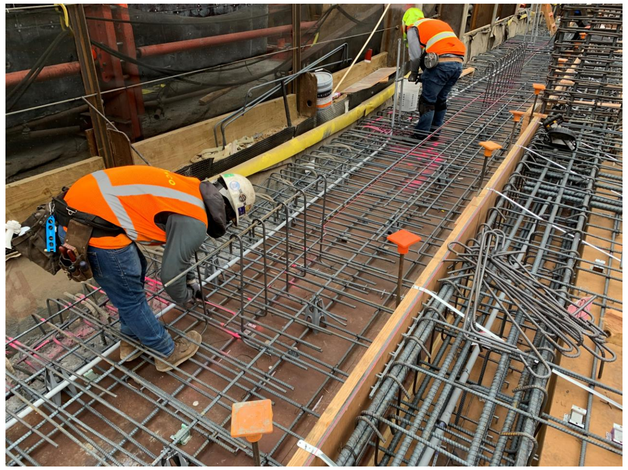
Pre-Pour Concrete Embed Deviation Analysis



Embedded Steel, MEP & Void Features

BLUE BANGER

PULL BOX



EDGE FORM

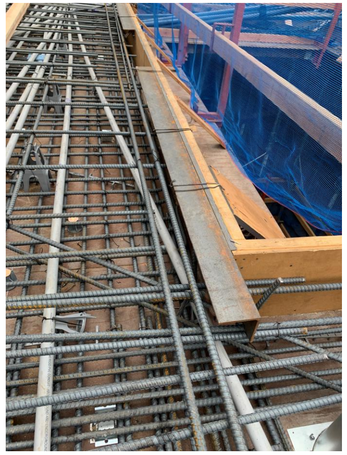
PANEL RISERS

PT CABLES

CONDUIT ELBOWS
(PER SYSTEM)

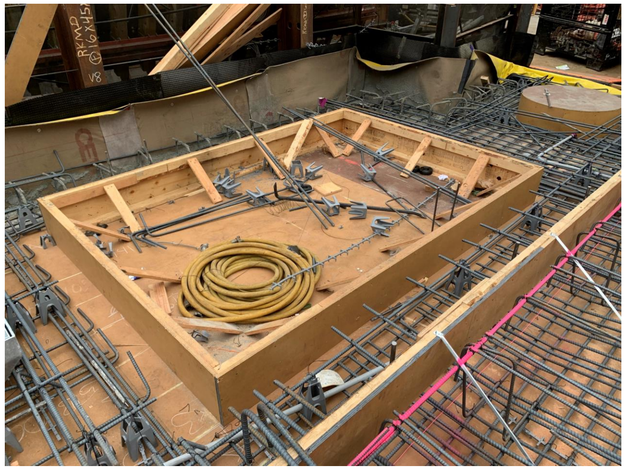
Embedded Steel, MEP & Void Features

SHEAR WALL



STAIR EMBED

STUD RAILS

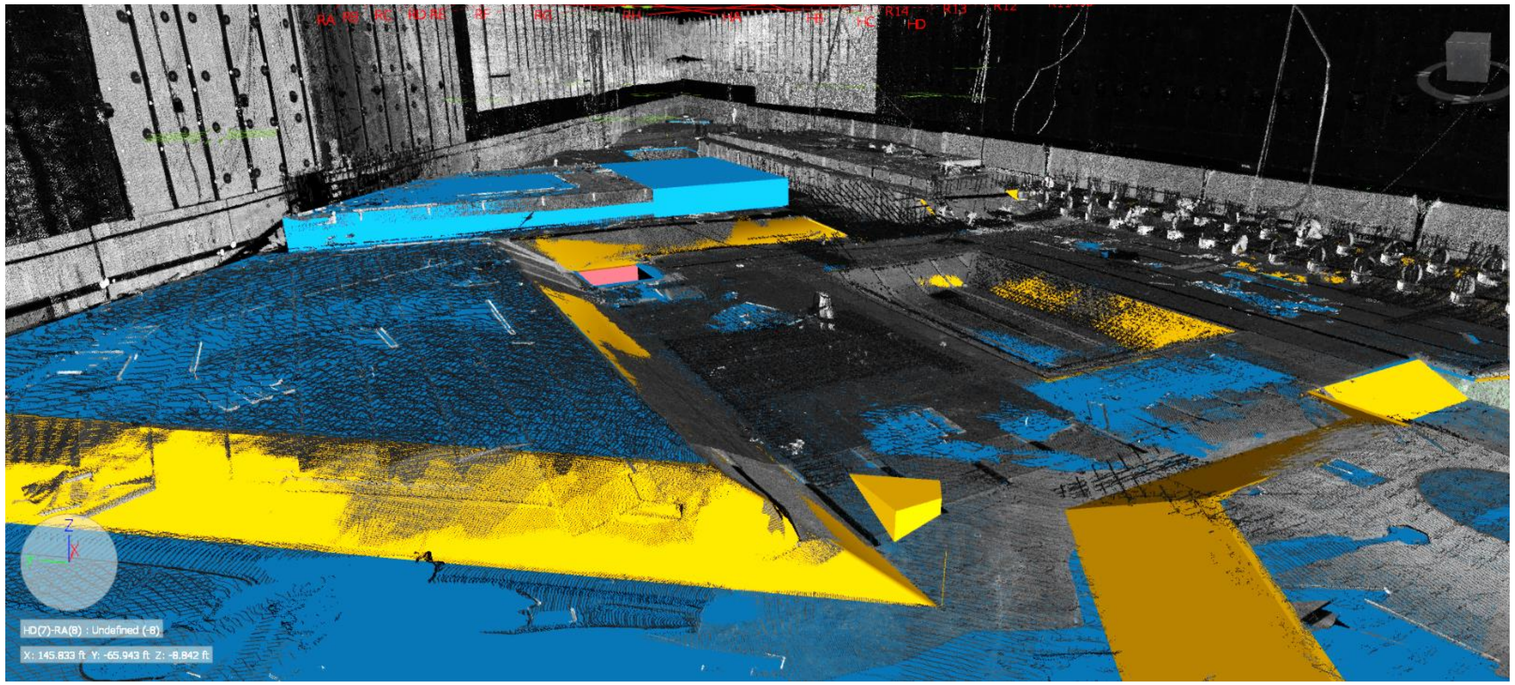


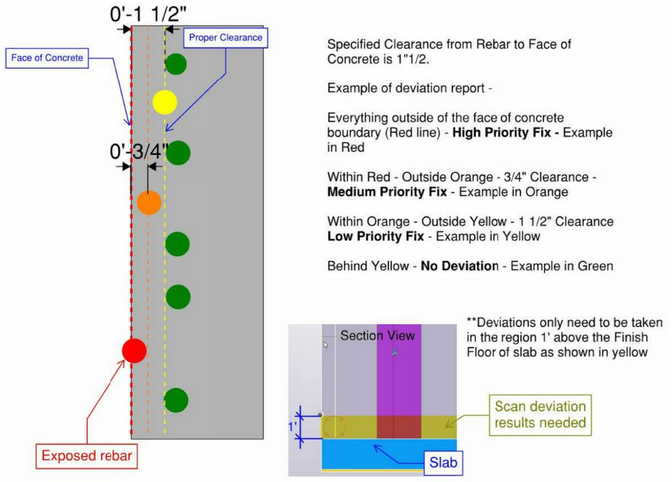
BLOCKOUT

DRAIN

CONSTRUCTION DRAWINGS

PreciseConstruction QA/QC & Deviation Method





Specified Clearance from Rebar to Face of Concrete is 1"1/2.

Example of deviation report -

Everything outside of the face of concrete boundary (Red line) - **High Priority Fix -** Example in Red

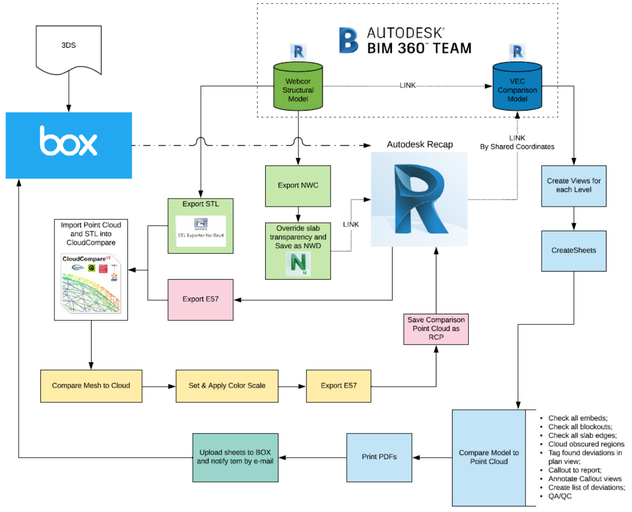
Within Red - Outside Orange - 3/4" Clearance - **Medium Priority Fix** - Example in Orange

Within Orange - Outside Yellow - 1 1/2" Clearance **Low Priority Fix** - Example in Yellow

Behind Yellow - **No Deviation** - Example in Green

**Deviations only need to be taken in the region 1' above the Finish Floor of slab as shown in yellow

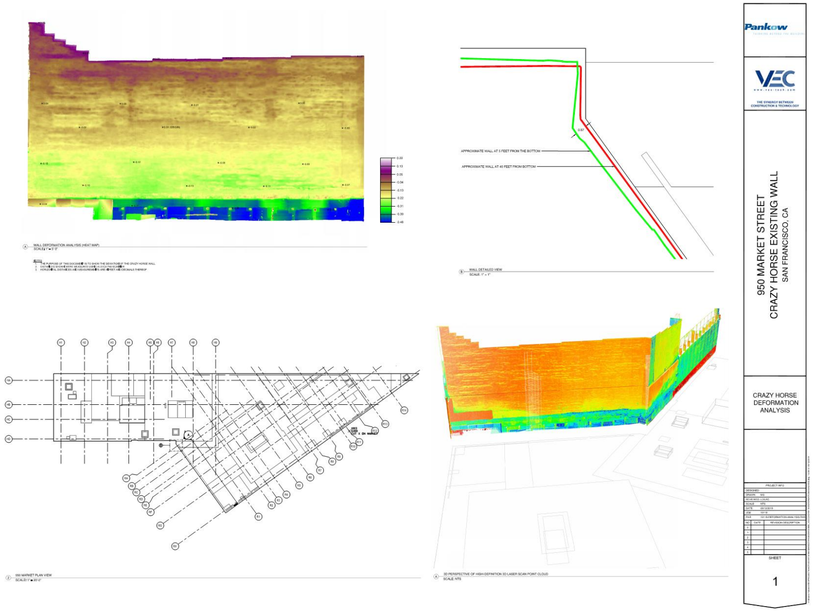
SPECIFICATIONS

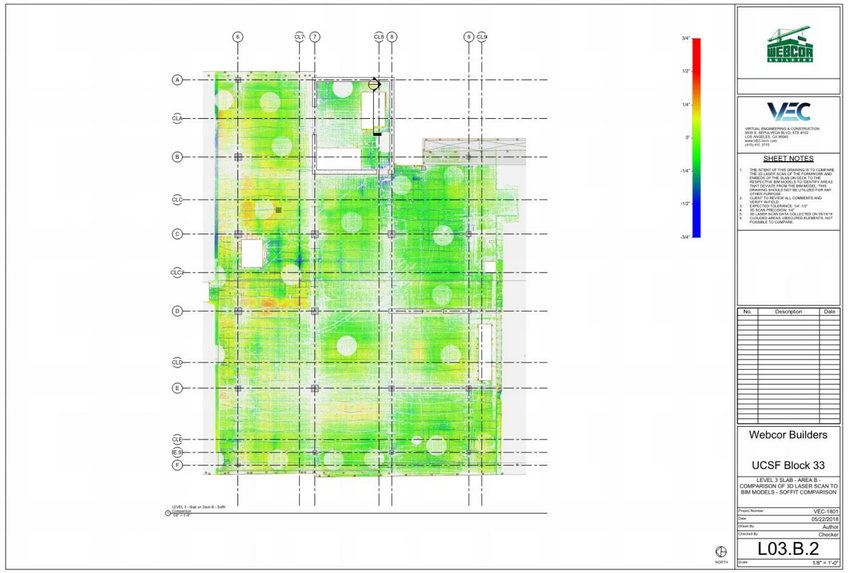


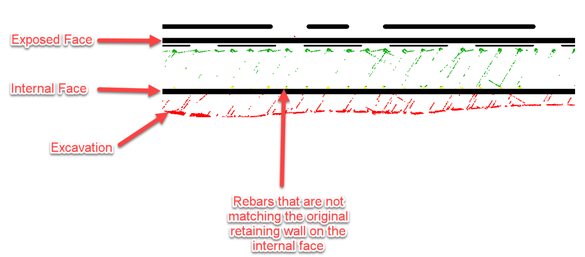
WORKFLOW

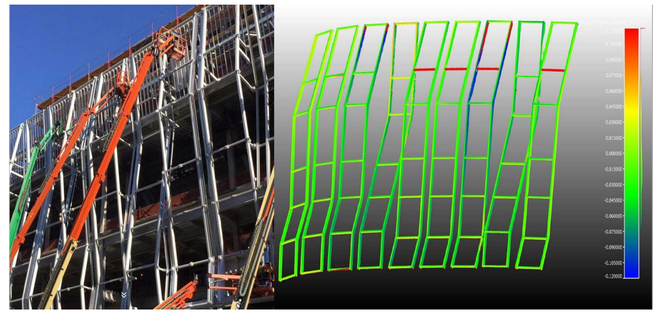
DETAILED MODEL
+
CLIENT SPECS
+
REALITY CAPTURE

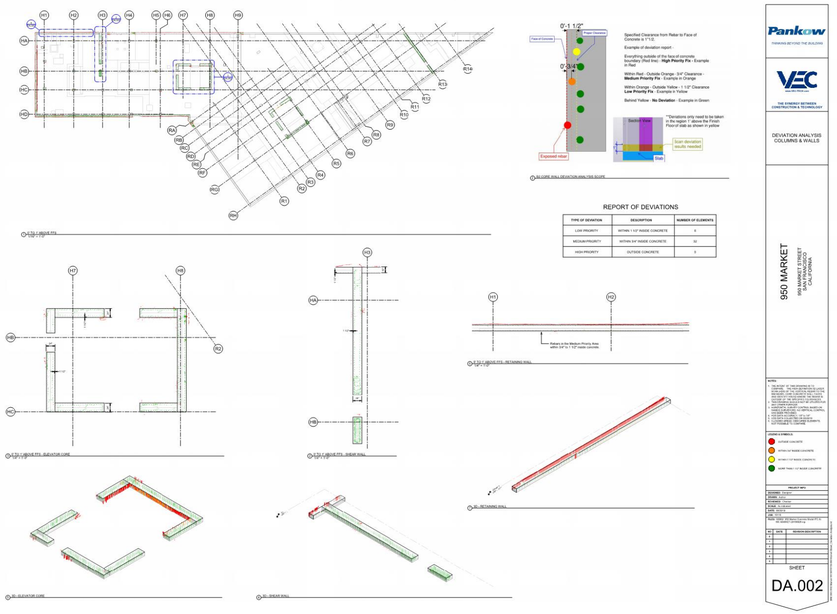
QA/QC Reporting Results & Deliverable

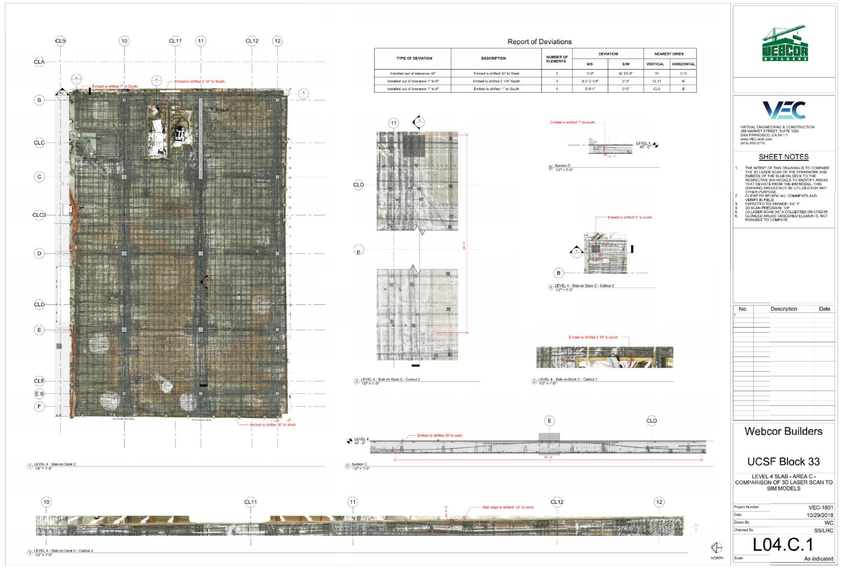




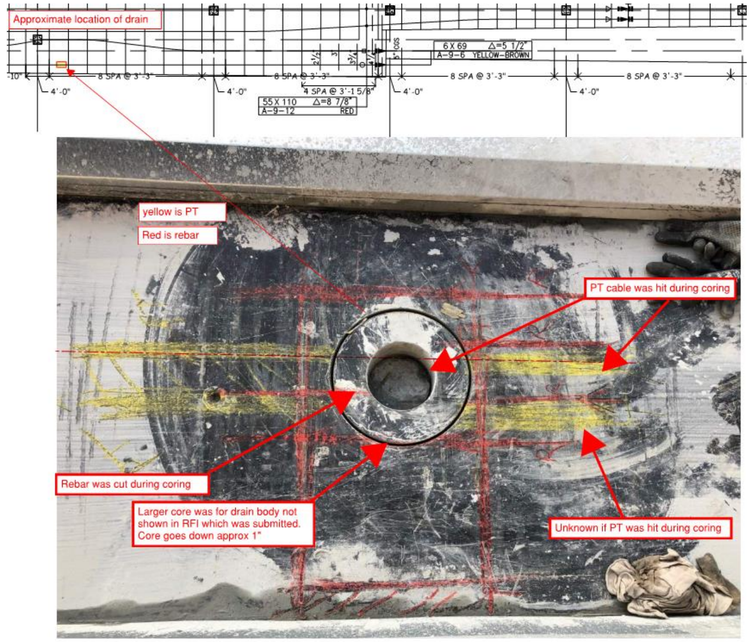




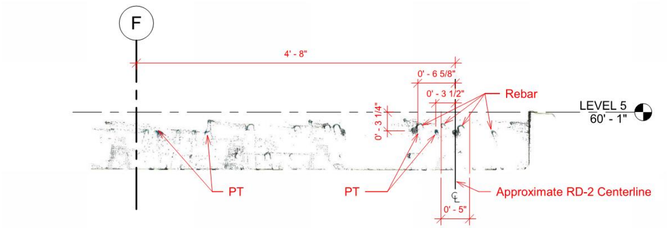




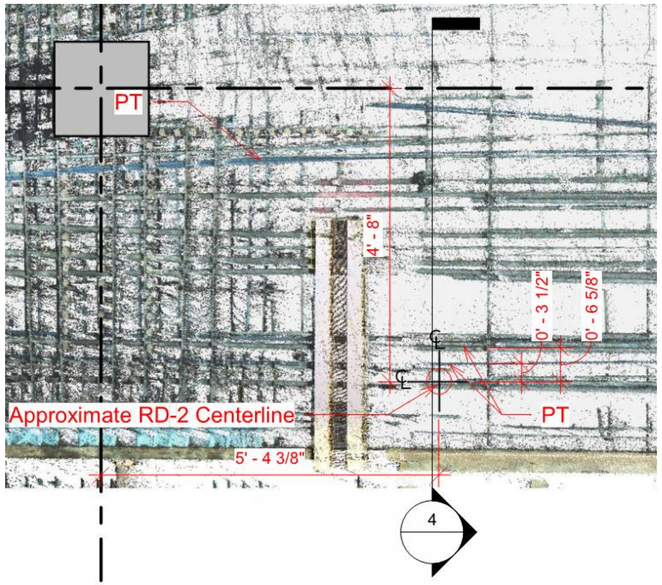
Additional Benefits of Reality Capture Technology

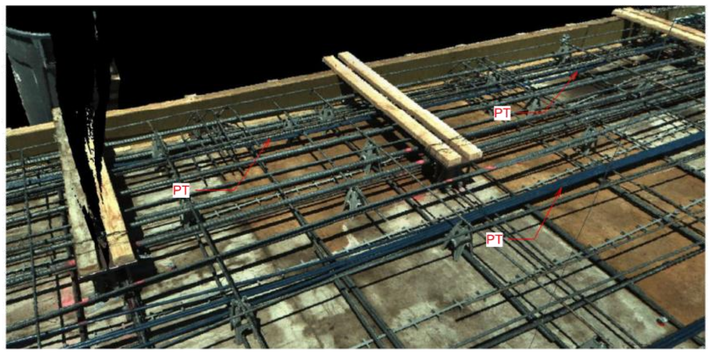


"I need a better understanding of where some PT cables are located on level 5. We hit a PT cable while coring for the roof drain noted below and may have to do some chipping in this area in order to repair this cable. Based on the PT shop drawings there may be two PT cables directly adjacent or they may be sweeping back together from the construction joint however scanning the concrete does not tell us this level of detail. I am hoping to get a bit more info about exactly where the PT cables are in order to help us fix the broken cable or cables."



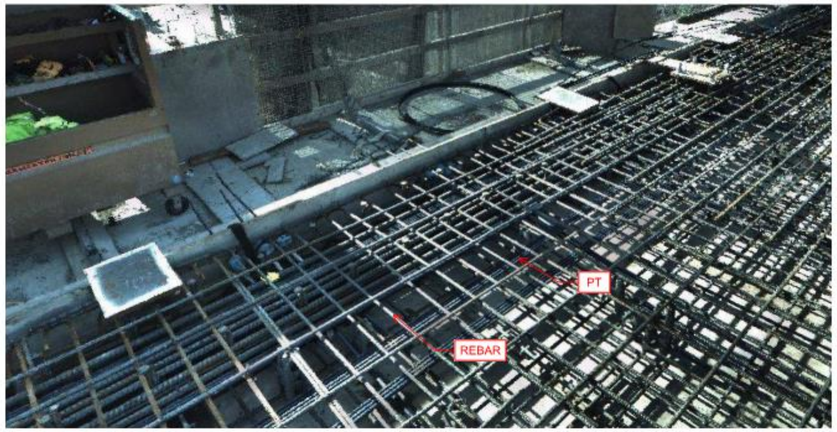
4 LEVEL 05 - Slab on Deck B - Detail Section 01
1" = 1'-0"





9 LEVEL 05 - Slab on Deck B - Looking East
NTS

5 LEVEL 13 - Slab on Deck B
NTS



6 LEVEL 13 - Slab on Deck B
NTS

"Just as before with the details of the slab, can you guys shoot me over some detailed pictures of the in slab items of the marked area (red) of the PDF attached? The team is looking to do some drilling in this area and would like to know where Rebar/PT is in the slab. Dimensions would also be appreciated."

What are the Results?

Players on the Field

mini Ranger *

PHOENIX UAV LIDAR

40 Lbs

1/3 Hour Battery

42 MP Camera

0.1 Pts/Sq In

~$165,000

* Based on sample data provided

RTC 360

LEICA MID-RANGE STATIC LIDAR

11 Lbs

4 Hours Battery

432 MegaPixel

500 Pts/Sq In

~$100,000

BLK 360

LEICA CLOSE-RANGE STATIC LIDAR

2.2 Lbs

2 Hours Battery

15.1 MegaPixel

35 Pts/Sq In

~$25,000

MP Pro2

MATTERPORT CAMERA

8 Lbs

8 Hours Battery

8 MegaPixel

15 Pts/Sq In

~$10,000

Mavic 2 Pro

DJI UAV CAMERA PHOTOGRAMMETRY

2 Lbs

½ Hour Battery

13 MegaPixel

7 Pts/Sq In

~$3,500

One X

INSTA360 CAMERA PHOTOGRAMMETRY

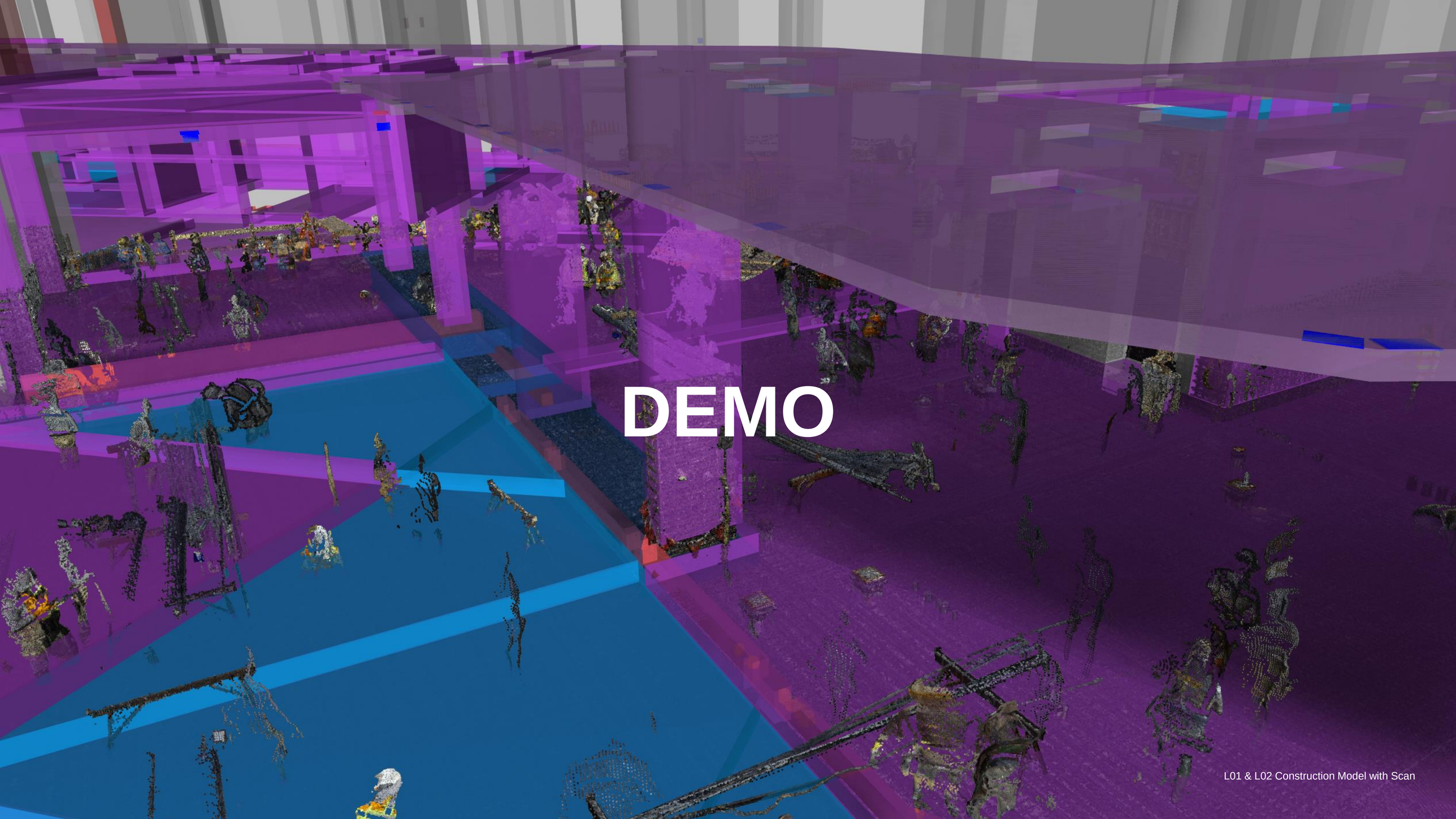
0.2 Lbs

1.5 Hour Battery

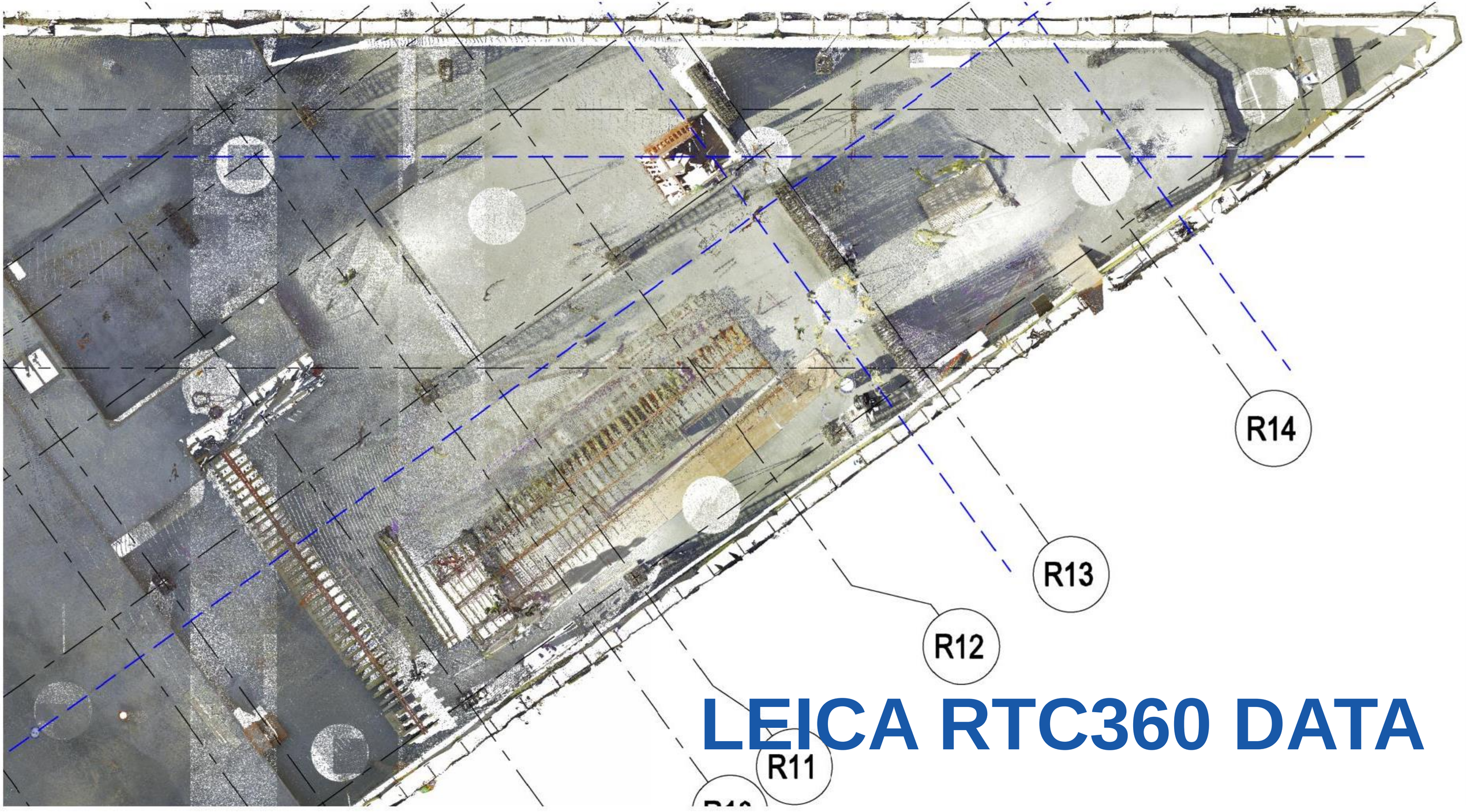
24 MegaPixel

X Pts/Sq In

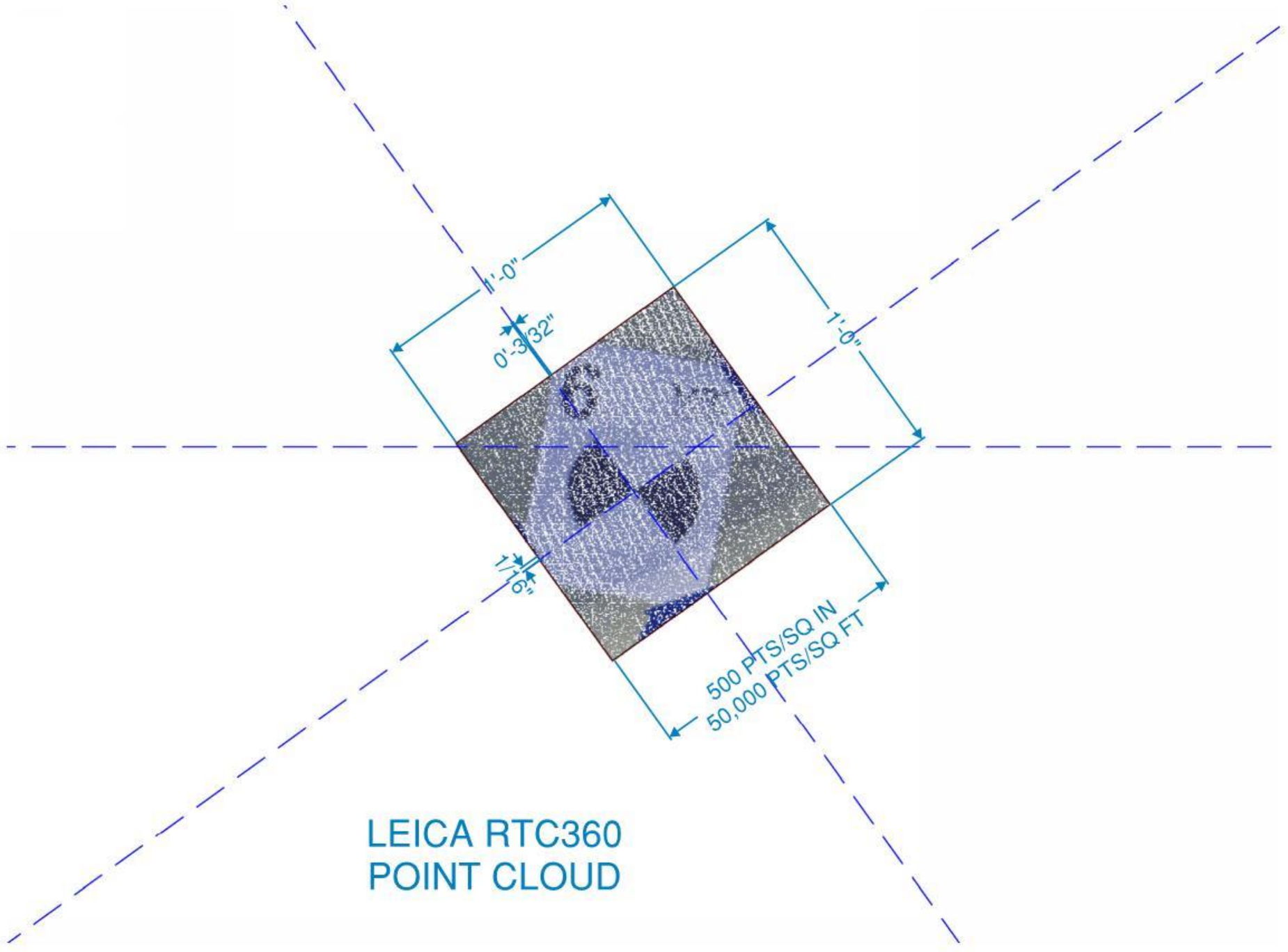
~$1,500



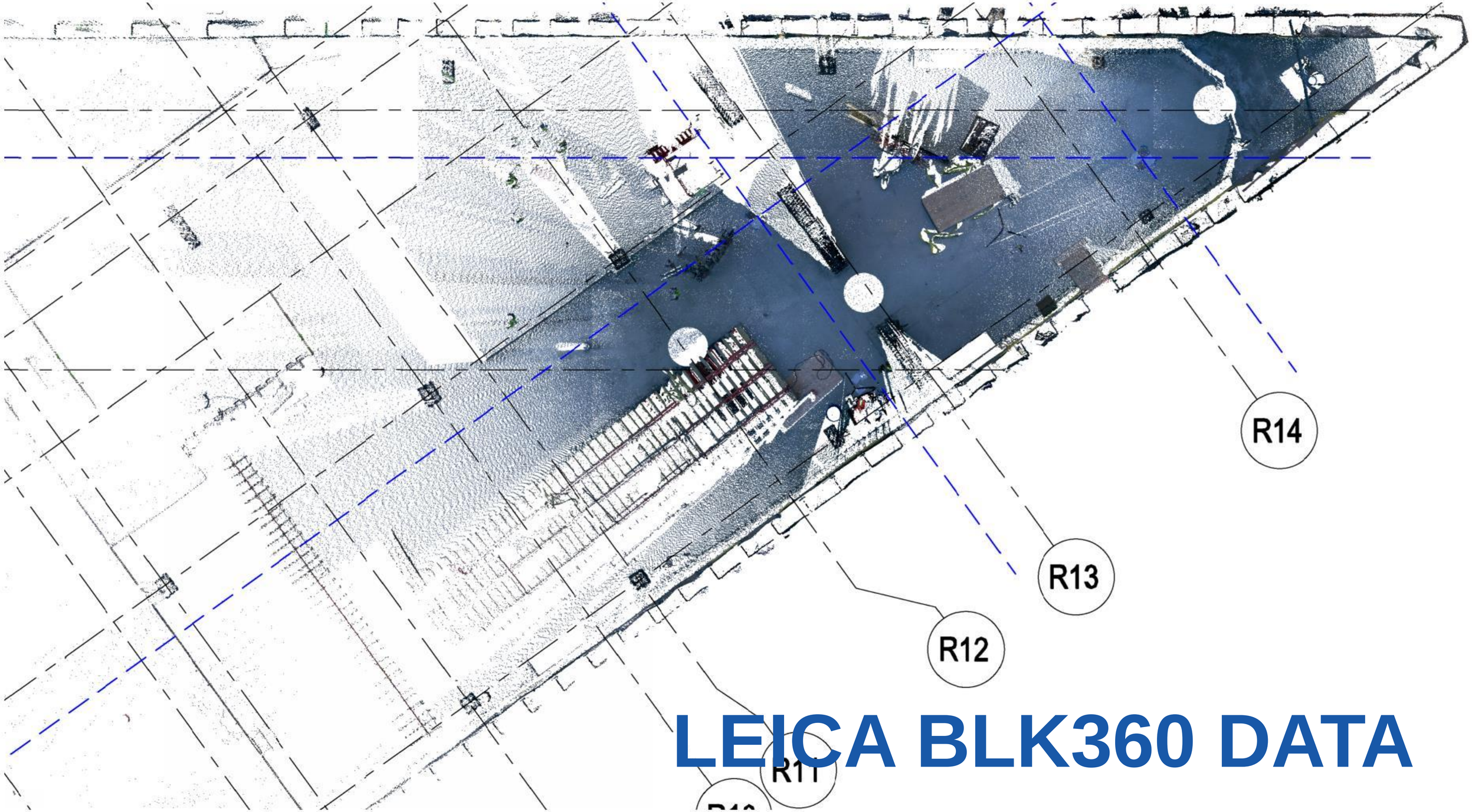
L01 & L02 Construction Model with Scan



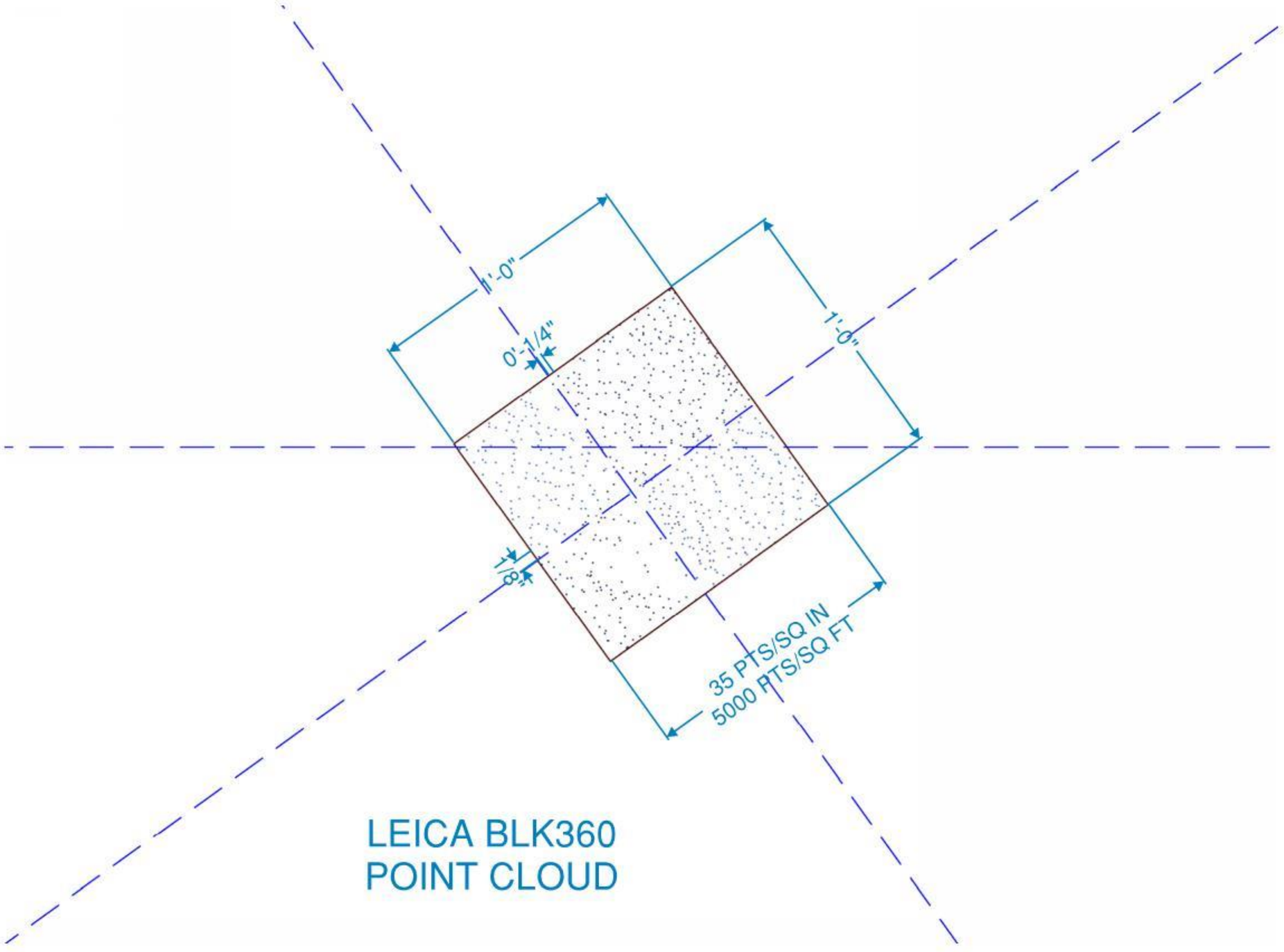
LEICA RTC360 DATA



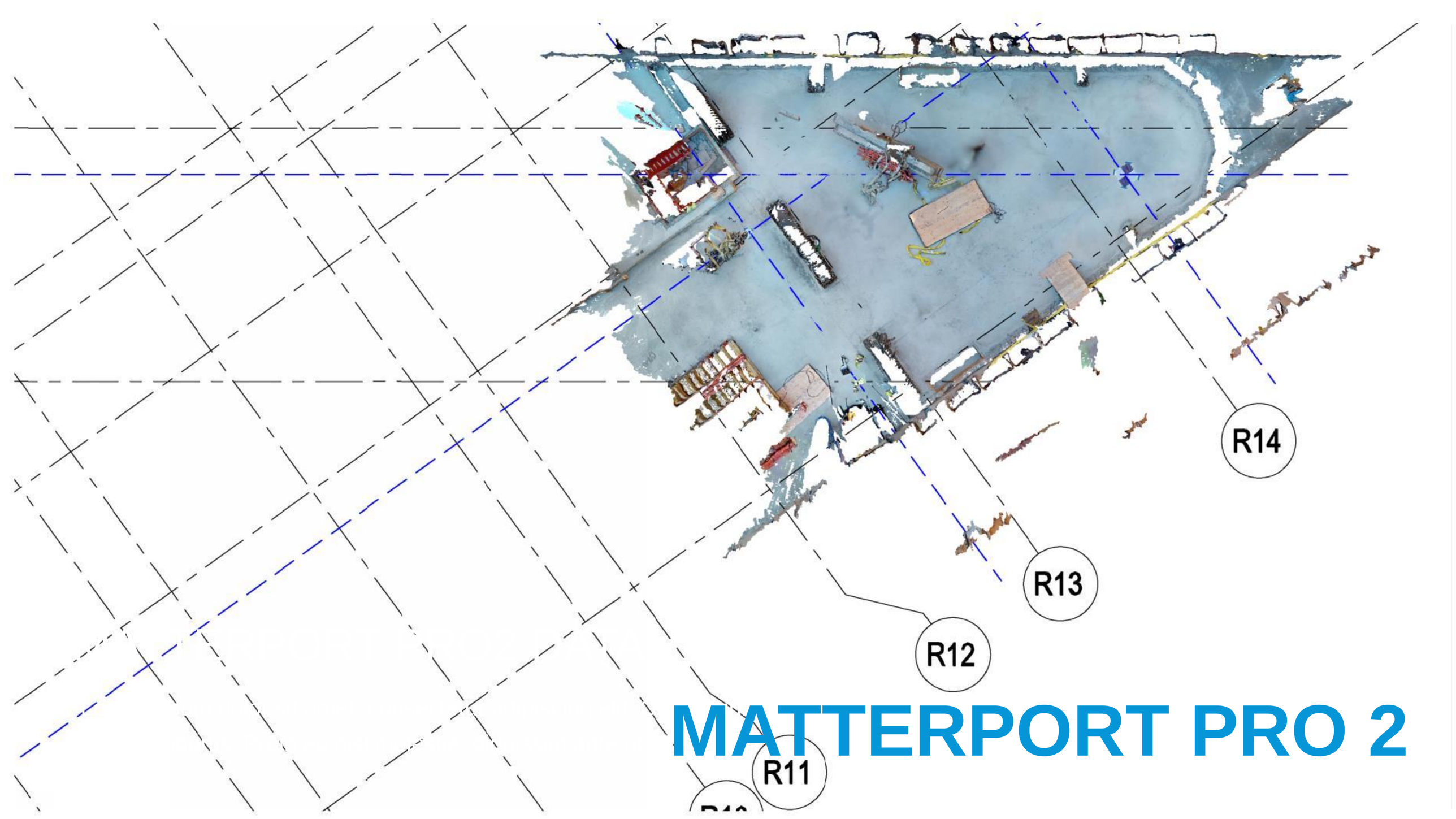
LEICA RTC360
POINT CLOUD



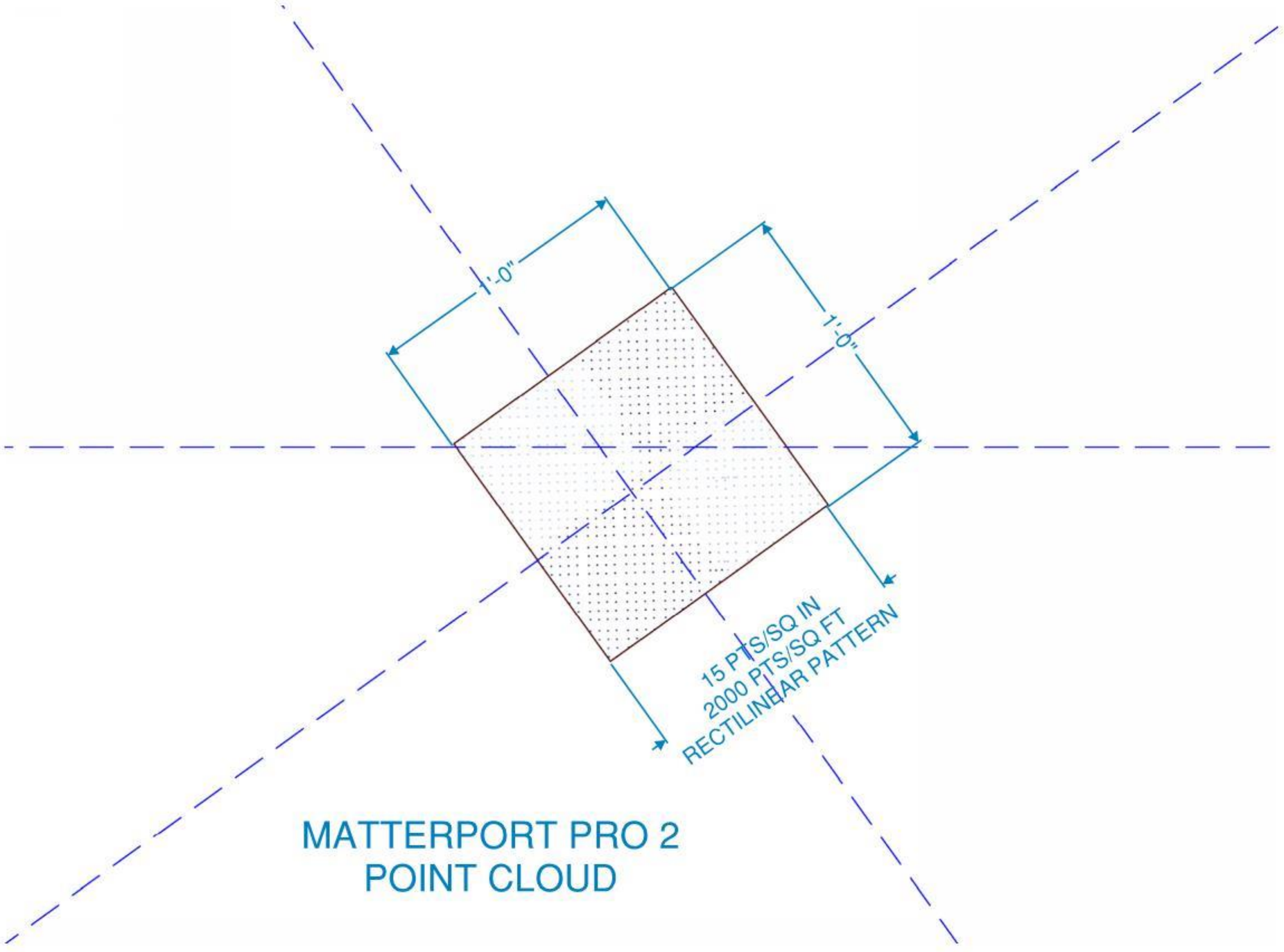
LEICA BLK360 DATA



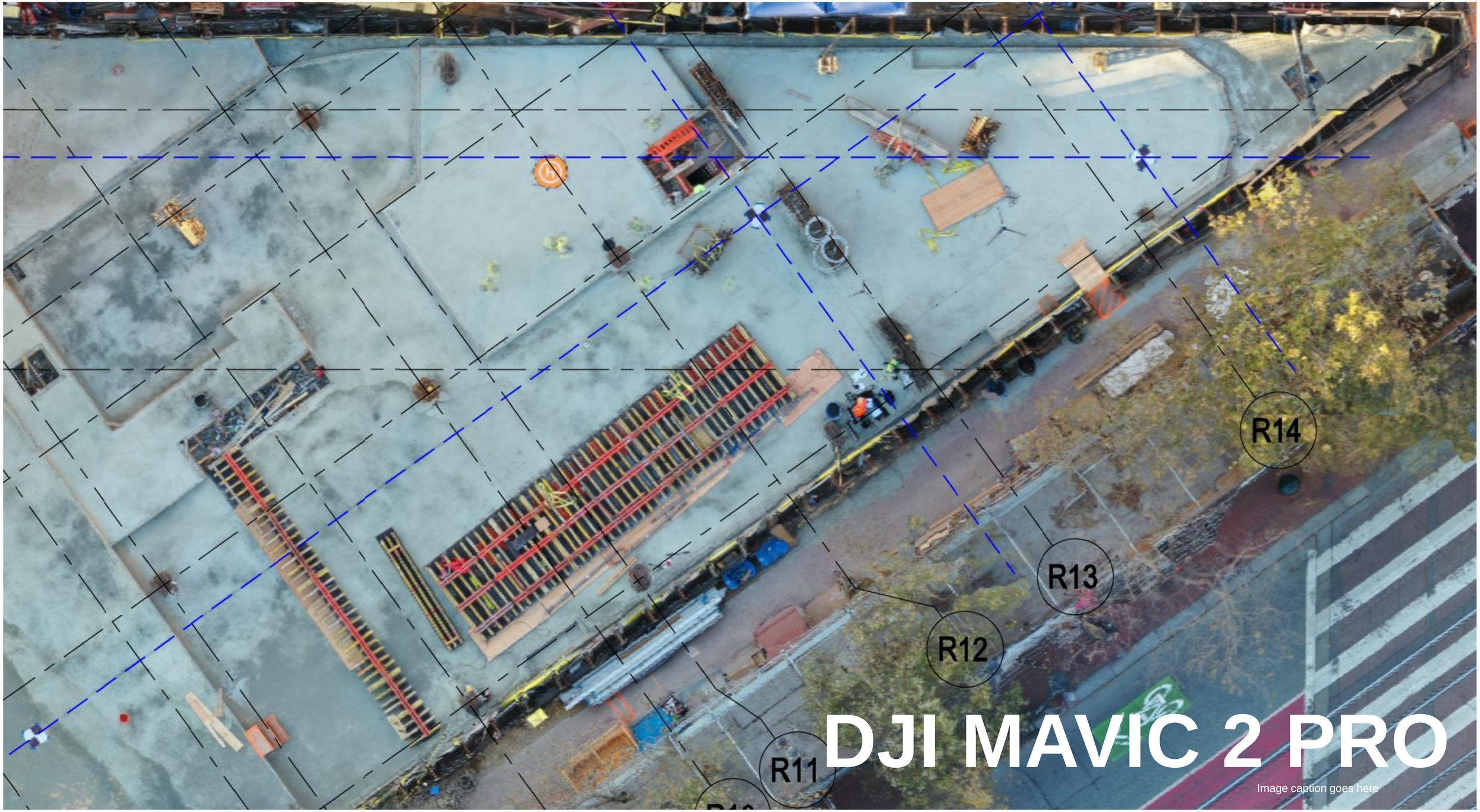
LEICA BLK360
POINT CLOUD

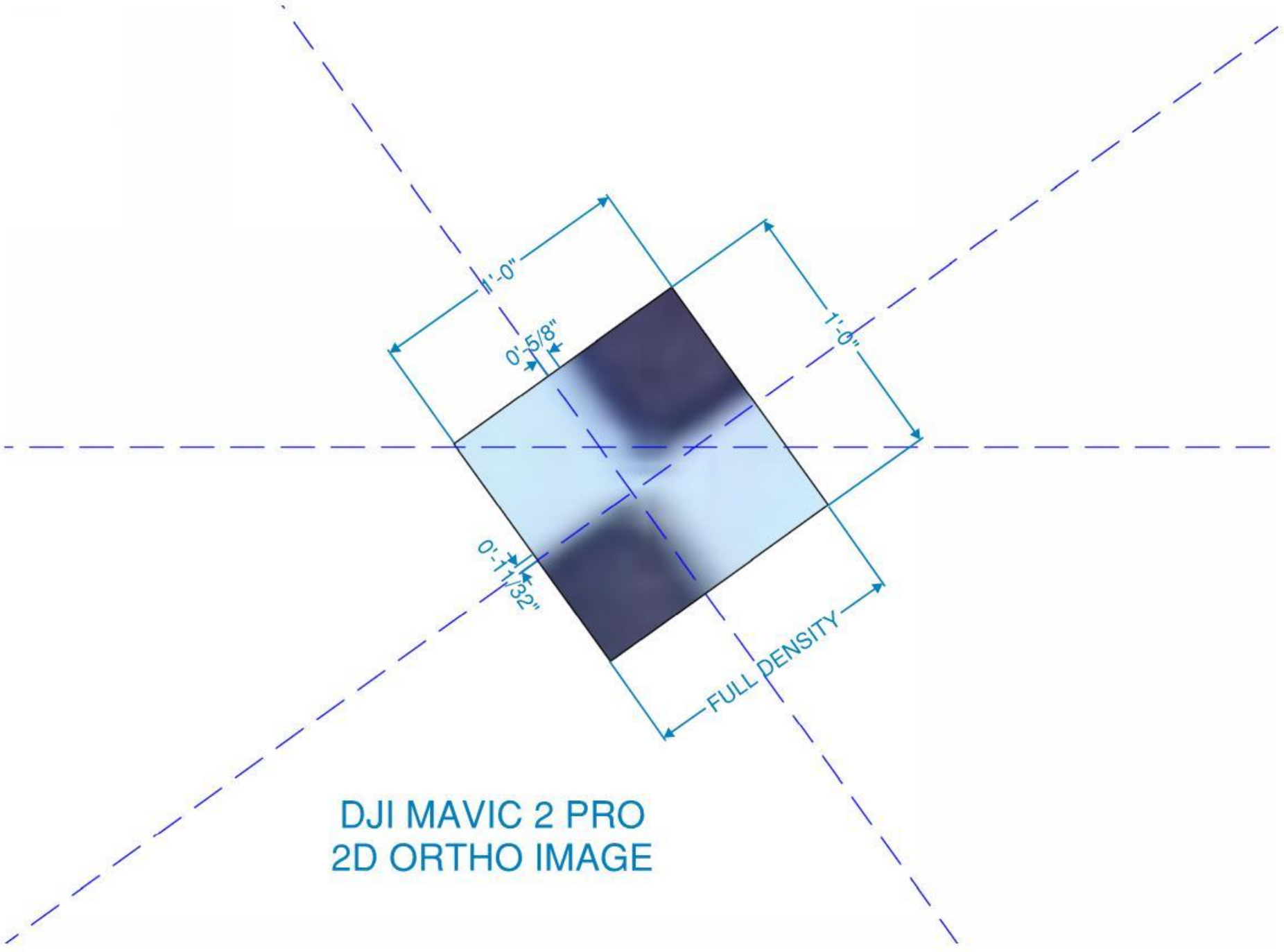


MATTERPORT PRO 2



MATTERPORT PRO 2
POINT CLOUD


R14
R13
R12
R11
DJI MAVIC 2 PRO
Image caption goes here



DJI MAVIC 2 PRO
2D ORTHO IMAGE

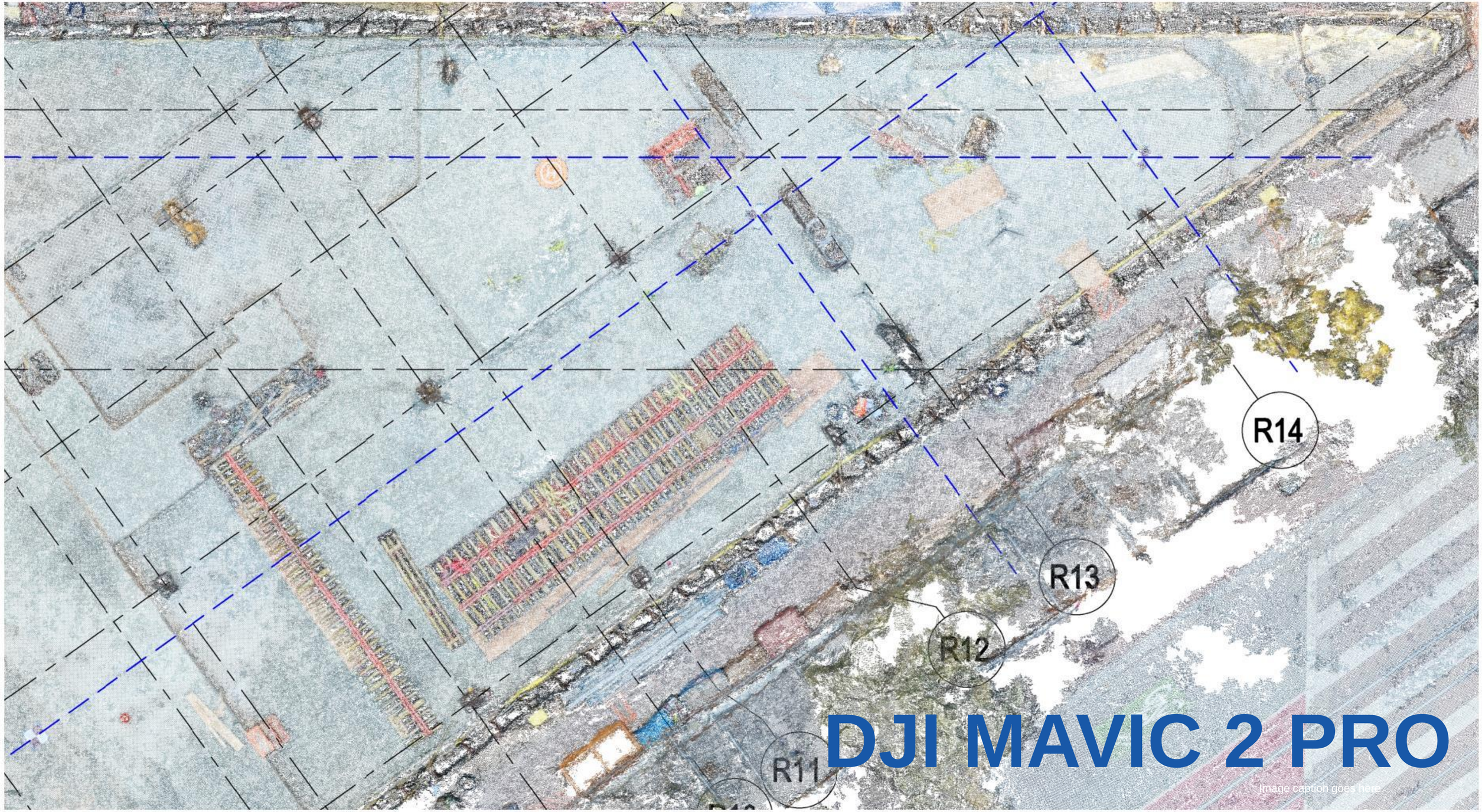
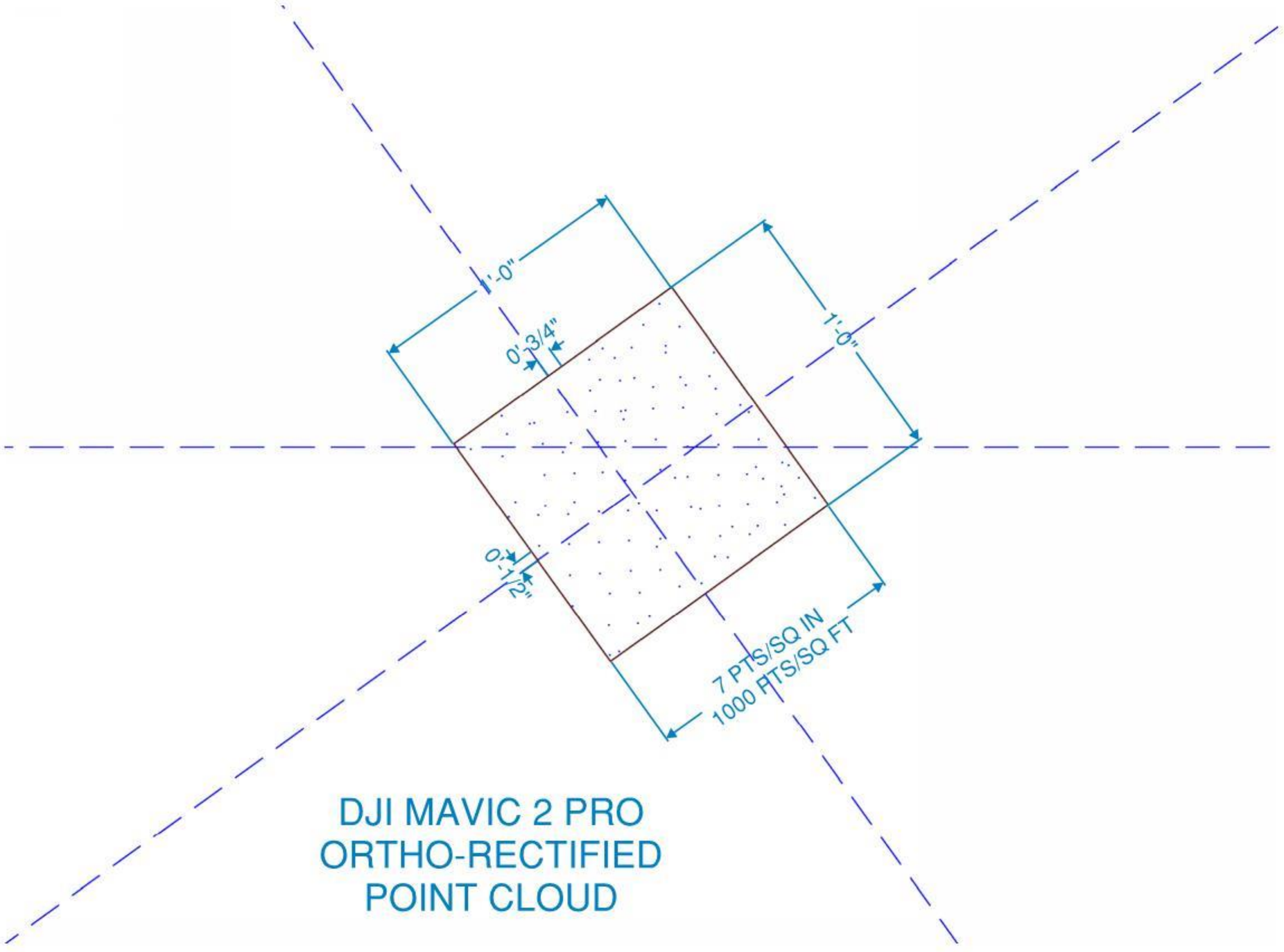


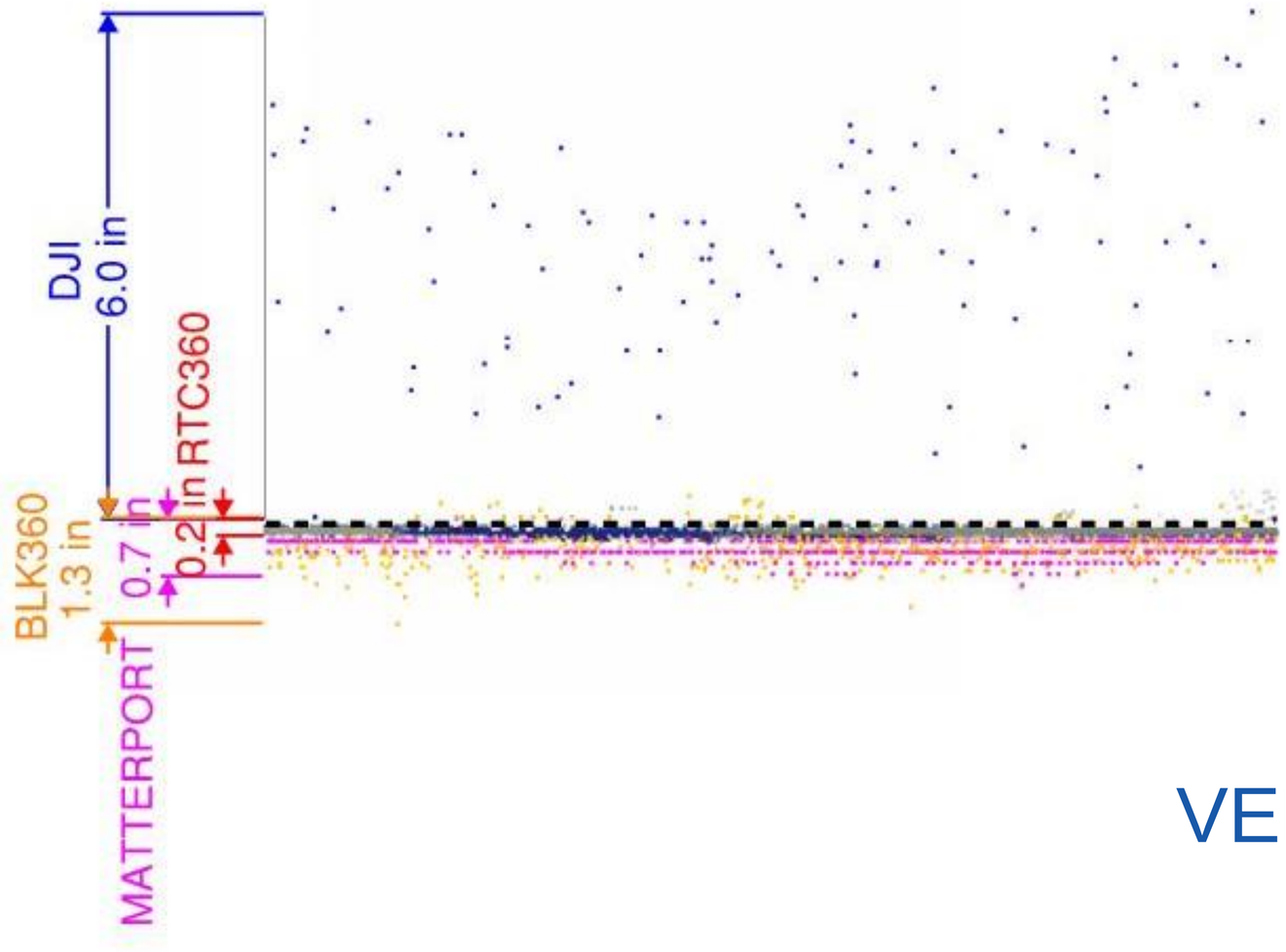
Image caption goes here



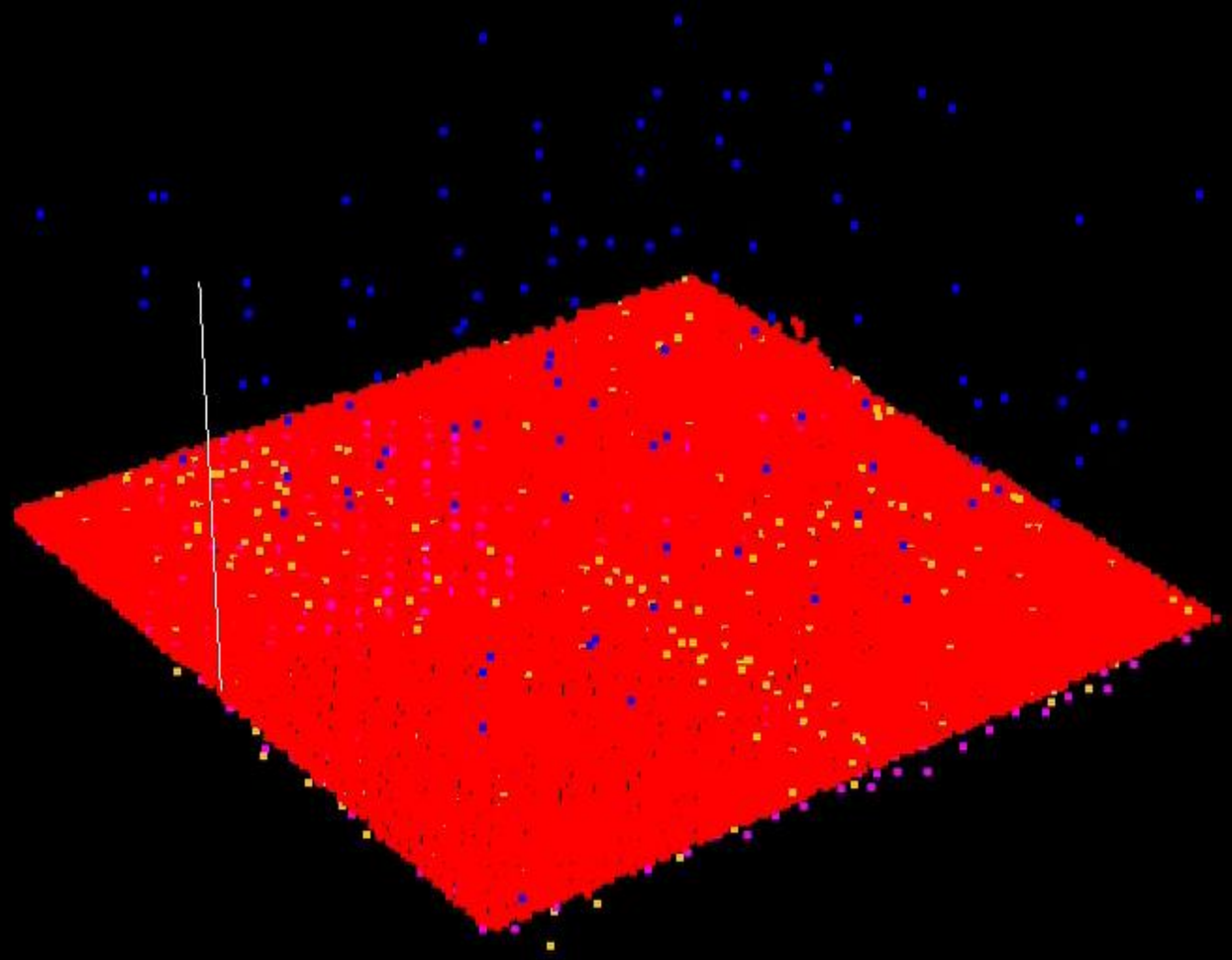
DJI MAVIC 2 PRO
ORTHO-RECTIFIED
POINT CLOUD


950 Market 111819
INSTA360 FLOORPLAN
Photo credit goes here

RTC360 V ERROR	BLK360 V ERROR	MATTERPORT PRO2	DJI MAVIC 2 PRO	INSTA360
3/32”	5/8”	3/8”	3”	0/0”
0.1”	0.6”	0.35”	0.25-ft	0.0”
0.008-ft	0.05-ft	0.03-ft		0.00-ft



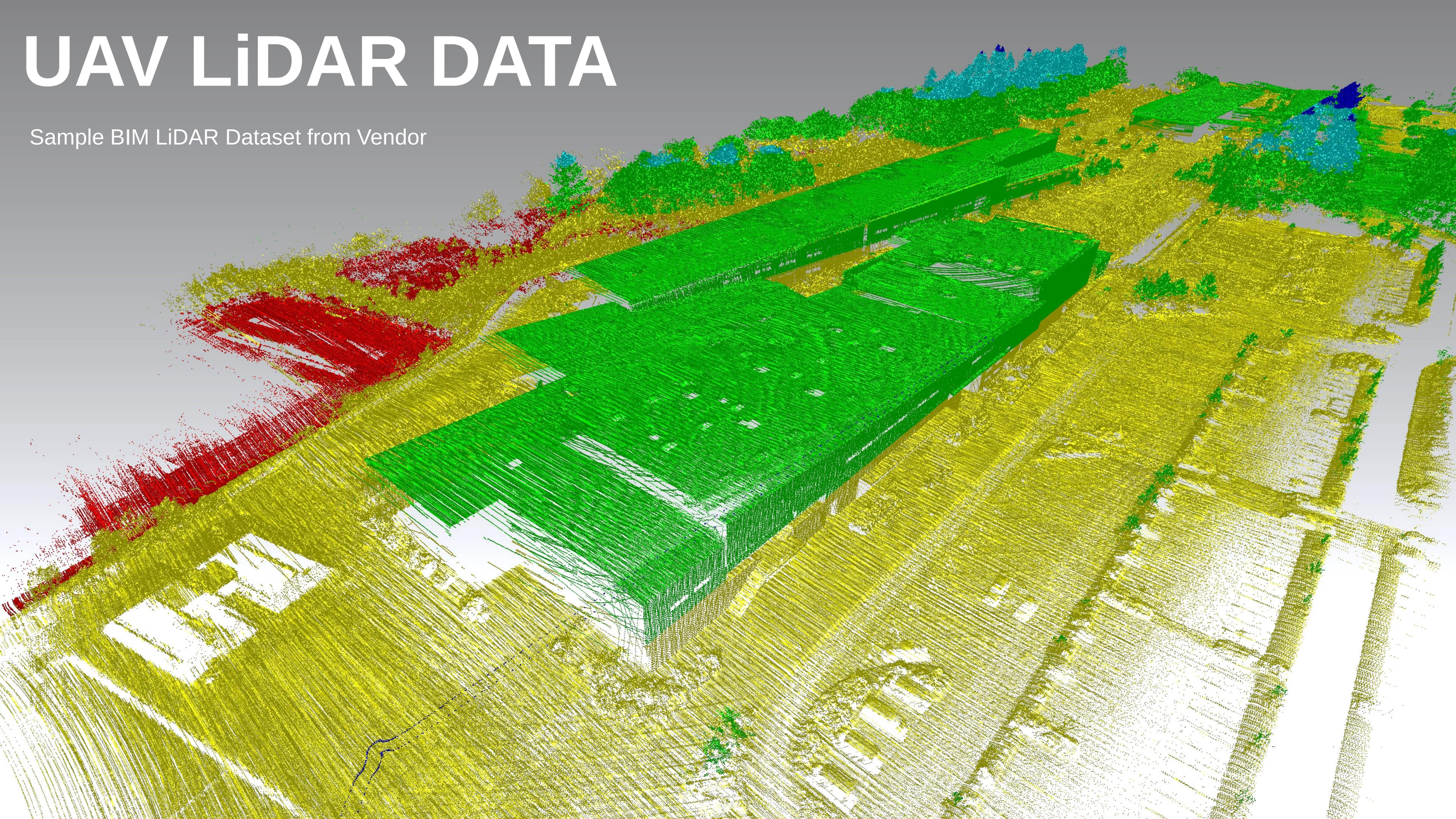
VERTICAL ACCURACY

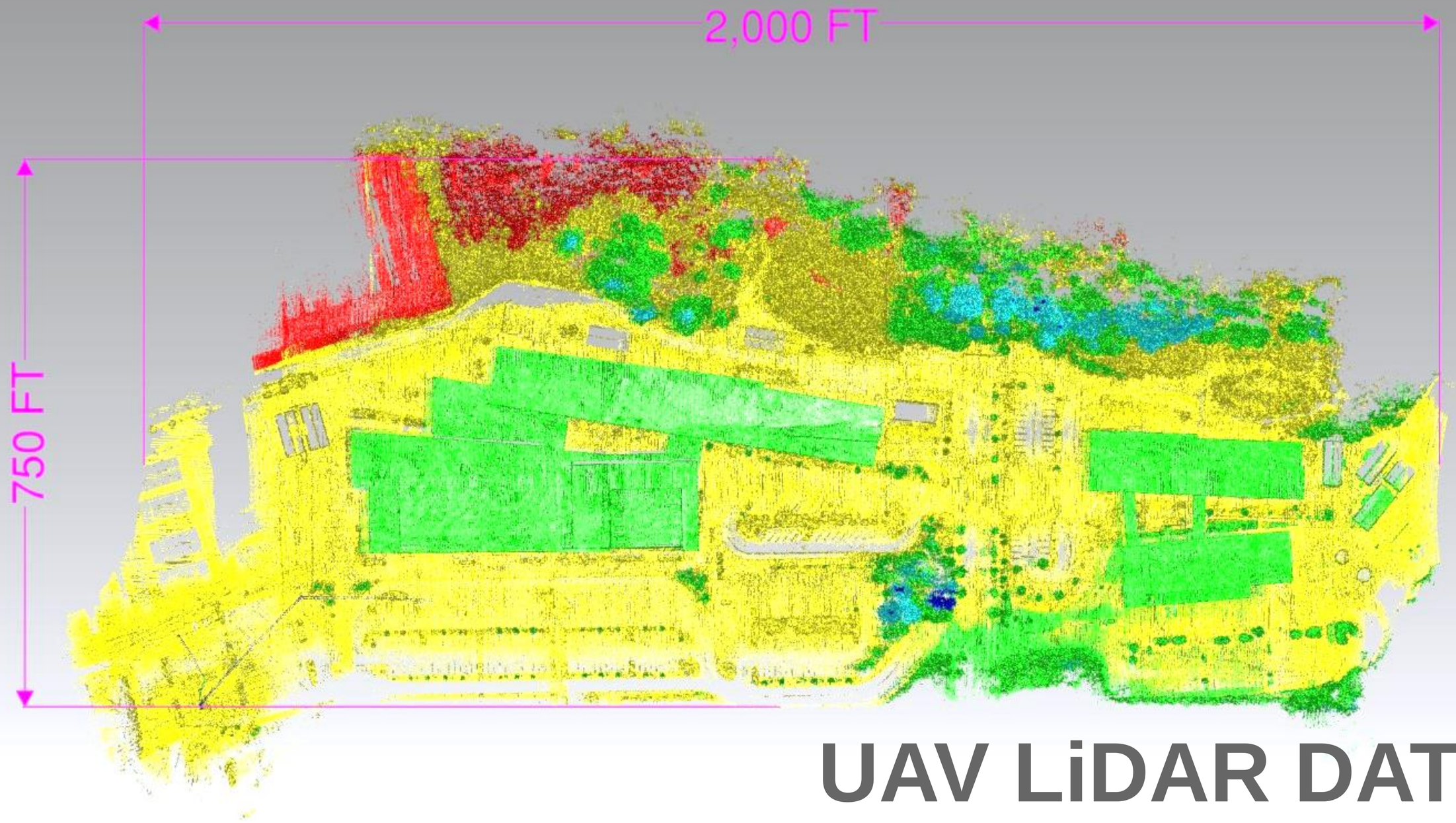


VERTICAL ACCURACY

UAV LiDAR DATA

Sample BIM LiDAR Dataset from Vendor





UAV LiDAR DATA

Sample BIM LiDAR Dataset from Vendor

MINIRANGER H ERROR

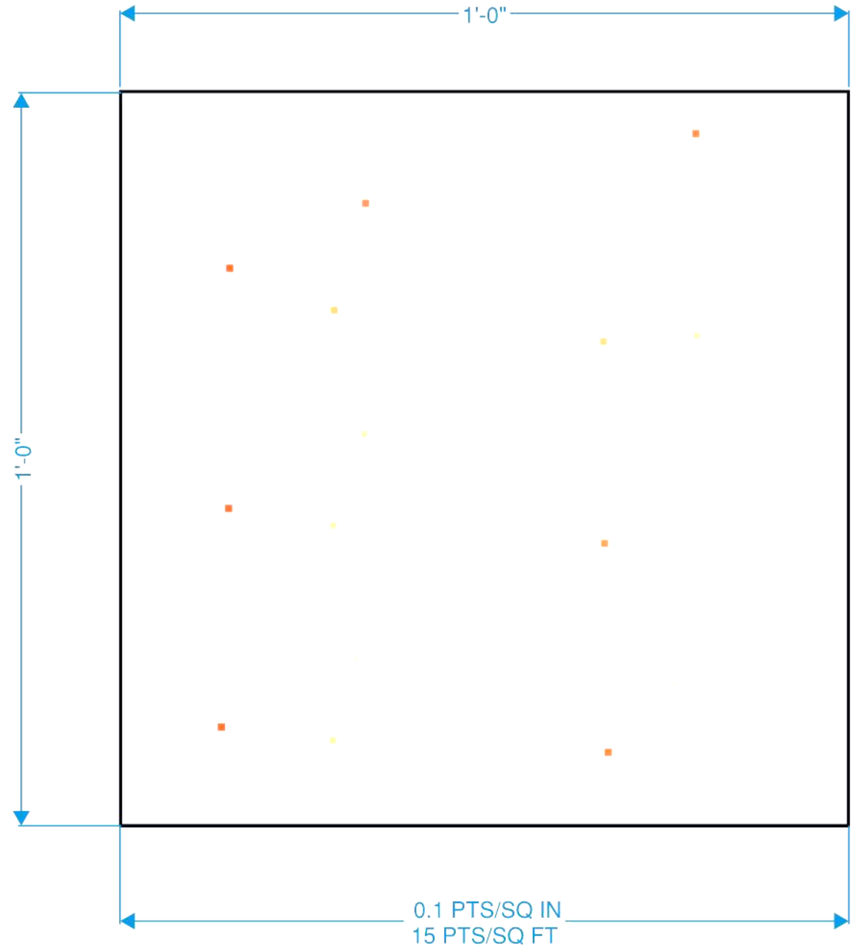
Not Analyzed by VEC

2” Provided by Vendor

MINIRANGER ACHIEVABLE H ERROR FROM VENDOR

3/4”

0.06-ft



UAV LIDAR HORIZONTAL ACCURACY

MINIRANGER V ERROR

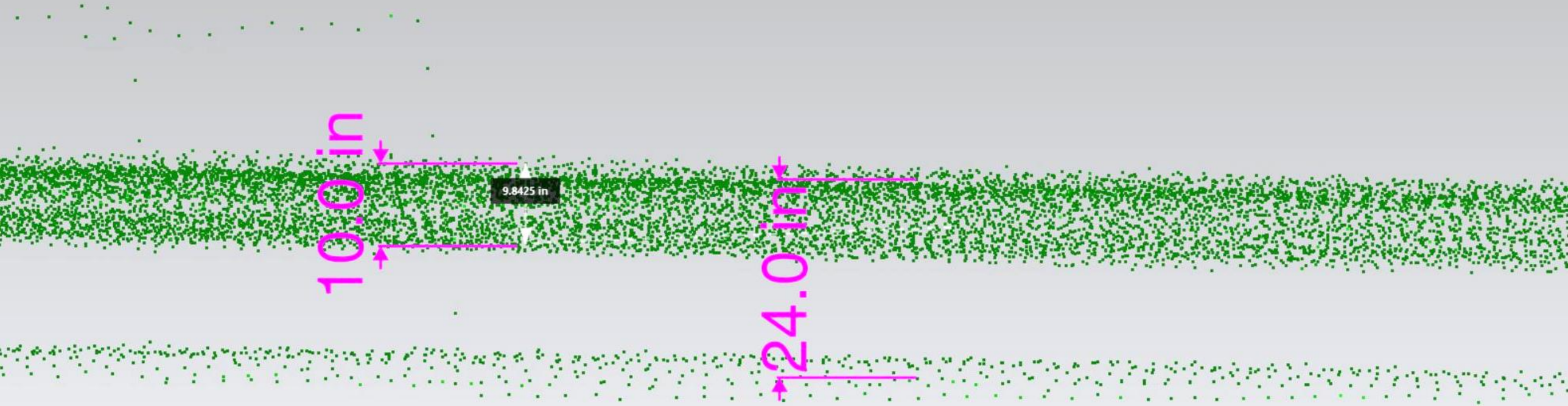
5”

0.4-ft

MINIRANGER ACHEIVABLE V ERROR FROM VENDOR

2”

0.17-ft



UAV LIDAR VERTICAL ACCURACY

Qualifications & What We Did Not Include

mini Ranger

PHOENIX UAV LIDAR

RTC 360

LEICA MID-RANGE STATIC LIDAR

BLK 360

LEICA CLOSE-RANGE STATIC LIDAR

MP Pro2

MATTERPORT CAMERA

Mavic 2 Pro

DJI UAV CAMERA PHOTOGRAMMETRY

One X

INSTA360 CAMERA PHOTOGRAMMETRY

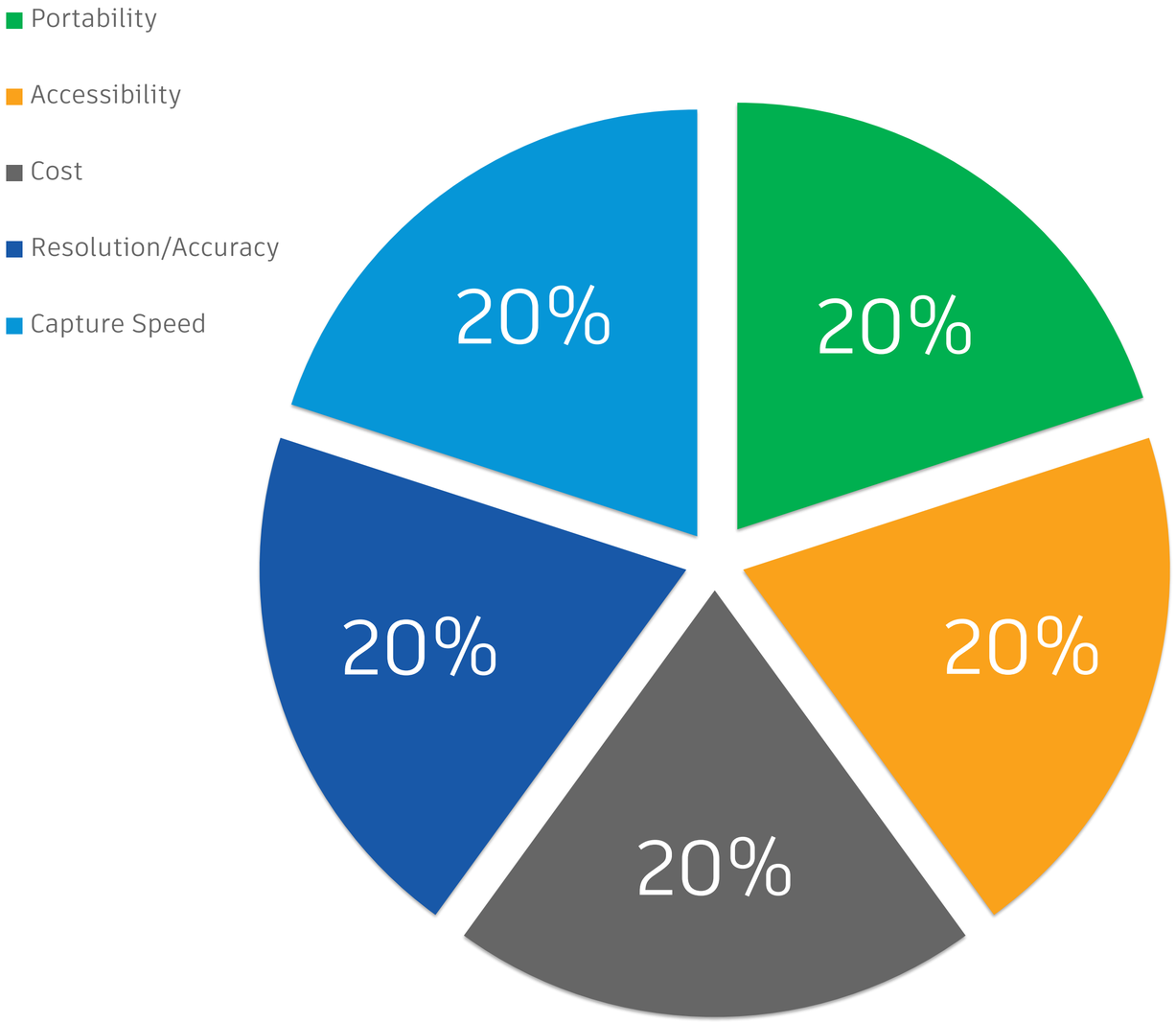
Included in our Capability & Suitability Review:

1. The Reality Capture hardware
2. Reality Capture Processing/Registration Software
3. Averaged ~2-weeks of training time to use the software
4. 2-person team to operate scanners & UAV systems

Not Factored in to our Capability & Suitability Review

1. Post-Registration Modeling Software
2. Software add-ons for deliverable production
3. Training time/cost over 2-weeks for expert-level use
4. Recap Point Cloud Decimation

Evaluation & Rating Weighting Criteria



PORTABILITY

How effortless is this technology to deploy and implement considering power requirements, safety considerations, regulatory considerations and personnel carrying convenience

ACCESSIBILITY

How easy is this technology to rent/purchase in the open market? How quickly could it be deployed to the project site?

COST

How expensive/inexpensive is this technology including the minimum hardware/software to rent/purchase in the open market?

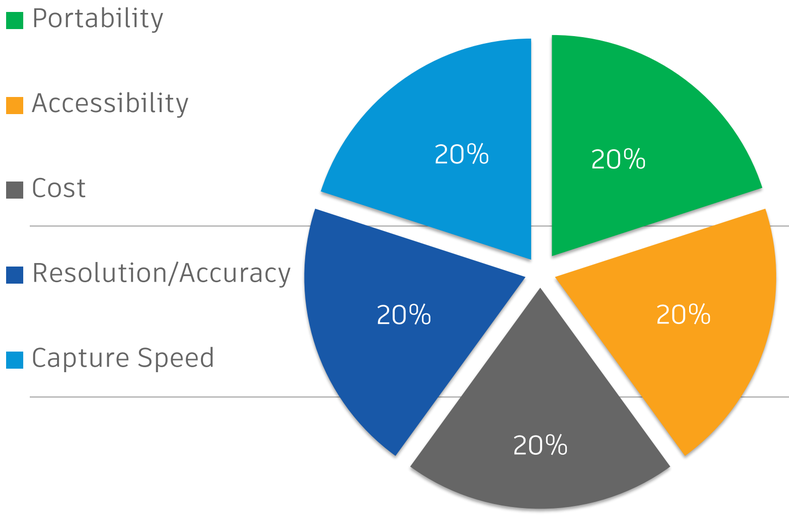
RESOLUTION/ACCURACY/PRECISION

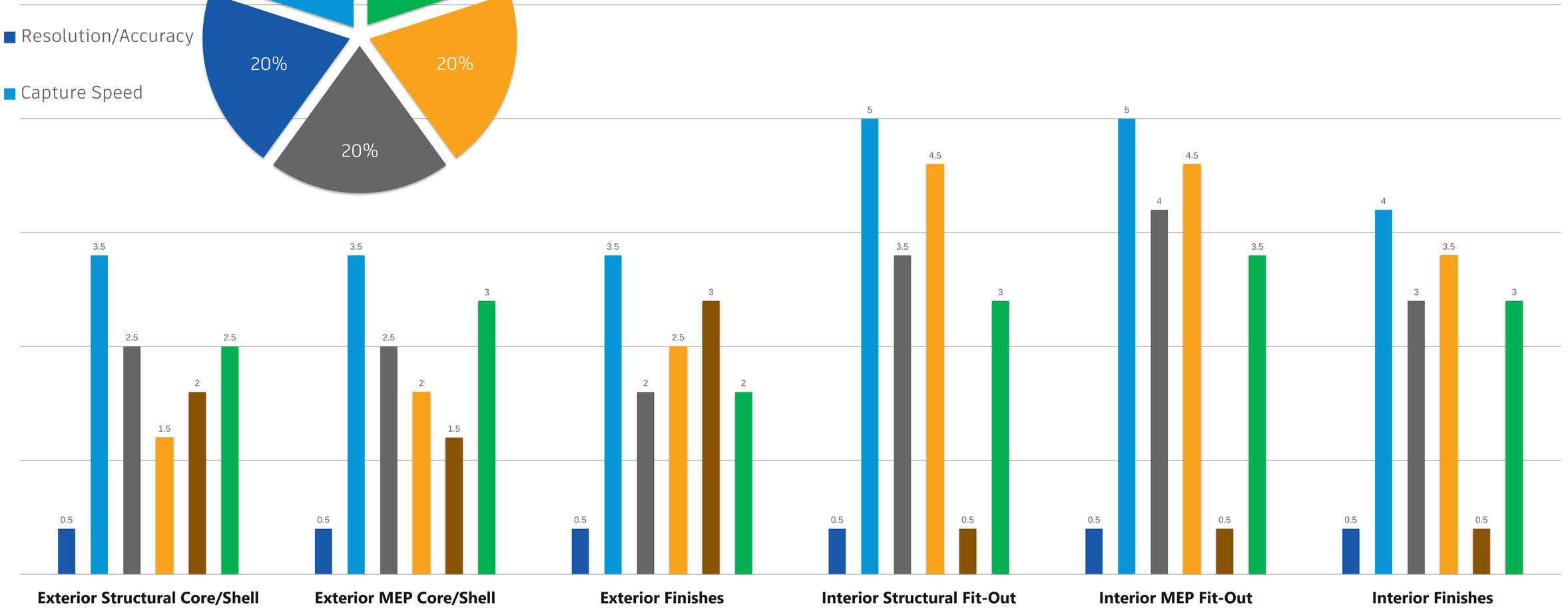
What repeatable resolution & accuracy can be achieved with this technology with minimum training (2 weeks) and a minimal impact to construction schedule/operations

CAPTURE SPEED

What is the length of time it takes to setup onsite, deploy and capture the area of interest

VEC Suitability & Reliability Rating





miniRanger RTC360 BLK360 MATTERPORT PRO2 DJI MAVIC 2 PRO INSTA360

* based on H:V accuracy provided by Vendor

We Make Construction Easy

AUTODESK®

Make anything™