



# Field-to-Plan with Regular Cameras and Small UAVs

Ilan Solel, VP Sales & Distribution

TRB AFB80 2015 Summer Committee Meeting

July 26 - 29, 2015

Marten House & Lilly Conference Center Indianapolis



**Datumate**  
Geomatics Expert Systems



# About Datumate

- 'Field-to-Plan' with regular cameras and small UAVs
- Software company: R&D center in Israel
- Leading VC investors
- Few hundred customers worldwide: surveying, construction, mining, infrastructure, civil engineering
- Leading distribution partners worldwide



# Leading distribution partners

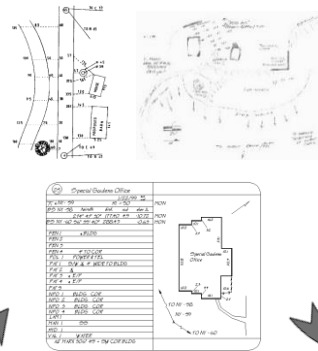


# Field-to-plan today...

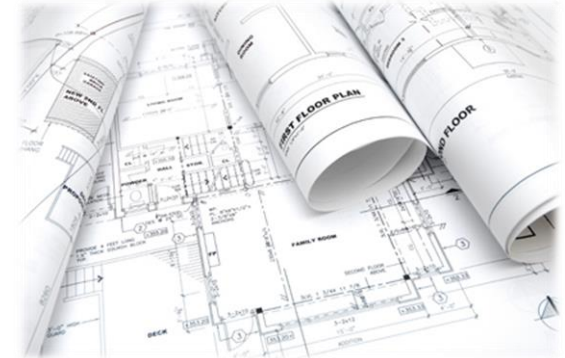
Laborious, complex and error-prone



Making field measurements



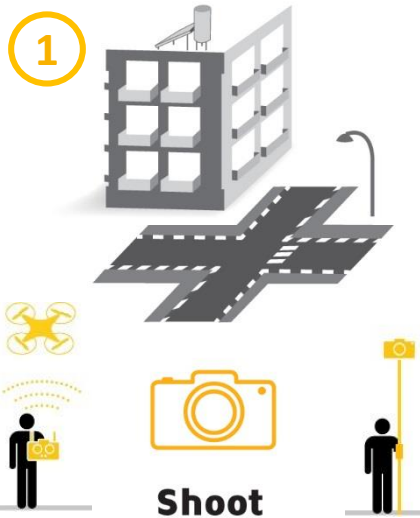
Sketching in the field by hand



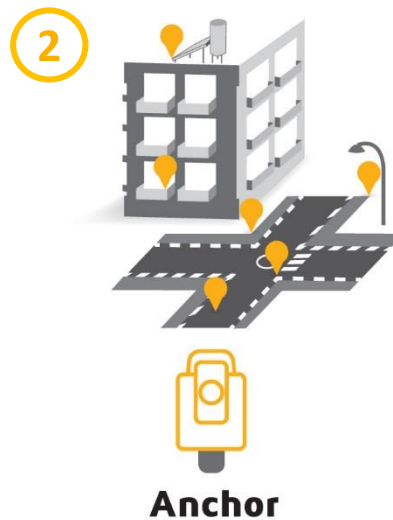
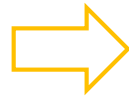
Drafting of technical plans

# Field-to-plan with regular cameras

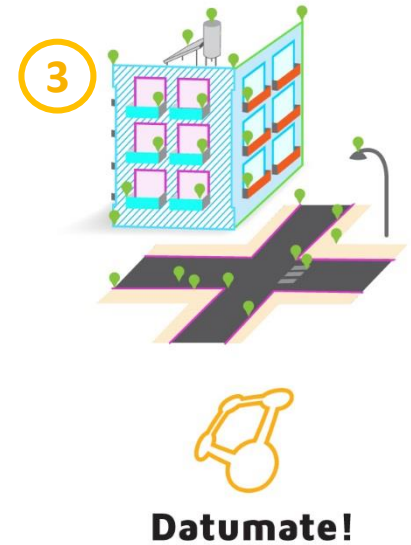
Cost-effective, simple and accurate



Photograph the areas/objects to be surveyed with a regular camera



Measure a few control points to geo-reference the images

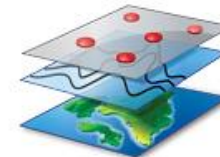


Start your CAD drafting directly on the images

# At the office ....



**CAD**



**GIS**

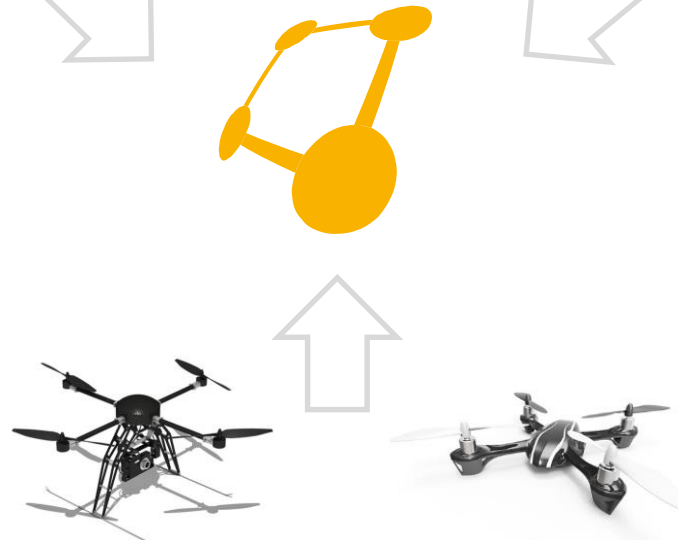


# A perfect timing!

A revolution in digital photography



Continued evolution of office computing



Rapid proliferation of UAVs

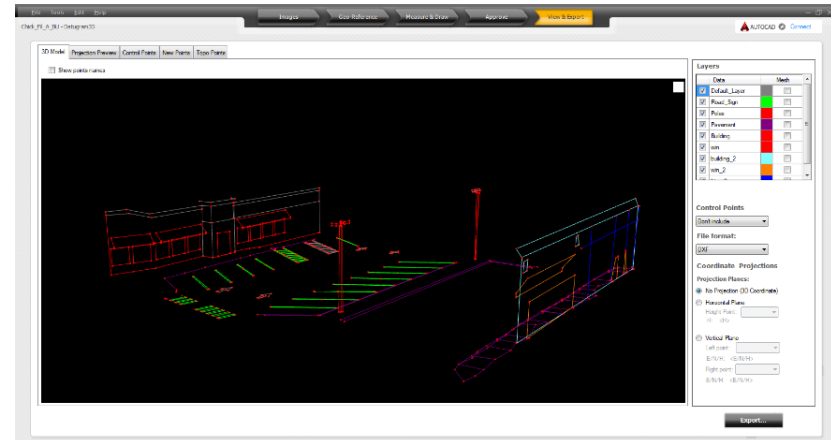
# Case study: small-sized property survey

The task: survey the property  
(Atlanta, GA) 

Key challenges: a very cold day...

Planned effort with conventional methods: 1 day (1/2 day in the field, 1/2 day in the office)

Actual effort with DatuGram<sup>TM</sup>3D:  
4 hours (1 hour in the field, 3 hours in the office)





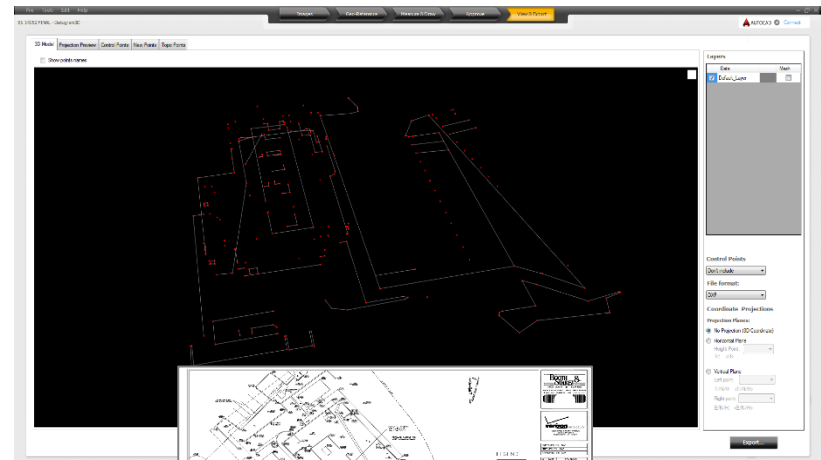
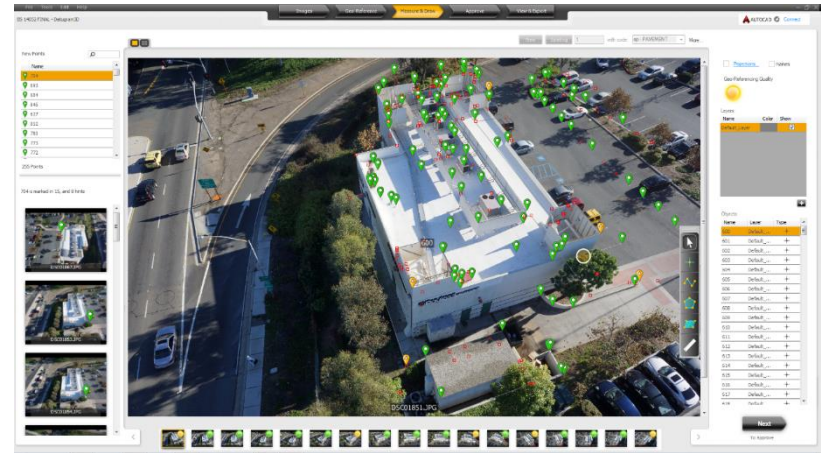
# Case study: medium-sized property survey

**The task:** survey the property, roof top, parking lot and surrounding area (San Diego, CA)

**Key challenges:** a hot day in California...

**Planned effort** with conventional methods: 2 days (1 day in the field, 1 day in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 5 hours (1 hour in the field, 4 hours in the office)



Camera: Sony Alpha NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 120'

# Case study: large property survey

**The task:** survey the property  
(Israel)

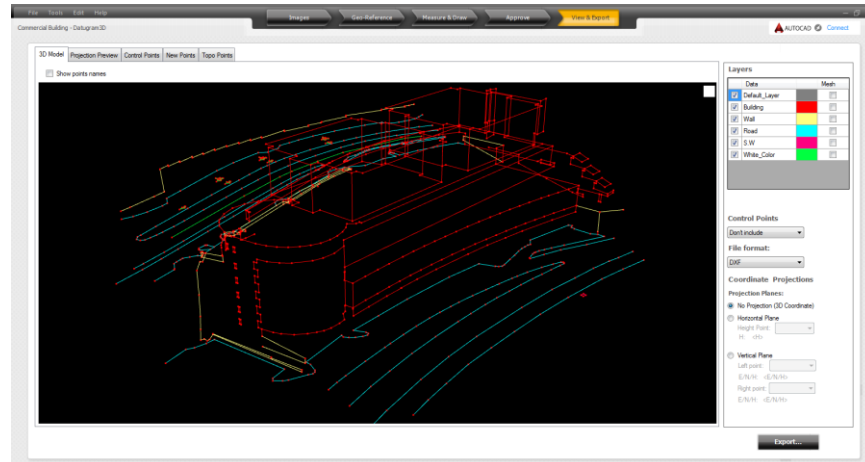
**Key challenges:** need to climb the  
rooftops

**Planned effort** with conventional  
methods: 4 days (2 days in the  
field, 2 days in the office)

**Actual effort** with DatuGram™<sub>3D</sub>:  
1 day (1 hour in the field, 6  
hours in the office), no need to  
climb the rooftops



Camera: Sony Alpha NEX-7 (24-megapixel), 16mm fixed lens,  
mounted on a small quadcopter at 120'



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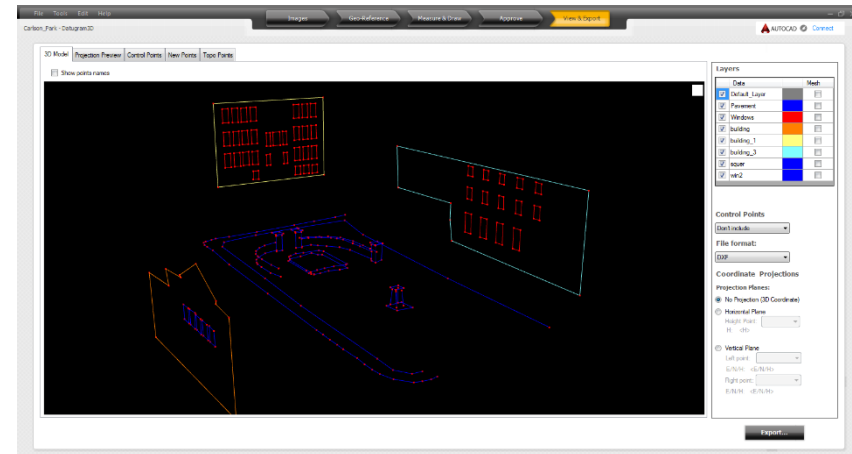
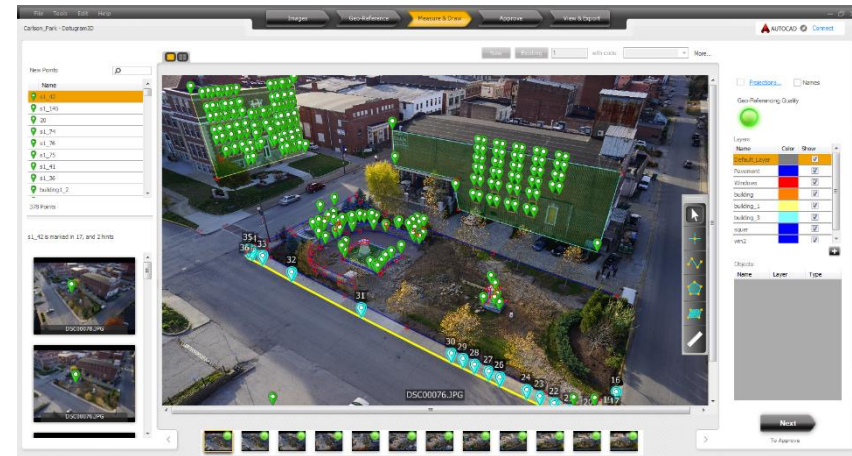
# Case study: as-built

**The task:** as-built survey of the park and surroundings (Maysville, KY)

**Key challenges:** a very cold day in Kentucky...

**Planned effort** with conventional methods: 3 days (2 days in the field, 1 day in the office).

**Actual effort** with DatuGram™<sub>3D</sub>: 6 hours (1 hours in the field, 5 hours in the office)



Camera: Sony Alpha NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 120'



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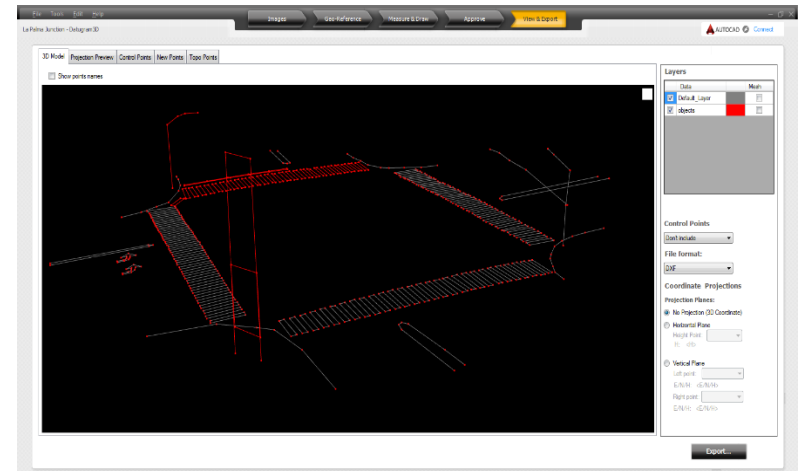
# Case study: small intersection

**The task:** survey the intersection  
(Anaheim, CA)

**Key challenges:** traffic-intensive road,  
occupational safety

**Planned effort** with conventional  
methods: 2 days (1 day in the field,  
1 day in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 6  
hours (1 hour in the field, 5 hours in  
the office); no need to step into  
the intersection



Camera: Samsung NX mini (20-megapixel), 9 mm fixed lens,  
mounted on a 24' telescopic pole, Wi-Fi controlled

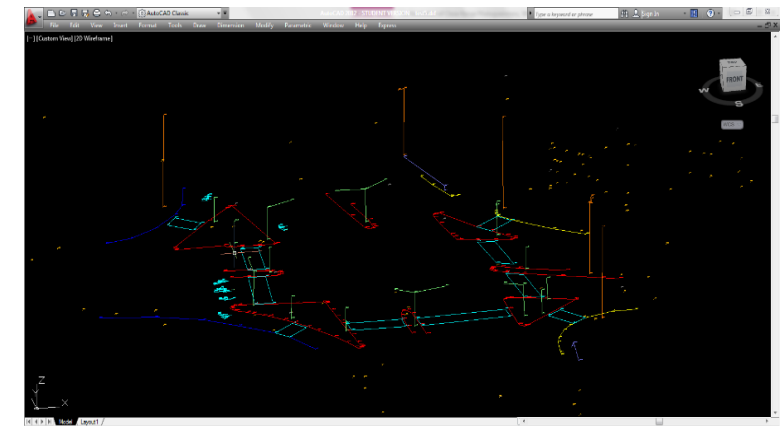
# Case study: small intersection

**The task:** survey the intersection (Israel)

**Key challenges:** traffic-intensive road, occupational safety

**Planned effort** with conventional methods: 3 days (2 days in the field, 1 days in the office).

**Actual effort** with close-range photogrammetry: 1 day (1/2 day in the field, 1/2 day in the office).



Camera: Sony NEX-7 (24-megapixel), 16 mm fixed lens, mounted on a 20' telescopic pole, Wi-Fi controlled



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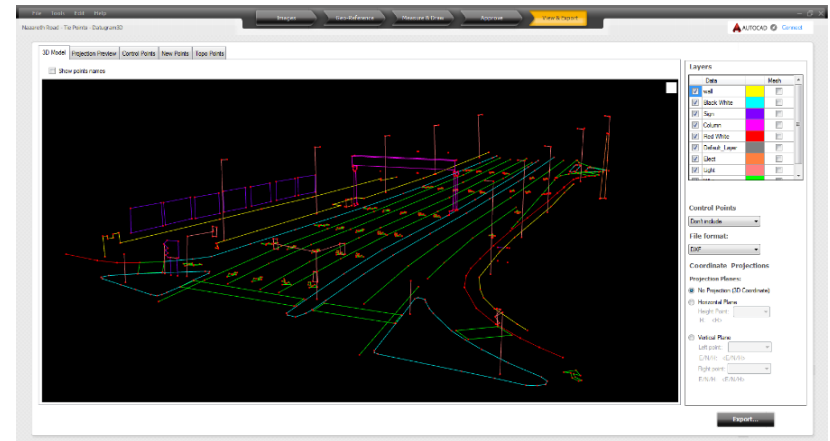
# Case study: 1-mile roadway mapping

**The task:** survey a 1-mile long road, traffic markings, overhead signs and street lighting structures

**Key challenges:** traffic-intensive road, occupational safety challenges

**Planned effort** with conventional methods: 3 days (2 days in the field, 1 days in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 6 hours (1 hour in the field, 5 hours in the office)



Camera: Sony Alpha NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 80'



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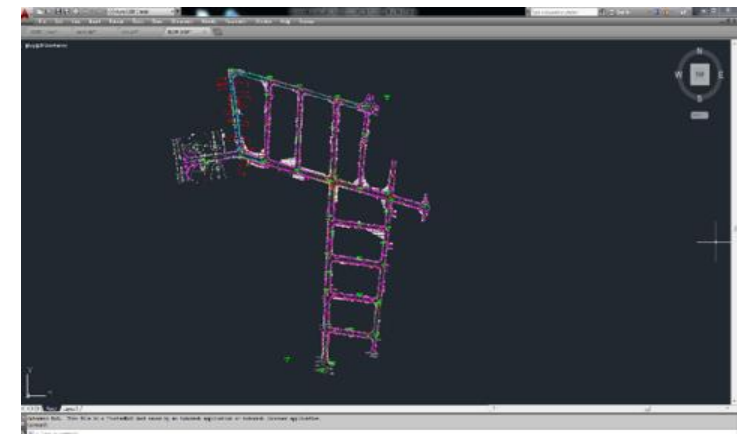
# Case study: 6.5-km road in an industrial area

**The task:** as-built update survey of a 6.5-km road in an industrial area

**Key challenges:** traffic-intensive area; right of passage

**Planned effort** with conventional methods: 25 days (15 days in the field, 10 days in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 6 days (1 day in the field, 5 days in the office)



Camera: Sony Alpha NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 100'

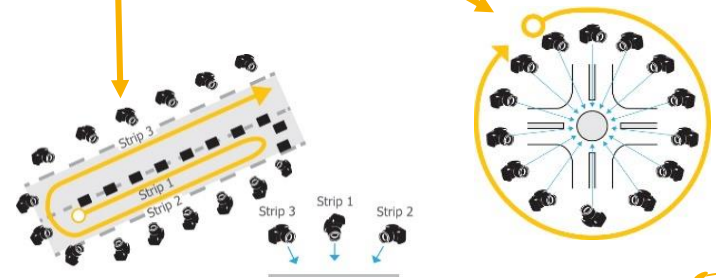
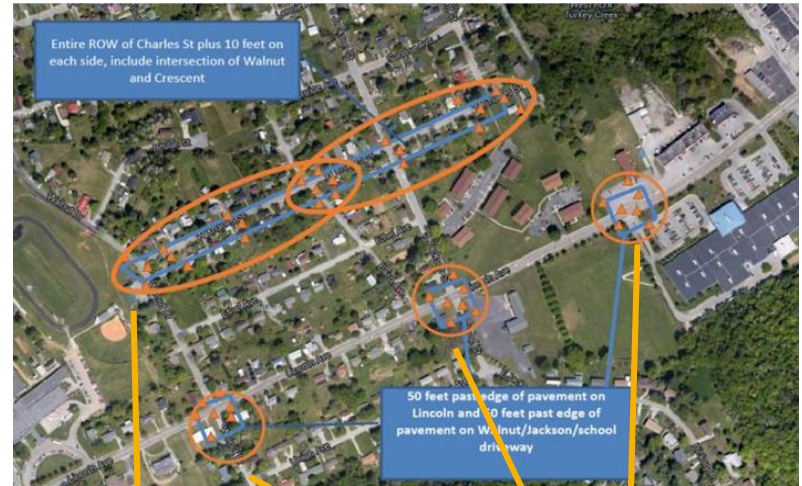
# Case study: road and intersection mapping

**The task:** survey and draft Charles St. in Morristown, TN (1,800' length) and adjacent intersections

**Key challenges:** time to deliver project; traffic-intensive road

**Planned effort** with conventional methods: 16 days (8 days in the field, 8 days in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 5 days (2 days in the field, 3 days in the office)



Camera: Sony ILCE-6000 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 80'

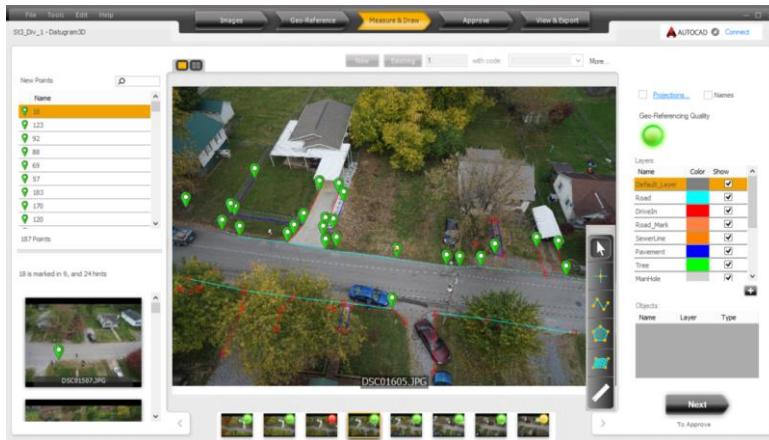


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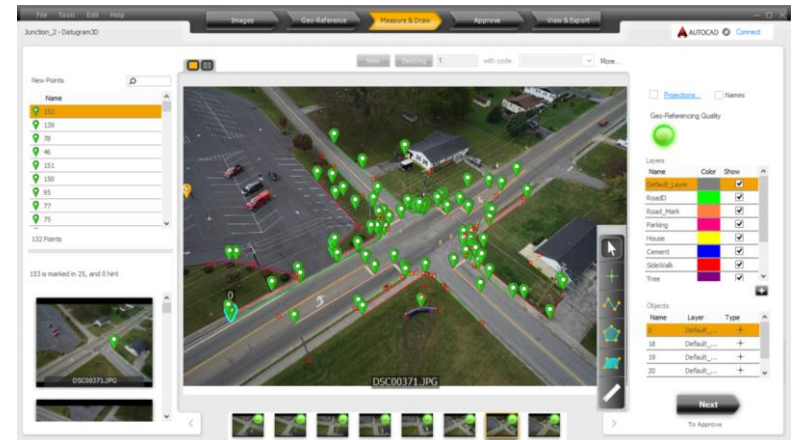


# Case study: road and intersection mapping (cont.)

## Surveying Charles St.:



## Surveying the intersections:

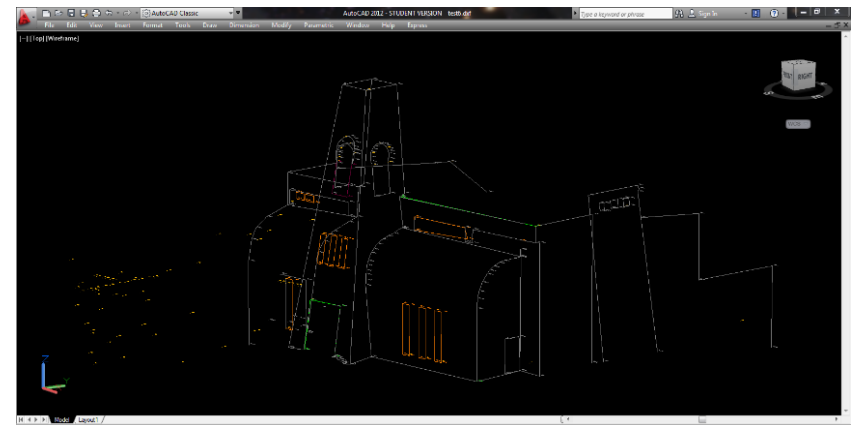
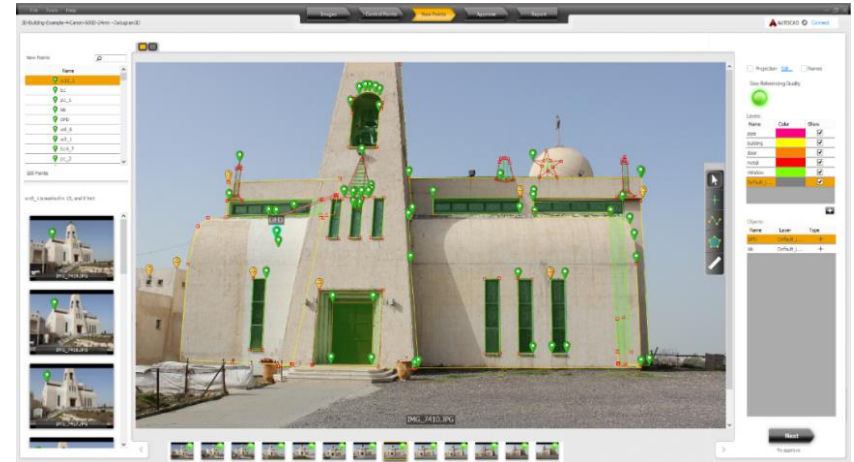


# Case study: façade

**The task:** mapping of the façade for renovation

**Planned effort** with conventional methods: 2 days (1 day in the field, 1 day in the office)

**Actual effort** with DatuGram<sup>TM</sup><sub>3D</sub>: 4 hours (1 hour in the field, 3 hours in the office)



Camera: Canon EOS T3i 18MP, 18mm fixed lens, handheld



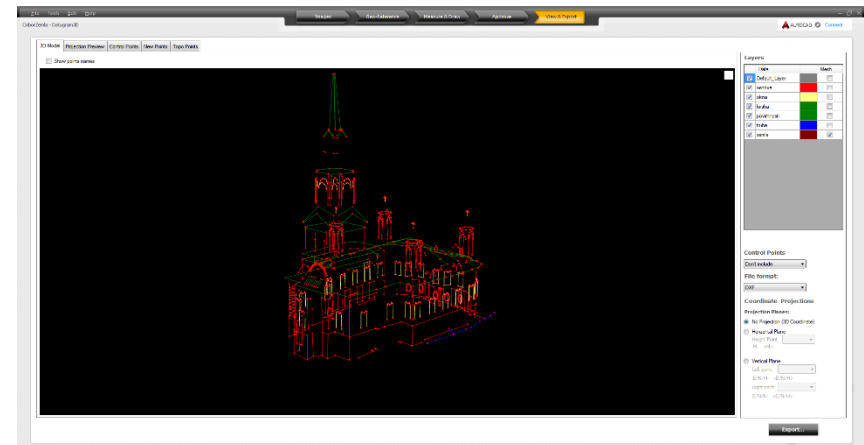
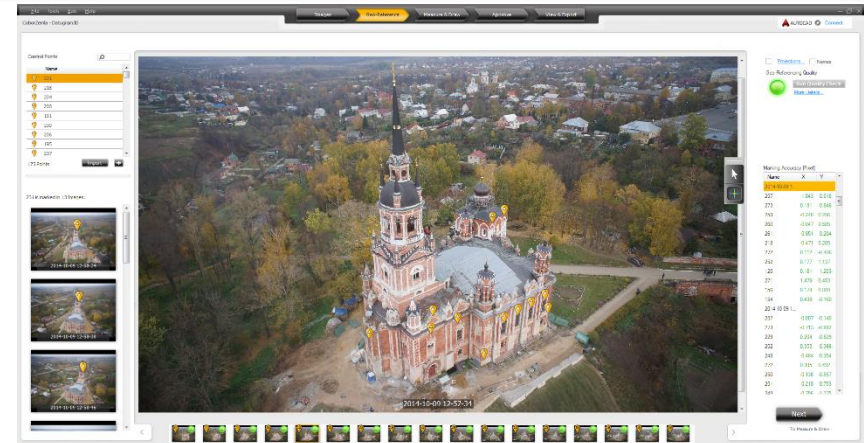
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# Case study: architecture

**The task:** mapping of the façades for renovation

**Planned effort** with conventional methods: 3 days (2 days in the field, 1 day in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 6 hours (1 hour in the field, 5 hours in the office)



Camera: Sony NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 150'



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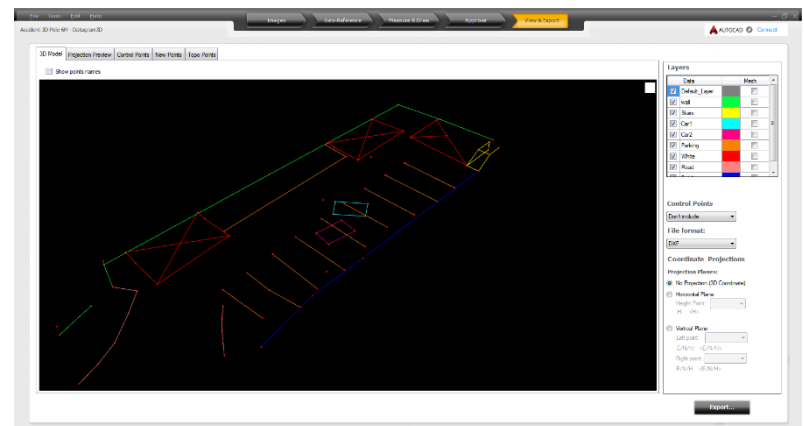
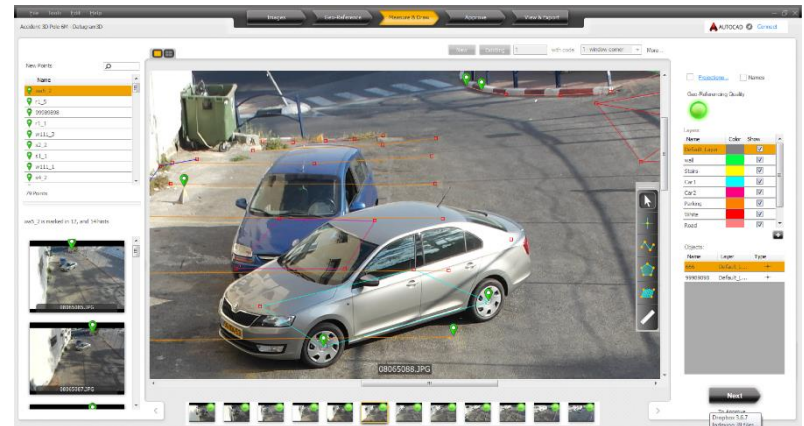
# Case study: accident reconstruction

**The task:** demonstrate vehicular accident reconstruction

**Planned effort** with conventional methods: 2 hours the field, 2 hours in the office

**Actual effort** with DatuGram™<sub>3D</sub>: 30 minutes in the field, 1 hour in the office

**Road may be cleared as soon as images are taken (~10 minutes); images may be used for further measurements in the future;**



Camera: Samsung NX mini (20-megapixel), 9 mm fixed lens, mounted on an 18' telescopic pole, Wi-Fi controlled



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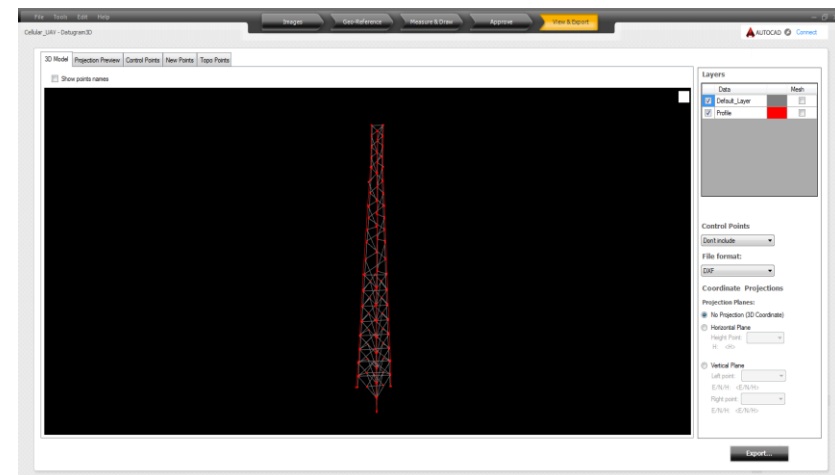
# Case study: cell tower

**The task:** drafting the structure of the cell tower (Israel)

**Key challenges:** challenging object to survey

**Planned effort** with conventional methods: 3 days (2 days in the field, 1 day in the office)

**Actual effort** with DatuGram<sup>TM</sup>3D : 5 hours (1 hour in the field, 4 hours in the office)



Camera: Sony Alpha NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 120'

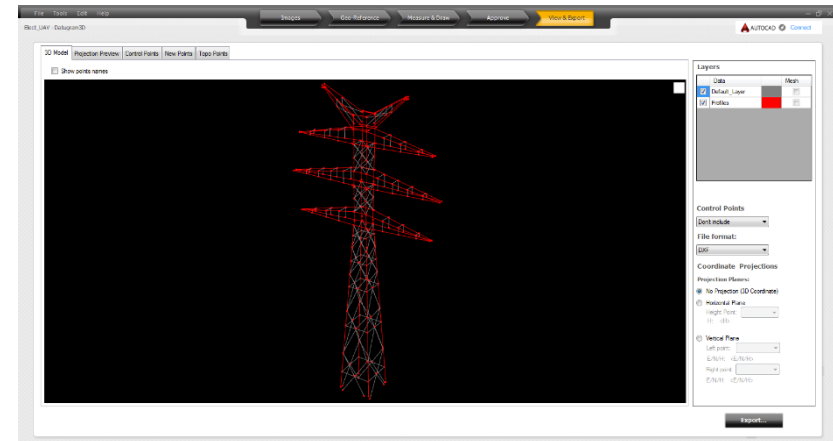
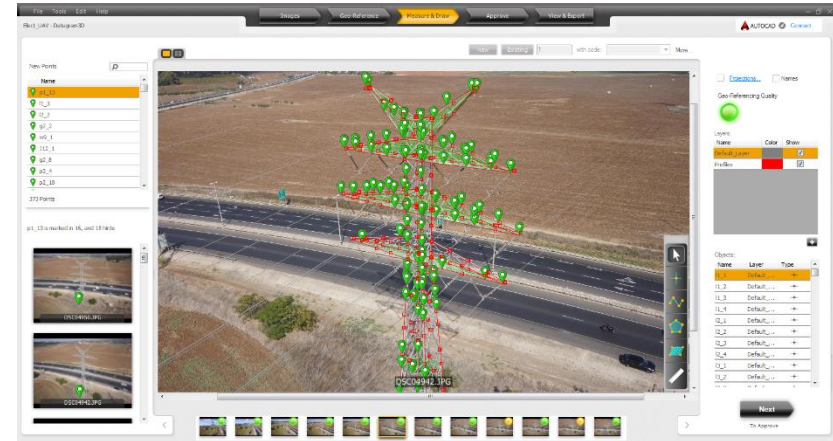
# Case study: electrical tower

**The task:** drafting the structure of the electrical tower (Israel)

**Key challenges:** challenging object to survey

**Planned effort** with conventional methods: 2 days (1 day in the field, 1 day in the office)

**Actual effort** with DatuGram™<sub>3D</sub> : 6 hours (1 hour in the field, 5 hours in the office)



Camera: Sony Alpha NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 120'

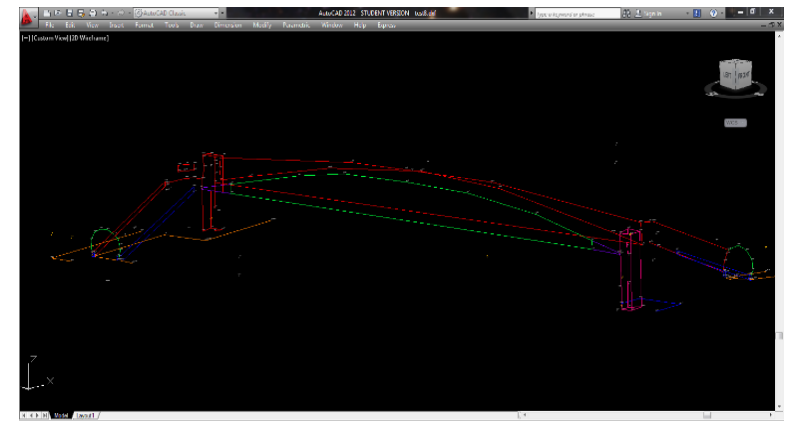
# Case study: pedestrian bridge

**The task:** survey a pedestrian bridge across a highway

**Key challenges:** traffic-intensive road; bridge with reflective surfaces

**Planned effort** with conventional methods: 3.5 days (2 days in the field, 1.5 days in the office)

**Actual effort** with DatuGram<sup>TM</sup>3D: 5 hours (1 hour in the field, 4 hours in the office)



Camera: rebel 650D (24-megapixel), 24 mm fixed lens, mounted on a 25' telescopic pole, Wi-Fi controlled



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# Case study: highway bridge

**The task:** survey a bridge across a highway, including its underlying structures, roads and surroundings

**Key challenges:** traffic-intensive road, occupational safety

**Planned effort** with conventional methods: 6 days (3 days in the field, 3 days in the office)

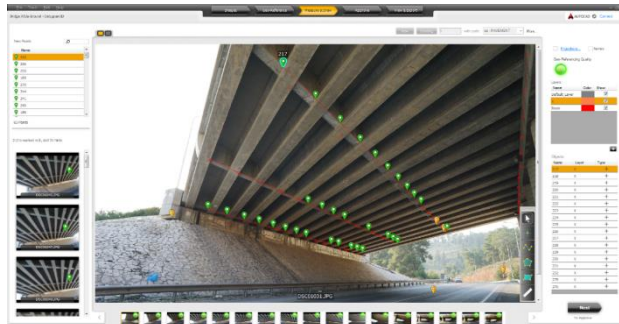
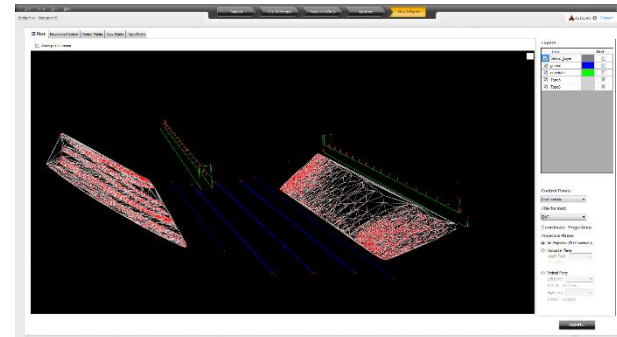
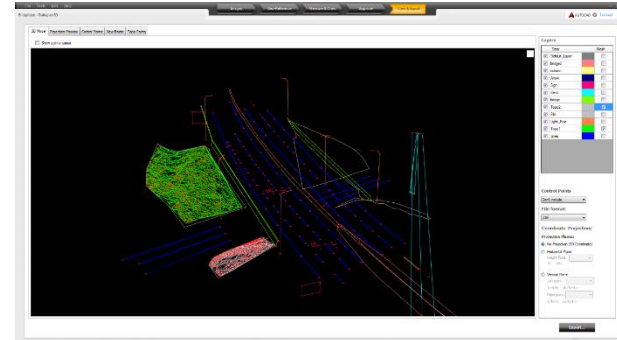
**Actual effort** with DatuGram™<sub>3D</sub>: 2.5 days (4 hours in the field, 2 days in the office)

Camera: Sony ICLE-6000 (24-megapixel), 16 mm fixed lens, handheld + mounted on a 25' telescopic pole + mounted on a small quadcopter at 120'





# Case study: highway bridge (cont.)

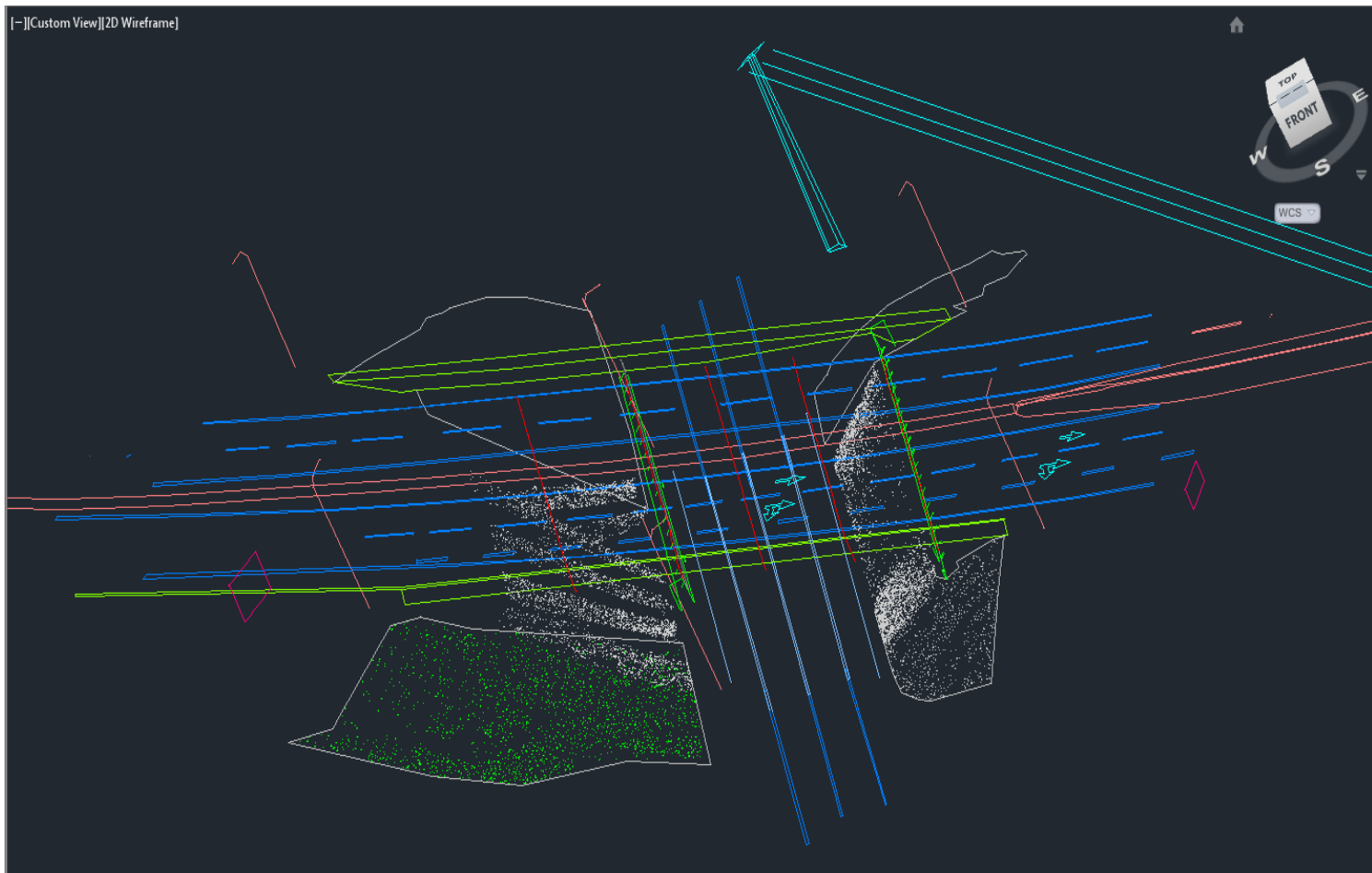


The key success factor:  
effectively combine different  
data collection techniques!



# Case study: highway bridge (cont.)

## The final 3D CAD plan:



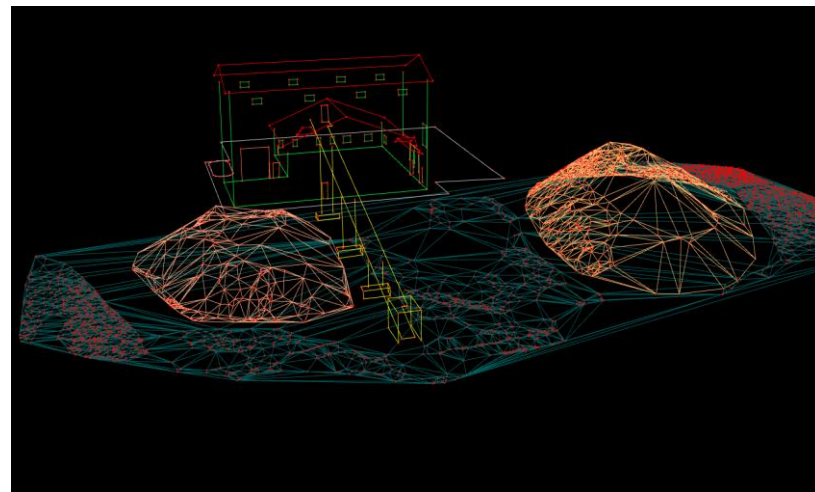
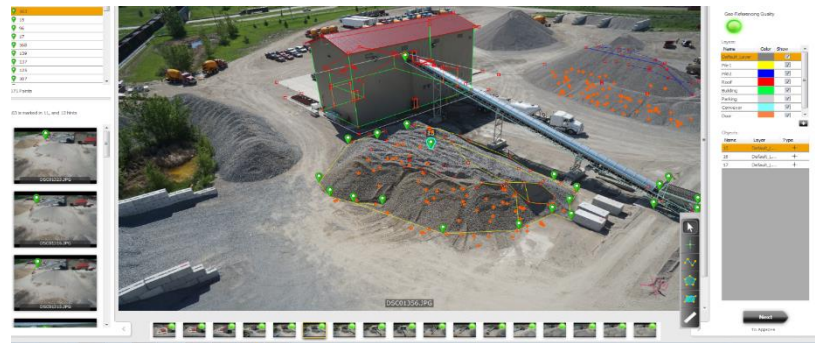
# Case Study: Surveying a Quarry Site

**The task:** surveying a quarry site (Grand Forks, North Dakota, USA)

**Key challenges:** working in an active site; climbing the stockpiles

**Planned effort** with conventional methods: 1 ½ days (1 day in the field & ½ day in the office)

**Actual effort** with DatuGram3D: ½ a day (1 ½ hours in the field, 3 hours in the office); no need to climb the stockpiles; minimize time in site



Camera: Sony A6000 24 megapixel camera and a 16mm wide-angle lens, mounted on a small quadcopter at go'



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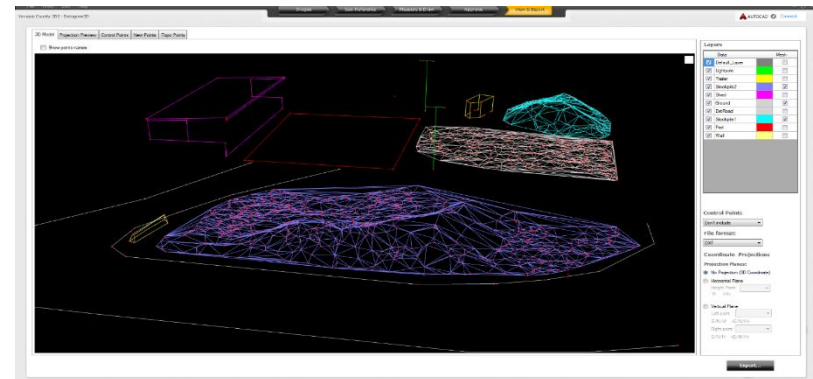
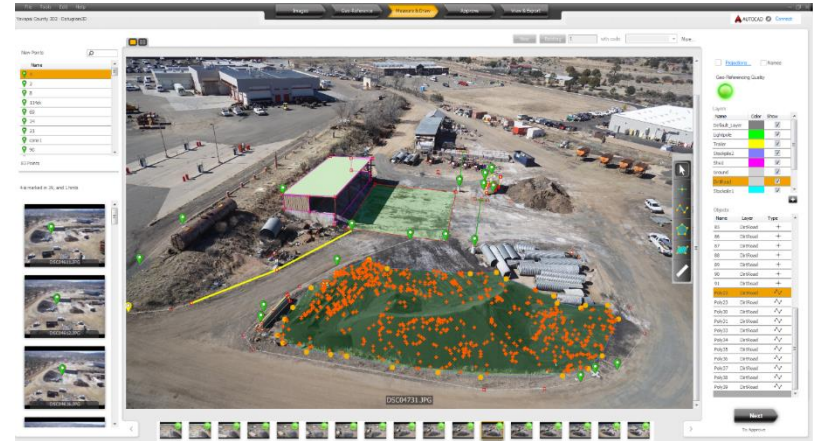
# Case Study: Construction Site

**The task:** surveying a construction site (Yavapai County, Arizona, USA)

**Key challenges:** working in an active site; climbing the stockpiles

**Planned effort** with conventional methods: 1 ½ days (1 day in the field & ½ day in the office)

**Actual effort** with DatuGram3D: ½ a day (1 ½ hours in the field, 3 hours in the office); no need to climb the stockpiles; minimize time in site



Camera: Sony A6000 24 megapixel camera and a 16mm wide-angle lens, mounted on a small quadcopter at go'



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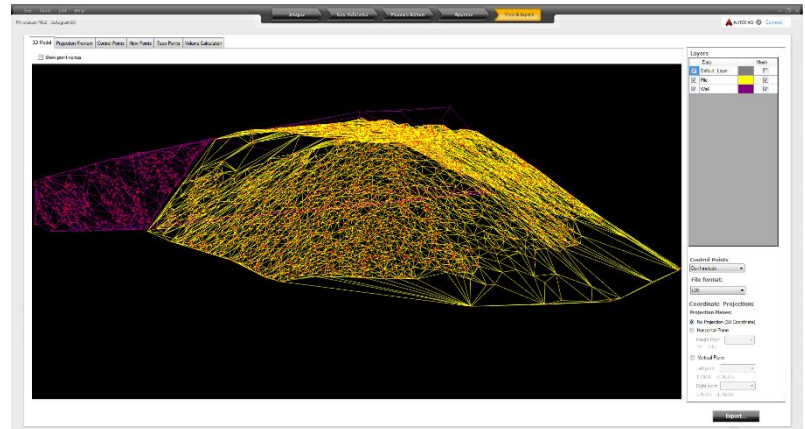
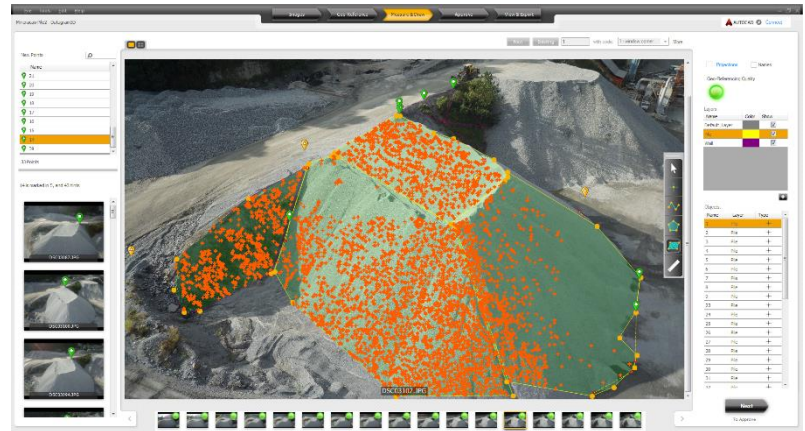
# Case Study: stockpile (gravel)

**The task:** surveying a gravel stockpile (Sau Paulo, Brazil)

**Key challenges:** working in an active site; climbing the stockpile

**Planned effort** with conventional methods: 1 day (½ day in the field, ½ day in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 1.5 hours (1 hour in the field, ½ hour in the office); no need to climb the stockpile; minimize time in site



Camera: Sony NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 70'



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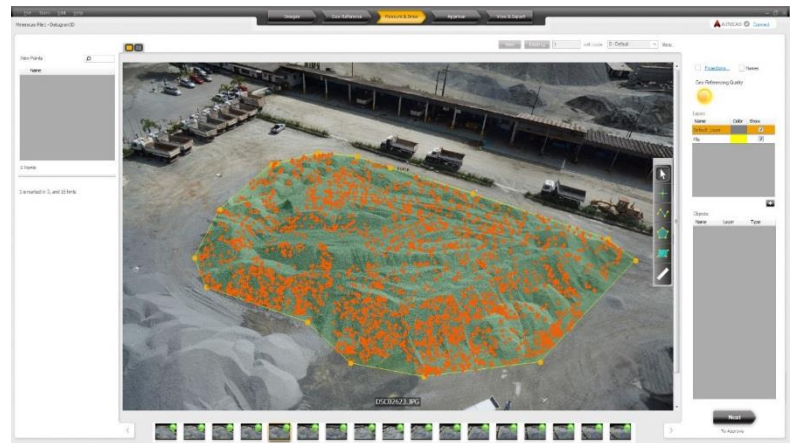
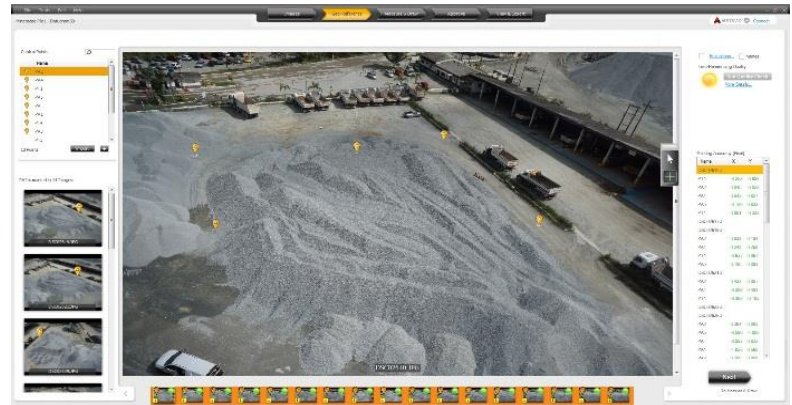
# Case Study: stockpile (gravel)

**The task:** surveying a gravel stockpile (Sau Paulo, Brazil)

**Key challenges:** working in an active site; climbing the stockpile

**Planned effort** with conventional methods: 1 day (½ day in the field, ½ day in the office)

**Actual effort** with DatuGram™<sub>3D</sub>: 1.5 hours (1 hour in the field, ½ hour in the office); no need to climb the stockpile; minimize time in site



Camera: Sony NEX-7 (24-megapixel), 16mm fixed lens, mounted on a small quadcopter at 50'



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# Excellent accuracy of volume calculation

Method	Number of measured points	Volume (M <sup>3</sup> )	Volume difference
Conventional Total Station	206	4,254.364	<b>0.32%</b>
DatuGram™ 3D	4,931	4,240.451	

Serveng Mineração

Projeto: Brita 02 Barueri

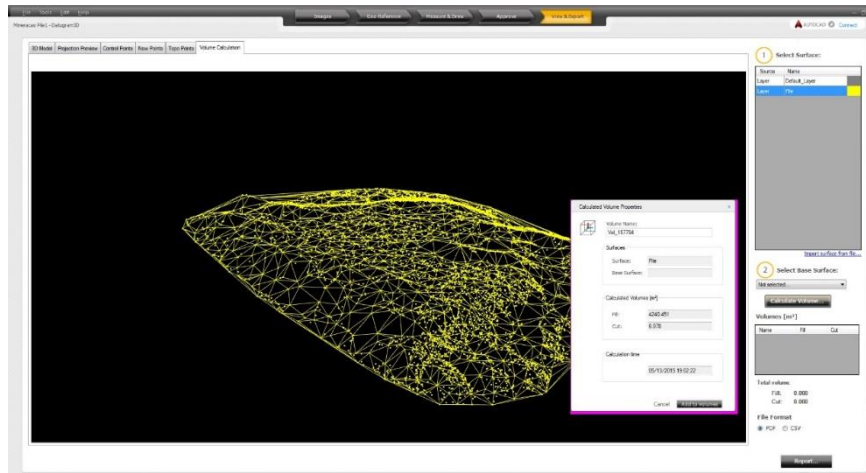
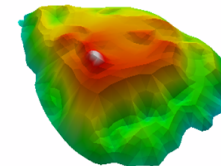
## RELATÓRIO DE CÁLCULO DE VOLUME

### PARÂMETROS:

Superfície Base: Brita 02  
 Superfície de Referência: Brita 02 base  
 Interpolação: Interpolação Linear  
 Largura da Malha de Interpolação: 0,50

### RESULTADOS:

Área da Pilha: 1.930,875 m<sup>2</sup>  
**Volume da Pilha: 4.254,364 m<sup>3</sup>**



# Measurement accuracy

## Position accuracy depends on:

- Camera resolution in mega-pixels
- Distance from camera of measured object
- Accuracy of geo-referencing the control points
- Minimum angle between images

**20 mega-pixel camera allows 1-2 centimeter accuracy from a distance of ~100 meters**





# Recommended models (July 2015)

## Sony Alpha ILCE-A6000

24 megapixel, mirror-less, interchangeable lens, APS-C format sensor = 370 mm<sup>2</sup> sensor size, Wi-Fi connectivity, body weight 285 g) + Sony 16 mm fixed lens



## Samsung NX Mini

21 megapixel, mirror-less, interchangeable lens, 1" BSI format sensor = 116 mm<sup>2</sup> sensor size, Wi-Fi connectivity, body weight 158 g) + Samsung 9 mm fixed lens.



## Nikon 1 J4

18 megapixel, mirror-less, interchangeable lens, CX format sensor = 116mm<sup>2</sup> sensor size, Wi-Fi connectivity, body weight 232g) + Nikon 10 mm fixed lens.



## Panasonic Lumix DMC-GM1

16 megapixel, mirror-less, interchangeable lens, Four- Thirds format sensor = 225mm<sup>2</sup> sensor size, body weight 274 g + Panasonic 14 mm fixed lens.



# Summary: unique value proposition

**Step function in productivity** save field and office time

**Exceptional quality control** see what was measured

**Enhanced occupational safety** OSHA regulations

**First time right** no need for follow-up works

**Faster turnaround times** offer next day delivery



# DatuGram™3D software demo



File Tools Edit Help

Images Geo-Reference Measure & Draw Approve View & Export

La Palma Junction - DatuGram3D

AUTOCAD Connect

New Existing 1 with code: 0 - Default More...

Projections... Names

Geo-Referencing Quality

Layers:

Name	Color	Show
Default_Layer		<input checked="" type="checkbox"/>
objects		<input checked="" type="checkbox"/>

Objects:

Name	Layer	Type
d1_1	Default_...	+
d1_2	Default_...	+
d1_3	Default_...	+
d1_4	Default_...	+
d2_1	Default_...	+
d2_2	Default_...	+
d2_3	Default_...	+
d2_4	Default_...	+
d3_1	Default_...	+
d3_2	Default_...	+

Next  
To Approve

New Points

Name
w17_1
w19_1
z20_1
d13_1
w16_2
w15_2
d22_2
w17_2
d16_2

547 Points

w17\_1 is marked in 41, and 8 hints

SAM\_0086.JPG

SAM\_0076.JPG

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***Thank You!***



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