

How to Create 3D Digital Cities Using Drones

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CEO

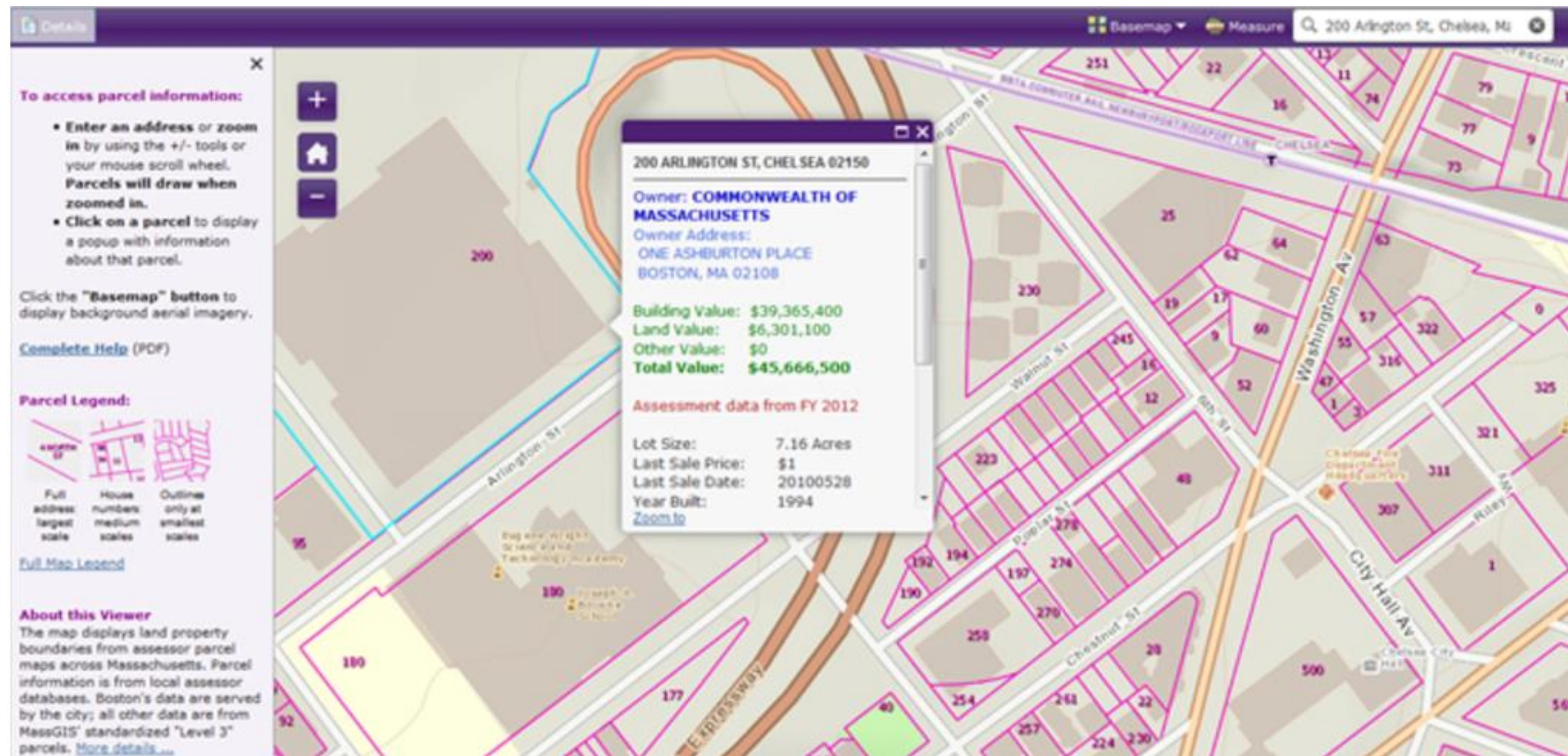
How to Create 3D Digital Cities Using Drones

3D Digital City Definition

A three dimensional representation (3D) of a city or an urban environment.

Every city model consists of a digital elevation model (ground height) and 3D building data (building heights)

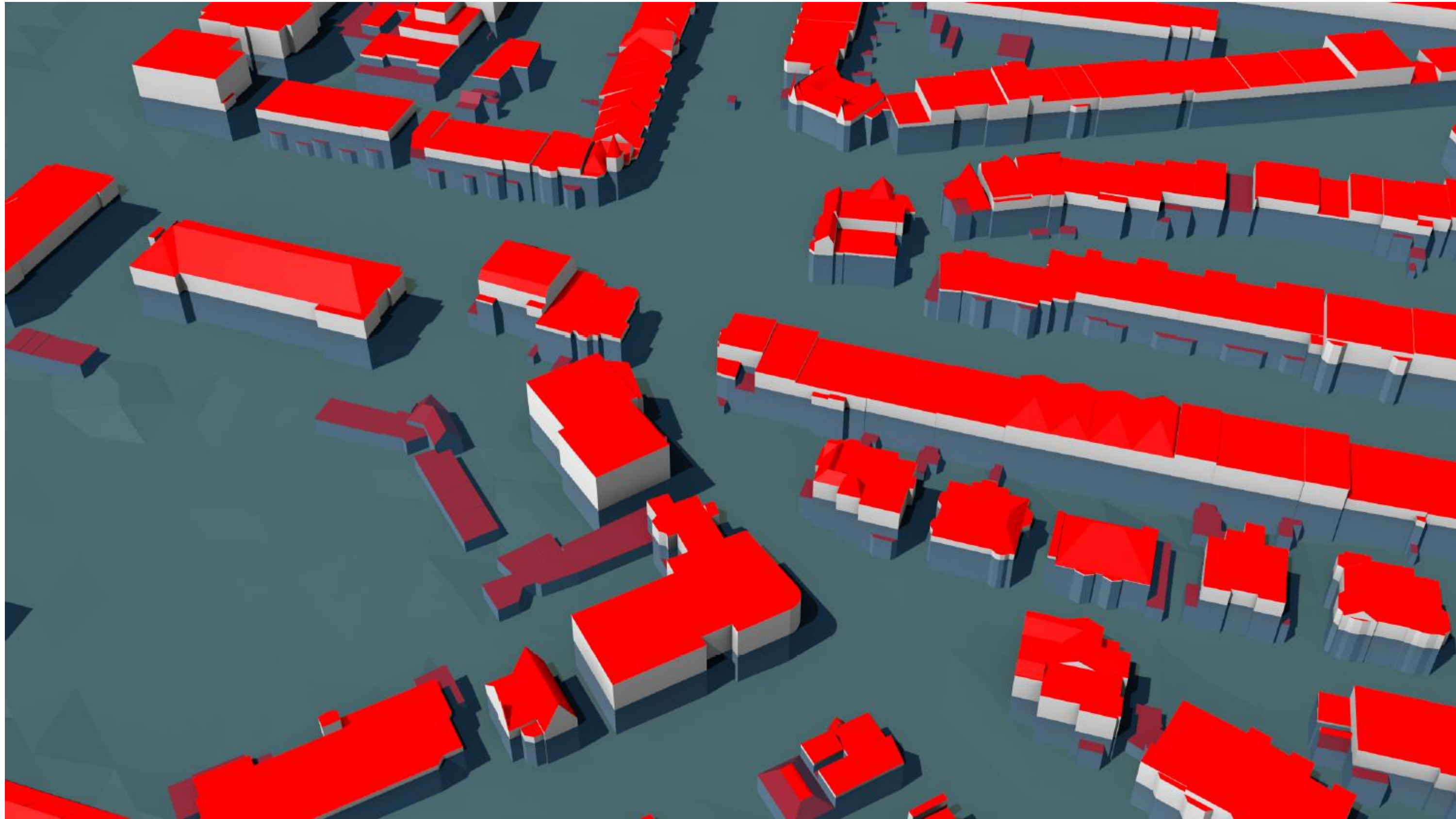
3D Digital City Applications



Valuation of Buildings

Determination of the floors pace

3D Digital City Applications



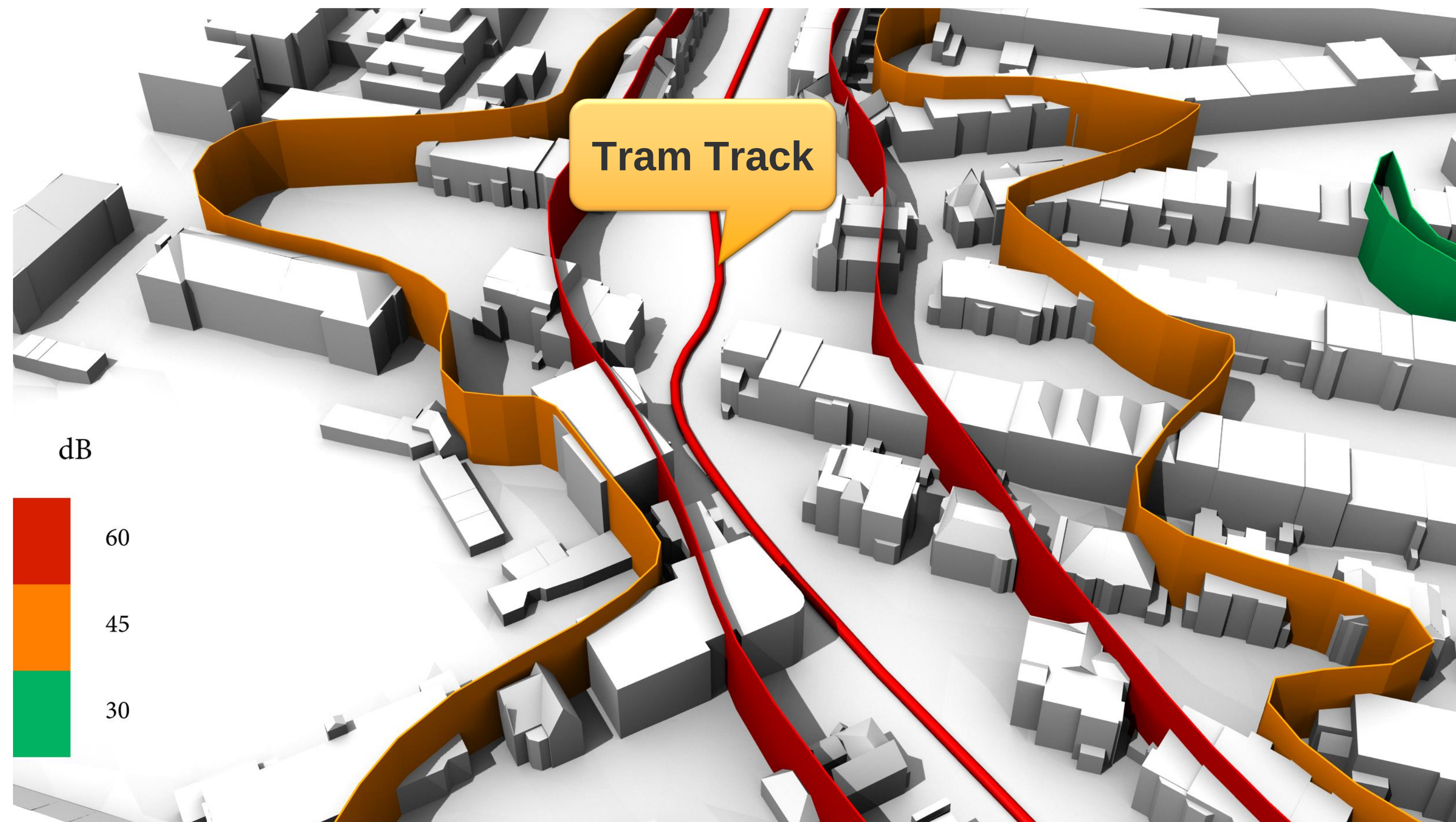
useful for applications
such as:

- Insurance
- Disaster management

Flood Simultaions

<https://doi.org/10.4233/uuid:f12931b7-5113-47ef-bfd4-688aae3be248>

3D Digital City Applications

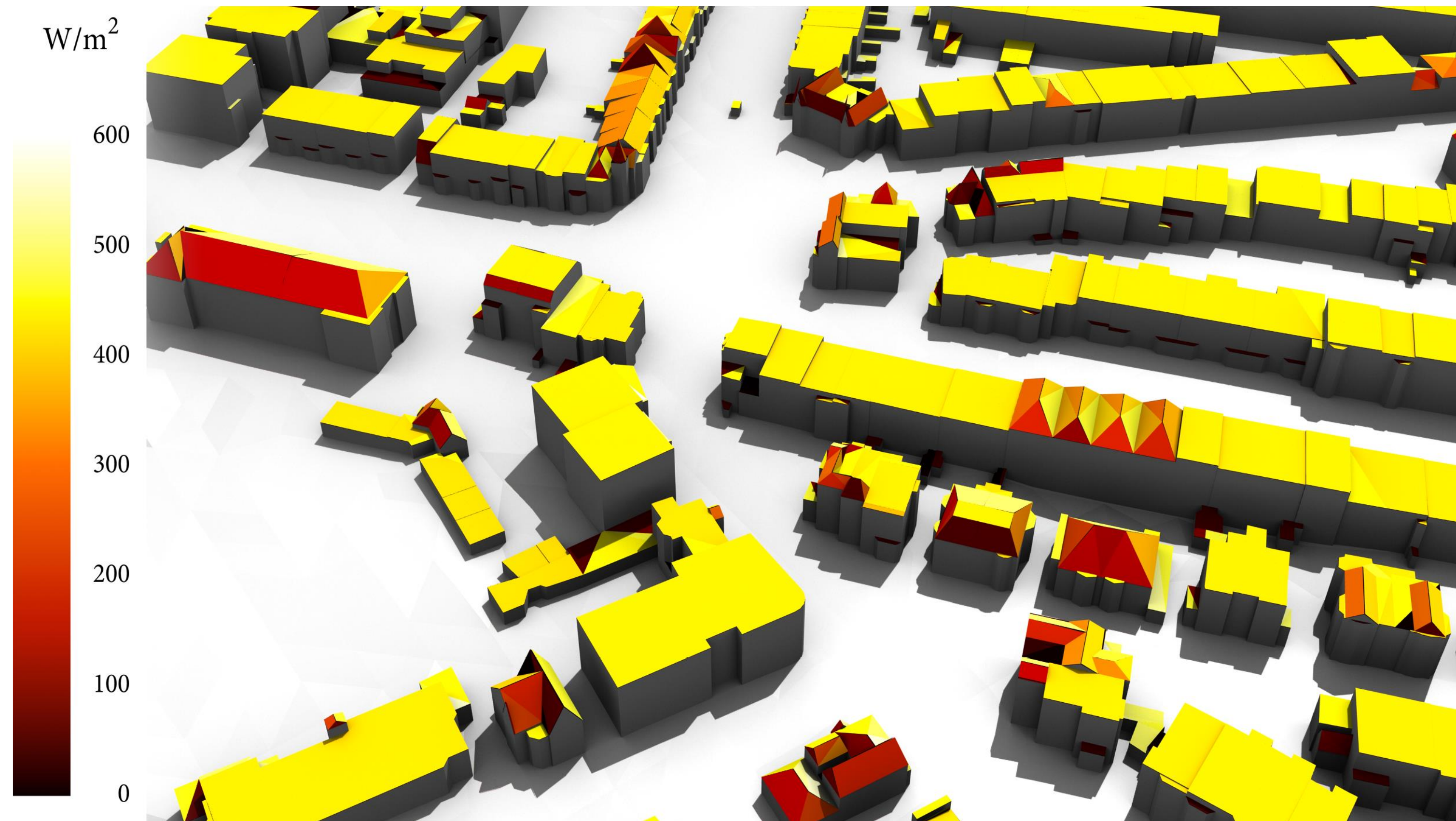


This is an illustration of noise from a planned tram track.

Noise impact analysis

Estimating noise pollution

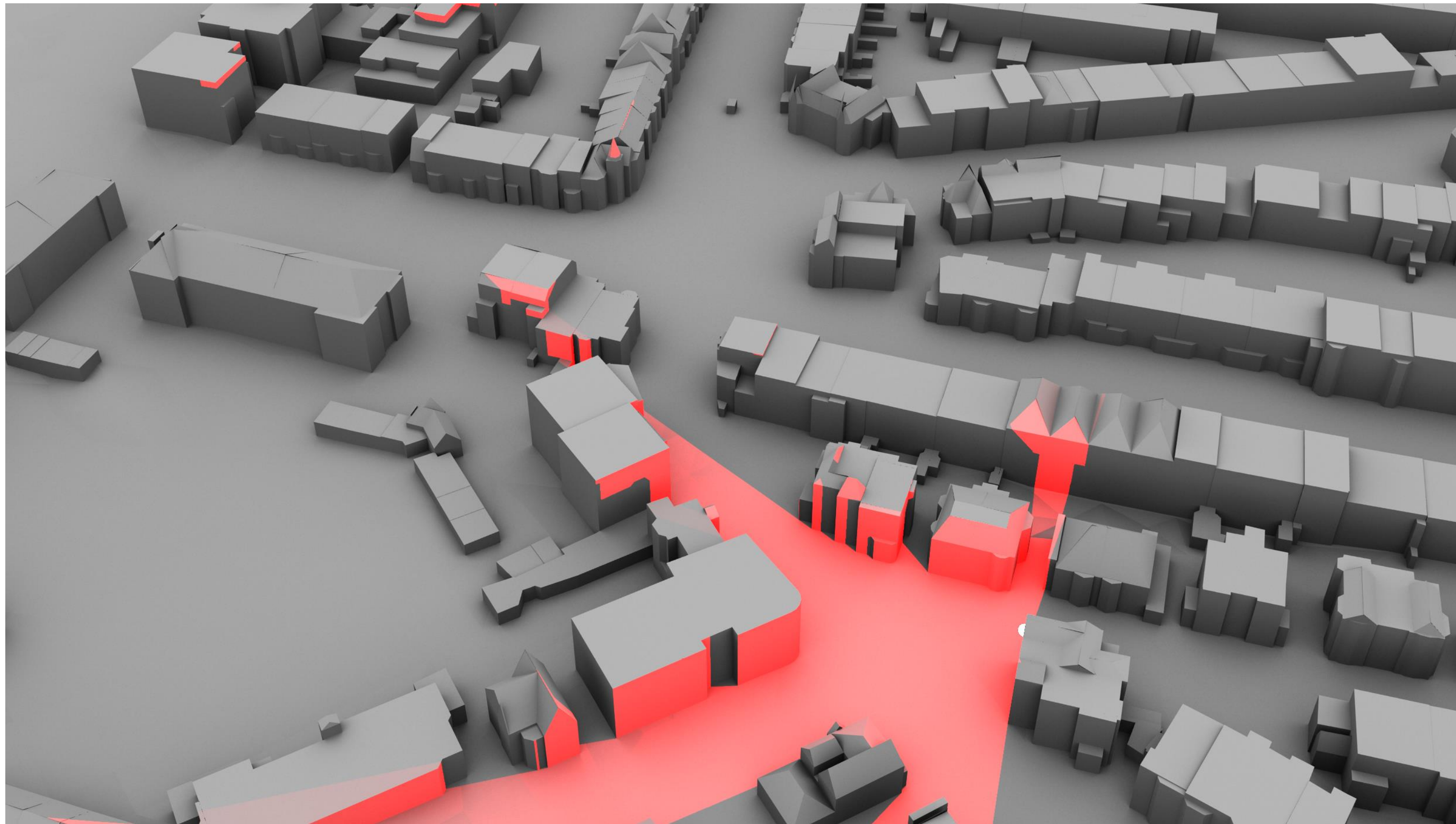
3D Digital City Applications



Finding optimal locations to place solar panels

Estimation of solar energy of rooftops

3D Digital City Applications



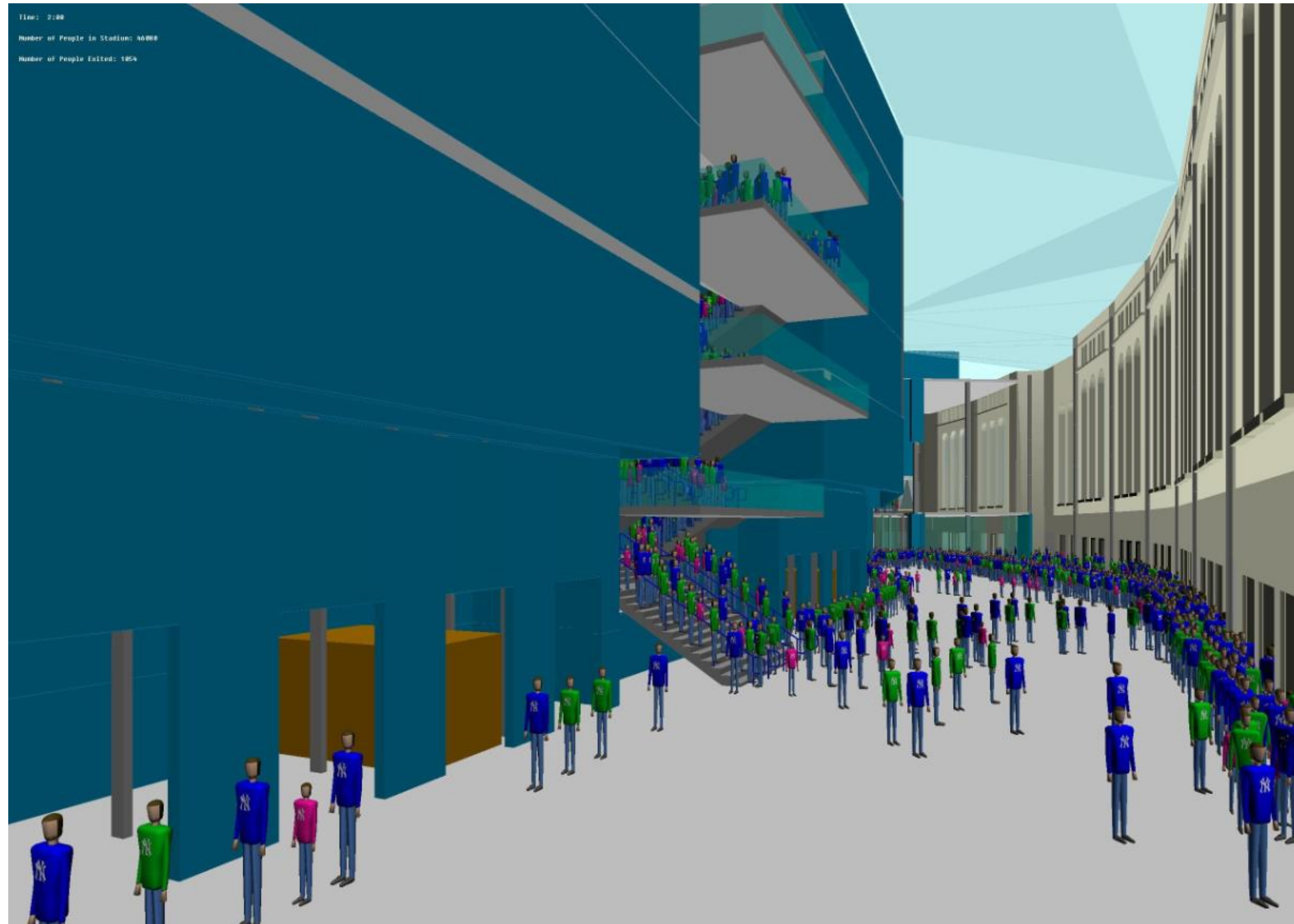
Predicting the view
from an apartment

Applications such as:

- Security
- mass valuation of real estate

Visibility analysis

3D Digital City Applications



Evacuation Planning

Emergency response planning on city, building, floor or interior space level.

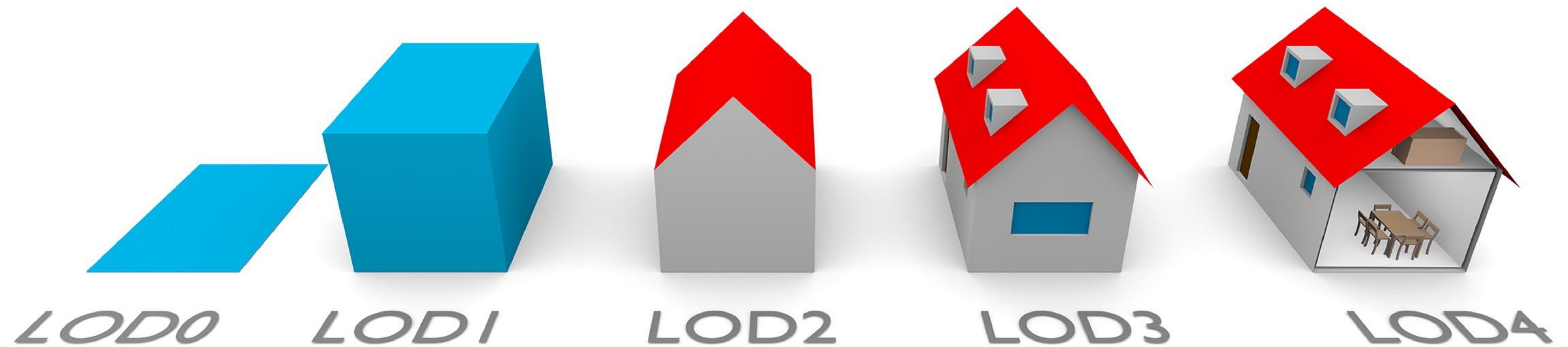
3D Digital City Applications



City Strategic Plans

- Testing different urban design alternatives
- Analyze each design implication virtually, to select the best socio-economical alternative for the city.
- visualizing city growth and experiencing different growth strategies for the city

3D Digital City Types



https://ars.els-cdn.com/content/image/1-s2.0-S0198971516300436-gr1_lrg.jpg

3D Digital City Types

LOD1

LOD2

LOD3

LOD4

Building

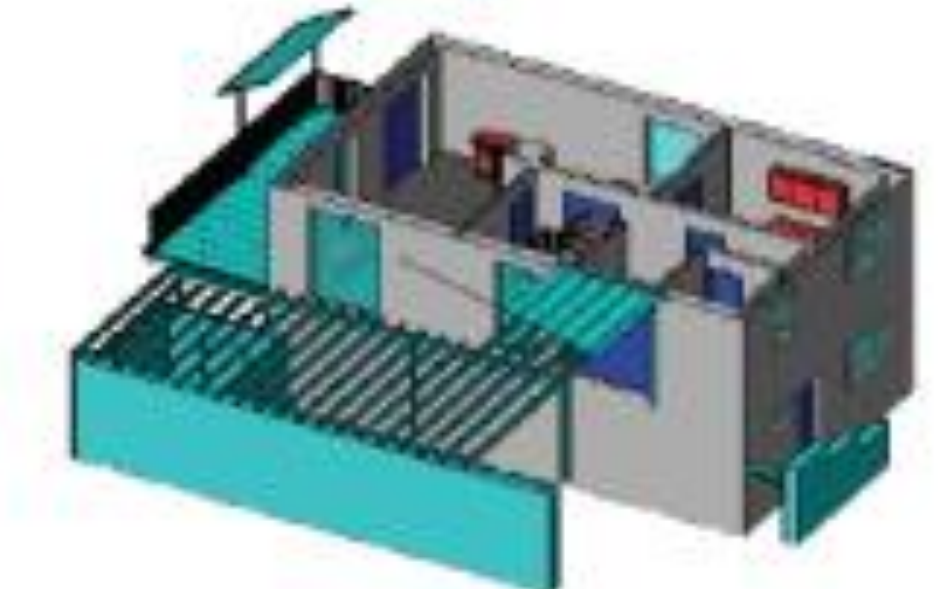
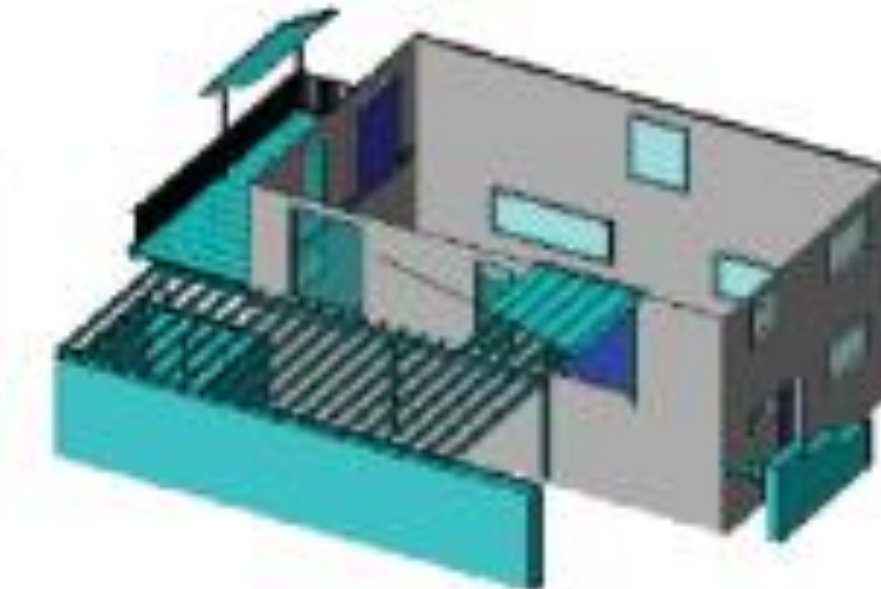
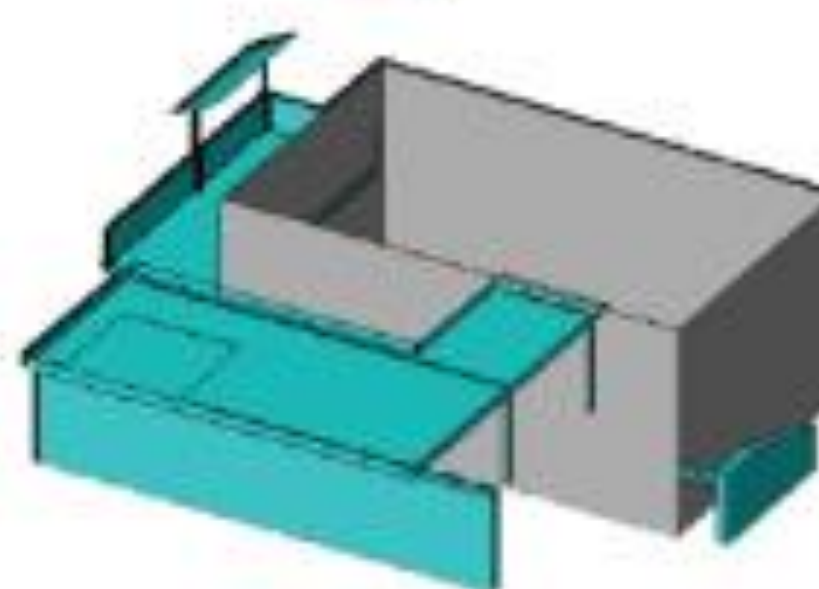
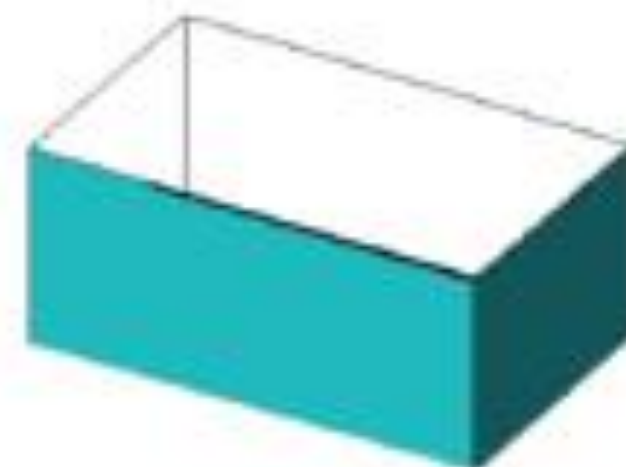
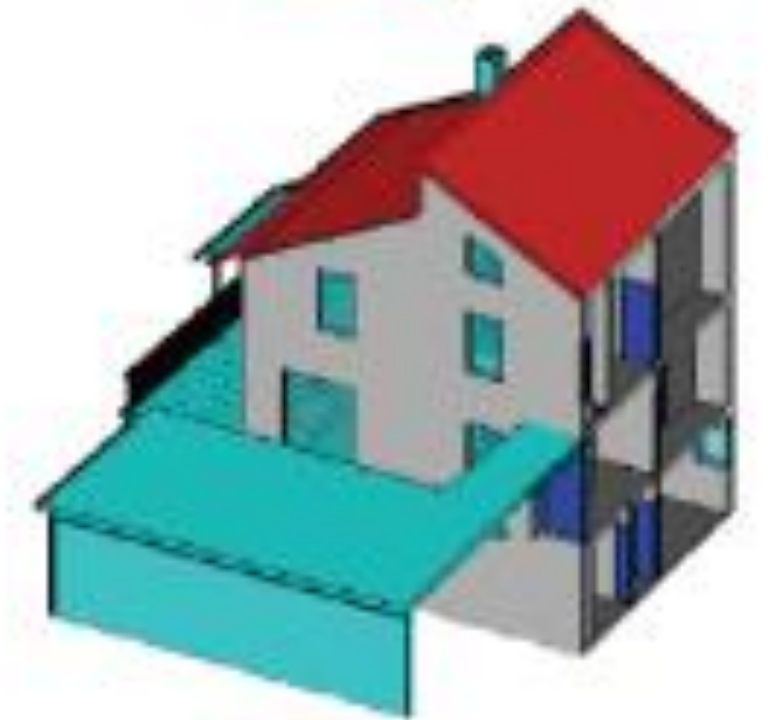
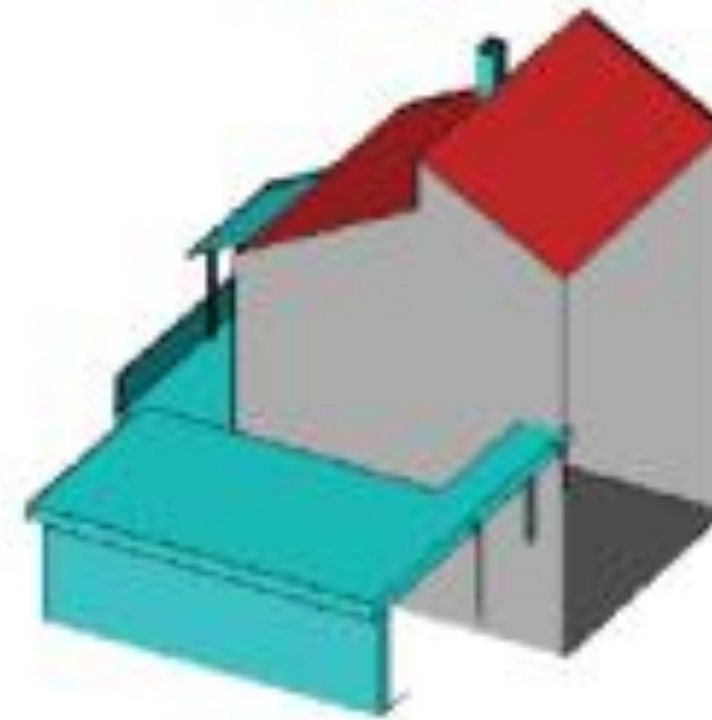
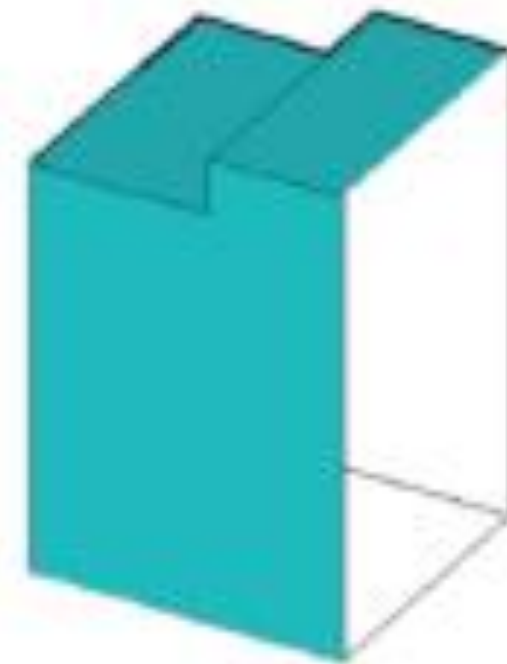
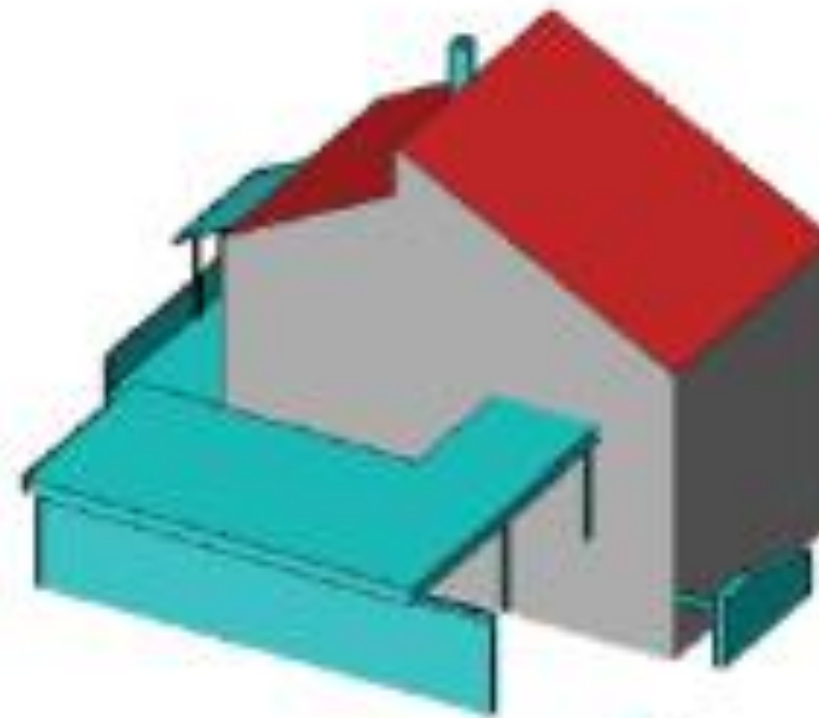
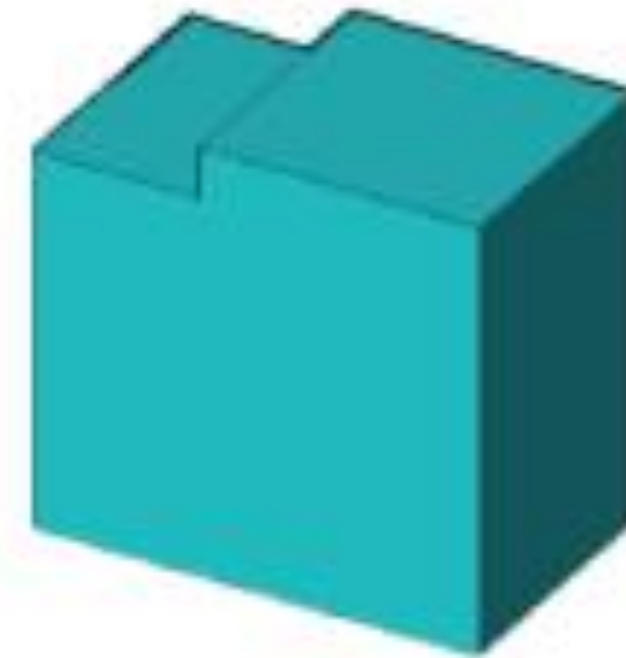
Building Interior

LOD1

LOD2

LOD3

LOD4



3D Digital City Types

LOD1

LOD2

LOD3

LOD4

CityGML homepage

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applications ▾

misc ▾

Cities around the world with open CityGML datasets

dataset	country	year	Building LOD	other classes	textures	acquisition	CityGML version	notes
Berlin	Germany	2013	LOD2		true		2.0	Released in 2015
Brussels	Belgium	2014	LOD2	Building	false		1.0	
Dresden	Germany	2009	LOD1/LOD2/LOD3		Partially		1.0	
Dutch cities	Netherlands	2016	LOD1	Terrain and many other	false		2.0	A few Dutch cities generated with 3dfier
Hamburg	Germany	2017	LOD1 and LOD2			Cadastre footprints + LiDAR	2.0	
Helsinki	Finland	2016	LOD2		true		2.0	
Linz	Austria	2011	LOD2		false		1.0	
Lyon	France	2012	LOD2	Terrain, water			2.0	
Montréal	Canada	2009	LOD2	terrain (TIN in CityGML format)	true	Photogrammetry	1.0	The LiDAR dataset of the same area is also available

https://www.citygml.org/3dcities/

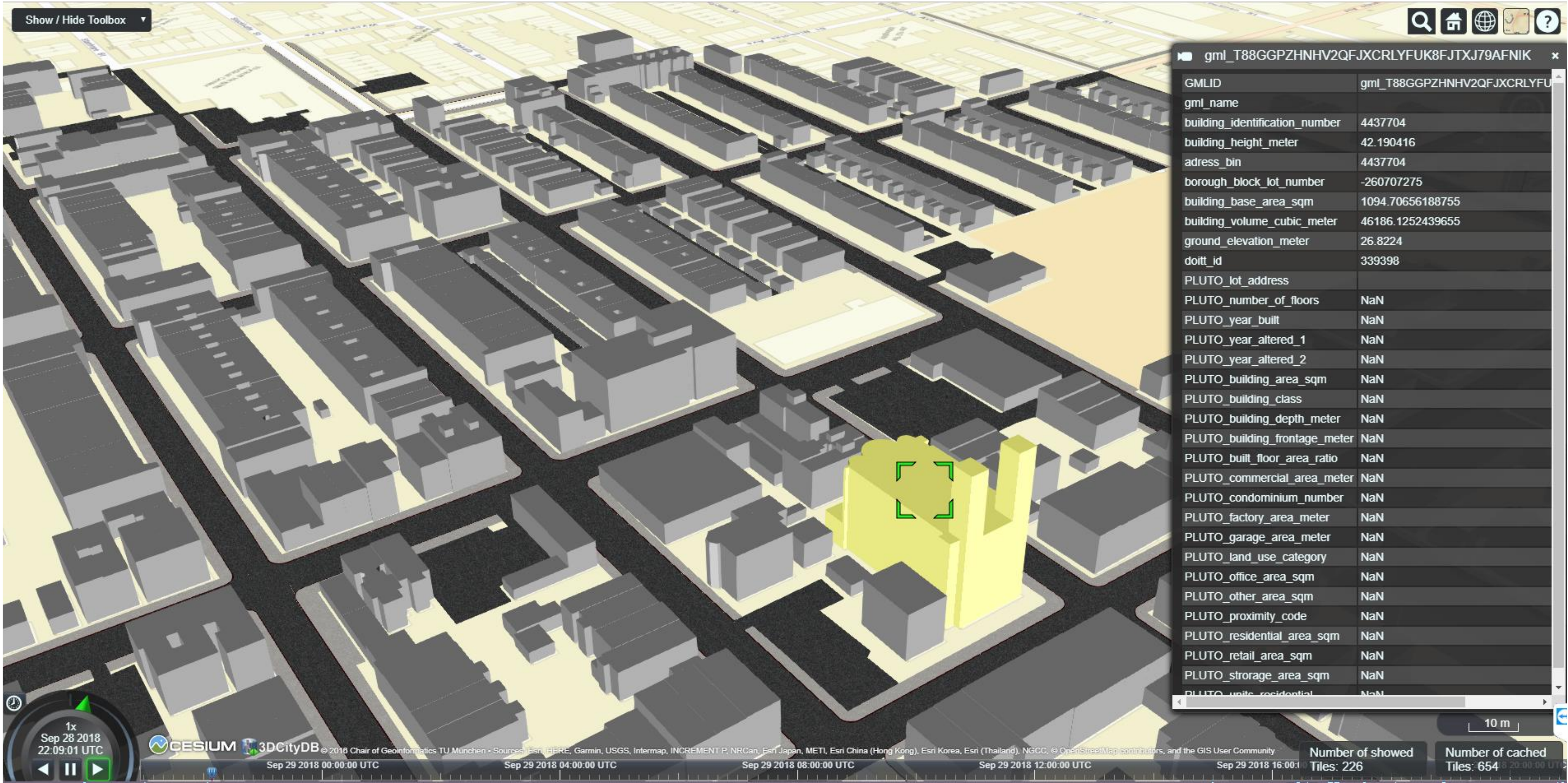
3D Digital City Types – LOD 1 – New York

LOD1

LOD2

LOD3

LOD4



link

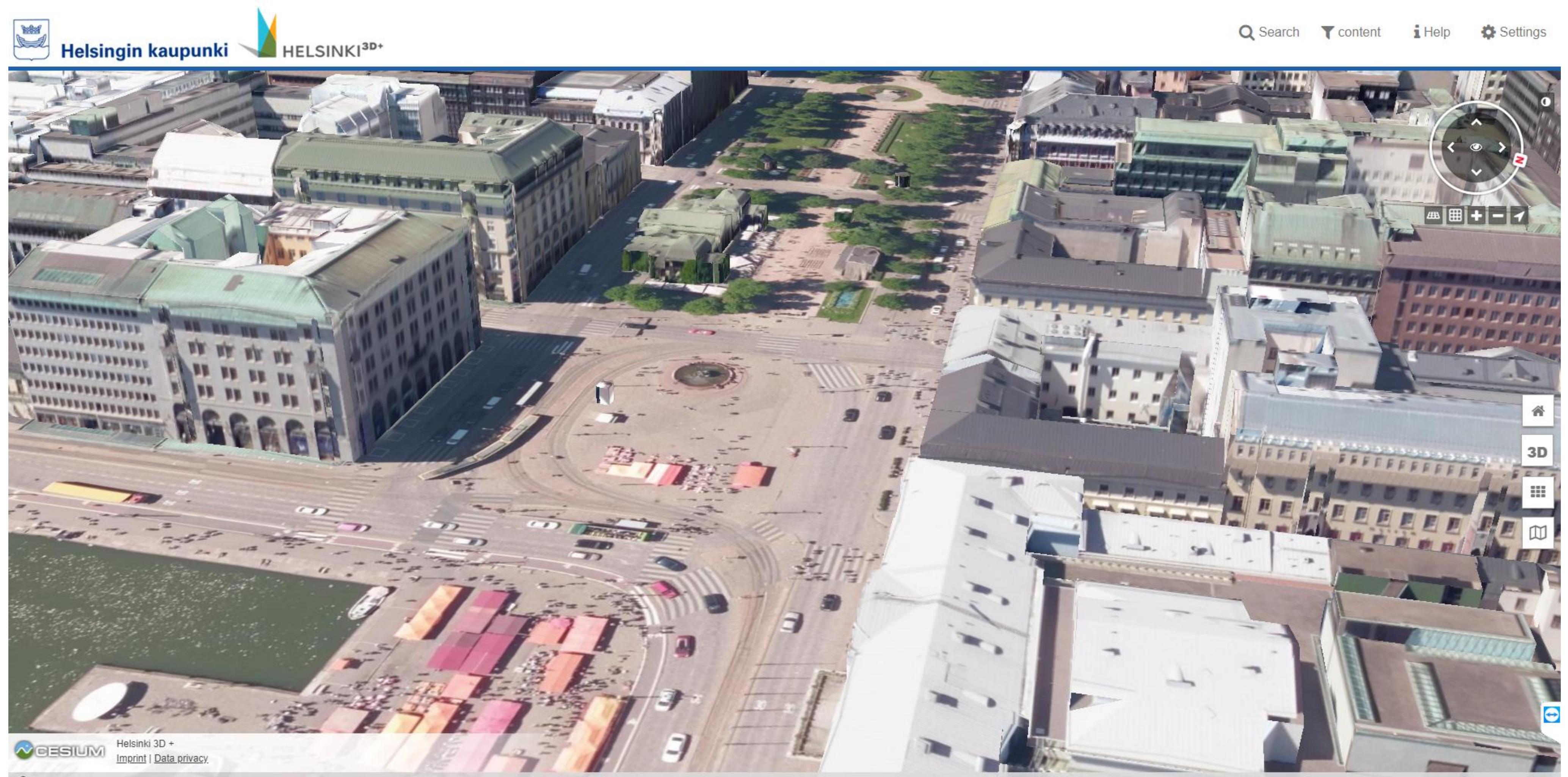
3D Digital City Types – LOD 2 – Helsinki

LOD1

LOD2

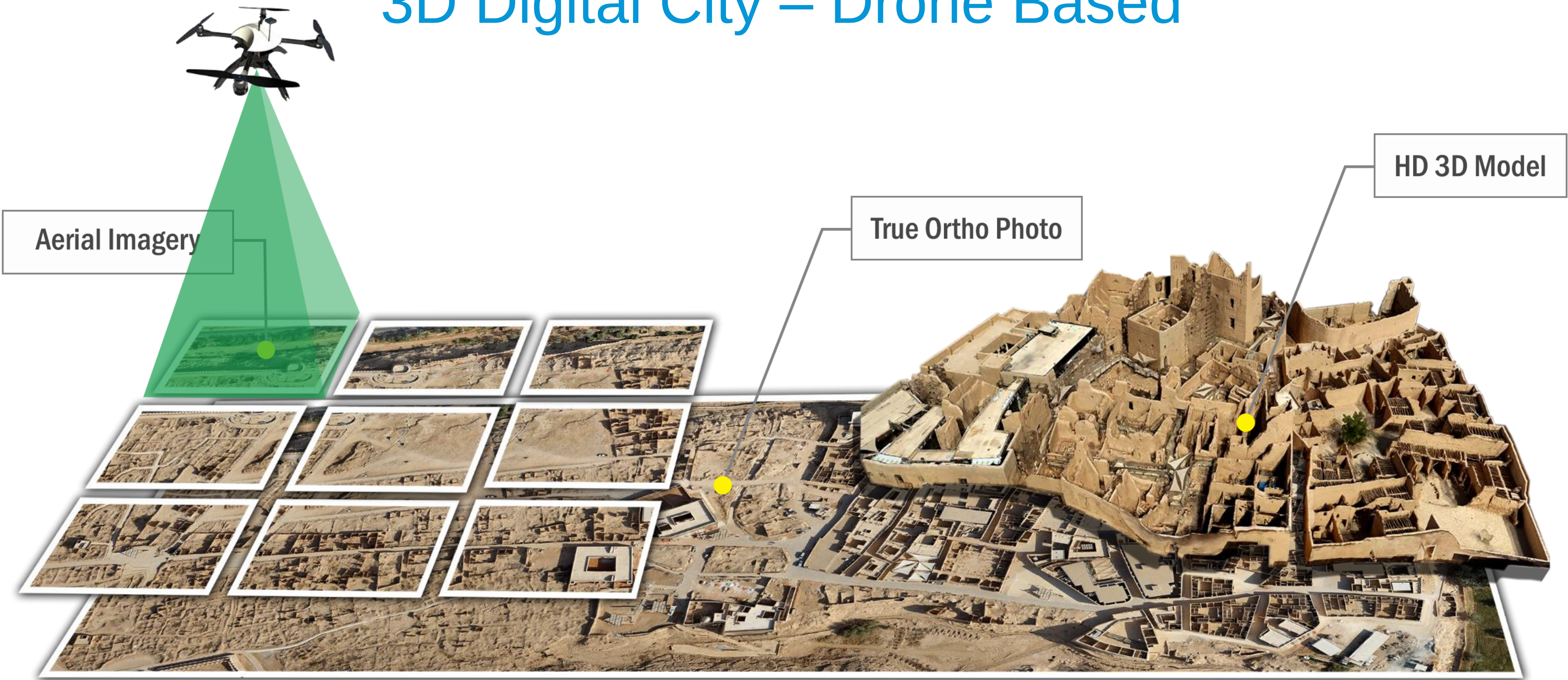
LOD3

LOD4



<https://kartta.hel.fi/3d/>

3D Digital City – Drone Based



1. Scanning

2. Processing

3. Modeling

Falconviz Drones Fleet

SURVEY HEXA-COPTER

HIGH PRECISION



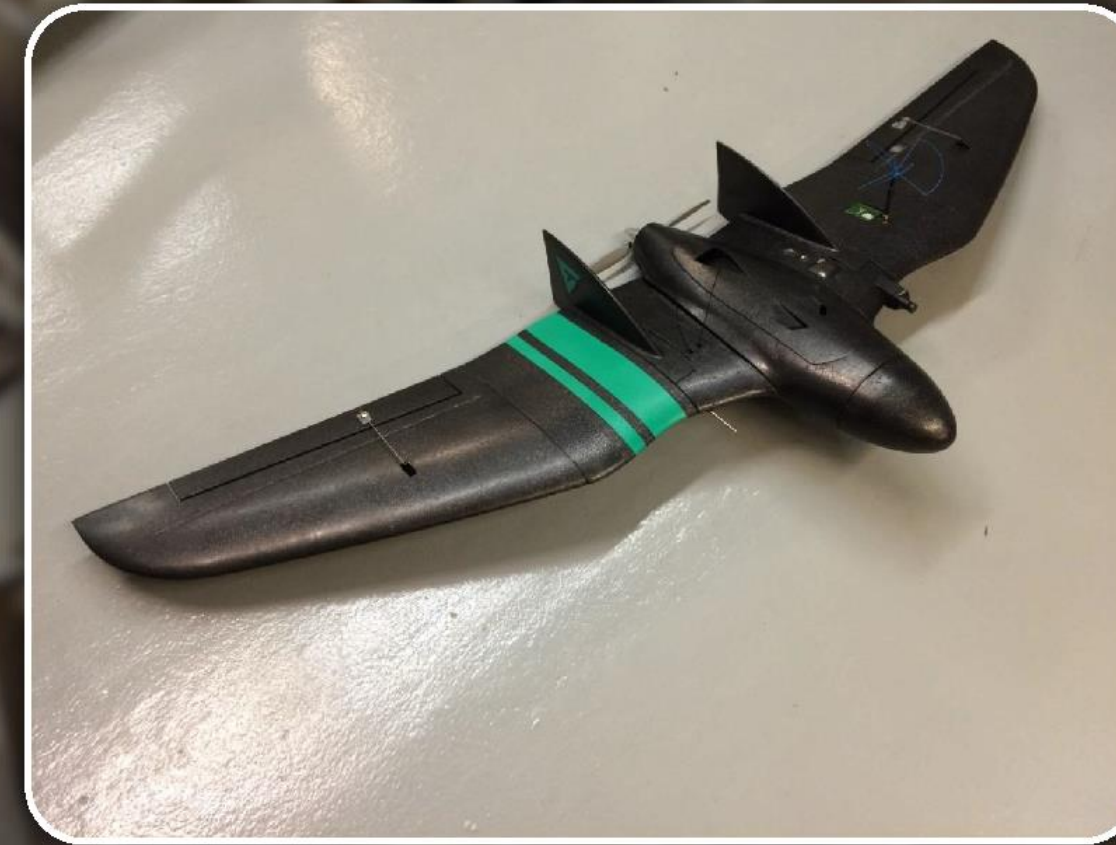
HEAVY LIFT QUAD-COPTER

THERMAL & MULTISPECTRAL



FIXED WING PLANE

HIGH PRECISION



FIXED WING PLANE

HIGH PRECISION



SURVEY QUAD-COPTER

HIGH PRECISION



CINEMATOGRAPHY

EPIC SHOTS/VIDEOS



CINEMATOGRAPHY

HIGH RESOLUTION



FIXED WING PLANE

HIGH PRECISION



+120 Scanning and
Visualization Projects



Our Clients

 جامعة الملك عبد الله للعلوم والتقنية King Abdullah University of Science and Technology	 الهيئة الملكية لمحافظة العلا Royal Commission for Al-Ula	 AECOM	 BCG	 JACOBS®	 dar	 JLL
 susten By Mahindra	 وزارة الإسكان MINISTRY OF HOUSING	 أمانة جدة	 DOW®	 KING ABDULLAH ECONOMIC CITY	 LAFARGE	 البواني AL BAWANI
 Hyder	 جامعة الملك فهد للبترول والمعادن KING FAHD UNIVERSITY OF PETROLEUM & MINERALS	 أمانة العاصمة المقدسة HOLY MAKKAH MUNICIPALITY	 AIB	 GULF RELATED	 N.C.C. NAJRAH CEMENT COMPANY	 PrecisionXYZ Aerial Services
 مدينة الملك عبدالعزيز للعلم والتقنية KACST	 الشركة السعودية للكهرباء Saudi Electricity Company Empowering Energy	 البلدية الإقليمية أمانة منطقة المدينة المنورة Al Madinah Regional Municipality	 شركة معاد العالمية MAAD INTERNATIONAL CO	 مجموعة بن لادن السعودية SAUDI BINLADIN GROUP	 أرامكو السعودية Saudi Aramco	 شركة جدة الاقتصادية JEDDAH ECONOMIC COMPANY
 اساس OMRANIA العمرانية ARCHITECTS ENGINEERS CONSULTANTS	 DAR AL-OMRAN Planners . Architects . Engineers	 1866 AUB American University of Beirut الجامعة الأمريكية في بيروت	 geokali	 نادار	 MIDWAM	 وزارة النقل TRANSPORT MINISTRY

Case Studies



Case Study 01

Al-Balad Historical District

Location: Jeddah, KSA

Area: 2.600,000 Sqr foot

LOD: LOD 3

Capturing Technique: Drone nadir/oblique

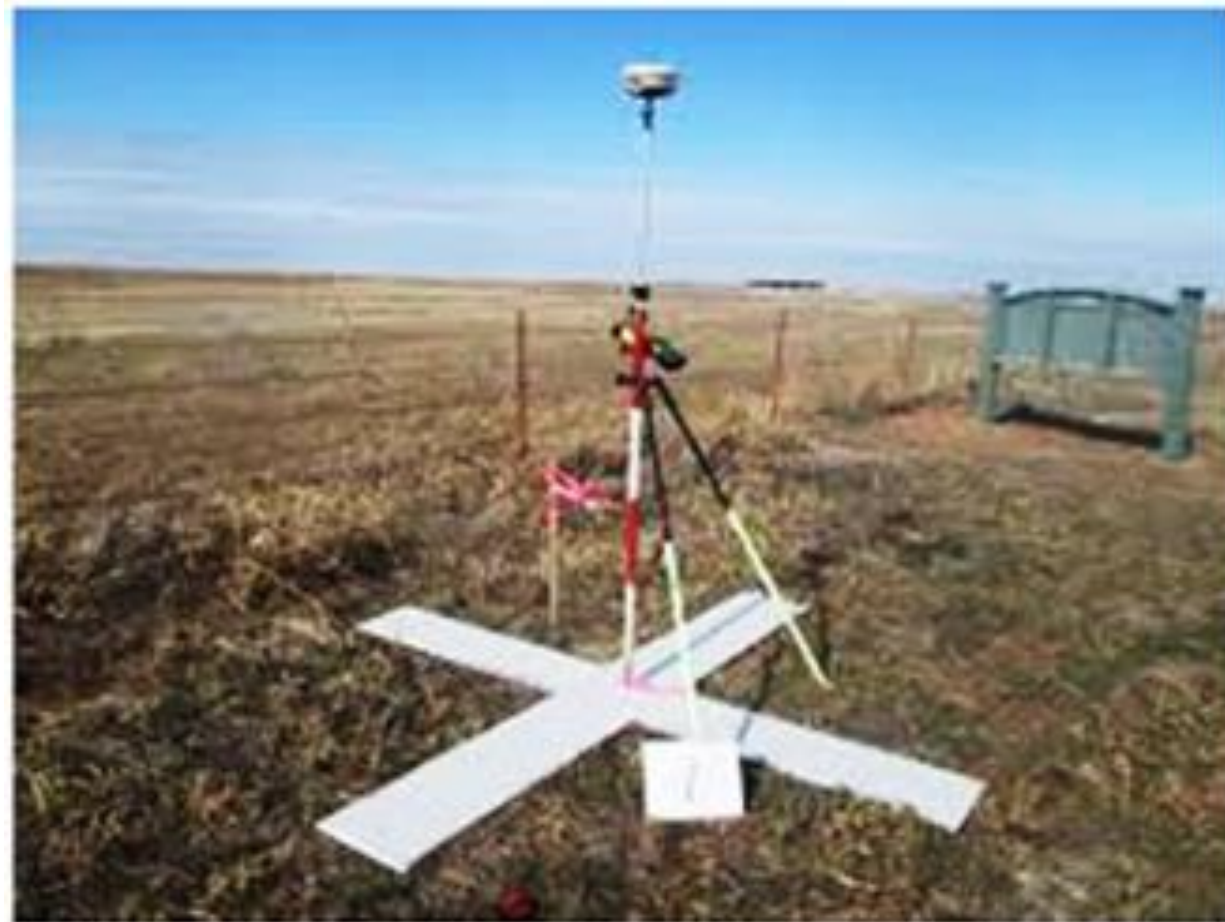
Purpose: Cultural Documentation



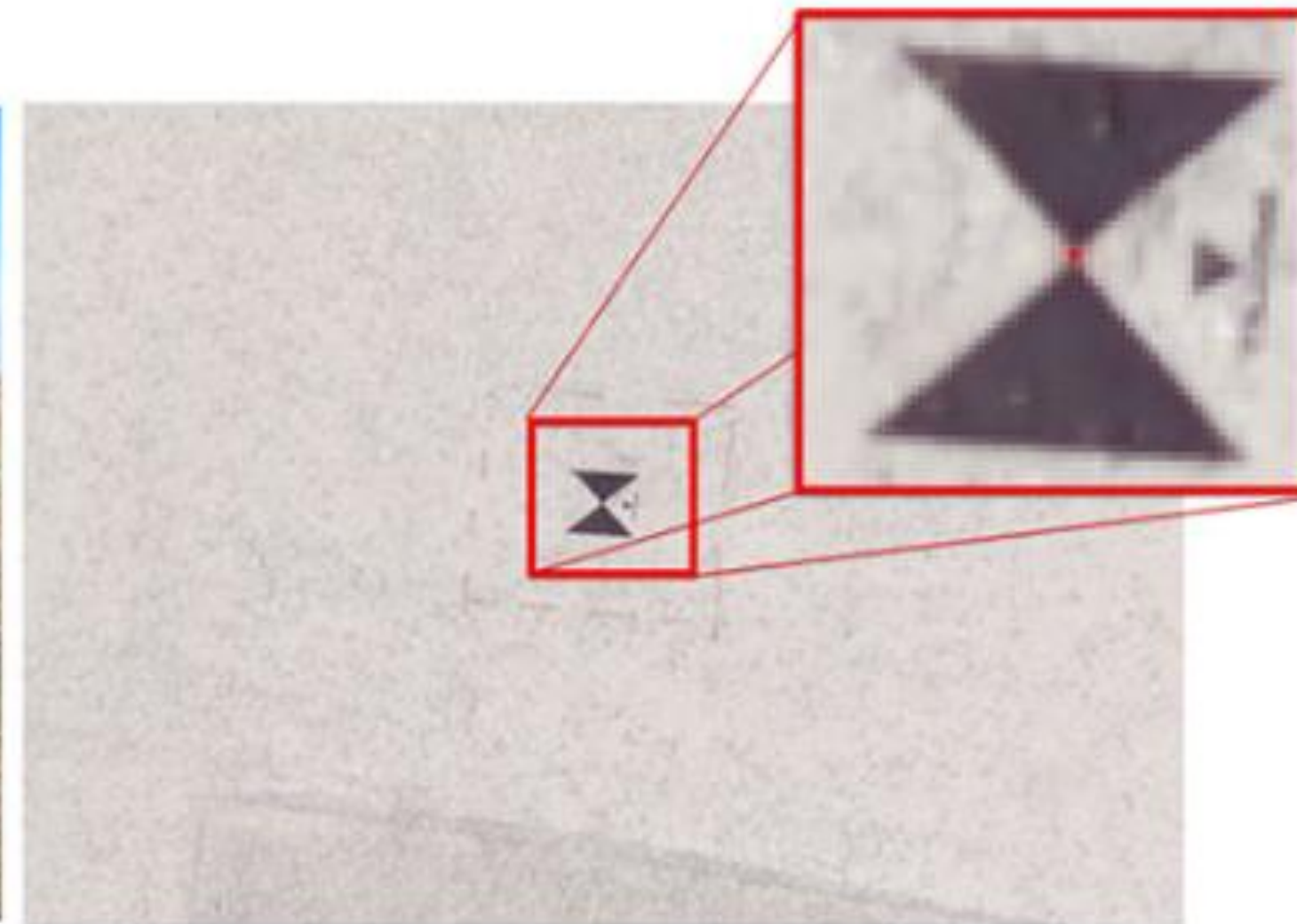
Al-Balad Historical District: **Workflow**



Al-Balad Historical District: **Workflow**



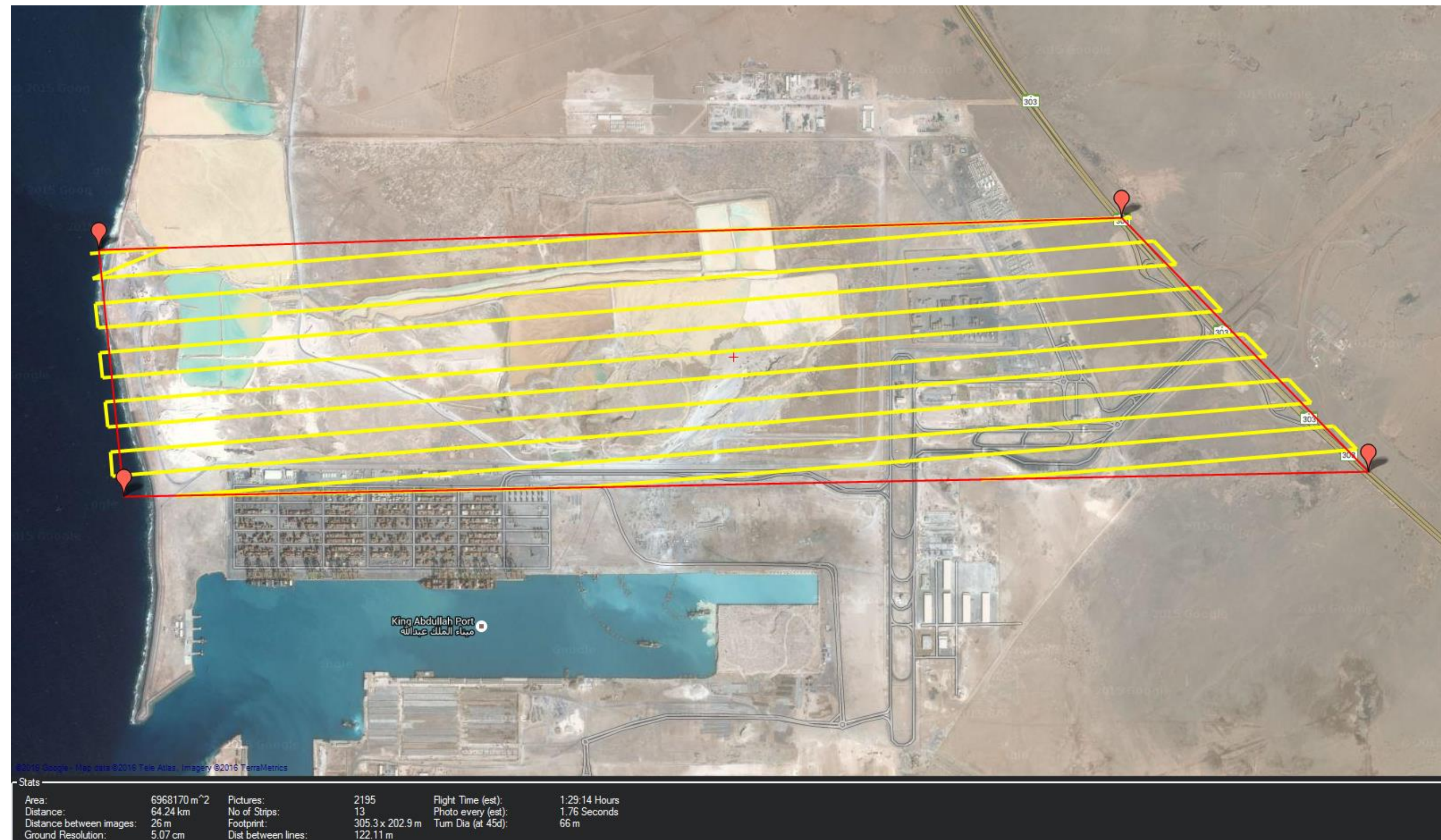
Traditional Mapping Markers
(Low Accuracy ~10cm, Large GSD Pixel Error)



FalconViz Survey-Grade Markers
(High Accuracy 0.5cm XY, 1.0cm Z, Sub-Pixel Precision)

- Studying the area of interest
- Determine the best ground control points (GCP) distribution
- Stake them out using our high accuracy GPS device
- Unlike traditional aerial survey we use our own proprietary FV GCP markers that allow sub-pixel precision measurement and reduce sun reflectivity

Al-Balad Historical District: **Workflow**



- Design the best effective flight path
- Ensure covering the whole area in less time with the maximum number of aerial images

Al-Balad Historical District: **Workflow**



DJI M600

Nadir and oblique captures



Al-Balad Historical District: **Workflow**

Pre-scanning

Scanning

Processing

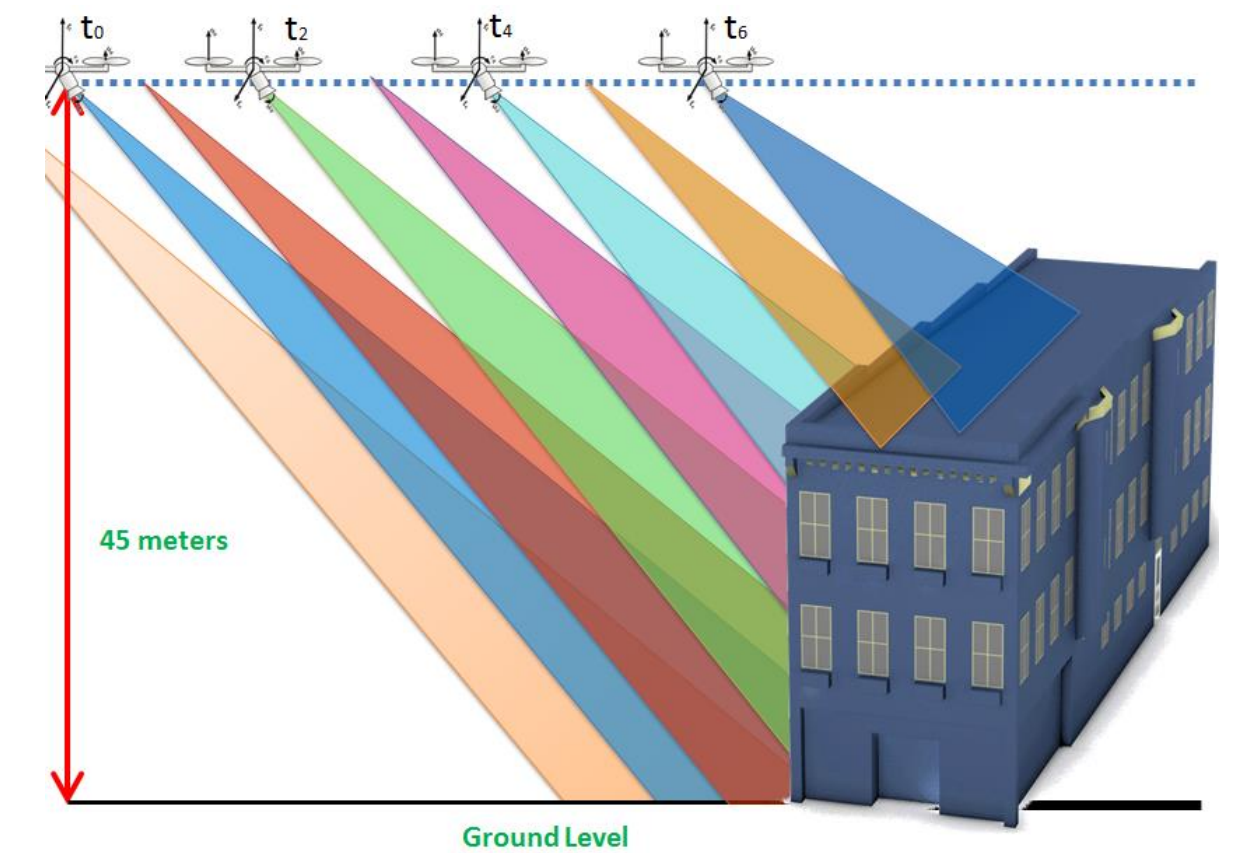
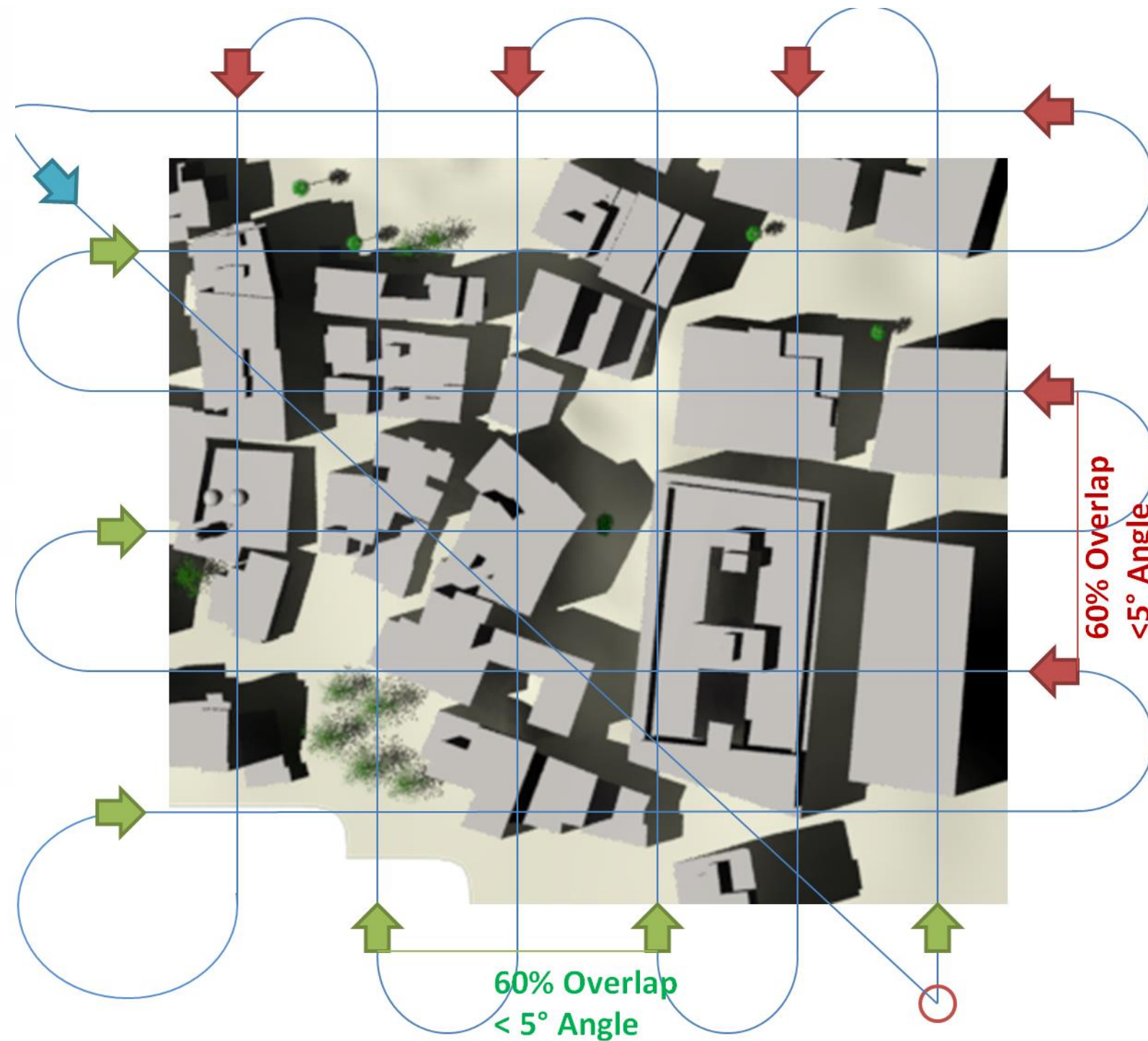
Modeling

Visualization



DJI M600

Nadir and oblique captures



Al-Balad Historical District: **Workflow**



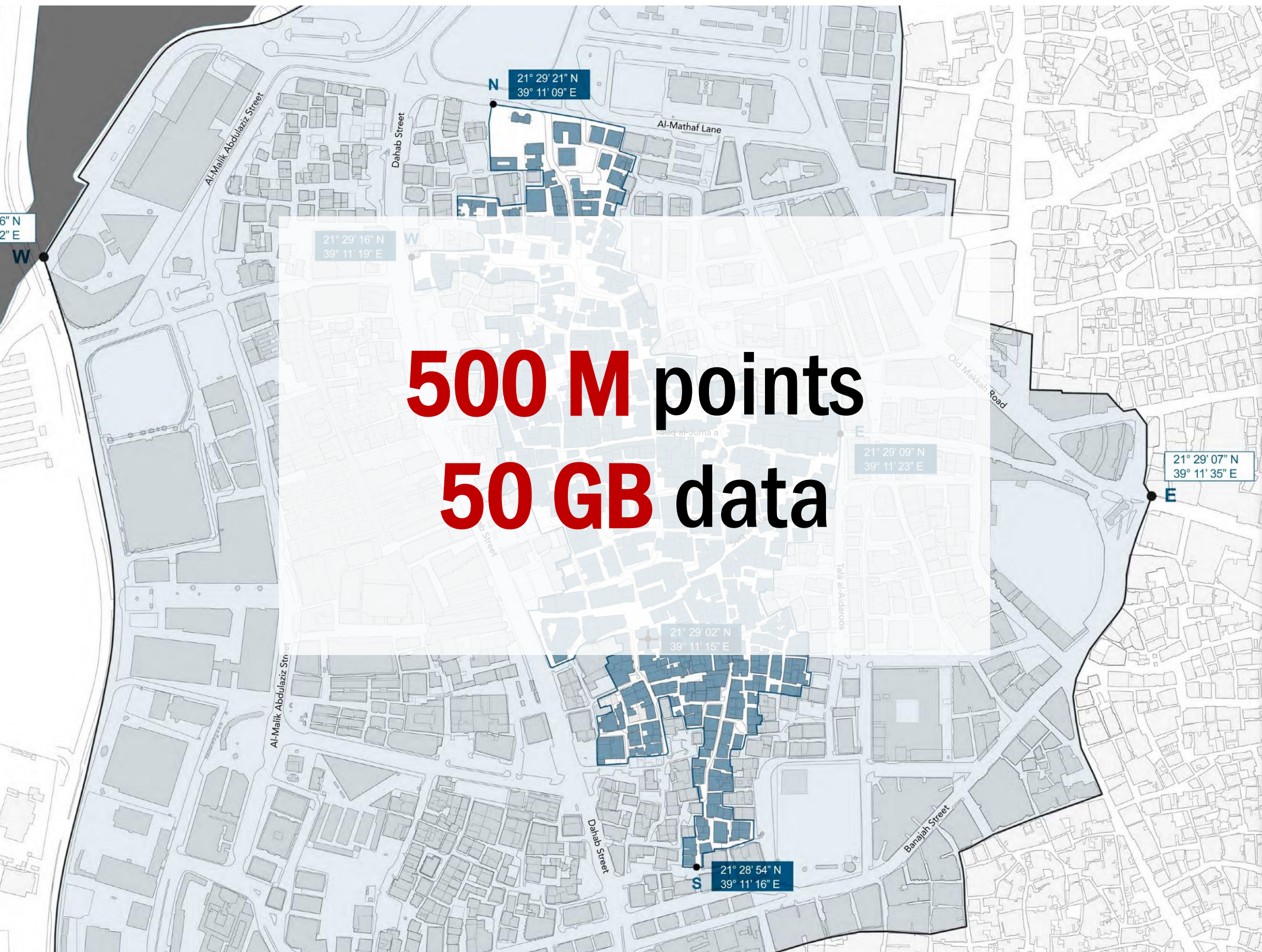
DJI M600

Nadir and oblique captures

8 Oblique flights – 4,397 images
2 Nadir flights – 1,119 images

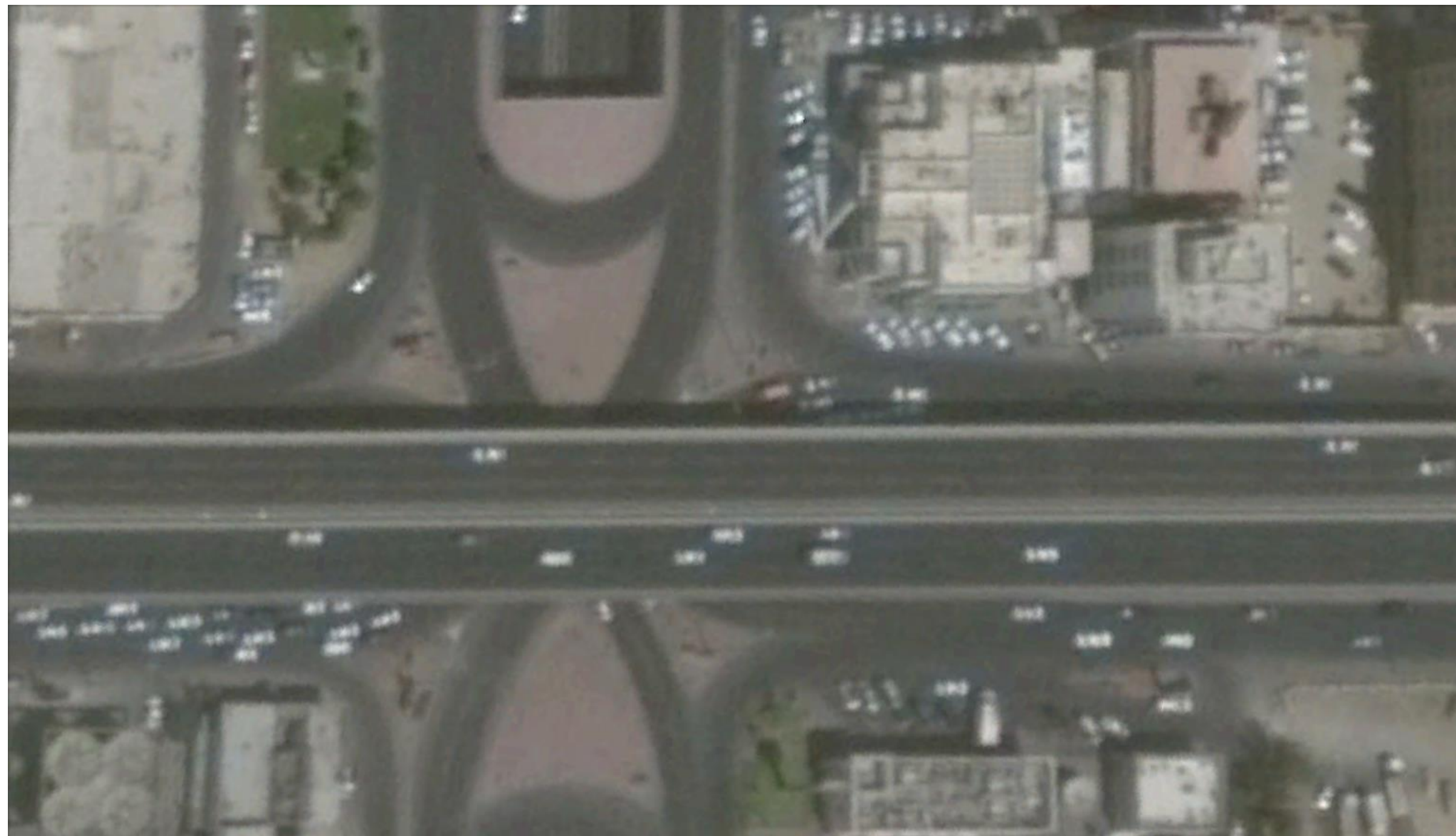
Total images: 5,516

Al-Balad Historical District: **Workflow**



Sample Point Cloud– Al-Balad

Al-Balad Historical District: **Workflow**



Satellite image +/- 30 cm



FalconViz drone image +/- 2 cm

Al-Balad Historical District: **Workflow**





Create

Home

Map View

rayCloud

Layers

- > ☒ Cameras
- > ☒ Rays
- > ☒ Tie Points
 - > ☒ GCPs / MTPs
 - > ☒ Automatic
- > ☐ Point Clouds
- > ☐ Point Groups
- > ☐ Triangle Meshes
- > ☐ Objects

Processing

Log Output

Processing Options

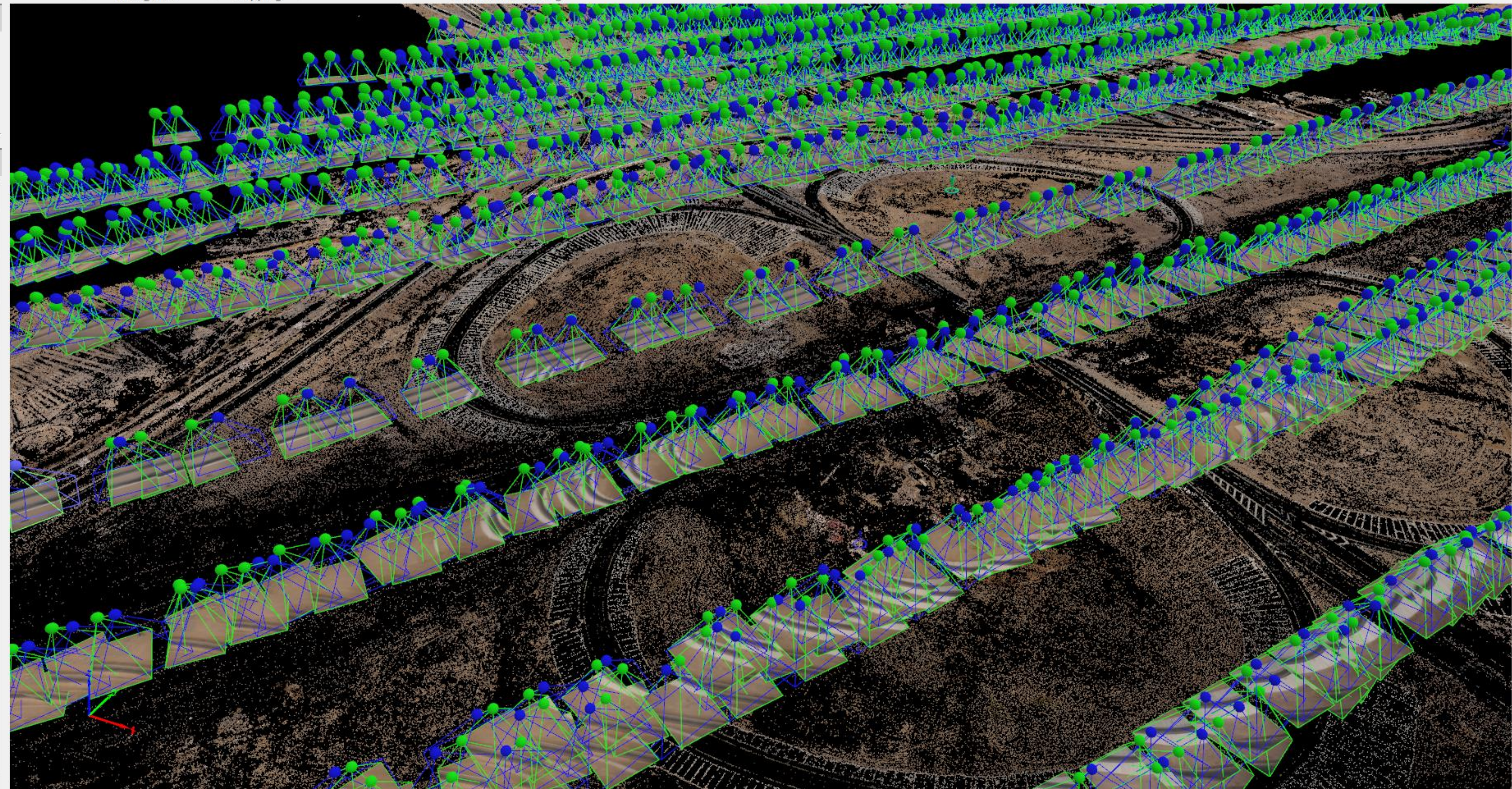
Processing

☐ 1. Initial Processing ☒ 2. Point Cloud and Mesh ☐ 3. DSM, Orthomosaic and Index

Current: Group group1, cluster 1/1 : initializing 2439 cameras 42%

Total: 2. 0/10

Output Status... Start Cancel Help



Al-Balad Historical District: **Workflow**

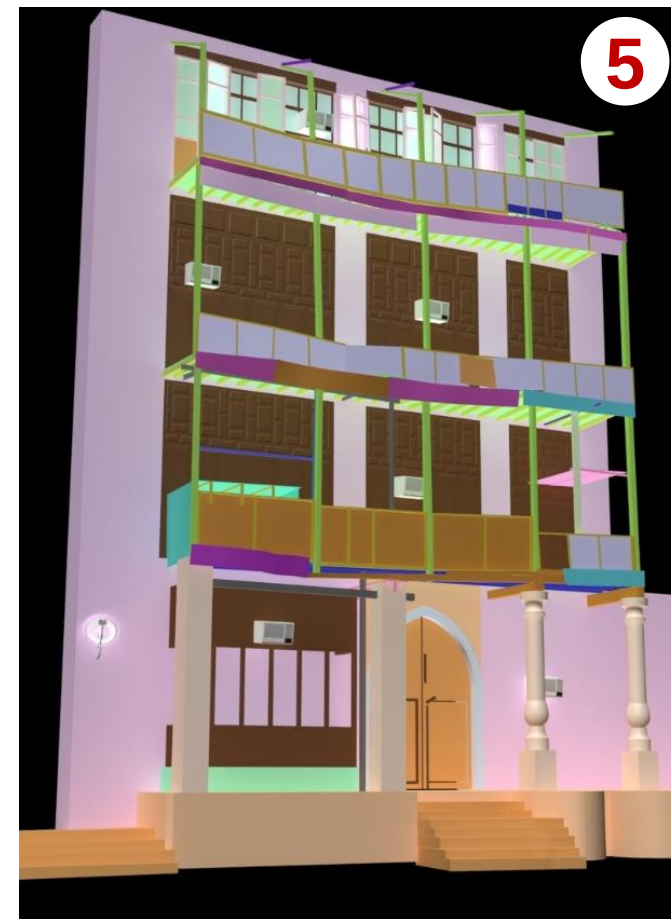
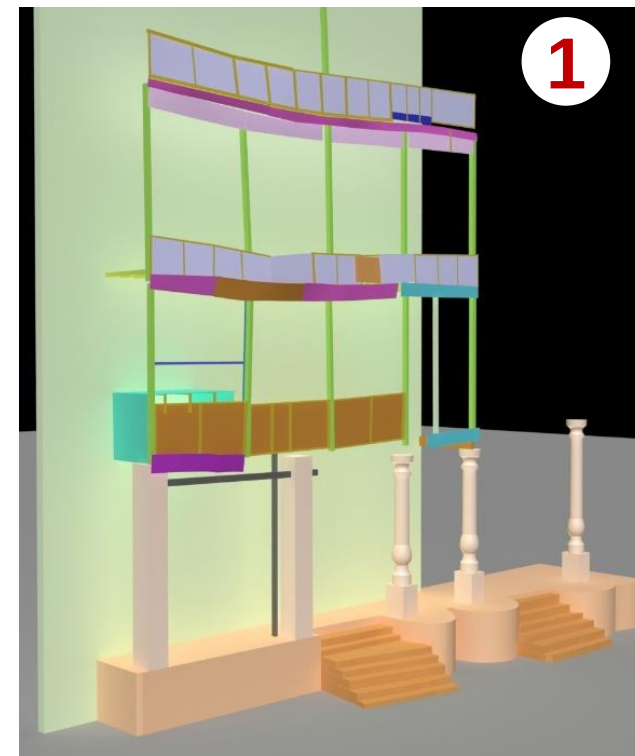


-
1. Automatically generated 3D textured mesh
 2. 3D solid models of selected buildings
-

Al-Balad Historical District: **Workflow**



Bait Al-Batarjy

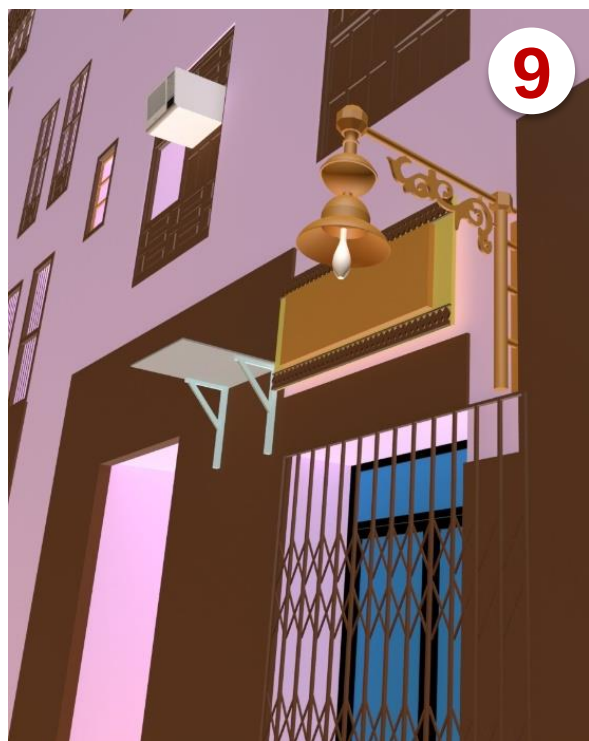


Modeling Progress (**2 Working Weeks**)

Al-Balad Historical District: Workflow



Bait Al-Batarjy



Modeling Progress (2 Working Weeks)

Al-Balad Historical District: Workflow



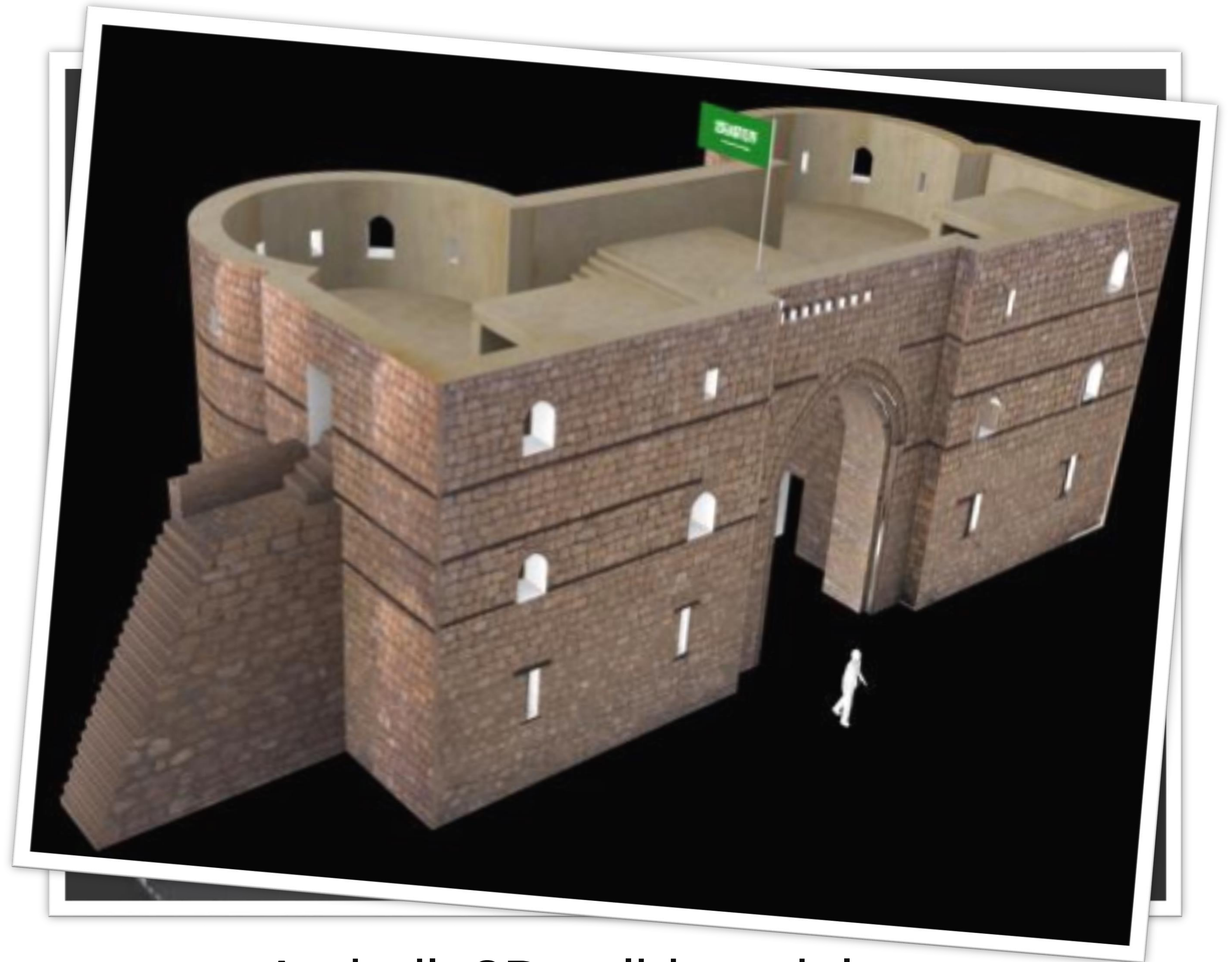
Bait Al-Batarjy



Al-Balad Historical District: **Workflow**



Bab Jadeed

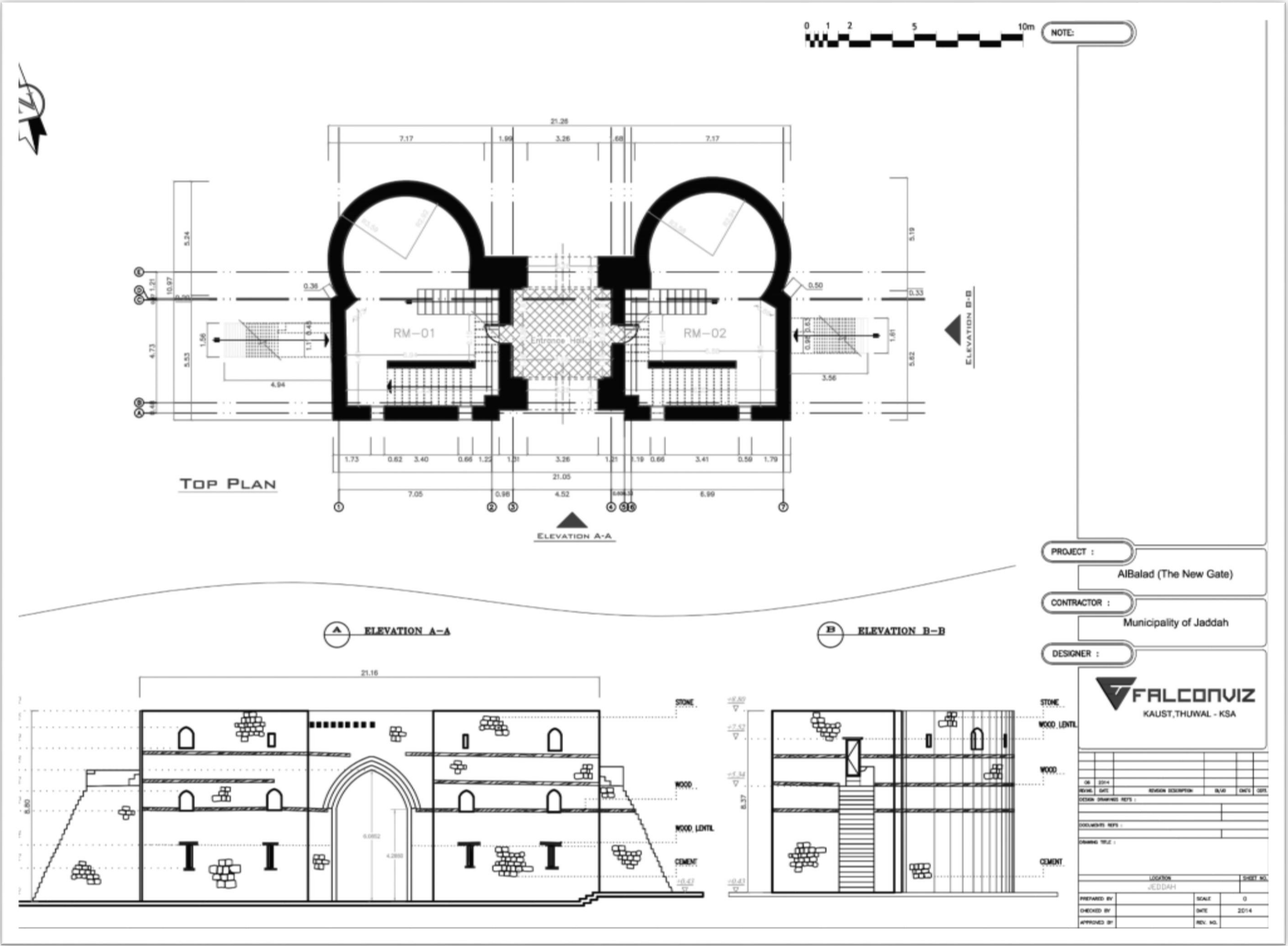


As-built 3D solid model

Al-Balad Historical District: Workflow



Bab Jadeed



As-built 2D plan and elevations



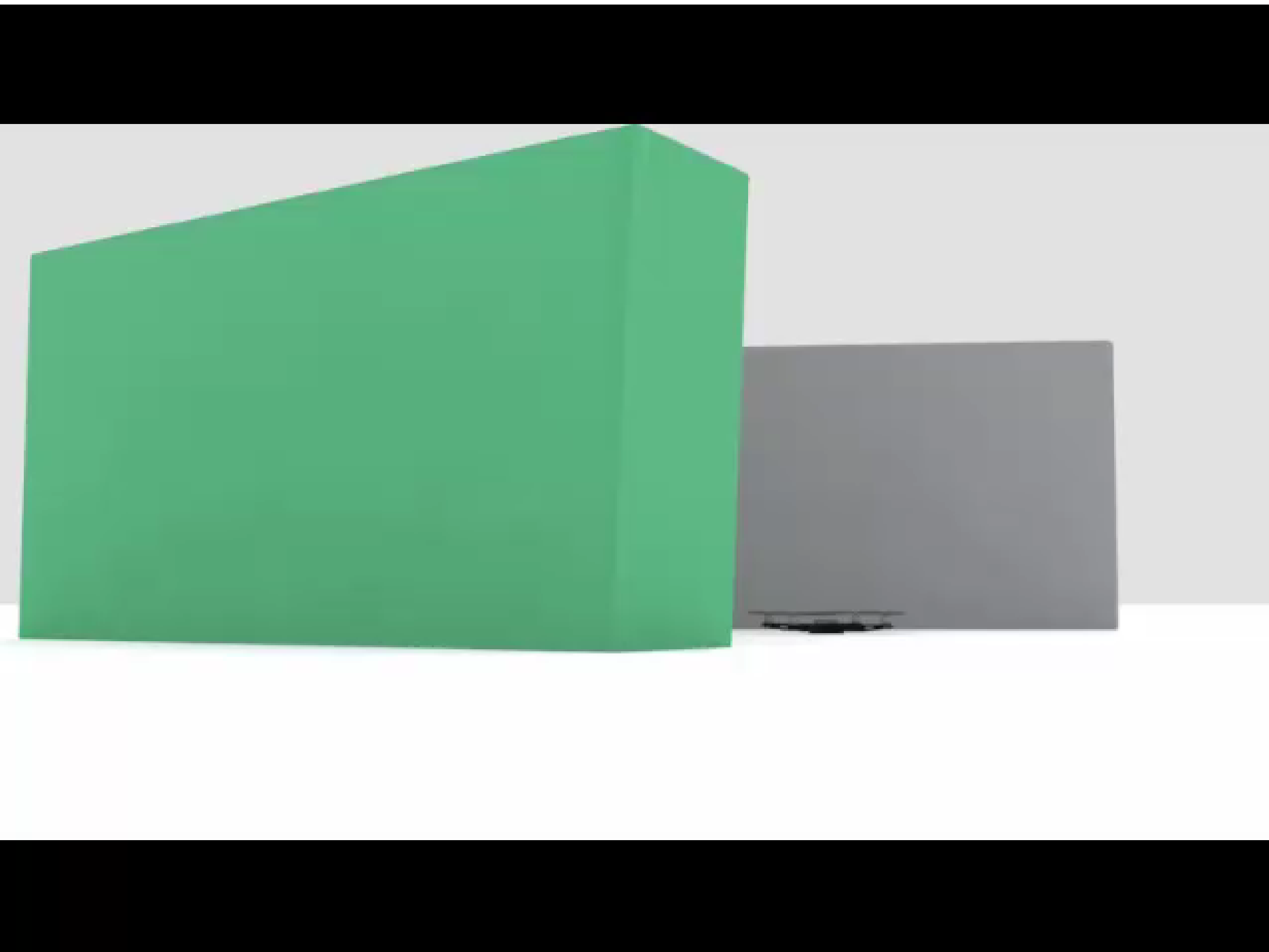
Al-Balad Historical District: **Workflow**



Bab Jadeed



Al-Balad Historical District: Workflow



Al-Balad Historical District: **Workflow**



Existing Features

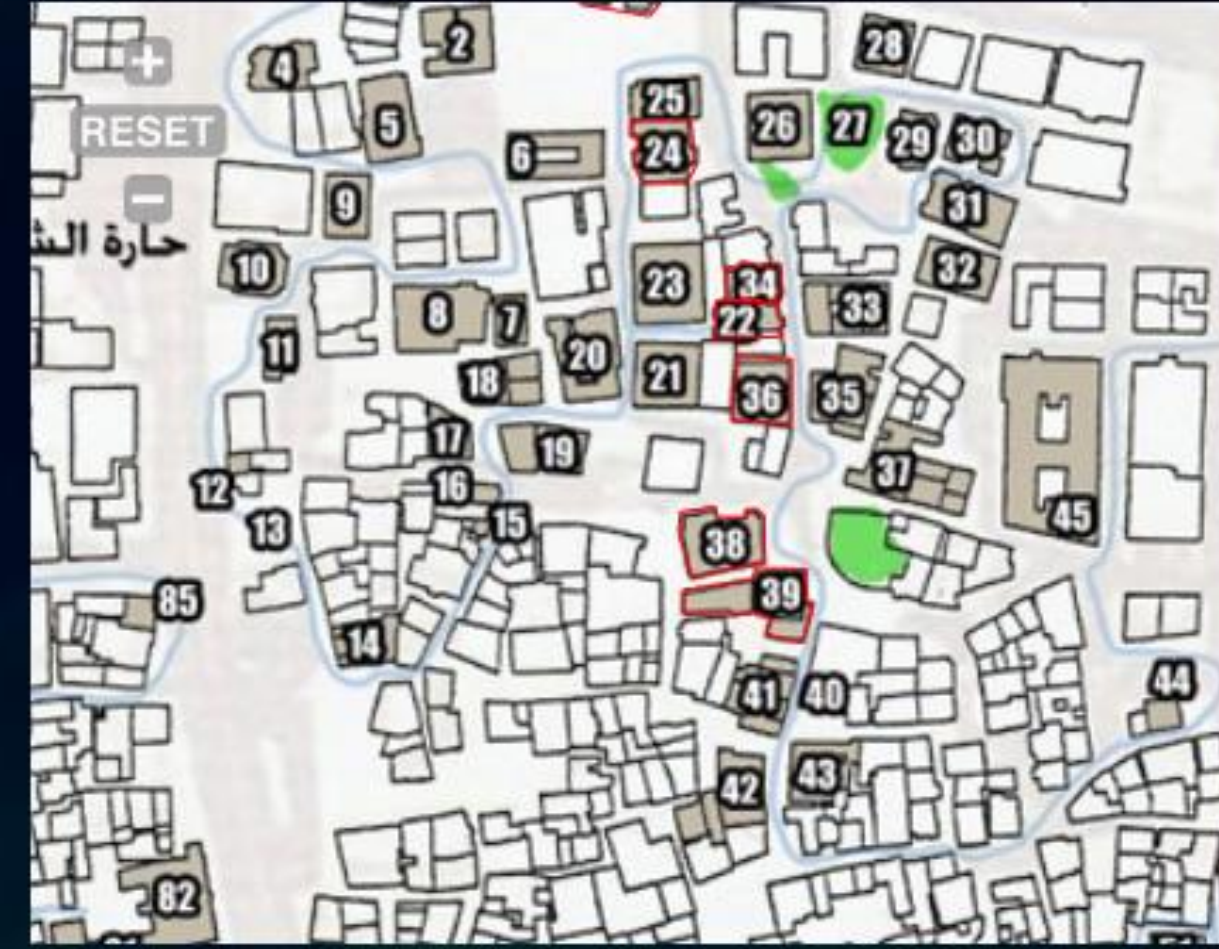
- ✓ Interactive Application
- ✓ 3d Full Detailed Video
- ✓ 3d Full Detailed Images
- ✓ Historical Background Info
- ✓ 360 3d Panorama

Upcoming Features

- ✓ Multi-language
- ✓ Gigapixel Panorama Walkthrough
- ✓ Interactive Historical Timeline



جده البلد



بيت البترجي

بيت البترجي من بيوت العائلات العريقة التي عاشت في منطقة جدة التاريخية في حارة الشام و يقع ضمن مدينة جدة التاريخية، حيث كان مقراً لأول سفارة أمريكية في المملكة العربية السعودية والمنزل الآخر بجانبه كان موطناً لأول بعثة بريطانية لاستكشاف النفط وهناك ميل الأسرة لتحويل هذا المعلم التاريخي إلى متحف يعني الزوار والسياح بالتعاون مع السفارة الأمريكية وسفارة المملكة المتحدة والهيئة العامة للسياحة والآثار وأمانة مدينة جدة.



المقارنة

الكتل الرئيسية

قارن

الكتل الرئيسية

بانوراما



فيديو



مجسم



واجهة جانبية



واجهة رئيسية

واقع افتراضي



معرض الصور



Case Study 02

King Abdullah Economic City

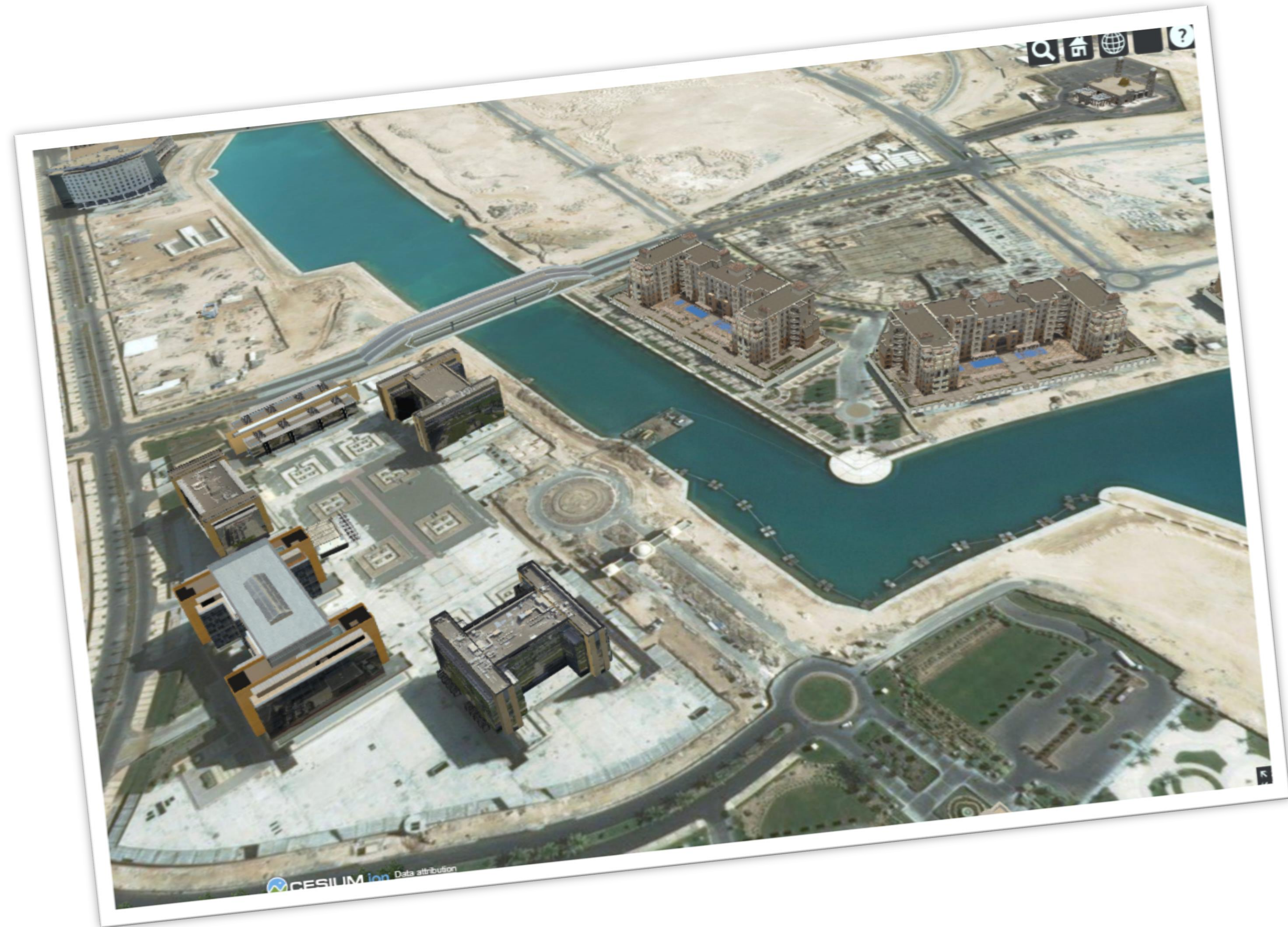
Location: Rabigh, KSA

Area: 26,400,000 Sqr foot

LOD: LOD 2

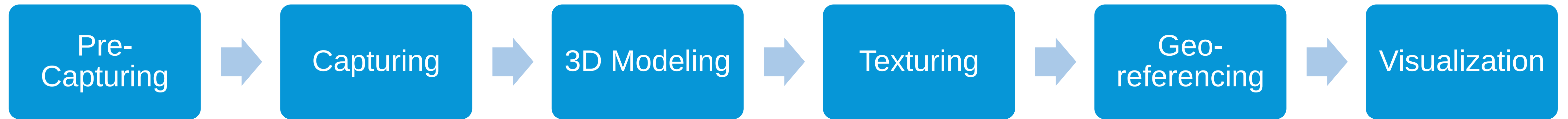
Capturing Technique: Drone nadir/oblique

Purpose: Interactive Visualization

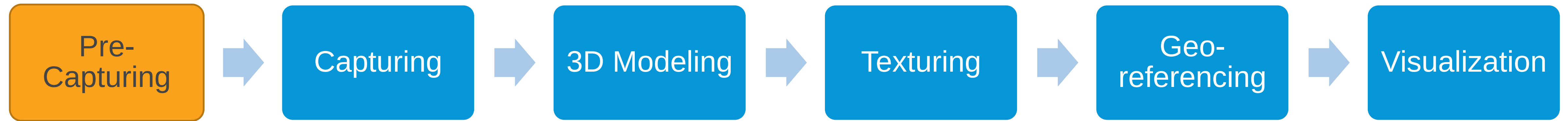




Workflow

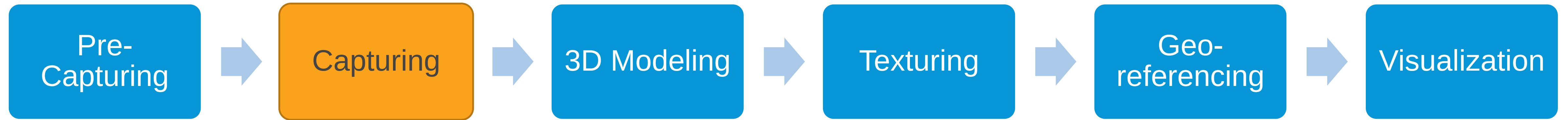


King Abdullah Economic City: **Workflow**



- Total number of buildings 70
- Unique building (21 buildings)

King Abdullah Economic City: **Workflow**



DJI Inspire 2

ZENMUSE X7



Inspire 2 Compatibility

Super 35 Sensor

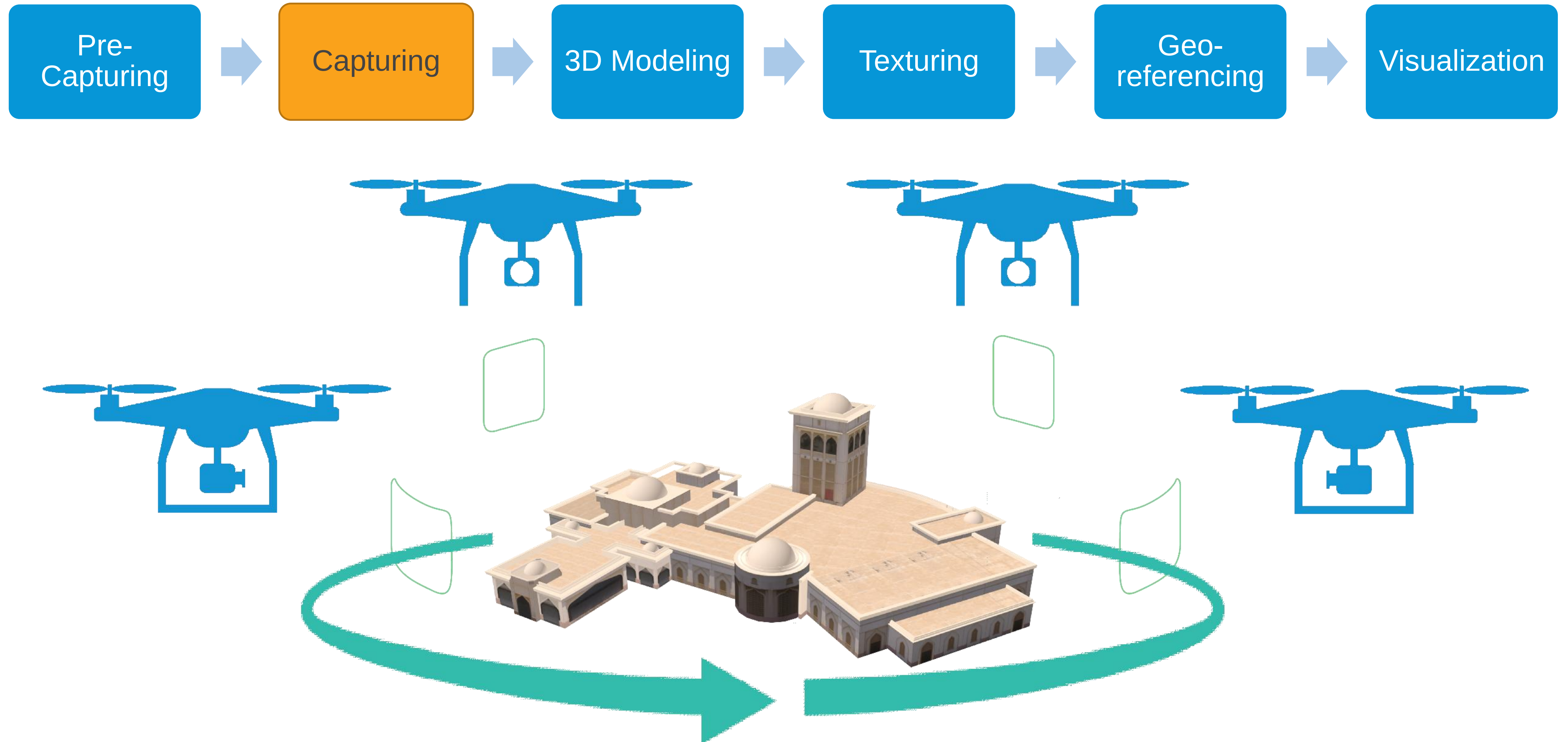
6K CinemaDNG

5.2K Apple ProRes

14 Stops of Dynamic Range

24 MP Stills

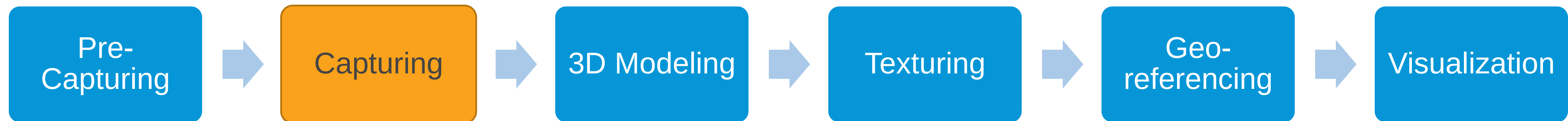
King Abdullah Economic City: **Workflow**







King Abdullah Economic City: Workflow



DJI_0110.JPG



DJI_0111.JPG



DJI_0112.JPG



DJI_0113.JPG



DJI_0114.JPG



DJI_0115.JPG



DJI_0116.JPG



DJI_0117.JPG



DJI_0118.JPG



DJI_0119.JPG



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DJI_0123.JPG



DJI_0124.JPG



DJI_0125.JPG

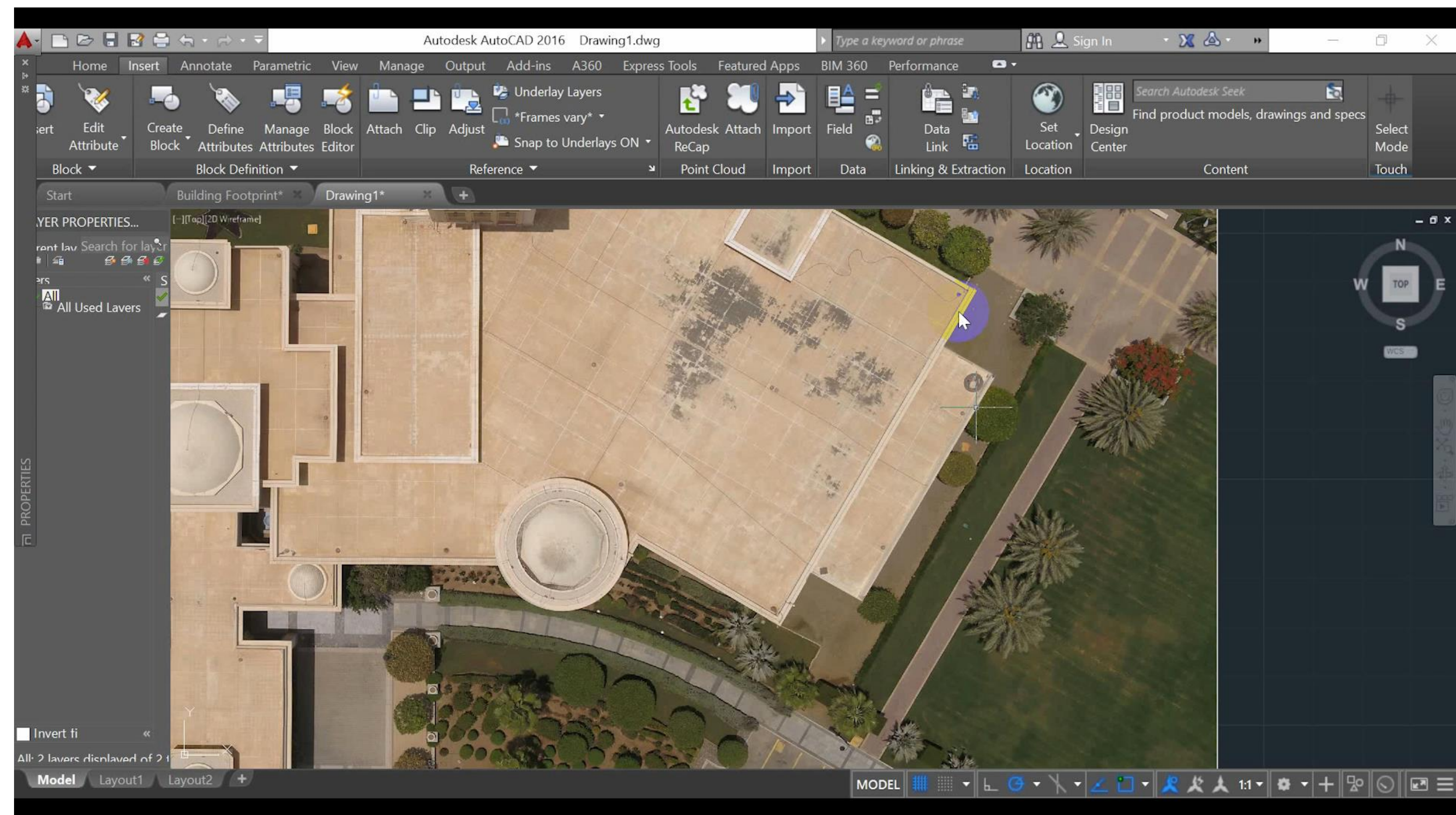
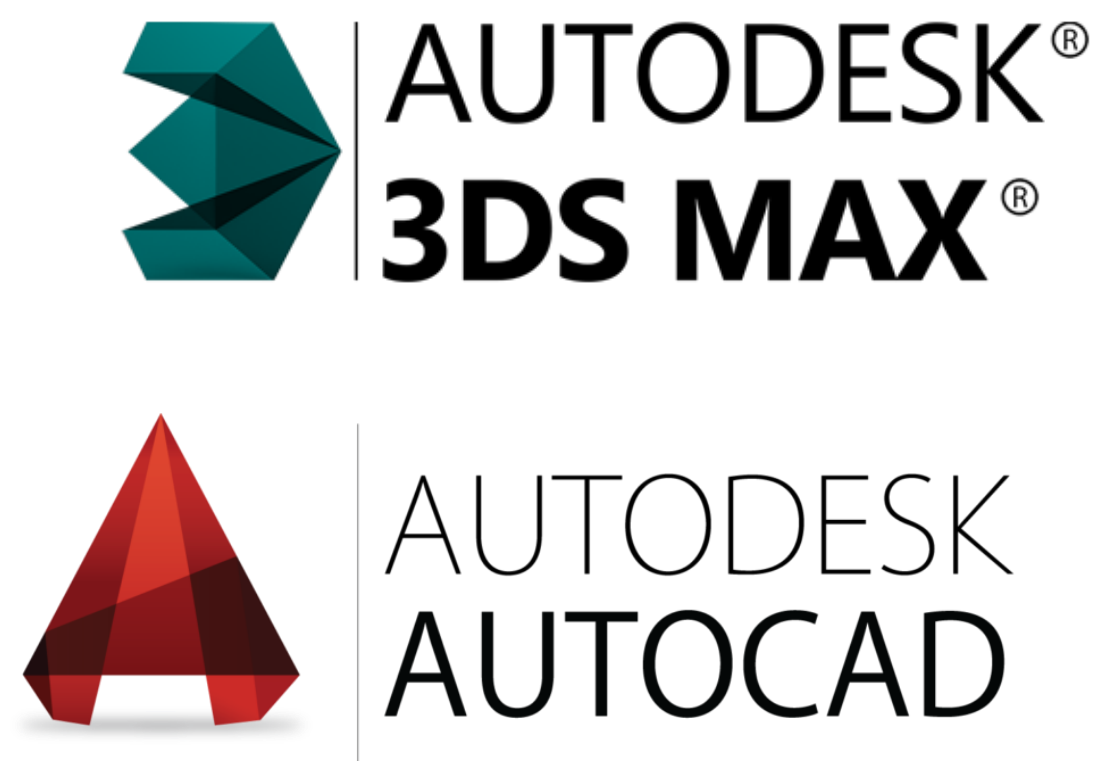
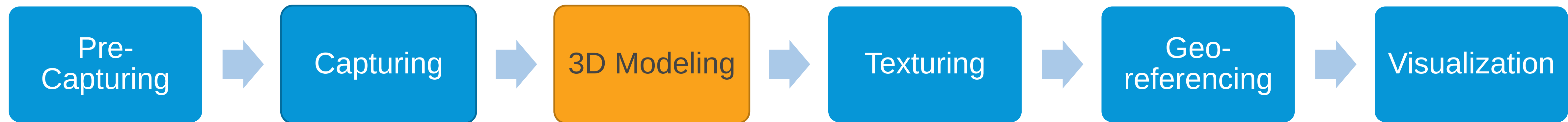


DJI_0127.JPG

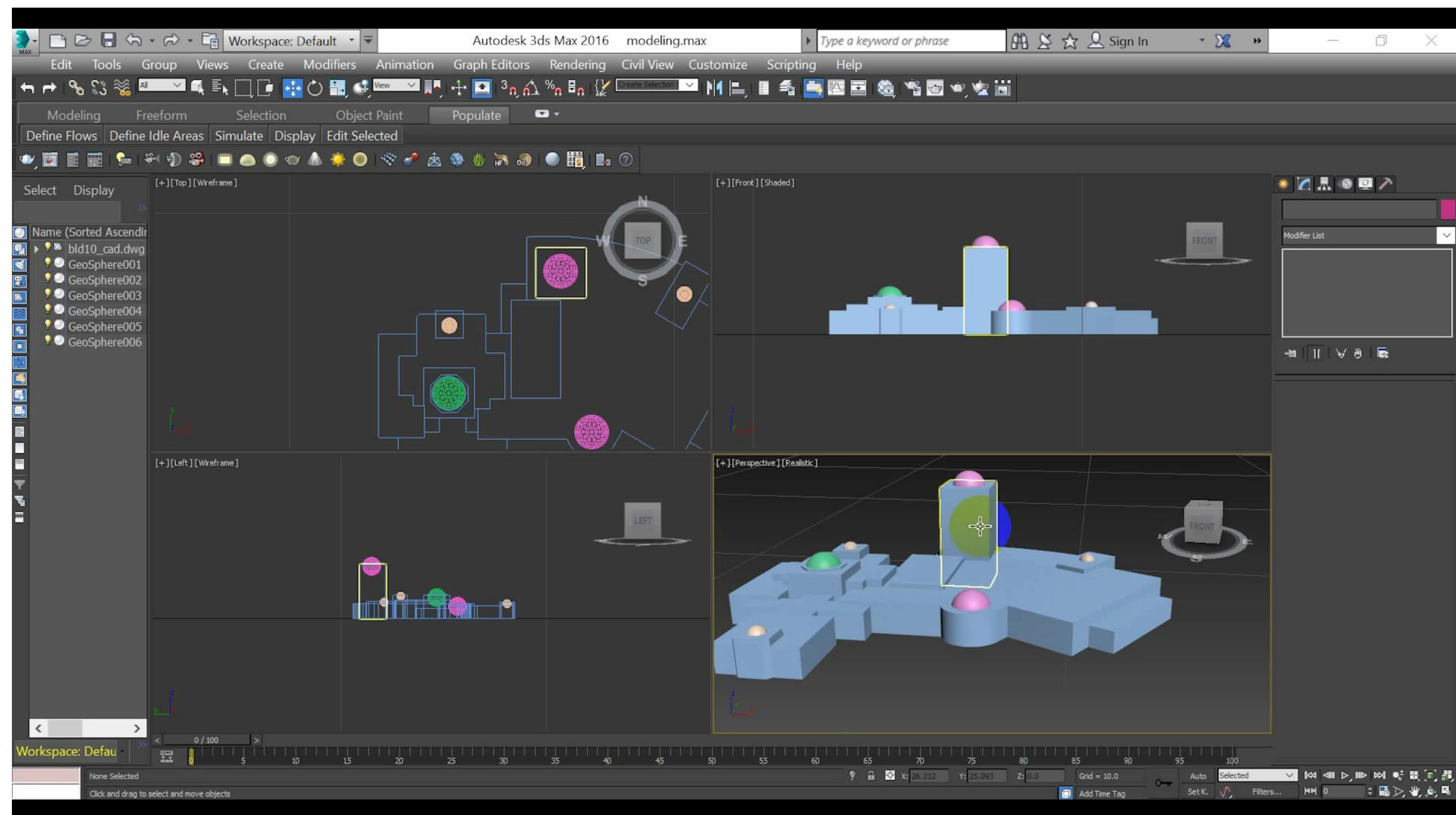
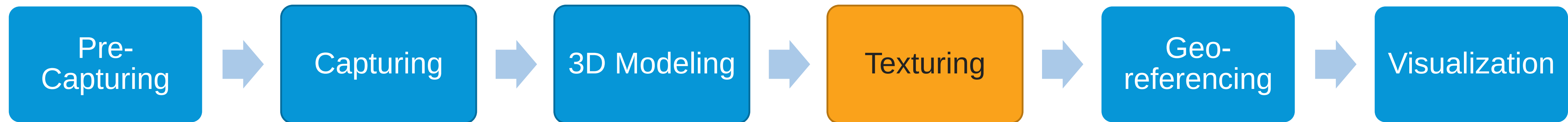


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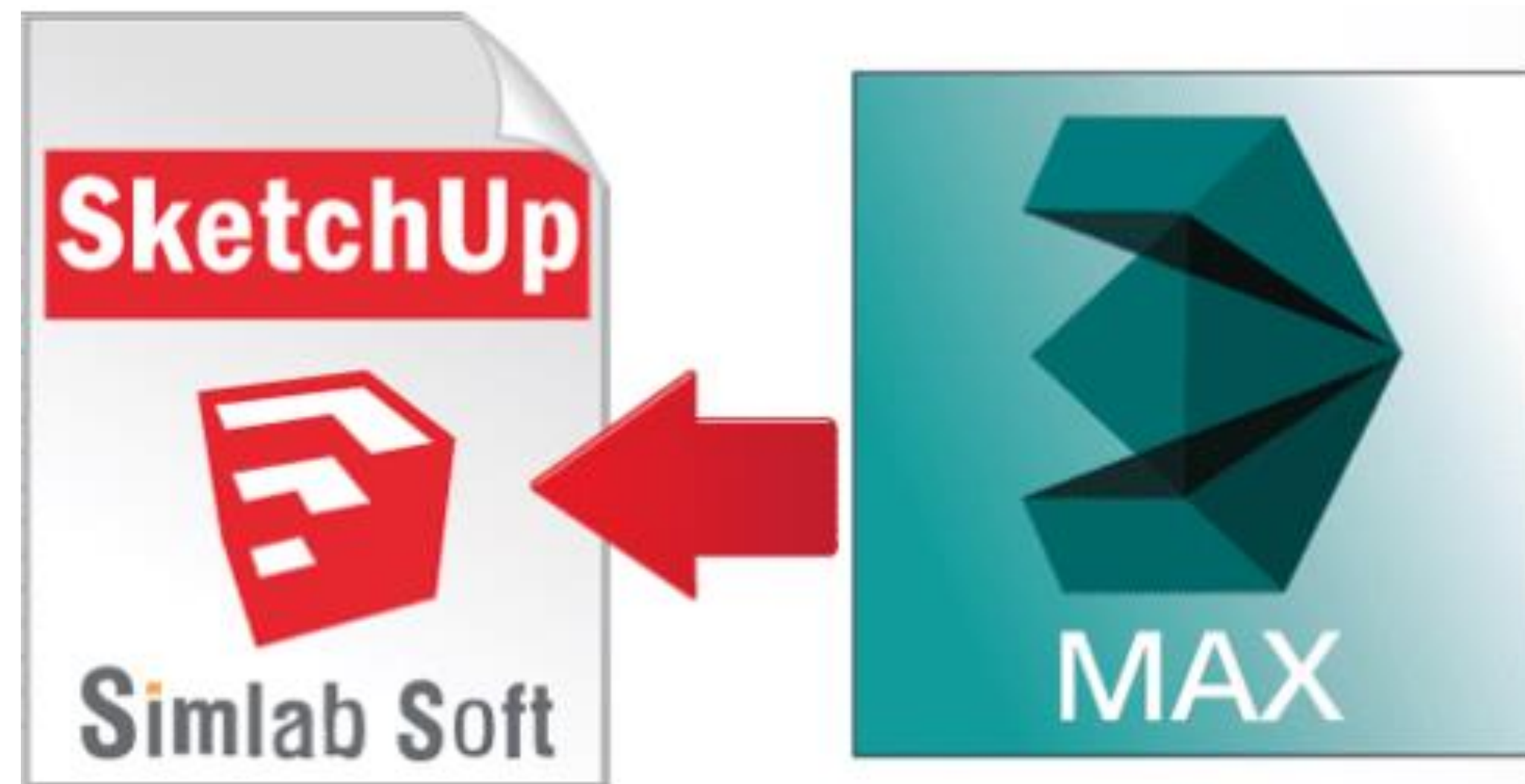
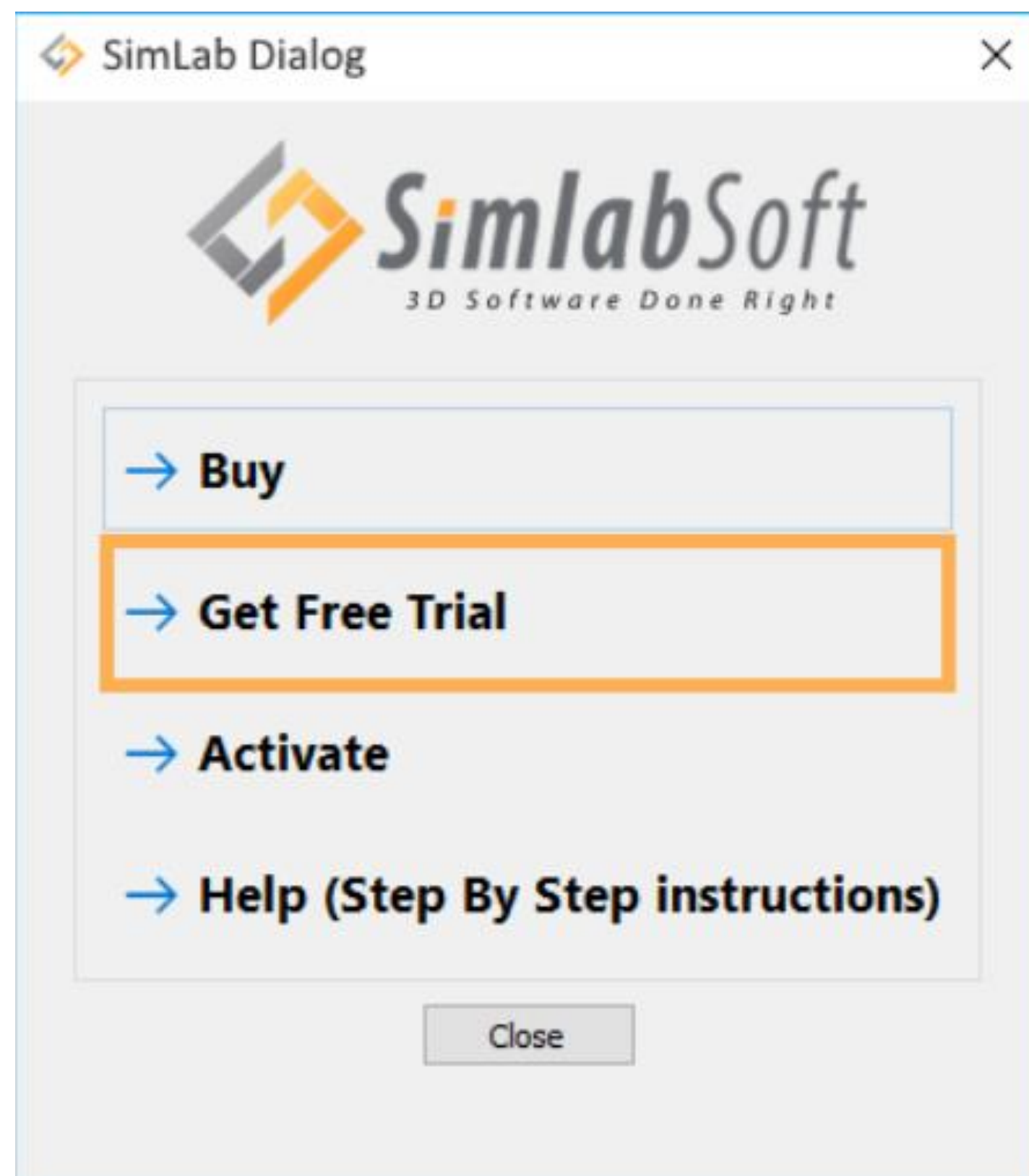
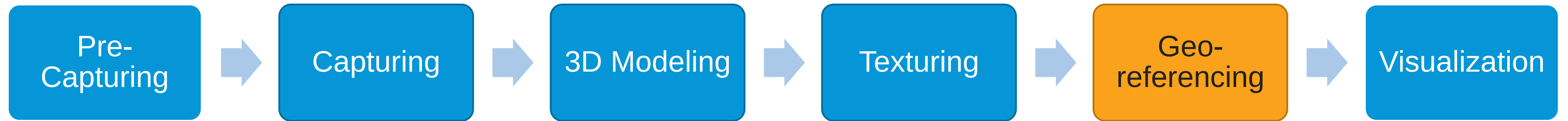
King Abdullah Economic City: **Workflow**



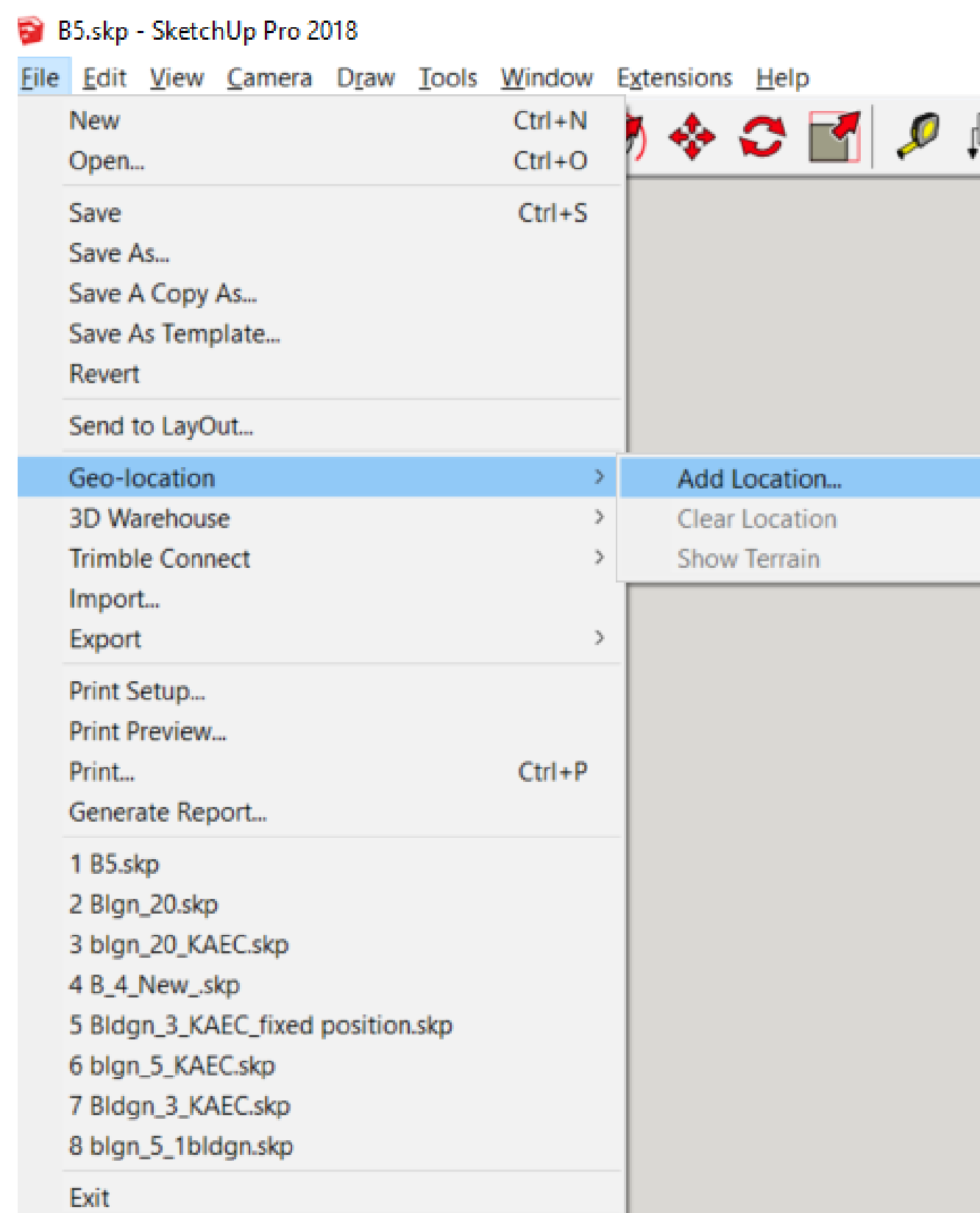
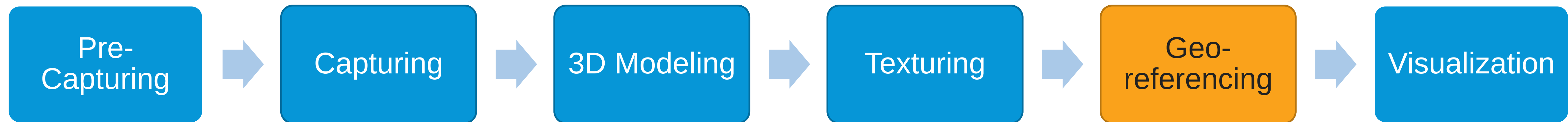
King Abdullah Economic City: Workflow



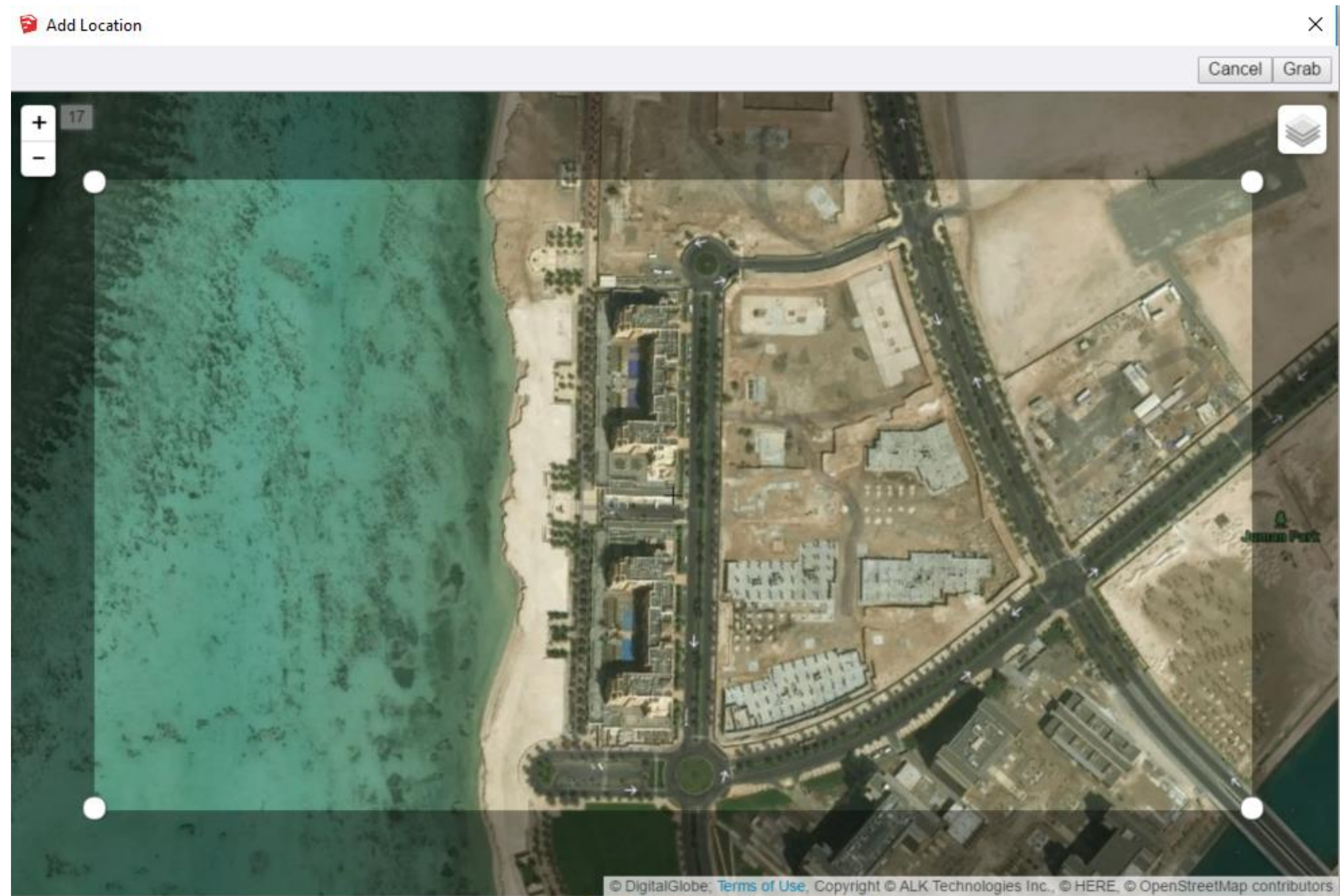
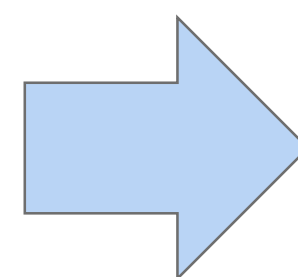
Workflow



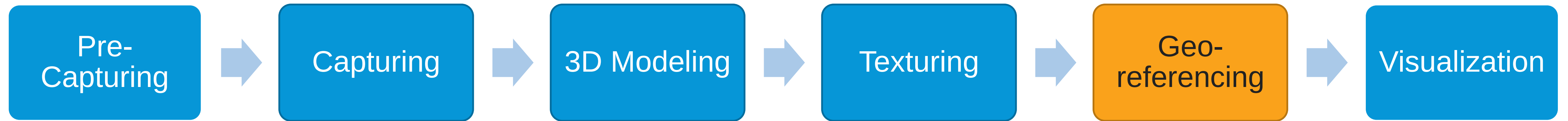
King Abdullah Economic City: **Workflow**



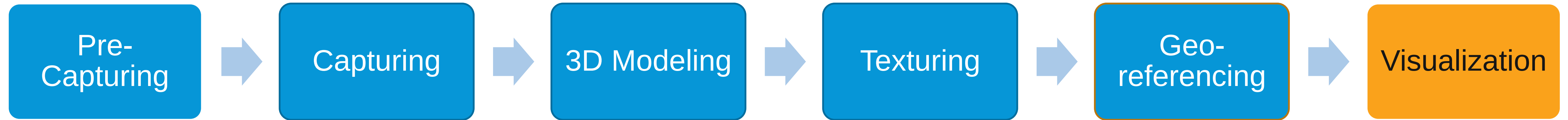
Add geo-location



King Abdullah Economic City: **Workflow**



King Abdullah Economic City: **Workflow**



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My AssetsAsset DepotAccess TokensUsage

Upload Asset [?]

Files	Size	Remove
B5_pt1.kmz	2.61 MB	

Add files...

Asset name

B5_pt1

What kind of asset do you want to create?



Imagery



Terrain



3D Tiles

Upload

Cancel

KML/COLLADA Tiling Settings

Clamp to terrain

Search for...



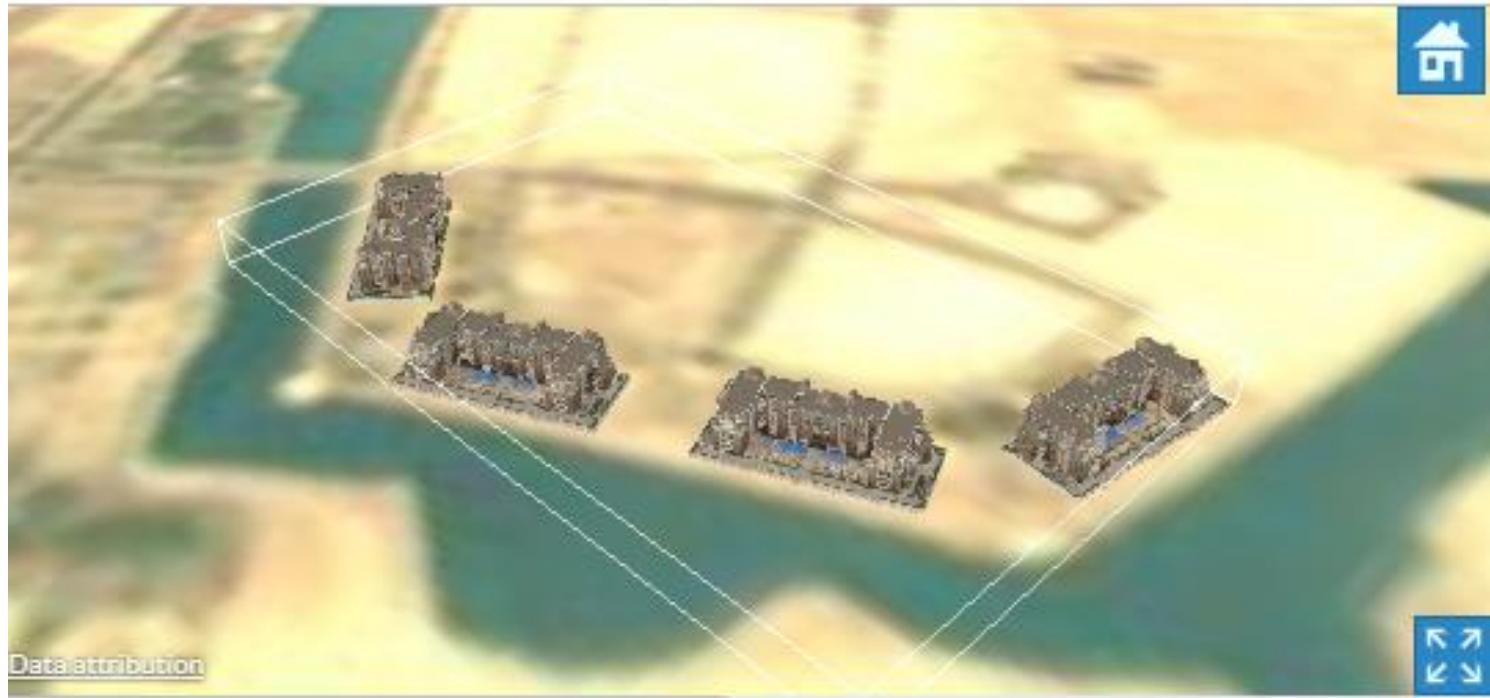
Name ▾	Type ◆	Date Added ◆
WGS84 Ellipsoid	Terrain	-
Cesium World Terrain	Terrain	10/18/2016

King Abdullah Economic City: Workflow

15+16

Delete

Adjust Tileset Location



Information

Source Files

Name

(ID: 7854)

15+16

Description

No description provided

Attribution

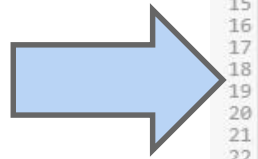
No attribution provided

Labels

Code

```
var tileset = viewer.scene.primitives.add(  
  new Cesium.Cesium3DTileset({  
    url: Cesium.IonResource.fromAssetId(7854)  
  })  
);
```

Open complete code example in Sandcastle



Hello World - Cesium Sandcastle

My Assets | Cesium ion

Secure | https://cesiumjs.org/Cesium/Build/Apps/Sandcastle/index.html?src=Hello%20World.html&label=Showcases&code=eyJjb2RlIjoilY8gR3JhbnQgQ2VzaXVtSIMgYWNjZXNzIHRvIHVldXlgaW9uIGFzc2V0c1xuQ2VzaXVtLkVib5kZWZhdWw0QWNjZXNzV... |

New

Run (F8)

Suggest (Ctrl-Space)

Info

Save As

Share

Import Gist

Open in New Window

View as Thumbnail

Search Gallery

JavaScript code

HTML body & CSS

```
1 // Grant CesiumJS access to your ion assets  
2 Cesium.Ion.defaultAccessToken = 'eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJqdGkiOiIyMTJjOTkwMS0zYmY2LTRmC...  
3  
4 var viewer = new Cesium.Viewer('cesiumContainer');  
5  
6 var tileset = viewer.scene.primitives.add(  
7   new Cesium.Cesium3DTileset({  
8     url: Cesium.IonResource.fromAssetId(8115)  
9   })  
10 );  
11  
12 var tileset = viewer.scene.primitives.add(  
13   new Cesium.Cesium3DTileset({  
14     url: Cesium.IonResource.fromAssetId(8116)  
15   })  
16 );  
17  
18 viewer.zoomTo(tileset)  
19   .otherwise(function (error) {  
20     console.log(error);  
21   });  
22
```

Cesium 1.50



1x

Oct 21 2018
13:39:33 UTC



Oct 21 2018 16:00:00 UTC Oct 21 2018 20:00:00 UTC Oct 22 2018 00:00:00 UTC Oct 22 2018 04:00:00 UTC Oct 22 2018 08:00:00 UTC Oct 22 2018 12:00:00 UTC

Gallery

Console

How to Create 3D Digital Cities Using Drones

Thank You



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