

CGIS Qatar Case Study: Leveraging Vexcel Imaging for True 3D City Modeling

The [Centre for Geographic Information Systems \(CGIS\)](#), the official geospatial agency of the State of Qatar under the Ministry of Municipality, has taken a pioneering step in aerial imaging and 3D city modeling. In January 2025, CGIS successfully completed a groundbreaking project to create a true 3D city model of Doha, marking a major milestone in the nation's data capture and mapping initiative.

By integrating [Vexcel Imaging](#) technology with advanced 3D modeling software solutions, CGIS has set new standards in GIS-based city modeling. The high-quality dataset produced will support urban planning, infrastructure management, and digital twin development, driving smart city initiatives forward.

Building Qatar's First Advanced Vectorized 3D City Model

The journey began in 2021 when CGIS, in collaboration with [Khatib & Alami \(K&A\)](#) and Vexcel Imaging, secured a bid on a tender from the State of Qatar. CGIS acquired the region's first [UltraCam Osprey 4.1](#) – a state-of-the-art photogrammetric nadir and oblique aerial camera system – alongside a comprehensive geospatial data processing suite. This initiative transformed Qatar's geospatial capabilities, enabling the creation of an advanced 3D city model using cutting-edge aerial imaging technologies.

CGIS further strengthened its geospatial capabilities with the purchase of:

- [UltraMap](#) processing suite, optimizing data processing and 3D reconstruction workflows.
- [RIEGL 780II-S](#) topographic and [RIEGL 880-GII](#) bathymetric LiDAR sensors, mounted on a DA62 MPP Survey Star from Diamond Aircraft, ensuring comprehensive terrestrial and coastal mapping.
- [RhinoCapture \(RhinoTerrain\)](#) and [Summit Evolution \(DAT/EM\)](#) for digitalisation of vectors in 3D stereographic environment
- [RhinoCity \(RhinoTerrain\)](#) for automated production and automated texturing of watertight 3D models based on geometry and semantic information

Transforming Aerial Images Into High-Quality LOD3 and LOD2 City Models

In 2023, CGIS captured aerial data over Doha with the UltraCam Osprey 4.1 and processed it using Vexcel's UltraMap photogrammetric processing software. Furthermore, the workflow combined complementary RhinoTerrain and DAT/EM solutions to generate a watertight vectorized 3D city model of Doha. K&A, leveraging its extensive expertise in geospatial solutions, played a crucial role in converting the high-resolution nadir and oblique aerial imagery into a detailed true 3D city model. The key steps in the workflow were:

1. UltraCam Osprey 4.1 Image Collection

- A total of 44,000 images was captured at 8 cm GSD, with 80% forward and sideward overlap, increasing to 90% over high-rise buildings in the West Bay area.

2. Image Processing & Orientation

- Image post-processing with UltraMap Essentials
- Aerial triangulation using UltraMap AT for nadir & oblique imagery

3. DSM, DTM & 3D Mesh Generation

- Creation of Digital Terrain & Digital Surface Models (DTM/DSM)
- TrueOrtho generation via UltraMap Ortho Pipeline

4. Vectorized True 3D City Models

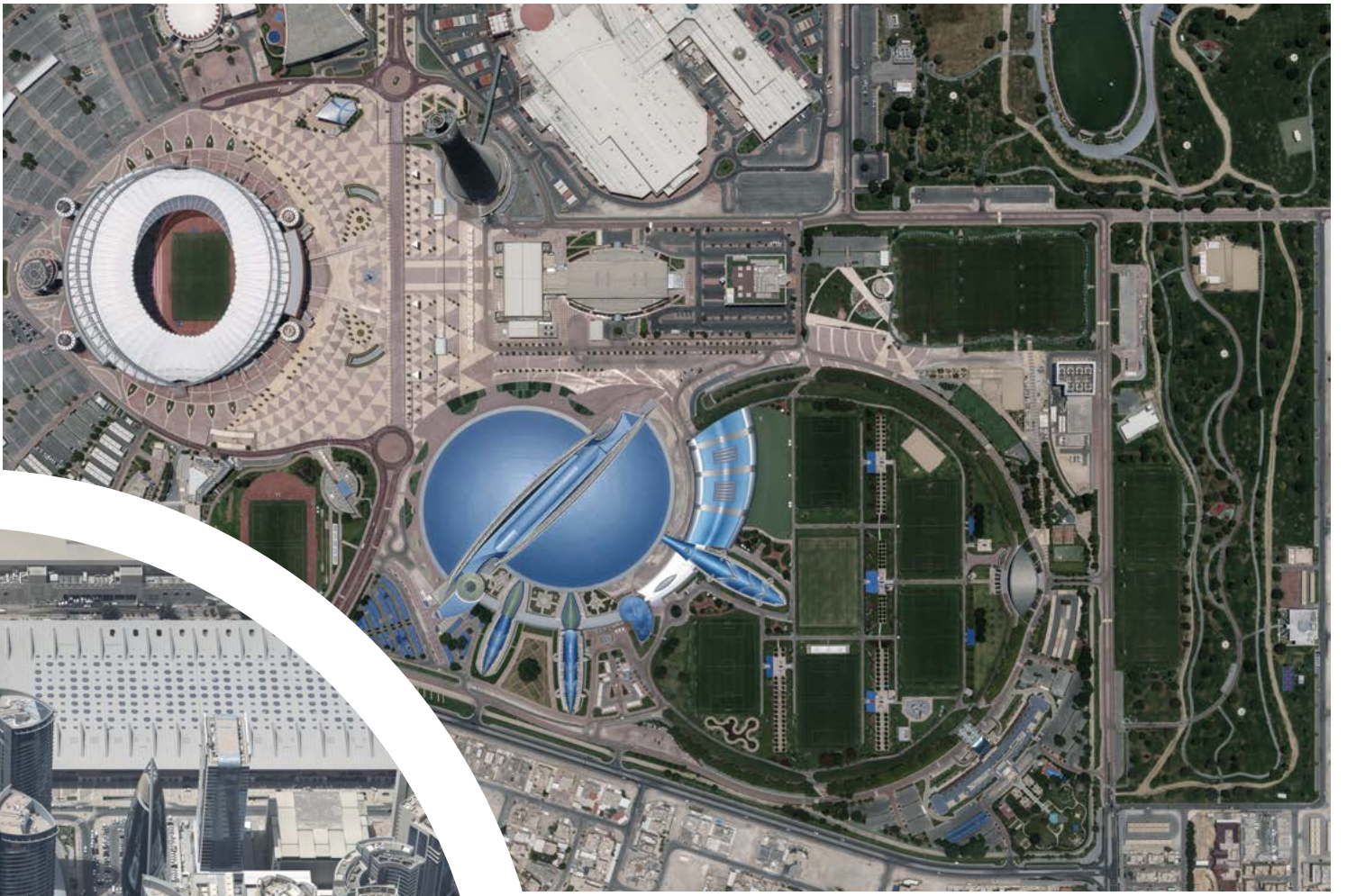
- Roof vector digitization in a 3D stereographic environment using Summit Evolution (DAT/EM) and Rhino Capture™ (RhinoTerrain)
- Automated modeling and texturing with nadir and oblique Osprey imagery via RhinoCity™
- Exporting in multiple formats, including CityGML, GDB, and DXF

5. Quality Control & Validation

- The generated 3D city model underwent rigorous validation using CGIS's geospatial datasets and was cross-referenced with terrestrial images and field checks.

In the end, an area of 218 km² covering 16 specified urban regions was mapped, resulting in a total of 43,310 LOD2 and 300 LOD3 buildings. The final textured, watertight 3D city model of Doha complies with CityGML standards, ensuring seamless integration into GIS applications.





Enhancing Spatial Analysis With CGIS's Custom Image Viewer Built on Esri Technology

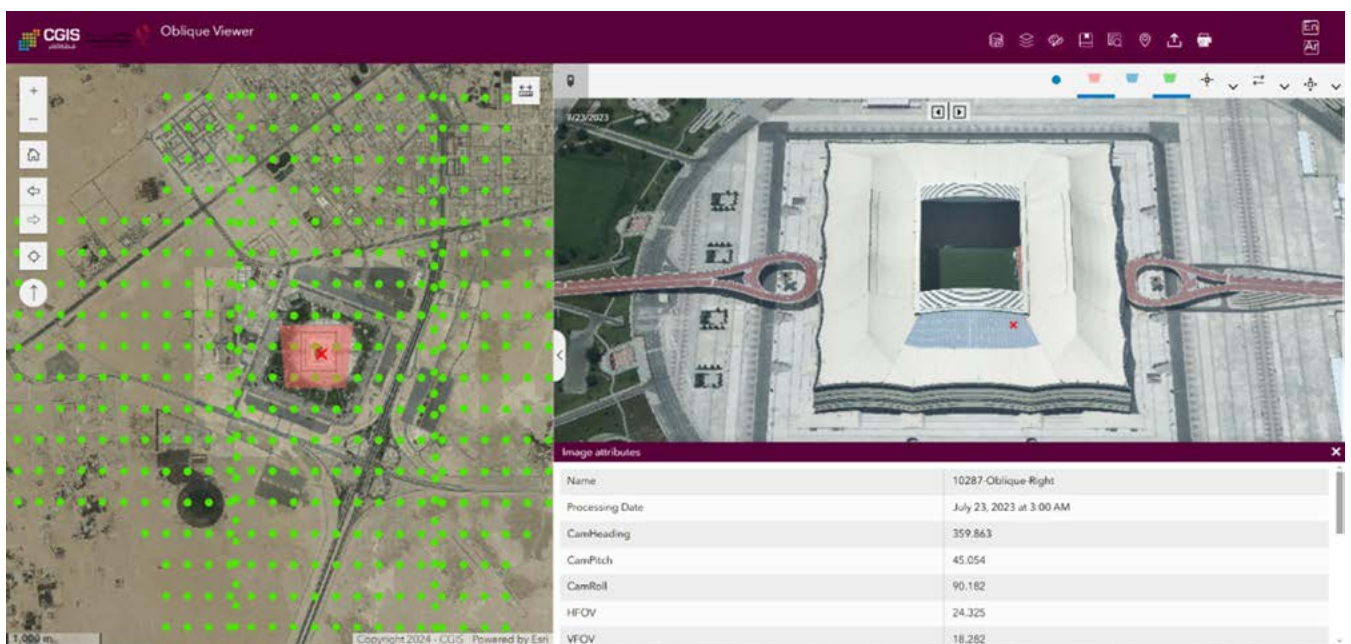


3D buildings of Al Dafna and the Corniche area in Doha, Qatar, visualized in the custom CGIS Image Viewer

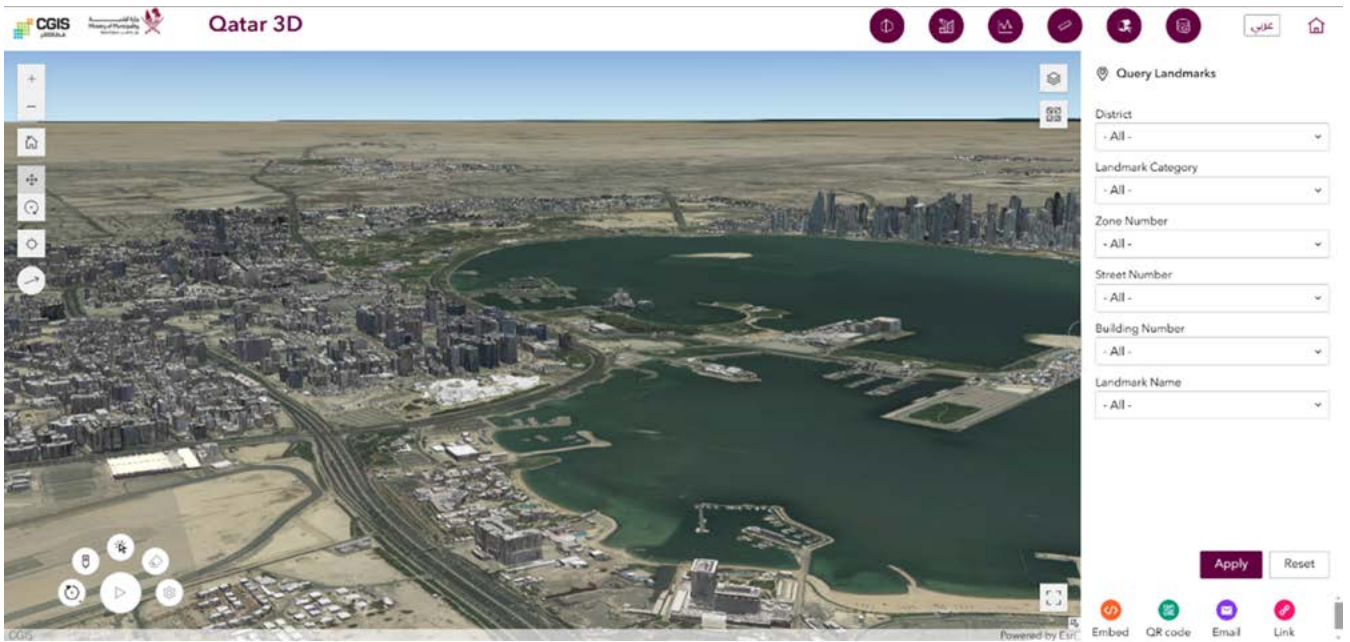
With over 44,000 images captured, CGIS developed a custom-built Image Viewer within the Esri environment to efficiently manage and analyze its vast dataset. The application enables CGIS users to interactively explore image coverage, analyze metadata, and visualize spatial relationships with ease. As the image archive continues to expand annually, the system supports users by:

- Providing interactive access to image metadata (e.g., image name, capture date, processing date)
- Enhancing situational awareness with a dynamic perspective of urban landscapes
- Optimizing spatial decision-making by seamlessly integrating oblique imagery with GIS workflows

By leveraging this technology, CGIS enhances its ability to monitor urban changes, support planning efforts, and improve data accessibility for various stakeholders.



Oblique imagery of Al Bayt Stadium displayed in the Oblique Viewer



True 3D city model of the Doha area displayed in the CGIS Viewer application

Impact and Future Prospects

This project sets a new benchmark in Qatar’s national data capture and mapping initiative, providing a high-precision 3D city model that will be instrumental in:

- Urban Planning – Supporting city development and infrastructure projects
- Smart City Initiatives – Enabling digital twins and advanced urban analytics
- Infrastructure Management – Enhancing asset tracking and city maintenance
- Disaster Response – Improving preparedness through high-resolution 3D mapping

By utilizing Vexcel Imaging technology and innovative 3D modeling tools, CGIS together with K&A have successfully demonstrated the transformative power of geospatial innovation. Their pioneering efforts pave the way for future advancements in 3D city modeling across the region.



Vectorized, watertight 3D building models of the AI Dafna area shown within the RhinoTerrain interface