

PhotoMesh[®]

Version 7.0

Quick Guide

Overview

TerraBuilder PhotoMesh fully automates the generation of high-resolution, textured, 3D mesh models from standard 2D photographs, offering a significant reduction in cost and time compared to traditional modeling methods. These models can be directly outputted in PhotoMesh as stream optimized urban model databases (3DML) for immediate viewing in TerraExplorer, or they can first be merged in TerraBuilder CityBuilder with classification information to transform them into powerful geospatial data. The 3DML layers generated in CityBuilder can be integrated seamlessly into TerraExplorer terrain, as well as measured, analyzed, and queried using TerraExplorer's advanced analysis and spatial query capabilities. Mesh models can also be merged in CityBuilder with BIM and other model data sets to create a unified and efficient 3D mesh layer that is optimized for desktop, web, and mobile use.

The 3DML database can be made available to local TerraExplorer clients or published to remote clients using the TerraGate SFS 3DML service.

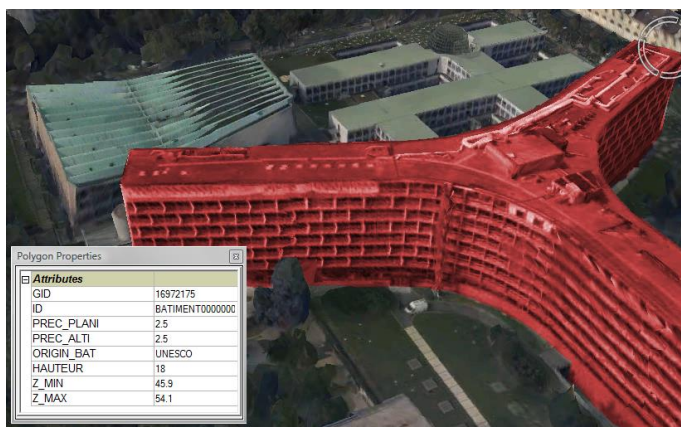
TerraBuilder PhotoMesh

Combining any number of photographs, in a wide range of formats and resolutions, PhotoMesh generates highly-detailed 3D models that can be viewed and queried using TerraExplorer or other 3D and GIS products. PhotoMesh uses high-quality texturing and advanced color balancing to produce seamless, realistic models. Powerful compression algorithms avoid any unwanted loss of geometric accuracy.

PhotoMesh employs elaborate tiling mechanisms to efficiently handle projects with even hundreds of thousands of photos. Running on standard hardware, PhotoMesh can also exploit computer clusters and cloud computing to accelerate database creation. A single project can run simultaneously on hundreds of fuser machines, each processing different build steps and communicating with PhotoMesh Build Manager.

PhotoMesh supports multiple output formats to ensure compatibility with a vast number of CAD and 3D solutions:

- **3DML** – Stream-optimized, high-resolution 3D Mesh Layer database for loading directly into TerraExplorer and streaming with TerraGate SFS.
- **DAE** – Textured Collada model per build tile.
- **OBJ** – Textured OBJ model per build tile.
- **OSGB** – Multi resolution textured model for use in OpenSceneGraph.
- **CityBuilder** – CityBuilder-ready data that can be geospatially enabled by loading it into CityBuilder and merging it with classification information (such as building footprints).
- **TerraExplorer for Web** – Multi resolution textured model for streaming to the HTML5 based TerraExplorer for Web application.
- **Orthophoto** – A true-orthophoto that is created from the resulting textured mesh.
- **DSM** (Digital Surface Model) – An elevation model that includes all elevation data, including buildings and reconstructed objects in the mesh.
- **LAS** – Point cloud public file format for easy interchange of point cloud data.

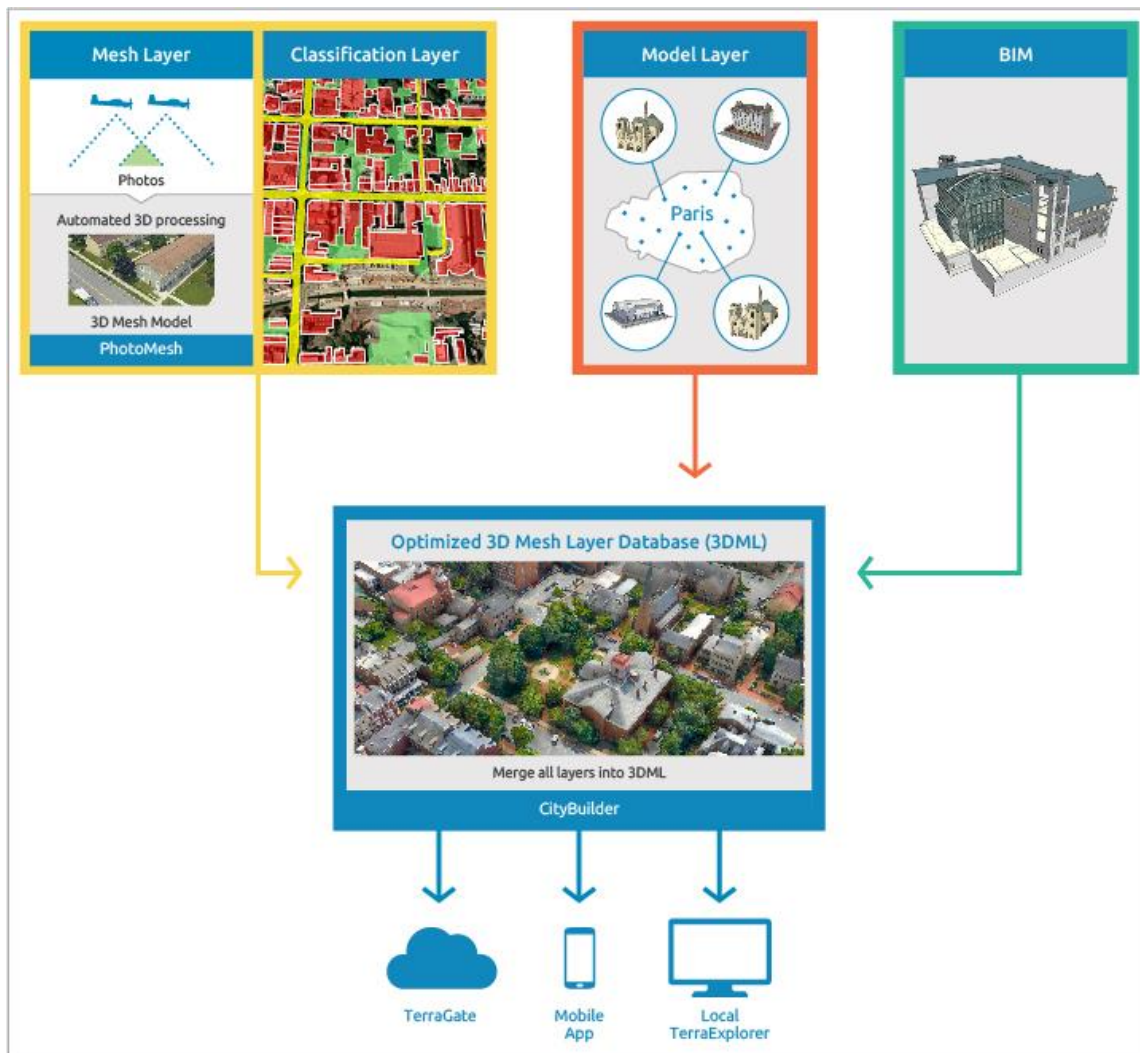


PhotoMesh 3D Models

TerraBuilder CityBuilder

CityBuilder can transform PhotoMesh mesh models into powerful geospatial data by merging PhotoMesh-generated mesh models with classification information such as building footprints. Generated 3DML layers are integrated seamlessly in TerraExplorer's terrain, and can be measured, analyzed, and queried using TerraExplorer's advanced capabilities.

CityBuilder can also stream-optimize BIM or model layers or merge any number of mesh models with BIM and other model data sets into a unified, efficient 3D mesh layer. Support for multi-threading allows full utilization of computer resources.



Creating a 3DML

Creating a 3DML and Serving the Data

This section outlines the basic steps in creating and working with a 3D mesh layer.

- [Step 1: Acquisition and Preparation of the Imagery Dataset](#)
- [Step 2: Loading Photos into PhotoMesh and Preparing Photos for the Build](#)
- [Step 3: Managing Local and Remote Fusers](#)
- [Step 4: Building the Mesh Model](#)
- [Step 5: Optional: Classifying the Mesh Layer](#)
- [Step 6: Distributing the 3DML](#)
- [Step 7: Working with 3DML in TerraExplorer](#)

Step 1: Acquisition and Preparation of the Imagery Dataset

The first step in creating a mesh model is photographing all visible surfaces of the intended object or scene from multiple overlapping viewpoints. PhotoMesh supports standard image formats and large frame sensors.

The accuracy of the resulting 3D mesh model is affected by several factors including: input image resolution and quality, lens distortion, overlapping ratio, directionality, and lighting. While PhotoMesh optimizes the accuracy of the 3D mesh model by selecting the best photos for an area, each factor can affect the overall output or cause varying levels of accuracy and quality in different areas of a project.

In most projects with good quality input, the resolution of the 3D model has been found to be approximately 1-2 times the ground sample distance of the source imagery.

In order to create the mesh model, Photomesh requires data regarding both: the camera (sensor size, lens focal length) and position/rotation of each photograph. Generally, a dedicated XML or Excel file is prepared with this information.

1. Photograph the object or scene. Capture nearly all visible surfaces, including walls and facades. Any object in the area of interest should be photographed multiple times from the top and at least four other directions.
2. Divide photographs into one or more **collections**, homogeneous groups of photographs, all taken by the same physical camera with identical focal length and dimensions.
3. Do either of the following:
 - Create a dedicated Excel/ XML file with a list of photos, their file paths, and all photo and photo collection information based on the sample Excel (PhotoMeshSample.xlsx) and XML template files (PhotosListSample.photomxml) included in the installation folder.
 - Load folders of photo files with Exif metadata (that includes information about camera locations, focal lengths and dimensions).

Step 2: Loading Photos into PhotoMesh and Preparing Photos for the Build

After photos have been imported, study the photos' position and orientation and modify photo properties as required. Once all properties are set, you can begin the build process.

For optimal performance, photographs should be divided into one or more **collections**, homogeneous groups of photographs, all taken by the same physical camera with identical focal length and dimensions. If a folder is added with photos that were taken by different cameras or with different focal lengths and dimensions, PhotoMesh will automatically place the photos in different collections as long as the required Exif metadata is encoded in the photo files.

Sample Excel (PhotoMeshSample.xlsx) and XML files (PhotosMeshSample.photomxml) are included in the installation folder, which can serve as templates for creating such files as well as provide basic property definitions.

1. In **PhotoMesh**, import photos into your project using any of the following methods:
 - Load photo files from disk.
 - Load an Excel/XML file with a list of photos, their file paths, and all photo and photo collection information.
 - Load a different PhotoMesh project into your project. Only the project's photos and photo and collection parameters are loaded.
2. Set basic project settings, including terrain database, tile size, mesh complexity, and texture quality.
3. Analyze photo position and rotation:
 - Project photos on the terrain to see if they fit the terrain imagery or to better understand their position.
 - Use the color-coded coverage map to analyze camera coverage and identify which areas of the project have sufficient coverage and which require more. When you click any point on the map, the number of cameras from each direction and names of related build/AT tiles is displayed.
4. Modify photo/ photo collection data in their property sheets, as required.

Step 3: Managing Local and Remote Fusers

Fusers allow you to share the demanding workload involved in processing the different build steps between several computers on the same network. The Master computer utilizes the computing power of the network's client computers by connecting to PhotoMesh fusers on the client machines. The fuser operates as a copy of PhotoMesh on the client machine, adding its resources to the build process.

PhotoMesh Build Manager keeps track of all build tasks and fusers, distributing tasks among the fusers and assigning new tasks as fusers complete their tasks and become available.

1. Activate fusers on the fuser computers.
2. Before starting the build process (as described in the [next step](#)), select the required fusers for this build from the list of available fusers in the Fusers section of PhotoMesh Build Manager.

As the build process progresses, PhotoMesh Build Manager displays information about the active fusers.

Step 4: Building the Mesh Model

The complete build process consists of six stages: photo preparation, aerotriangulation, point cloud creation, model creation, model texturing, and final output production. PhotoMesh offers flexibility both with regard to the output formats and the build stages that are to be performed. Thus, if rebuilding a project, you can start the build from a later stage by incorporating some of a previous build's results, and if building a preview model, you can end the build after model creation or texturing if that satisfies your preview needs.

When you begin the build process, the Build Parameters dialog box opens in which you set the required aerotriangulation and build parameters and select the initial and final build stages. The final output can be created in any of the following formats: 3DML (for import into TerraExplorer and streaming with TerraGate SFS), DAE, OBJ, OSGB, CityBuilder, TerraExplorer for Web, Orthophoto, or DSM (Digital Surface Model).

Before building the full mesh model, it is generally recommended to build a preview model of a small subset of the project to validate camera parameters and project settings and check the resulting AT and Build tiles.

As the build process is progressing, the 3D Window displays interim build results and PhotoMesh Build Manager displays information about the current stage and active fusers.

1. Define a subset area using the Preview Area polygon. Then build a preview model and review the results.
2. When you are ready to build the entire project area, set the Project Area as the current build area and start the build process. During the build process, PhotoMesh Build Manager monitors the build and provides the user with detailed information about the build progress. As soon as a build stage is completed for a tile, its build data is viewable in the 3D Window, e.g. if aerotriangulation was performed, PhotoMesh can display the calculated camera locations in the 3D Window, and if Build tiles were calculated, they can be displayed in the 3D Window, with each tile colored according to the Build stage completed.
3. If a previously built project requires modification, instead of building the entire project again from the first step of the build process, you can “rebuild”, incorporating some of a previous build’s results. Rebuilding provides flexibility both with regard to the project section (entire project, only error tiles or selected tiles) and project stages that are to be rebuilt. Alternative build parameters can also be set.
4. The resulting 3DML can be viewed in TerraExplorer. Note that PhotoMesh offers the option to output the mesh layer in CityBuilder format so it can be imported into CityBuilder for merging with classification data. This will enable the performance of attribute and spatial queries. See [step 5](#) below.



Build Stages

Step 5: Optional: Classifying the Mesh Layer

Classifying the mesh layer transforms it into advanced geospatial data which supports spatial and attribute queries when loaded in TerraExplorer.

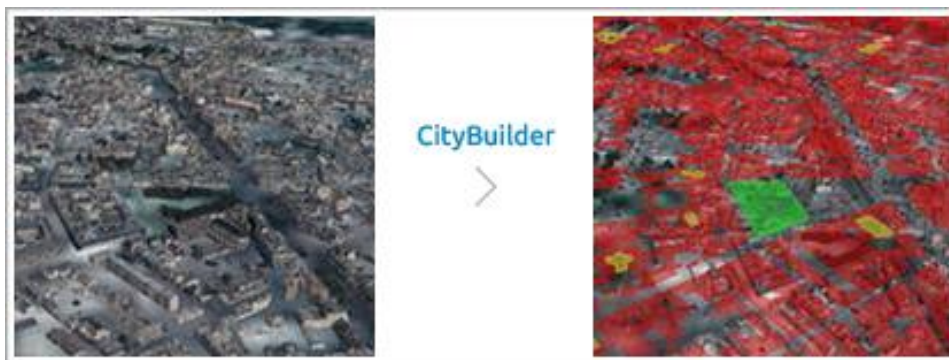
Mesh layers are classified by merging PhotoMesh models in CityBuilder with GIS data (such as building footprints) in the form of polygon feature layers. CityBuilder can also stream optimize different layers and layer types (mesh layers with classification layers, individually modeled layers, and BIM datasets) by merging them into a stream-optimized, fully textured, and geospatially-enabled mesh layer (3DML).

In **PhotoMesh**:

- Output the mesh model in CityBuilder format.

In **CityBuilder**:

1. Import the CityBuilder format output from PhotoMesh (LODTreeExport.xml file) and set the layer's properties as required in its property sheet.
2. Import the required classification layer and set its properties as required.
3. Save your project with all the required layers, and then **Create 3DML**.



Mesh Layer Classification

Step 6: Distributing the 3DML

Once the 3DML has been created, it can be opened directly in TerraExplorer, streamed via the TerraGate SFS 3DML service, or uploaded to a mobile device.

Opening the 3DML Directly in TerraExplorer

3DML layers can be loaded from 3DML files on your computer.

In **TerraExplorer**:

1. Add the **3D Mesh Layer from File** to the project.
2. Use the property sheet to modify the required properties.

Uploading the 3DML to the Database and Streaming the 3DML via TerraGate

CityBuilder's Upload 3DML to Database tool uploads and manages 3DML files on SQL, Oracle, and PostgreSQL servers for distribution via the TerraGate SFS 3DML service.

- Copy the 3DML file to the server computer.

Note: You can also use CityBuilder's **Upload 3DML to Database** tool to upload the 3DML file to the database.

In **TerraGate SFS**:

1. On **SFS Data Sources** page, define the 3DML data source (3DML folder, SQL, Oracle, or PostgreSQL).
2. On **SFS Layers** page, add the created 3DML file for streaming by SFS.

Then in **TerraExplorer**:

- Add the **3D Mesh Layer from SFS** to the project.

Uploading the 3DML to Mobile

A 3DML is uploaded to a mobile device by publishing the TerraExplorer project that contains it as a mobile kit. Using the TerraExplorer publishing capability, all files and objects used in a project are gathered to a kit folder which can then be uploaded to a mobile device.

The kit can be published either as a:

- **Mobile Kit** – All local files and objects are gathered to a kit folder, maintaining references to all network resources.
- **Mobile Offline Kit** - All local and network resources are copied to local files, for use offline on a mobile device. After marking an area of interest, TerraExplorer extracts the section of the terrain, layers (imagery and 3DML), objects, and resources that intersect with this selection area.

In **TerraExplorer**:

1. Add the **3D Mesh Layer from File** to the project, and save the project.
2. Publish the project as either of the following:
 - Mobile Kit
 - Mobile Offline Kit
3. Connect your mobile device, browse to the kit location, and upload the mobile kit to the device. TerraExplorer saves the project in a directory that the TerraExplorer app automatically looks in for published projects.

Then on your **mobile device**:

1. Launch the TerraExplorer app.
2. Touch the **Menu** button at the bottom right and then touch **Projects** to select the published project.
3. Touch the **Menu** button again and then touch **Raster Layers** to select the required layers.
4. Use touch screen navigation and a mobile-optimized user interface to navigate freely to locations defined in the FLY file, and search SkylineGlobe address server.



3DML Distribution

Step 7: Working with 3DML in TerraExplorer

In TerraExplorer, the generated mesh layers are integrated seamlessly into the terrain. If the mesh layers were merged in CityBuilder with classification data ([step 5](#)), they can also be measured, analyzed, edited, and queried using TerraExplorer's advanced analysis and spatial query capabilities.

Do any of the following:


<p>When a 3DML is loaded, it is read and put in the TerraExplorer Project Tree as a 3DML object that contains each of the feature layers which was included in creating it. Each individual layer can be shown or hidden, or alternatively highlighted.</p>	<p>To show/hide a layer:</p> <ul style="list-style-type: none"> ▪ Click on a layer's show/hide icon <input checked="" type="checkbox"/> to display or hide it in the 3D Window. <p>To highlight a layer:</p> <ul style="list-style-type: none"> ▪ In the Feature tab of the layer's property sheet, set the Tint Color and Tint Opacity with which to highlight the layer's features.
<p>Edit features' attribute values.</p>	<ol style="list-style-type: none"> 1. Use the Attribute Table tool to query the 3DML layer based on attribute value. 2. Then easily edit the attribute values of the feature results. Or create a new shapefile based on the filtered data.
<p>Perform a spatial query to select all features within a certain region.</p>	<ol style="list-style-type: none"> 1. Draw a polygon, line, or point or select an existing object with which to delineate the required geographical area for the spatial query. 2. If required, define a buffer to include all features within a certain radius of the selection.
<p>Perform complex measurement and analysis operations.</p>	<ul style="list-style-type: none"> ▪ Perform distance and surface measurement, line of sight and 3D viewshed analysis.




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