ArcGIS for 3D Cities: An Introduction
Thorsten Reitz, Craig McCabe, Seán William Morrish, Brian Sims
3D Across ArcGIS

- Manage Multiscale 3D Models
- Share 3D scenes
- ArcGIS for 3D Cities
- 3D Geodesign
- Surface modeling
- Native lidar support
- 3D Analysis
- 3D on all Clients
Agenda
How ArcGIS for 3D Cities helps tapping into the Value of 3D GIS

- Introduction to 3D Cities
- 3D Base Layers
  - 3D Cartography to build your world on
- Esri Global 3D Base Scenes
- Create 3D City Base Layers
  - Interoperability with CityGML
- Analytics
  - Zoning
  - Solar Potential & Shadow Analysis
Introduction to ArcGIS for 3D Cities
Thorsten Reitz / Brian Sims
Why ArcGIS for 3D Cities?
Driving the platform's 3D capabilities

GIS Professionals
- Manage & Maintain

Urban Planners
- Evaluate & Improve

Citizens, Decision Makers
- Understand & Share

Businesses
- Decide & Market

3D Services
3D Storage
3D Apps
3D enables Washington DC
How 3D Business Process add Value every year

- Faster and Better Understanding
- Inform highly public discussion
What is ArcGIS for 3D Cities?
Ready-to-use Workflows, Tools and Sample Data for Urban Management

- Create 3D City Base Layers
- Build a 3D Campus Map
- Visualize New Developments
- Understand Zoning
- Perform Solar Analysis
- Manage Public Safety

Check out the workflows now: http://bit.ly/esri3dcities
3D Cities Information Model: Themes

**Built Environment**
- *Created and actively managed by people*
- Structures, utilities, transportation networks, installations

**Legal Environment**
- *Defines restrictions on land use*
- Land use zones, property ownership boundaries, regulations

**Natural Environment**
- *Naturally occurring features on, above, or below the earth’s surface*
- Land cover, subsurface geology, atmosphere/climate/weather
Built Environment: Buildings

Connecting 2D and 3D Buildings

- The **Building** (Footprint object) carries most of the attributive information.
- **BuildingShell** represents the complete outer shell in 3D.
  - Procedural
  - Modeled
- **BuildingShellParts** can be used when separate processes for roofs/walls/ground plates are needed.
Built Environment: Building Interiors

Seamless usage of interior/exterior data

- Building interior data:
  - Building
  - Floor
  - Space
  - Structure
  - Entrance

- Used in analysis:
  - Query (where/who)
  - Routing
  - Asset allocation
Built Environment: Installations

Managing Portfolio of City Installations

- Street Furniture
  - Fire hydrants
  - Benches
  - Bike racks
  - Trash cans
  - Kiosks
  - Poles

- Vegetation
  - Trees
Built Environment: Utility Networks

*Discover the underground potential of your city*

- Water
- Sewer
- Stormwater
- Gas
- Electric
Legal Environment: From 2D to 3D

- **Administrative Districts**
  - How are territories organized?

- **Zoning Districts**
  - What current and future land usage is defined here?

- **Parcels** (Land/Tax/Unit)
  - Who owns this property and how can it be identified?

- **Regulations**
  - How can a Parcel or ZoningDistrict be used?
Legal Environment: Regulations

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setback Front</td>
<td>Min 5', max 15'</td>
</tr>
<tr>
<td>Setback Sides</td>
<td>Min 8'</td>
</tr>
<tr>
<td>Roof Type</td>
<td>Flat</td>
</tr>
<tr>
<td>Total Height</td>
<td>Max 40'</td>
</tr>
<tr>
<td>Site Coverage</td>
<td>0.6</td>
</tr>
<tr>
<td>FAR</td>
<td>Max 1.2</td>
</tr>
<tr>
<td>Levels Above Ground</td>
<td>Max 4</td>
</tr>
<tr>
<td>Units per Parcel</td>
<td>Max 4</td>
</tr>
</tbody>
</table>
The Natural Environment

- Subsurface Geology
- Atmosphere & Pollution
- Wind & Weather
- Land Cover
3D City Base Layers

Craig McCabe
3D City Base Layers

Buildings

3D Buildings

Multiple Levels of Detail
3D City Base Layers
Buildings

3D Buildings

Multiple Levels of Detail
3D City Base Layers

Trees

3D Buildings

Trees
3D City Base Layers

Water Bodies

3D Buildings

Trees

Water Bodies
3D City Base Layers
Basemap Skin

3D Buildings
Trees
Water Bodies
Basemap Skin
3D City Base Layers

Terrain

3D Buildings
Trees
Water Bodies
Basemap Skin
Terrain
3D City Base Layers
Designed to support the understanding of cities

- 3D Buildings
- Trees
- Water Bodies
- Basemap Skin
- Terrain
The Esri Base Scene

Seán William Morrish
Base Scenes

• Earth Scene
  - Global map Cartography
  - Living atlas of 3D layers

• World Landscape scene
  - Global to Local scale
  - Understanding and visualizing Landscape layers

• City Scenes
  - Terrain, basemap, buildings, street furniture, vegetation, waterbodies
  - Analytic and informative layers

• Campus/Interior Scenes
  - Campus to room scale
  - Analytics and navigation
Base Scenes
Demo
Earth Scene

Visualizing information at a global scale

- Physical environment
- Natural resources
- Transportation
- Population
World Landscape Scene

Understanding landscape scale and context

Landscape Layers

- Physical environment
- Geology
- Natural resources
- Transportation
- Demographics
City Scenes

*Provides context & support for urban planning and design, city maintenance, public safety, emergency response*

City Layers

- Terrain
- 2D Maps
- Buildings LOD1 – LOD4
- Water Bodies
- Trees
- Street Furniture
- Utilities
Campus Scenes

*Enables campus and building level analysis and management*

**Campus/Building Layers**
- Terrain
- 2D Maps
- Buildings LOD1 – LOD4
- Water Bodies
- Trees
- Building structures
- Interiors
- Utilities & Navigation
Create 3D City Base Layers

Craig McCabe
3D City Base Layers
ArcGIS for Professionals Workflows
Base Layer Editing

Video Demo
3D City Base Layers

Building Height Tool
Interoperability with CityGML
Thorsten Reitz / Seán William Morrish
CityGML throughout the World
Adoption as an Exchange Format
When to use CityGML, when to use the 3DCIM
Lossless I/O of 17 core CityGML Feature Classes

- Building, BuildingPart
  - Roof-, Wall-, GroundSurface
  - Room
  - BuildingFurniture
  - IntBuildingInstallation
  - BuildingInstallation
  - Opening, Window, Door
  - FloorSurface
  - InteriorWallSurface

- PlantCover

- SolitaryVegetationObject

- CityFurniture

- TrafficArea

- Address

- LandUse

- WaterBody & Surface

3D Cities Information Model in File GDB

Note: ADEs are not supported out of the box.
How and What?

• Uses FME/Data Interop Technology as a base
  - Comes with a CityGML 1.0/2.0 Reader/Writer

• Resolve problems with existing tools
  - Texture Atlas Repetition in File GDB
  - Stability with large files
  - Resilience to variety of CityGML files (especially different Geometry models)
  - Resilience to common issues in CityGML files

Available with the 3D Cities template: https://github.com/esri/3d-cities-template
Analytics: Zoning and Development Potential
Thorsten Reitz / Brian Sims
What is Zoning?

• *Where can Who build What?*
  - What should it look like?
  - What may it be used for?
  - What needs to be protected?

• Typical Form: Legal Texts
  - Optional: 2D Map Part
  - Very rare: 2D/3D GIS Data Part
    - CityGML
    - XPlanGML
    - INSPIRE Planned Land Use
Usage-based Zoning Code: Washington D.C.

840 HEIGHT OF BUILDINGS OR STRUCTURES (C-M, M)

840.1 Except as provided in § 840.2 and in chapters 20 through 25 of this title, the height of buildings or structures in an Industrial District shall not exceed that given in the following table:

<table>
<thead>
<tr>
<th>ZONE DISTRICT</th>
<th>MAXIMUM HEIGHT (Feet)</th>
<th>MAXIMUM HEIGHT (Stories)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-M-1</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>C-M-2</td>
<td>60</td>
<td>No Limit</td>
</tr>
<tr>
<td>C-M-3</td>
<td>90</td>
<td>No Limit</td>
</tr>
<tr>
<td>M</td>
<td>90</td>
<td>No Limit</td>
</tr>
</tbody>
</table>
Form-based Zoning: Bradenton, U.S.
Mixed Zoning Code: Zurich, CH

- Special clauses to protect the historic character of different city quarters
- References to state regulations
- Clauses that describe the form of buildings and the usage
The Value of Zoning

• Urban and Building Planning
  - Verify proposals and built environment
  - Determine Policy Requirements and Impacts
  - Communicate master and development plans

• Commercial Development Agencies
  - Identify Development Potential
  - Get suitable sites for projects

• Real Estate
  - Find Good Property Deals
  - Model value development

• Others: Telecommunications, Logistics, Regional Marketing, ...
Zoning Analysis

Demo
Analytics: Solar Potential

Seán William Morrish
Solar Potential

• Why calculate:
  - Evaluate potential of built environment for solar energy generation
  - Optimise installation and improve payback
  - Set rules for future urban design and development

• How to calculate:
  - Create calculation surfaces
  - Integrate location and solar exposure for best output potential
  - Evaluate results prior to installation
Solar Potential

Demo
Shadow Effects

- Why calculate
- Evaluating shadow effects of new construction on surroundings
- Time of year and time of day Shadow effects
- Existing right to light and solar right
Shadow Effects
Demo
Summary

Get the 3D Cities Template: https://github.com/Esri/3d-cities-template
Get Key Links in 24 hours
Thank you...

- Please fill out the session survey:

  Wed Offering ID: 1928
  Thu Offering ID: 1927
  Fri Offering ID: 1995

Online – www.esri.com/ucsessionsurveys
Paper – pick up and put in drop box