ArcGIS for 3D Cities
Thorsten Reitz, Sean William Morrish
Craig McCabe
Outline

• Introduction

• Building a 3D City
  - 3DCIM data model
  - Procedural Runtime
  - Asset Editing
  - Managing Building models

• 3D Analysis
  - Zoning Regulations
  - Slope / Shadow / Network

• Sharing via Web Scenes
ArcGIS 3D

Because our world is 3D

- Improve understanding
  3D is easy for everyone to understand

- Better communication
  3D makes it easier to articulate ideas

- Solve 3D problems
  Some spatial problems can only be solved in 3D
3D GIS Features

- Multiscale 3D Models
- Share 3D scenes
- Integrated 3D
- Native lidar support
- 3D Geodesign
- Surface modeling
- 3D Analysis
- ArcGIS for 3D Cities
Introducing ArcGIS for 3D Cities

Thorsten Reitz
ArcGIS for 3D Cities

- Based on Desktop and Server Software
  - ArcGIS Desktop
  - CityEngine
- Maps & Apps
  - Map docs, Scene docs, CE projects
  - Online resources
- Tools and Extensions,
- Workflows,
- An information model
  ...for a specific community.
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
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.
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
Transport Network

Multimodal Transit including walking and biking routes

- Multi-modal network containing:
  - Routes
  - Stops
  - Inter-modal connections
  - Network slope
  - True elevation
  - Building interior networks

- Routing service supporting:
  - Restrictions
  - Barriers
  - Timetables
Installations

Managing Portfolio of City Installations

- Street Furniture
  - Fire hydrants
  - Benches
  - Bike racks
  - Trash cans
  - Kiosks
  - Poles
- Vegetation
  - Trees
Utility Networks

Discover the underground potential of your city

- Water
- Sewer
- Stormwater
- Gas
- Electric
The Legal Environment

- Administrative Districts organize territories into logical areas.
- Zoning Districts describe current or planned Land Use.
- Parcels provide address and ownership information and represent the unit that zoning rules have to be applied to.
The Natural Environment

- Land cover
- subsurface geology
- wind/weather
- atmosphere
Why is there a new information model?

<table>
<thead>
<tr>
<th>Basis for common development by esri, partners and users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define workflows and new requirements</td>
</tr>
<tr>
<td>Improve integration of components (CE, ArcGIS)</td>
</tr>
<tr>
<td>Foundation for the ArcGIS for Cities Solution</td>
</tr>
<tr>
<td>Provide Apps and Maps that can be used out of the box and adapted as necessary</td>
</tr>
<tr>
<td>Provide an Information Model that supports users around the globe andf is easy to adapt</td>
</tr>
<tr>
<td>Simplify usage of 3D city models</td>
</tr>
<tr>
<td>Support existing standards such as CityGML</td>
</tr>
<tr>
<td>Establish best practices in 3D cartography</td>
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</table>

- CityGML
- 3DCIM
- BISDM
- LGIM

Rule Packages & the Procedural Library

- Rule Authoring
- CE 2013.1
- Publish
- CityEngine Rule Package
- Use
- Features from CE Rules
- ArcScene 10.2
- ArcGIS Online
- Residential
- Office
- Kiosk
- Sports
- Gas Station
- Wind Turbine

ArcGIS for 3D Cities
Building a 3D City

Craig McCabe
5 Steps to a 3D City Model

1. **Import your data**
   Data integration tools process & incorporate existing GIS features and regulations into the 3DCIM.

2. **Make a DEM**
   Calculate a bare earth elevation surface from classified LiDAR data using ArcGIS' LAS Dataset tools.

3. **Go vertical**
   "3D-enable" your 2D building footprints and trees. Use the data management template to calculate dimensions for 3D visualization & analysis.

4. **Create and analyze 3D features**
   Automatically generate building & tree volumes from your 3D-enabled data, then analyze against the existing regulations in your city.

5. **Sharing web scenes**
   Share your 3D models and analysis with anyone online using WebGL. See the effects of a proposed development, etc.
3D City: Setting up the Information Model

- Use the Database Schema Generator and ETL tools to localize and populate your 3D City geodatabase
3D City: Asset Editing

- Use LiDAR and the 3D City Asset Editing map to extract feature heights
3D City: Modeling Façades in CityEngine

- Create 3D facades from 2D footprints in CityEngine

Key attributes:
- Height
- Base elevation
- Number of floors
- Land use
3D City: Editing Building Geometry

- Create or update building designs in CityEngine
The 3D City Asset Editor App

Craig McCabe
The Zoning Designer App

• Assess the impact and potential of changing zoning regulations
  - Visual impact
  - Conformance of built environment
  - Development potential

• Use CityEngine GP Tools to…
  - create analytic features (envelopes)
  - create representative models (realistic)
  - create advanced symbology (potential)
# Zoning Districts

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*LandUseType*: agriculture, leisure, openSpace, protectedSite, residential, utilityInfrastructure, industry, employment, commercial, transportInfrastructure
## Parcels & their Neighborhood

![Parcel Diagram]

### Attribute Types

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<th>Type</th>
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**Format for Attribute:** FeatureClassName/Type (/SubType), e.g. TransportNetwork/Road/Local

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## Regulations

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<td>filter</td>
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**ConstraintAspect**: height, eaveHeight, siteCoverage, GFA, plotRatio, cubicIndex, levelsAboveGround/BelowGround, setbackFront/Side/Rear, skyviewAngle, Orientation, ...

**ConstraintOperator**: min, max, avg, equal

Can be a zone or parcel FID, e.g. `ZoningDistrict/1348`
The 3D City Zoning Designer App

Thorsten Reitz
3D City Analysis

Sean W. Morrish
The 3D City Impact Analyzer App
Sean William Morrish
The 3D City Transport Network App

Sean William Morrish
Join the 3D Cities Group!

- Join the *ArcGIS for 3D Cities* group on ArcGIS.com
  
  http://bit.ly/YyK3Ua

- GitHub: https://github.com/Esri/3d-cities-template

- Test apps and workflows

- Provide feedback on the Information Model

http://www.arcgis.com/home/group.html?owner=ArcGISteam3DCities&title=ArcGIS%20for%203D%20Cities