



Procedural Modeling With **CityEngine**

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CityEngine

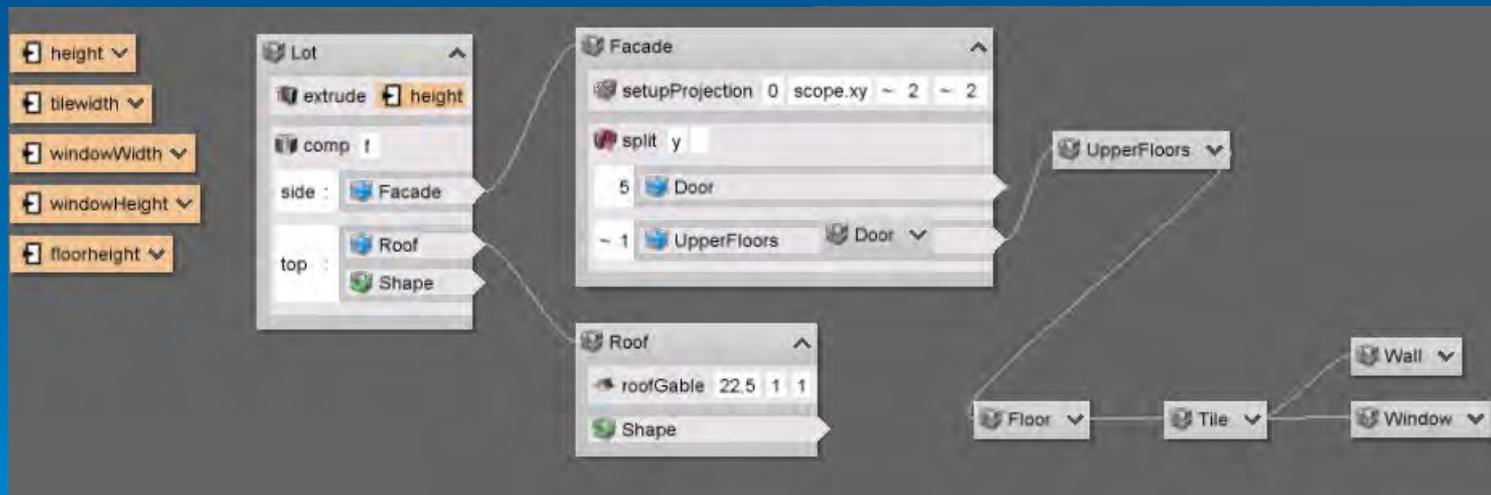
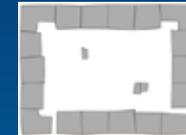


Transform 2D GIS Data into Smart 3D City Models

Procedural modeling

3D model creation using rules / algorithms

- Base geometry



Base geometry



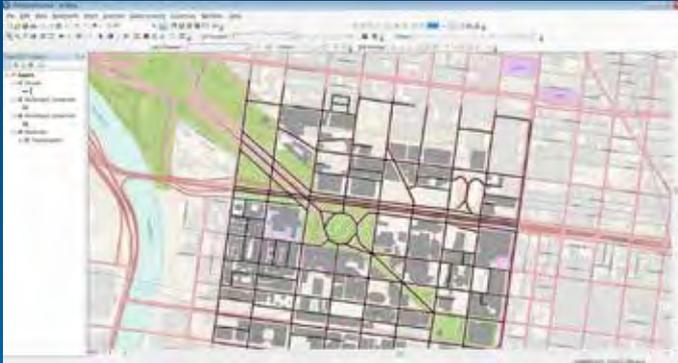
Final 3D model

Iterative refinement

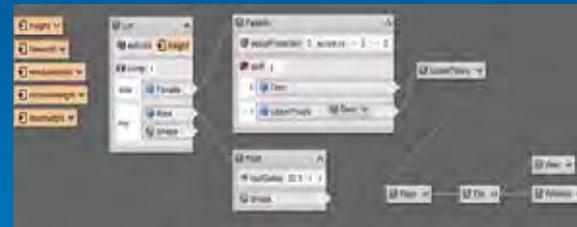
iteratively refine a design by creating more and more detail

2D GIS Data + Rules

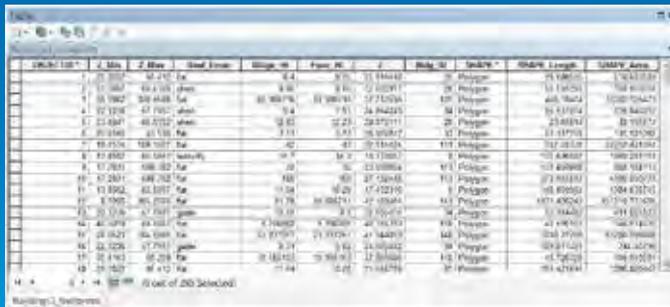
Procedural city modeling



Geometry



Rules



Block ID	Area	Perimeter	Volume	Height	Color	Material	Texture	Light	Shadow	Other
1	1000	1000	1000	10	Red	Brick	Brick	1000	1000	1000
2	1500	1500	1500	15	Blue	Concrete	Concrete	1500	1500	1500
3	2000	2000	2000	20	Green	Grass	Grass	2000	2000	2000
4	2500	2500	2500	25	Yellow	Wood	Wood	2500	2500	2500
5	3000	3000	3000	30	Purple	Marble	Marble	3000	3000	3000
6	3500	3500	3500	35	Orange	Slate	Slate	3500	3500	3500
7	4000	4000	4000	40	Light Blue	Stucco	Stucco	4000	4000	4000
8	4500	4500	4500	45	Dark Blue	Granite	Granite	4500	4500	4500
9	5000	5000	5000	50	Light Green	Marble	Marble	5000	5000	5000
10	5500	5500	5500	55	Dark Green	Slate	Slate	5500	5500	5500
11	6000	6000	6000	60	Light Purple	Stucco	Stucco	6000	6000	6000
12	6500	6500	6500	65	Dark Purple	Granite	Granite	6500	6500	6500
13	7000	7000	7000	70	Light Orange	Marble	Marble	7000	7000	7000
14	7500	7500	7500	75	Dark Orange	Slate	Slate	7500	7500	7500
15	8000	8000	8000	80	Light Yellow	Stucco	Stucco	8000	8000	8000
16	8500	8500	8500	85	Dark Yellow	Granite	Granite	8500	8500	8500
17	9000	9000	9000	90	Light Blue	Marble	Marble	9000	9000	9000
18	9500	9500	9500	95	Dark Blue	Slate	Slate	9500	9500	9500
19	10000	10000	10000	100	Light Green	Stucco	Stucco	10000	10000	10000
20	10500	10500	10500	105	Dark Green	Granite	Granite	10500	10500	10500

Attributes

Aggregate As-built and Procedural Cities



As-built models

- Reality at time of data capture
- Sensor derived
- Exterior shells
- Static models

-> Visualization of existing city



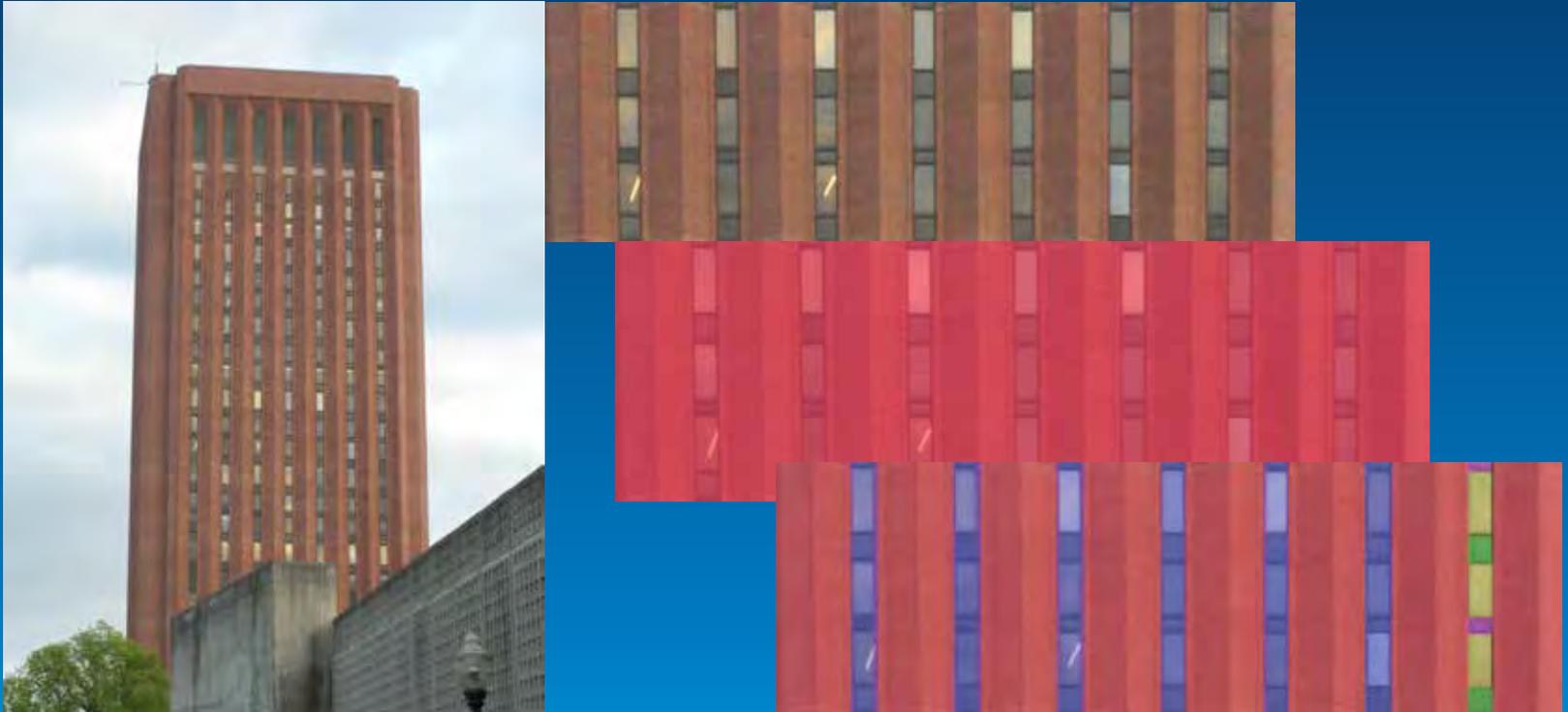
Procedural models

- Approximation of reality
- Based on GIS data
- Rule driven
- Exteriors and interiors
- Dynamic models

-> City planning / design

Architectural Rhythm

Key concept in procedural modeling



Repeatable patterns that guide creation of procedures.

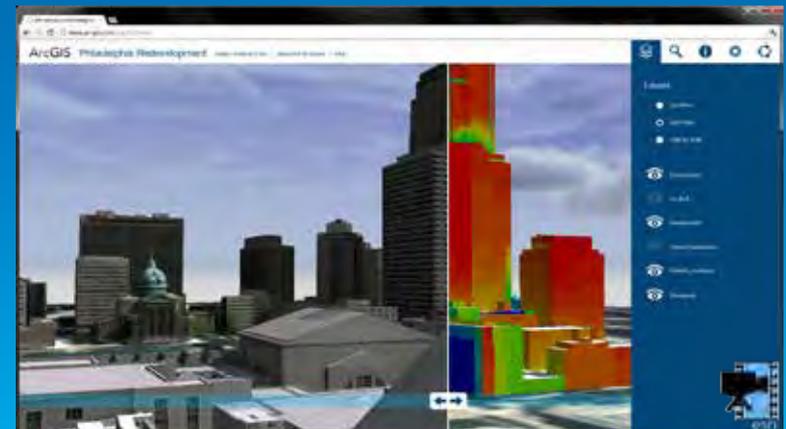
Share 3D Web Scenes



- 3D in the browser
- Easy-to-use (cloud solution)
- For Chrome, Firefox & Safari
- Modern GUI & graphics



Example: Side-by-side view to compare before/after



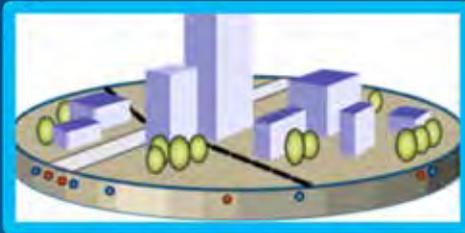
Example: Share analysis results (Swipe tool)

Road ahead

- ArcGIS for 3D Cities
- More 3D on the Web

3D Cities Information Model: Common Data Themes

The 3DCIM simplifies the initial creation, maintenance and usage of 3D cities.



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

Why is there a new information model?

Basis for common development by esri, partners and users

Provide an Information Model that supports users around the globe and is easy to adapt

Support existing standards such as CityGML

Simplify usage of 3D city models

Provide Apps and Maps that can be used out of the box and adapted as necessary

Define workflows and new requirements

Foundation for the ArcGIS for Cities Solution

Improve integration of components (CE, ArcGIS)

Establish best practices in 3D cartography



CityGML



3DCIM

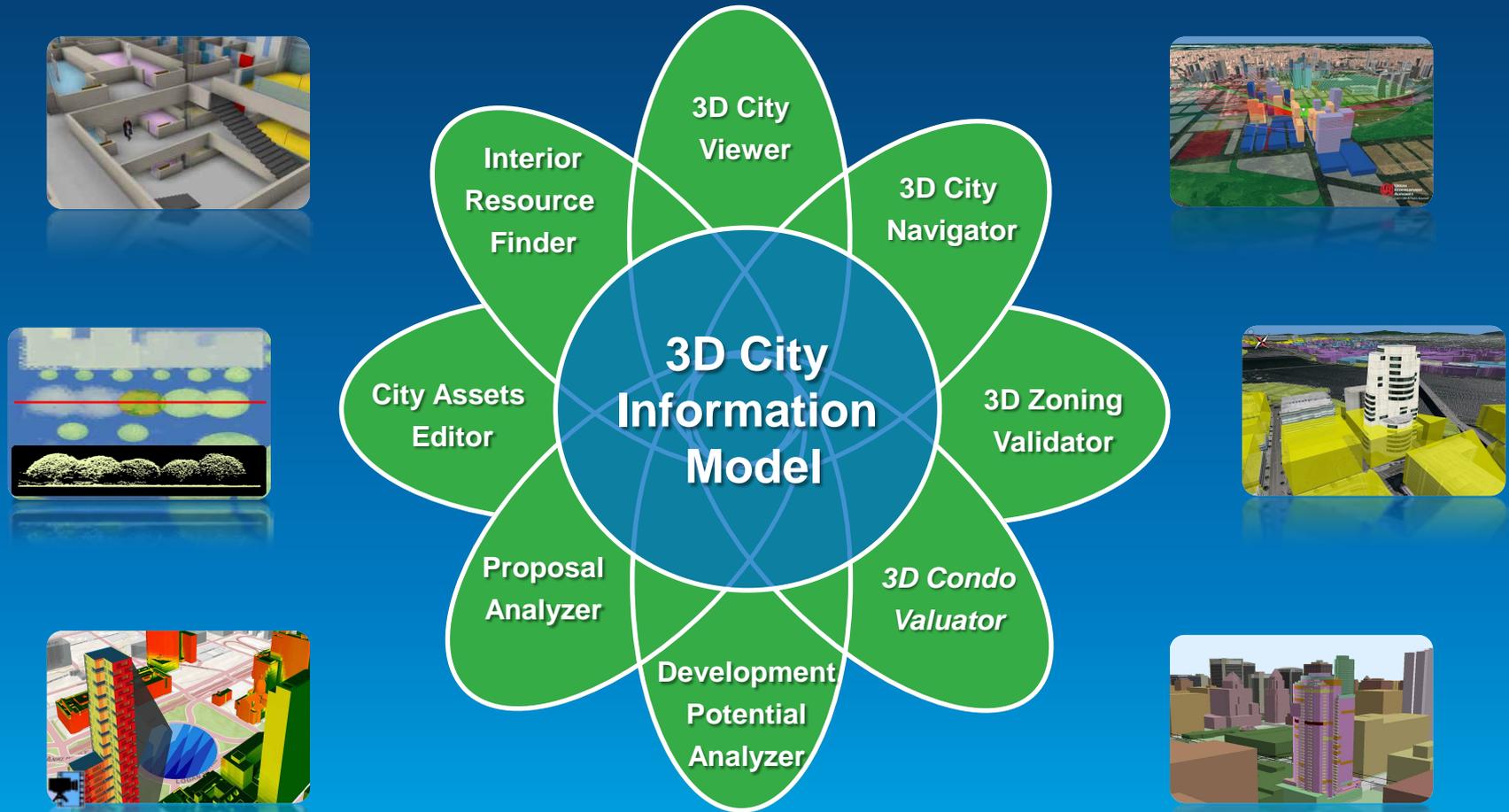


BISDM



LGIM

ArcGIS for 3D Cities



Plug 'n Play solution for city administrators, facilities managers...

Store 3D City Model (ArcGIS)



- **3D Cities Information Model**
 - Maps, apps, analytics
- **Different Levels of Detail**
 - Exterior
 - Interior



Building level



Floor level



Street level

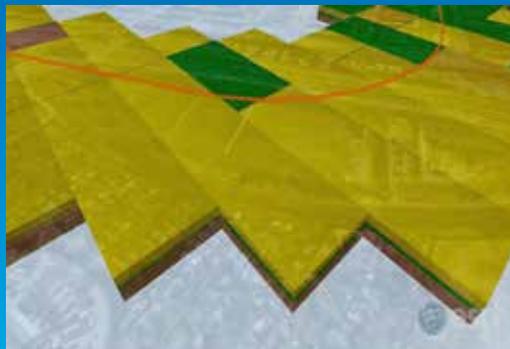
Analyze 3D City Model (ArcGIS)



- 3D Analyst Tools
- 3D Functions
 - Add Z Information
 - Buffer 3D
 - Distance 3D
 - Intersect 3D
 - Mask 3D by Attributes
 - Profile 3D
 - Intersect 3D
 - Intersect 3D Line With Polygon
 - 3D Count 3D
 - View 3D
 - Volume 3D
- 2D Functions
 - Cost Management
 - Function Surface
 - Raster Interpolation
 - Raster Mask
 - Raster Mosaic
 - Raster Stack
 - Triangulate Surface
 - Volume



- Model based approach
- Iterative analysis
- Time aware
- Quantitative results



Soil Analysis



Visual impact



3D routing



Visualize 3D City Model (ArcGIS)



- Desktop / Web * / Mobile **
- Massive 3D city models
- View cities in larger contexts
- Semantic / realistic views
- Incorporate sensor data



Thematic city



Photo-realistic city



Sensor data

Share your 3D Scenes

3D models in the browser and on mobile devices

Share your ArcScene Project as a Web Scene

“Clip and Share”



Stream 3D Scenes to the Browser and Mobile Devices

(End of 2013)



Useful links

CityEngine 2013

- Resource Links

- **3D Resource Center** - <http://resources.arcgis.com/en/communities/city-engine/index.html>
- **Tutorial 14 Polygonal Modeling 2012** - <http://www.arcgis.com/home/item.html?id=c930635e31ee4c5298a82c8f4be013b8>
- **3DCity Information Model**: <http://www.arcgis.com/home/search.html?q=3DCity&t=content>

- Training

- <http://training.esri.com>
- <http://training.esri.com/gateway/index.cfm?fa=search.results&searchterm=City+Engine>

3D is..



beautiful

effective



3D can provide..

understanding





Understanding our world.