3D Visualization and Decision-Making:
Applications for the University of Southern California

John P. Wilson, Ph.D.

Professor of Spatial Sciences, Sociology, Architecture,
Civil & Environmental Engineering, and Computer Science

Founding Director, Spatial Sciences Institute

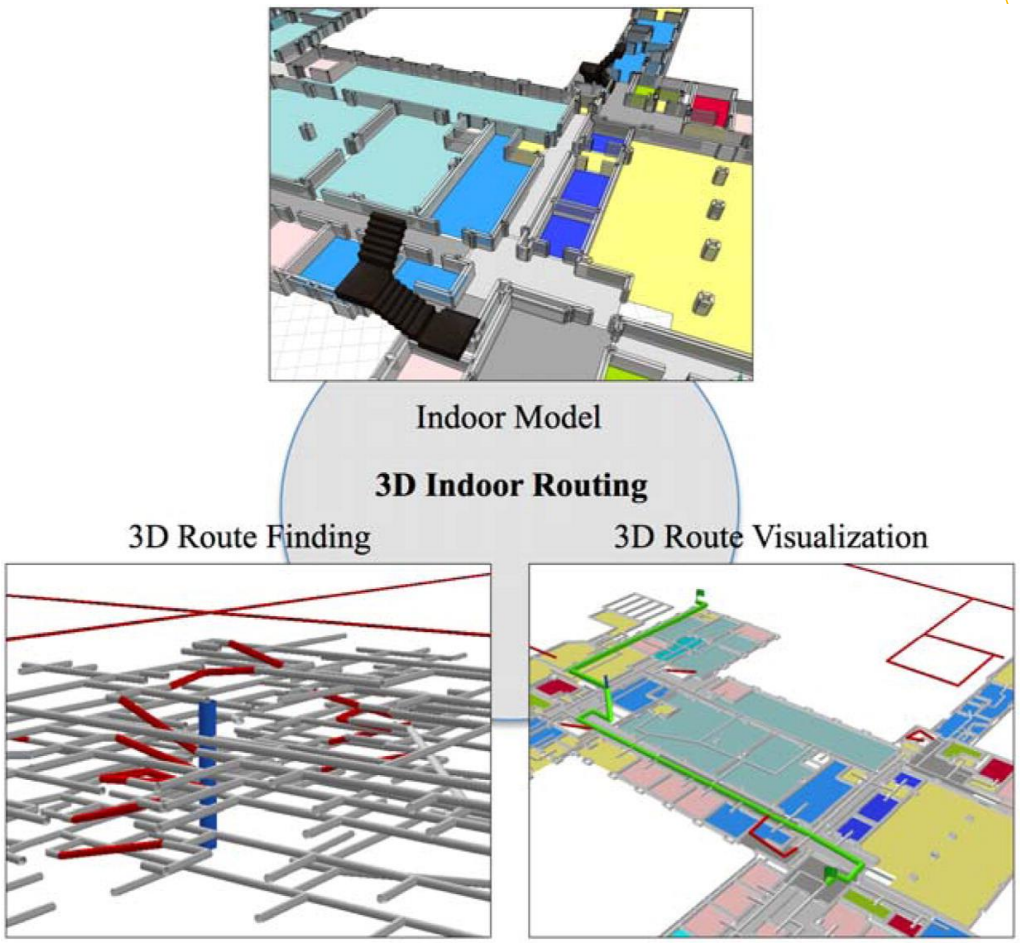
Visiting Professor, Institute of Geographical Sciences and Natural Resources Research,
Chinese Academy of Sciences

URISA GIS-Pro Conference

24 October, 2017

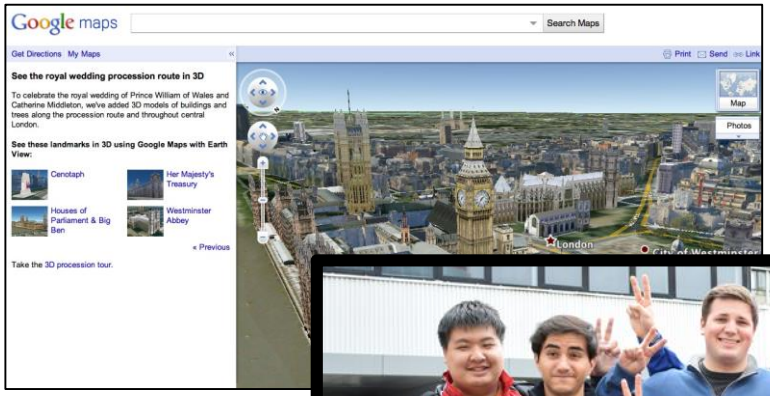
Outline

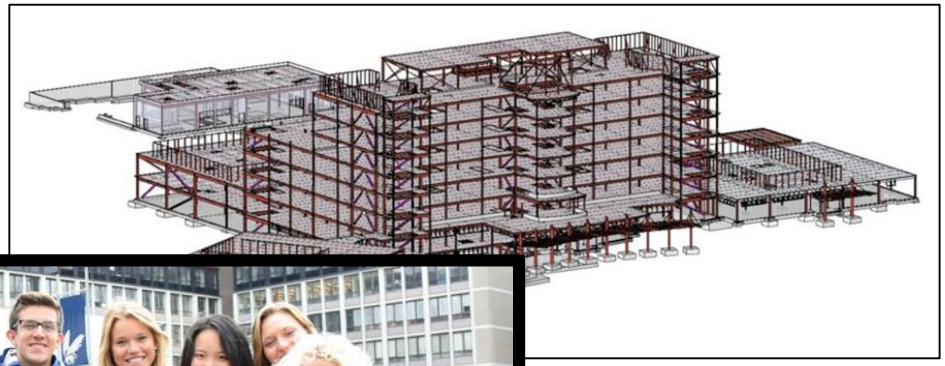
- Context
- Initial goal – Planning and visualizing 3D routes
  - CityEngine and CGA shape grammar
  - Workflow
    - 3D modeling of indoor spaces
    - 3D network and route finding
  - Example
- New student projects
- Closing comments



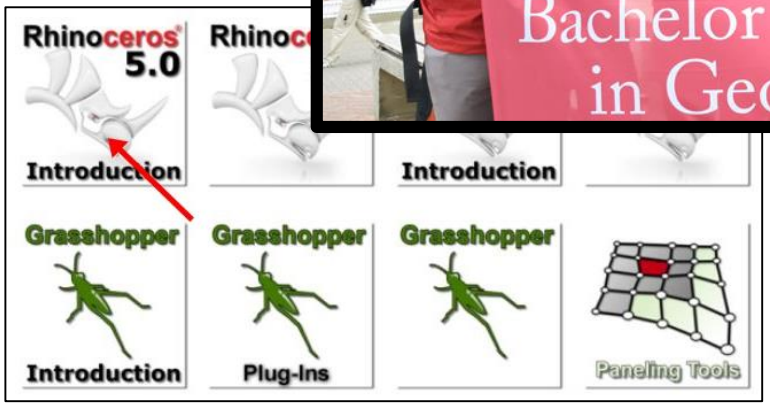
Core elements for 3D indoor routing applications

Context


Google maps
Search Maps
Get Directions
My Maps
See the royal wedding procession route in 3D
To celebrate the royal wedding of Prince William of Wales and Catherine Middleton, we've added 3D models of buildings and trees along the procession route and throughout central London.
See these landmarks in 3D using Google Maps with Earth View:
Cenotaph
Her Majesty's Treasury
Houses of Parliament & Big Ben
Westminster Abbey
« Previous
Take the 3D procession tour.
Print
Send
Link
Map
Photos
London




Bachelor of Science
in GeoDesign

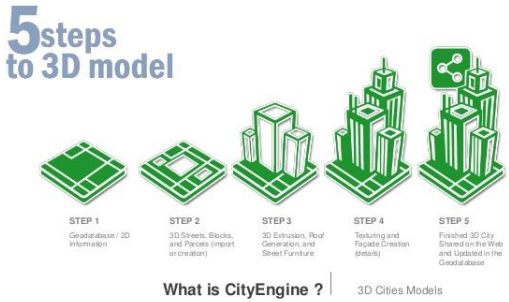

Rhinoceros 5.0
Introduction
Introduction
Grasshopper
Introduction
Grasshopper
Plug-Ins
Grasshopper
Paneling Tools


Products
3D for...
Buy
Learn
asiest way to draw in 3D
You love what you do. Now love how you do it.
Download SketchUp
What's New?

Planning and visualizing 3D routes (2013-2015)

- With the increasing size and complexity of modern buildings, 3D indoor routing is receiving more attention nowadays
- We generated 3D indoor and building models from CAD files and building footprints using CityEngine and its built-in procedural modelling approach
- An Americans with Disabilities Act (ADA) compatible 3D network was created by combining 3D floor lines and transitions such as staircases and elevators
- The resulting routes as well as the indoor and façade models were then visualized through a 3D WebScene generated by CityEngine

CityEngine Web Viewer

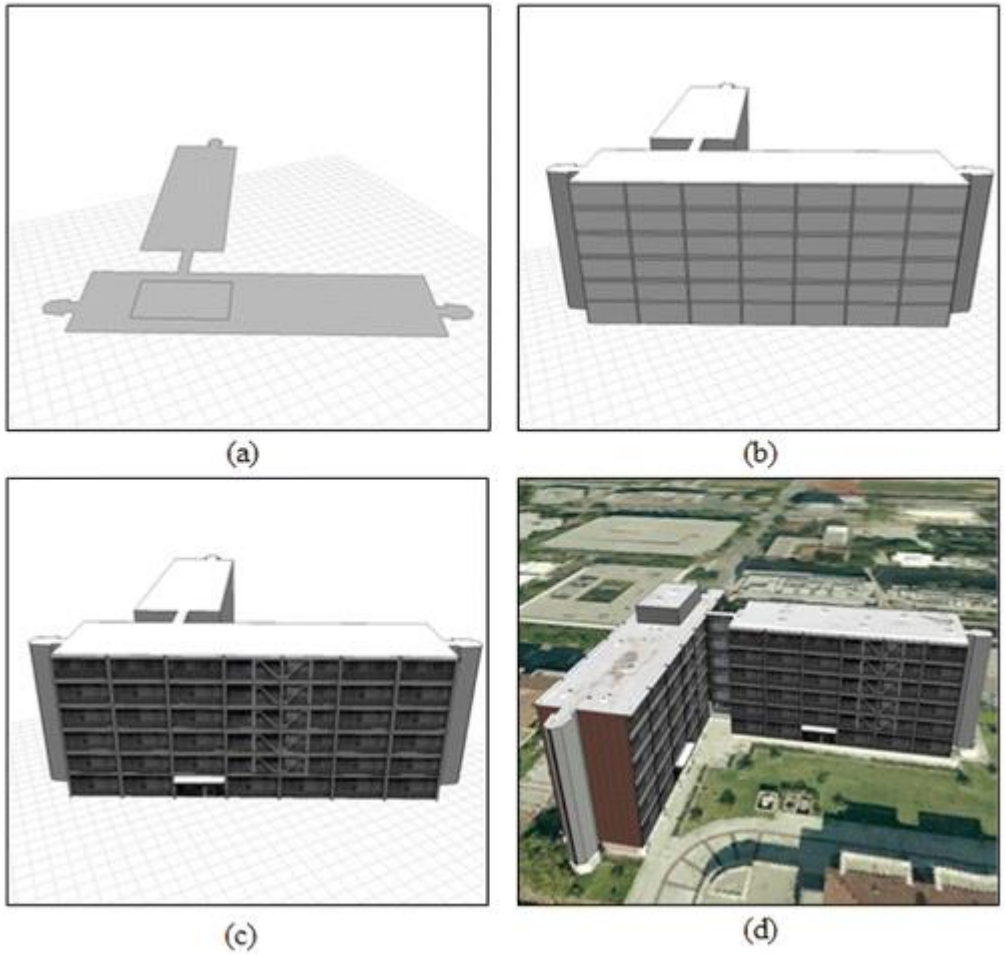


CityEngine and CGA shape grammar

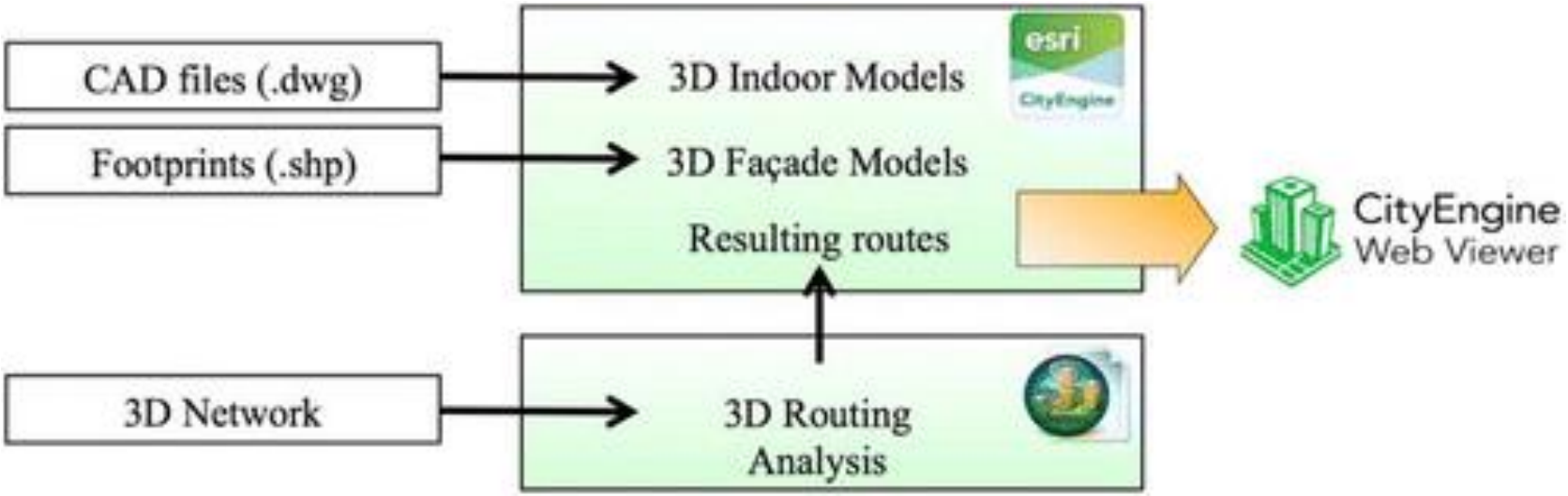
(a-c) Three examples of building façade models generated with CGA shape grammar; and (d) a CGA-generated 3D model of the Parkside Apartments at USC

CGA – Computer generated architectures shape grammar for procedural modeling (Muller et al., 2006)

LoD – Level of Detail



Overall workflow



3D modeling of indoor spaces

Extraction of principal features

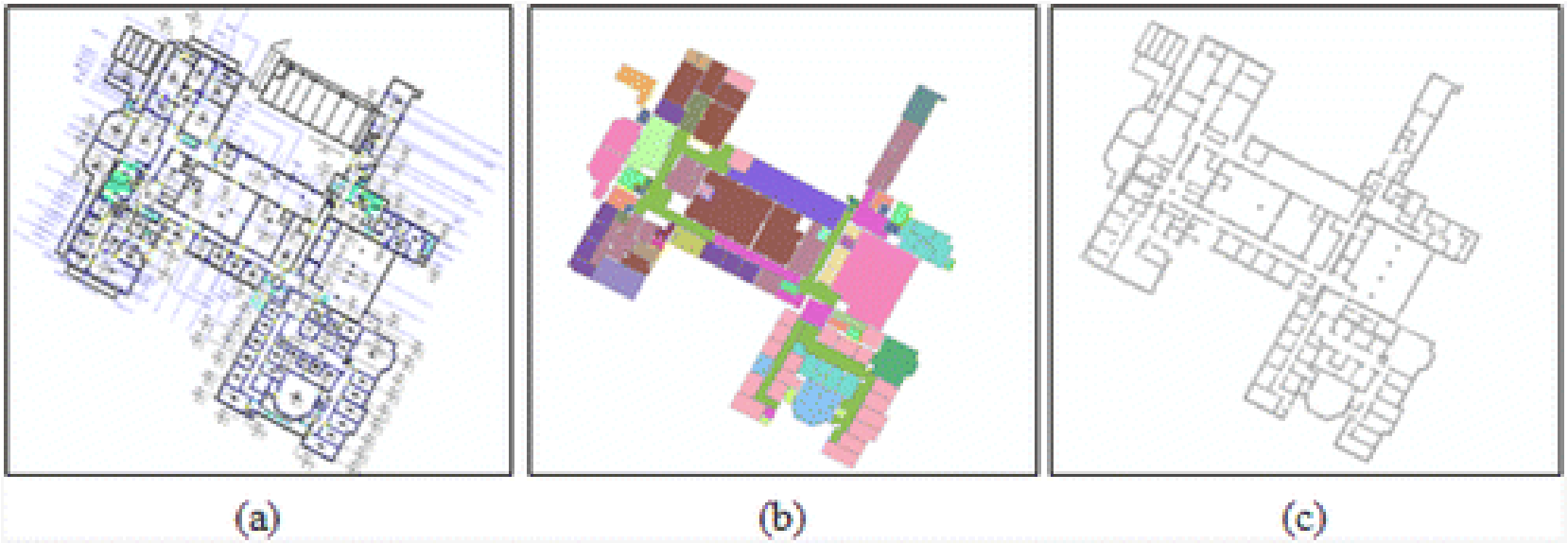
Generation of 3D indoor models

3D network and route finding

Construction of 3D network

Best route finding

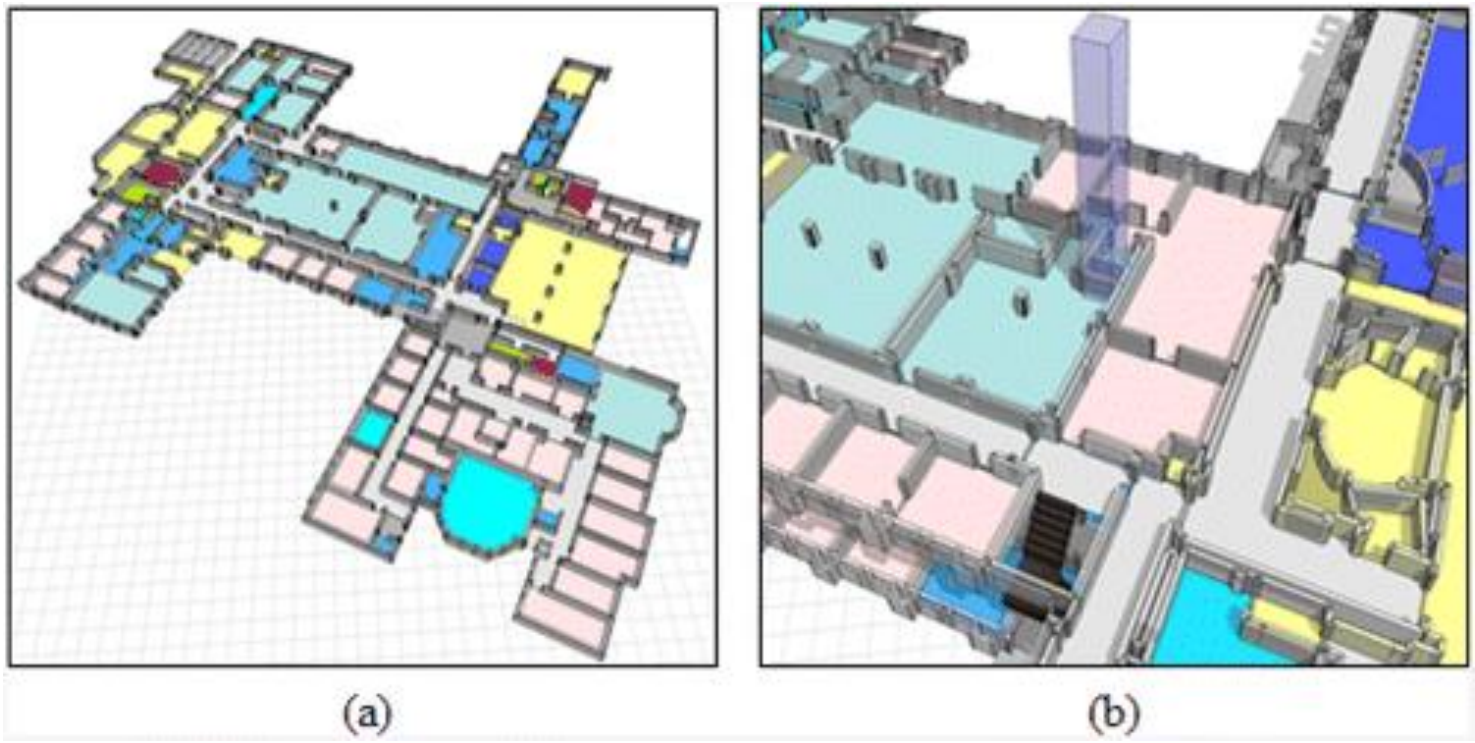
3D modeling of indoor spaces – extraction of principal features



Extraction of principal features, with sketches of: (a) the input CAD file; (b) the extracted polygons (color-coded with their usage type); and (c) the wall polygons

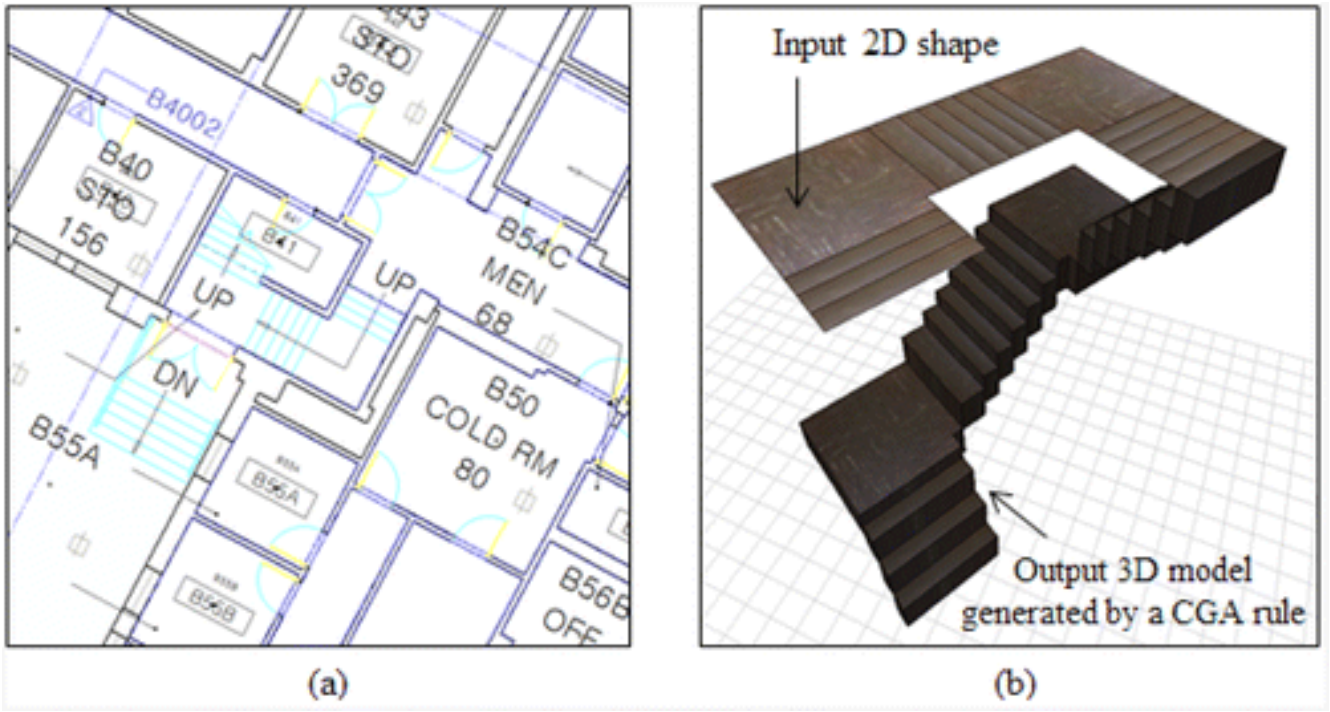
Geometry + Attributes

Generation of 3D indoor models



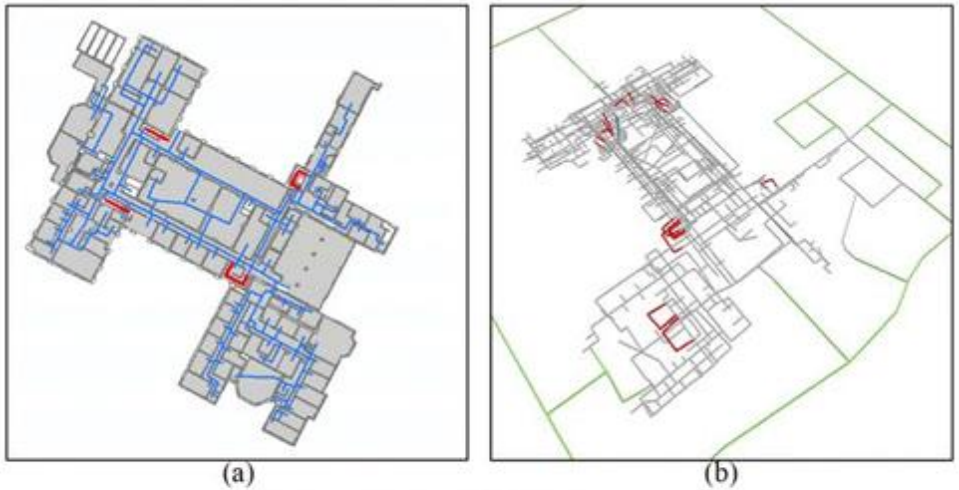
Generation of 3D indoor models: (a) 3D indoor model; and (b) CGA-generated elevator and staircase

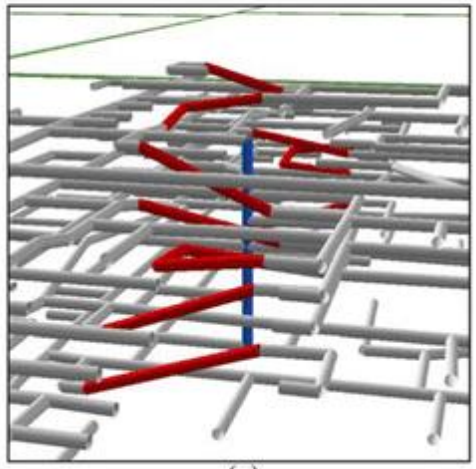
Generation of 3D indoor models (2)



3D staircase model: (a) Staircase in the CAD file; (b) CGA-generated 3D staircase model

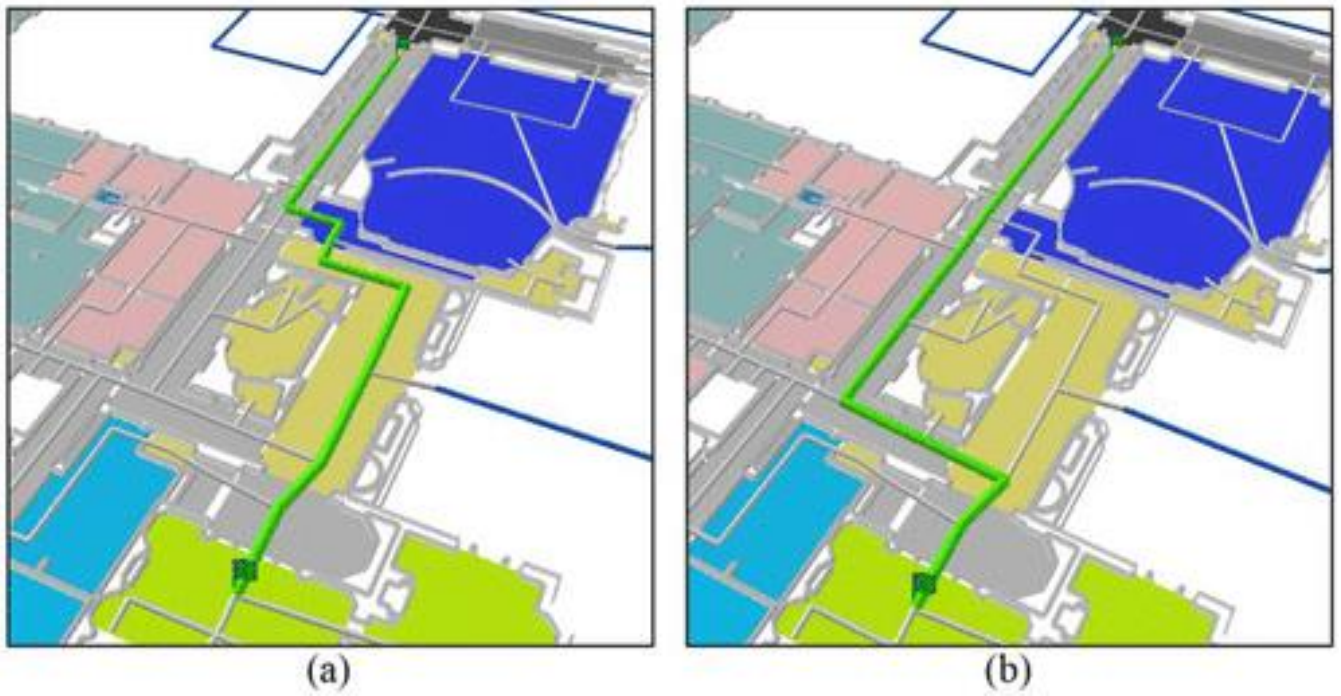
3D network and route finding





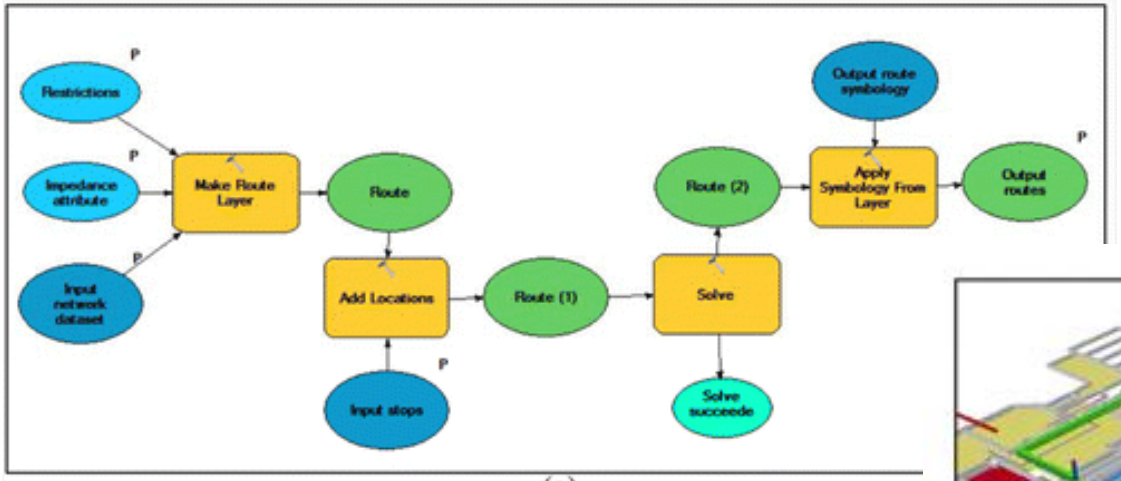
Construction of 3D network: (a) 2D floor lines (blue) and staircases (red); (b) Completed 3D multimodal network; and (c) Zoomed-in view

3D network and route finding (2)

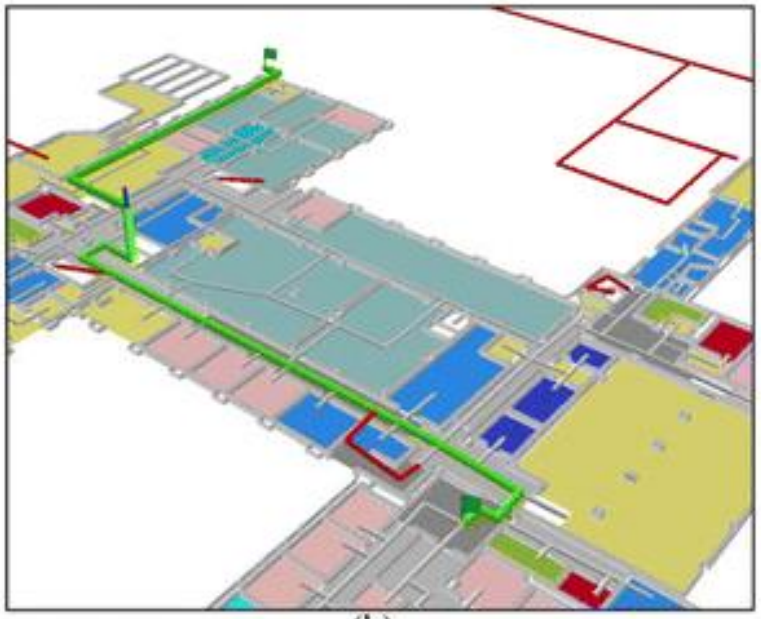


Different routing results: (a) without *PREFERENCE*; and (b) with *PREFERENCE*

Best route finding



(a)



(b)

3D route-finding task in ArcScene:
(a) Geoprocessing model; and (b) Resulting route visualized with 3D indoor model

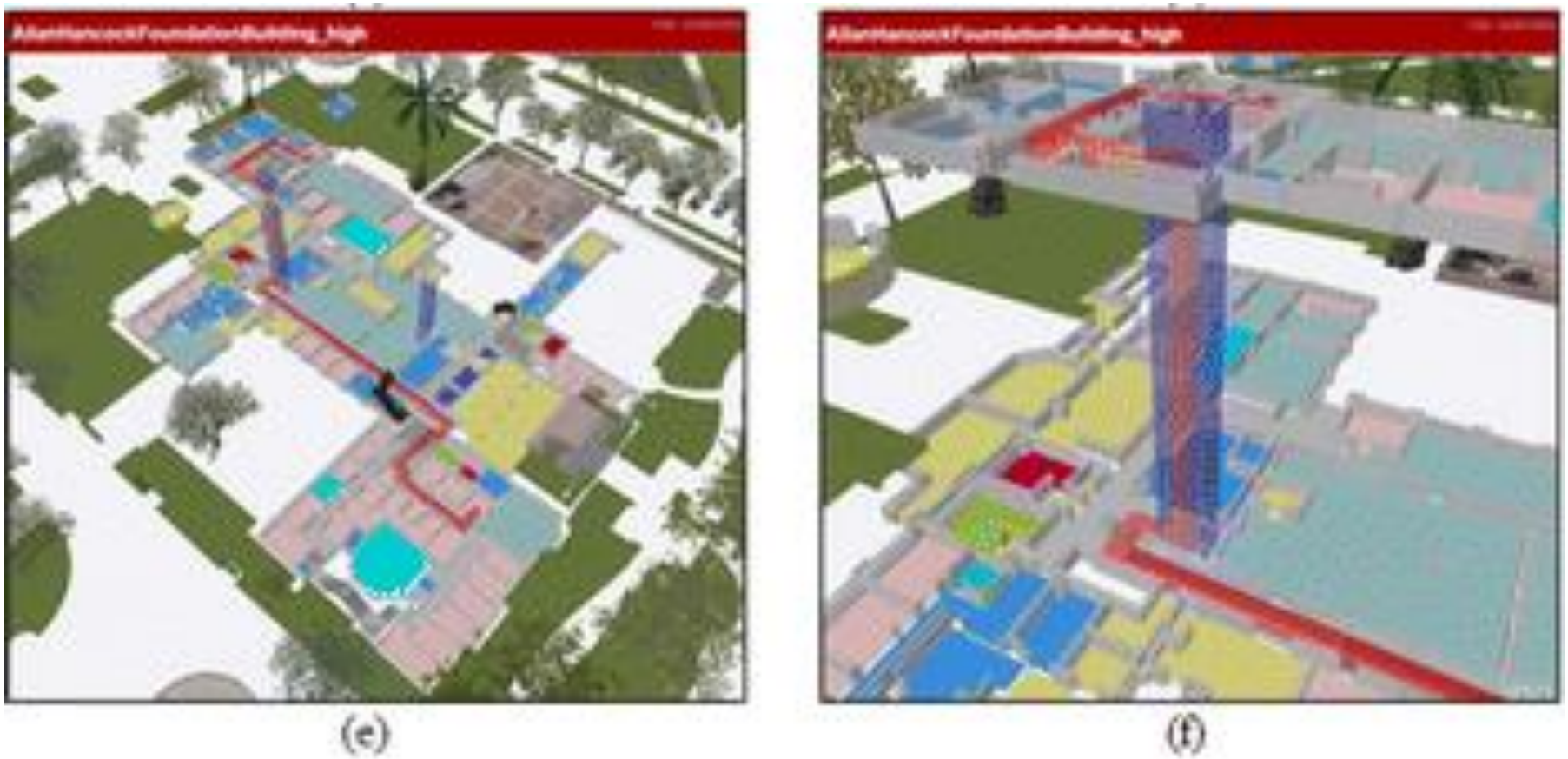
Examples of 3D routing visualization

Examples of 3D routing visualization: (a) and (b) ADA-restricted route to SSI

Examples of 3D routing visualization (2)

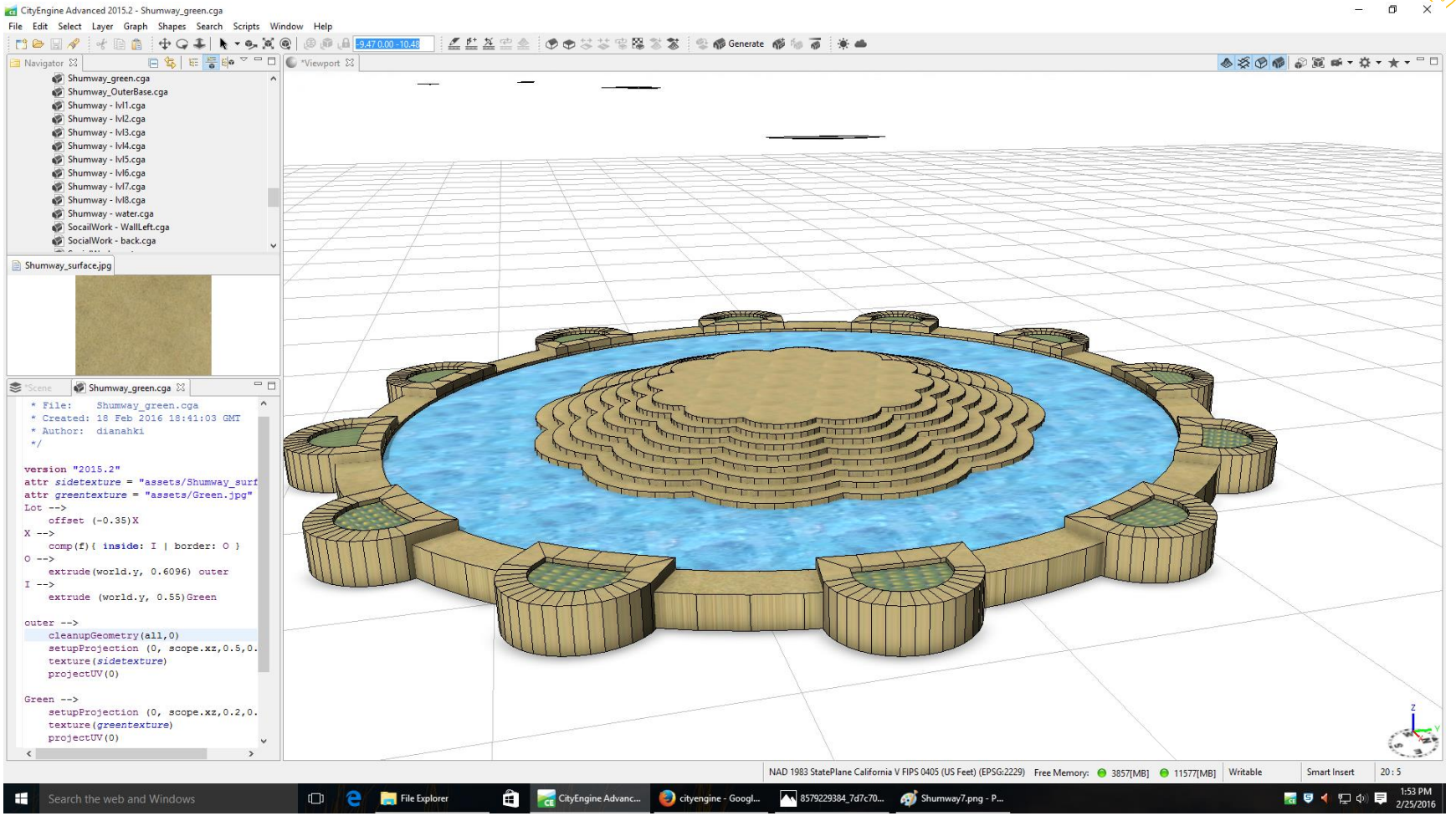
Examples of 3D routing visualization: (c) and (d) ADA-compatible route to SSI

Examples of 3D routing visualization (3)



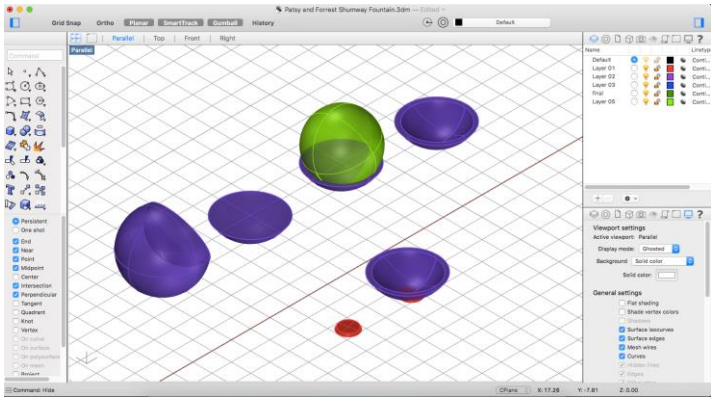
Examples of 3D routing visualization: (e) and (f) ADA-compatible route inside AHF building

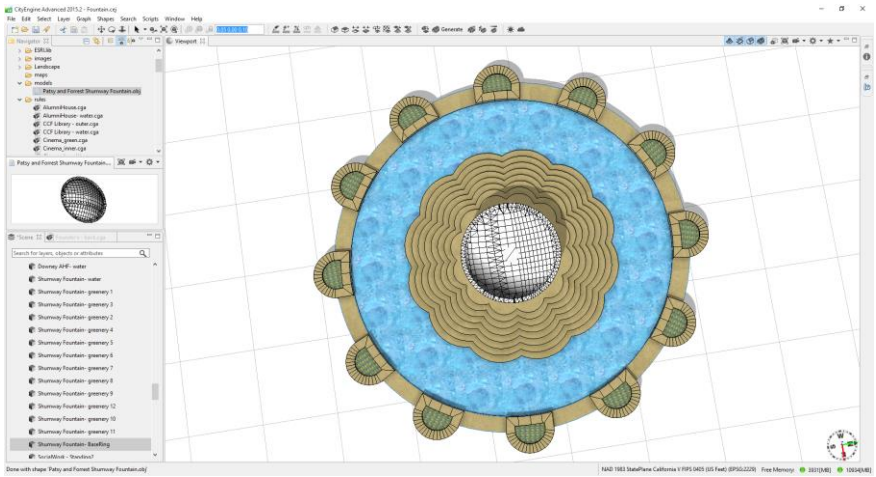
New student projects – Hardscape elements

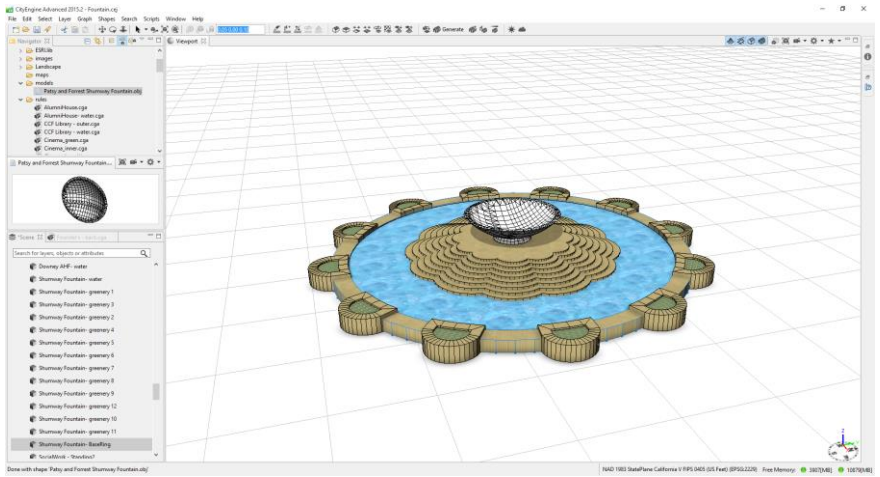


CityEngine extrusion and addition of textures: Shumway Fountain

New student projects – Hardscape elements (2)







Constructing bowl for Shumway Fountain. Exported 3D object placed onto completed base and water within CityEngine

New student projects – Ground cover

Modeling trees with regression equations by species (n = 200-600) to achieve varied sizes

Challenges

- Esri's constantly changing and evolving technology protocols and platforms on which this kind of work is performed and displayed
  - CityEngine
  - ArcGIS Pro
- Steadily increasing numbers of competing technology options, which are also constantly changing and evolving
- Constantly changing and evolving expectations on the part of current and potential new users as well

Google Earth's '3D Buildings' VS iOS 6's 'Flyover' POSTED BY : DOM ESPOSITO JULY 26, 2012

Build Flexible Scenarios Faster
Compare and analyze building proposals from every angle. See how they fit into your city's overall vision for the future. Make as many scenarios as you need and add modifications.

Rationale is straightforward

Requires substantial and varied skills

Create Realistic Context
See where a proposed building blocks the view, casts shadows, and reflects heat. By making the virtual 3D visualization as real as possible in the design phase, you will avoid costly mistakes in the building phase.

Share Your Urban Plan
Publish your 3D model online. Others can interact with it, understand your urban plan, and participate in improving their community.

Short shelf life

Need to continuously update skills

Esri's GeoNet and related resources

00:18 - Exporting high-resolution 3D maps

01:25 - Dynamically altering 3D surfaces after they are published

02:25 - Alternatives to modeling buildings and vegetation with Google Earth 3D

03:08 - Extracting rectangular rooftops from satellite imagery

03:57 - True 3D... is it coming?

05:25 - 3D for ArcGIS Pro roadmap

06:55 - Merges, intersects, and subtract operations on B-REP geometries

08:18 - Is Augmented Reality coming to ArcGIS?

09:16 - Support for extruded polygons in Portal for ArcGIS

10:06 - Best practices for LIDAR-2-multipatch procedure

Introducing *Esri Ten For*, a new video series on GeoNet where you can ask our experts anything. For each video our expert will select ten of your questions and answer them to their best ability.

First up is "Ten For a 3D Engineer" with **Nathan Shephard.** Nathan is originally from Bridgetown, Western Australia and has been working at Esri since 1999. He works on the Desktop Software Development Team and specializes in 3D GIS. He is also the inventor of Pixzel Puzzles, "the world's toughest word search puzzle game."

Questions

The winner of the Journal of Spatial Science award for the Best Professional Paper in 2015 is for the paper: ***Planning and visualizing 3D routes for indoor and outdoor spaces using CityEngine***, by Kyo-Hyouk Kim and John P. Wilson, published in Vol. 60, Issue No. 1

John Wilson | jpwilson@usc.edu | http://spatial.usc.edu