Digital Craftsmanship: Digital Fabrication Techniques for Custom Designed Landscape Elements.

Session Description
Digital craftsmanship allows designers to shape the most complex and artful forms from stone, pre-cast concrete, and metal in a process that reduces fabrication time, making custom elements more affordable for clients. The key is knowing how to use 3D modeling to your advantage.

Learning Objectives
1. Gain insights from built project examples in the US, UK and Italy.
2. Identify the best software and how to transfer the 3D files to a fabricator.
3. Learn the process behind making a pre-cast concrete mould from a 3D file.
4. Learn how to fabricate complex pieces of stone using 5-axil CNC milling techniques.
5. Learn how to fabricate custom metal site furniture and structures.

Further Information
http://ecards.aecom.com/landscapes/
http://www.coldspringusa.com
http://www.landscapeforms.com

(Continued)
The completed design.

Continuous seating encircling a water-skin covered plaza, which can be drained for large events.

Fabrication with Pre-cast Concrete – Case Study: Piazza Gae Aulenti, Milan, Italy. Completion 2012. On-structure mixed use development.

Seating modelled in Rhino. The design intended to stimulate a range of social interaction, its sinuous form referencing the curves of Italian fashion models.

Seating segmented to form a series of custom modular units.

Design optimized to reduce pre-cast module types, reducing cost by limiting the number of individual moulds needed to be fabricated. Moulds fabricated by CNC milling each module in high-density foam, then using this ‘positive’ form to create a ‘negative’ fiber-glass mould using standard methods.
Completed project.


Scripting used to generate complex paving pattern, saving time and enabling high degree of design refinement and cost certainty.

Script worked by: 1. manually drawing splines, with these forming the center lines for the paving; 2. paving generated by script; 3. quantification: Each paver was draw as a block enabling exact quantities to be counted then exported to AutoCAD, reducing uncertainty with costing.

Use Grasshopper plug-in with Rhino: Automating the modelling of complete objects, enabling greater creative freedom and design refinement.
Design optimization – the script enabled design options to be quickly generated and tested.

Completed project, with the paving pattern responding to desire lines and acting as a way finding device.

A rich ground plane even when filled with shoppers, using 3 granite paver sizes and 3 colors.

Scripting as a Design Tool – Case Study: Sacramento Entertainment and Sports Complex. Completion Fall 2016. Proposed arena for Sacramento King’s NBA team with mixed-use development and civic plaza.

Grasshopper used to generate paving for the entire site.

Use of Grasshopper simplifies the scripting process, enabling the design team to use this in-house as a design tool.

Design refinements generated in real-time. Varying degrees of dark paving highlights tested using a slider.
Using Grasshopper to modify the entire paving pattern for the project, to quickly make Value Engineering design options and modifications. 

Case Study: Intuit Corporate Campus, Mountain View CA. Completion 2013. Reimagining a 1980’s business park to form a unified campus, increasing open space, decreasing water use and putting the pedestrian first. Extensive use of digital fabrication techniques, including; CNC milled granite for a series of water features (fabricated by Coldspring); CNC moulds for pre-cast concrete seatwalls (fabricated by Quickcrete); digitally fabricated metal stage canopy (fabricated by Landscape Forms). 

Completed design at night. 
Image: Weinberg-Clark Photography

Complex curved stone water wall, which could only be effectively cut using CNC milling. 
Image: Weinberg-Clark Photography

Using laser cut model making techniques to create the design for a full size metal canopy, by slicing a 3D model into sections. Fabricated by Landscape Forms, Studio 431.

Rain garden seating design. Rhino model and laser cut physical model.

Detail of polished Mesabi Black granite seating, CNC milled by Coldspring. 
Image: Weinberg-Clark Photography
**Fabrication Part 1: Working with Natural Stone**

Rick Schmid, Coldspring

I. Control of creativity and design
II. Communication and coordination
III. Cost saving and effective fabrication times
IV. Transferring designer information
V. Digital CNC fabrication
VI. Fabrication methods

**Bio**

Rick Schmid has worked and excelled in the natural stone industry for 34 years. He attended St. Cloud Technical and Community College earning a degree in Sales and Management and Architectural Construction Technology. Rick currently specializes in developing and optimizing processes for CNC fabrication. His expertise includes digital file development, process planning and developing CNC tool paths. Recently he completed a digital sculpting process allowing a true digital only path to create sculpted works in natural stone. Rick holds a membership with the Society of Manufacturing Engineers.

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More info
http://www.coldspringusa.com

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**3 Axis motion, X, Y, and Z**

The maximum movement in each direction, X, Y, and Z will define the “Working Envelope” of the machine. This box area will determine the maximum piece size that can be processed. A typical Countertop grade machine will be very limited in Z (height) capability.

**5 Axis definition**

“Interpolated Axes” All 5 Axes can move at the same time giving smooth efficient movement

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While the saw is rotating around the C axis, the X and Y axis are moving in coordination to keep the contact point of the blade in the proper orientation. Each step in the Z axis movement the B axis rotates to keep the blade orientation perpendicular to the stone surface. Similar operation with a tool. The tool will remain perpendicular to the surface as all axis move in a sweeping motion. Many variables come into play when programming in 5 axes, making programming difficult and increasing the chance for a collision or error.
Fabrication Part 2: Working with Metal and Wood

John Shimer, Landscape Forms

I. Transferring design info to manufacturer
II. 3D site scanning
III. Manufacturing process
IV. Engineering considerations

Bio

John Shimer is the Engineering Team Leader for Studio 431 at Landscape Forms, and has been a member of Studio 431 for six years. He brought to the team valuable experience as product designer working on projects for the medical, automotive, and furniture industries. John’s ability to balance design with manufacturability has given Studio 431 an edge within the custom site furniture market. John has a degree in CAD/Engineering Design and has been a Certified Solidworks Professional since 2007.

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More info

notes area on back
Transferring design information
- Submittal Drawings - milestones

Concept to Reality
- Transferring design info to manufacturer
- 3D site scanning
- Manufacturing process
- Engineering considerations
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Material Options
- Supports – Cast Steel
- Stainless Steel or Carbon Steel?

Manufacturing Process Options
- CNC Wood Processing
- CNC Rolling/Forming
Manufacturing Process Options

- CNC Laser Cutting
- High Performance Welding

Concept to Reality

- Transferring design info to manufacturer
- 3d site scanning
- Manufacturing process
- Engineering considerations

Engineering

- Load Testing
- FEA Analysis
- BIFMA / ASTM Standards
- Structural Stamps

Notes