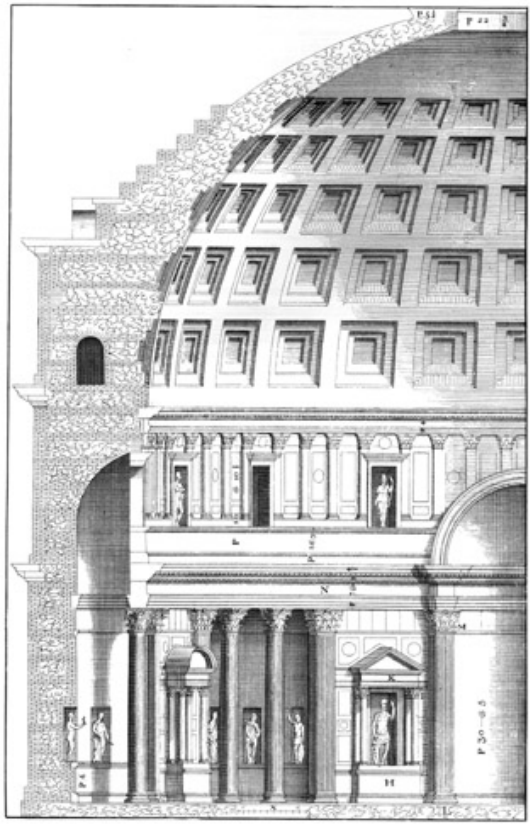
IAAC BUILDs - OTF 2018 - Workshop #3 Brief

Materiality challenges



Ref: Pantheon, Rome

Context

This workshop is the occasion to look at the question of materiality in architecture.

Additive manufacturing of multi-material open the possibility to carefully design the material distribution over geometries, taking advantage of the wide pallet of material available to build architecture. The relation between form and material distribution have structural, thermal and aesthetic implications yet to be explored.

This workshop will examine in particular the structural implications that multi-material design might have for architecture. We will explore this topic by using again the methodology of catalogues of forms, including this time the variation of materiality by introducing colour gradients in our 3D modeling tool.

The first catalogue will focus on revisiting previously developed surfaces and volumes with a simple gradient of material density in Z direction. The second catalogue will explore different material pattern using one surface from the first catalogue. The third catalogue will be a similar exploration on a volume from the first catalogue.

Finally, the workshop will conclude with a series of pattern logics based on structural assumptions.

Workshop objectives

1. to model simple gradient material adapted to a variety of geometry > catalogue 1
2. to model complex material patterns over surfaces and volumes > catalogue 2 & 3
3. to define a design methodology to allocate various materiality for structural performance.
4. to 3d print multi-material structures with the dual extruder and the small robotic arm.

In groups of 3/4, design and model catalogues of 12 geometries.

Catalogues / Givens

Givens:
Bounding box: X = 100 mm Y = 100 mm Z = 200mm
Models labelled 1 to 12, spaced 200 mm in the Y.

Catalogue 1 : Materiality in Geometries
Based on previous work, create a geometry catalogue of cantilevered surface and volumes, exploring the ideal linear distribution of matter with different densities.

- Varying geometries
- Material pattern : gradient
- Material A (Red Clay / Black pixel) = Denser material
- Material B (White Clay / White pixel) = Lighter material

Catalogue 2 : Materiality in Surface Patterns
Select one surface iteration from Catalogue 1 and design a catalogue of surface patterns representing ideal distribution of matter with different compressive and tensile strength
Exercise :

- Fixed geometry : surface
- Varying patterns

Assumption :

- Material A (Red Clay / Black pixel) = Material working better in Compression
- Material B (White Clay / White pixel) = Material working better in Tension / Flexion

Catalogue 3 : Materiality in Volumes
Select one volume iteration from Catalogue 1 and design a catalogue of volume patterns representing ideal distribution of matter with different drying / shrinkage properties.
Exercise :

- Fixed volume
- Varying patterns on internal surface

Assumption :

- Material A (Red Clay / Black pixel) = Drying faster / smaller retraction but lower strength
- Material B (White Clay / White pixel) = Drying slower / higher retraction but higher strength

Faculty roles:

Alexandre – workshop coordinator and structural advisor
Edouard – geometrical advisor
Kunal – machine, material and monitorisation coordinator
Joaquim –
Marco – daily check on workshop coordination

Calendar

Mon	10-11 :	- Introduction to workshop 3 + Material research review	//Alex +Joaq. + Kunal
	10:30	- Guest presentation Ricardo	
	12-14	- Modeling catalogue 1 : Gradient Surface	
	by 16	**> submission of the .dxf file for structural analysis**	
	16-20	- Tutorial ABB	//Kunal
Tue	10-14	- Printing Catalogue 1	
	by 14	**> submission of the presentation W3 - Review 1**	
	16-17	- Review Catalogue 1	//Alex + Kunal
	17-20	- Design Catalogue 2	
Wed	10-14	- Design & Printing Catalogue 2	
	16-20	- Printing Catalogue 2	
	by 20	**> submission of the presentation W3 - Review 2**	
Thu	10-11	- Review Catalogue 2	//Alex + Kunal
	11-14	- Design Catalogue 3	
	16-20	- Printing Catalogue 3	
	by 20	**> submission of the presentation W3 - Final Review**	
Fri	10-12	- Workshop Conclusions	//Alex +Joaq. + Kunal
	12-14	- Material research Extrusions	//Joaquim + Kunal
	16-20	- Material research Extrusions & ToolKit	
	by 20	**> submission of the Materiality Toolkit**	

Logistics

Clay printing material is provided by IAAC
Camera, Tripod and millimetric paper background to monitor the structural failure of the prints will be set up by students (with the support of Kunal).

Deliverables

By Thursday 8th of October 23h59 Each group will fill in the common presentation "Workshop 3 - Materiality Catalogues" , containing the following documents:

1. For each catalogue, 1 isometric vectorial drawing, following the typical OTF projection angle. (use the "make2d" command with the "hidden line" option activated, have the surface and the contour "switched on".) Indicate the variations of materiality using a gradient map of color from Red Brick to Brown brick.
2. For each catalogue, one selected geometry, featured in an annotated drawing comprising plan section and isometric projection. Include data such, axis surface area, total tool-path length, printing time, amount of material A, amount of material B., Total proportion
3. 4. Orthographic photography of each print.
4. 60' videos of the printing and testing. Optionally you can combine it with a digital animation from rhino.

Each group will also upload this same material in the google drive folder
"Workshop 3 / [Group Name]"

By Friday 9th of November 23h59, Each one should contribute to a common presentation "Materiality ToolKit" uploaded on the drive with at least 5 pages, each summarizing a point of conclusion with :

- 1 Material properties
- 1 Geometrical distribution logic
- 1 Sample geometry
- 1 Text description

References

- 1999, MIYAMOTO, Functionally Graded Materials: Design, Processing and Applications
- 2009, HILLER, Design Automation for Multi-Material Printing
- **2012, OXMAN, Functionally Graded Rapid Prototyping**
- 2014, GRIGORIADIS, Mixed Matters The Problems of Designing with Multi-materials
- 2015, BRESEGHELLO, A Performative Approach To 3D Printed Architecture
- 2017, GRIGORIADIS, Mixed Matters: A Multi-material Design Compendium