

Why MEL?

Why MEL?

Approaching Algorithmic Design with architecture students

Richard Dank

Why Creative Programming?

The demand today is plain obvious:

- Automation of recurring routines.
- Self-determined access to information processing.
- Advanced Digital Design.
- New building and constructing methods.
- ...

But moreover:

- **Investigate alternative strategies to explore ideas and develop conceptions.**

And most of all:

- **Enhance the mode of thought.**

At the end of the day for master design studio students **improving the design tools** - or rather upgrading the design strategies - **turns out to be far more rewarding** than designing one good building or a reasonable urban scheme.

Digital vs. Computational

John Maeda argues:

"Most of the parties involved do not realize that **computers, as they are used today, have nothing to do with design skill, or design education for that matter.**"

"Mechanical skills have taken secondary importance to the skills required to use complex software tools. But what is the nature of these digital skills, and more importantly, are they really of any significance?"

These skills "are nothing more than knowledge, and that we implicitly glorify rote memorization". **But "the true skill of a digital designer is the practiced art of computer programming, or computation".**

[Maeda, J. (2001). Design By Numbers. Cambridge: MIT Press.]

Enhanced creativity

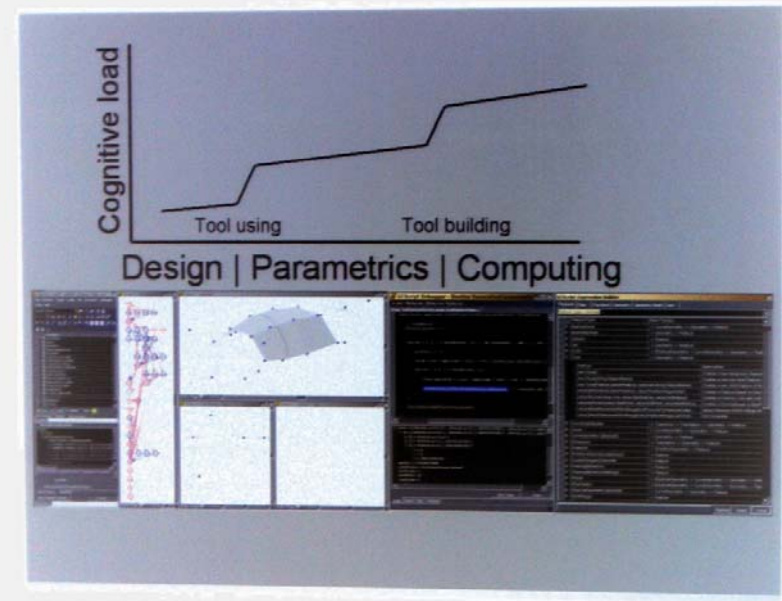
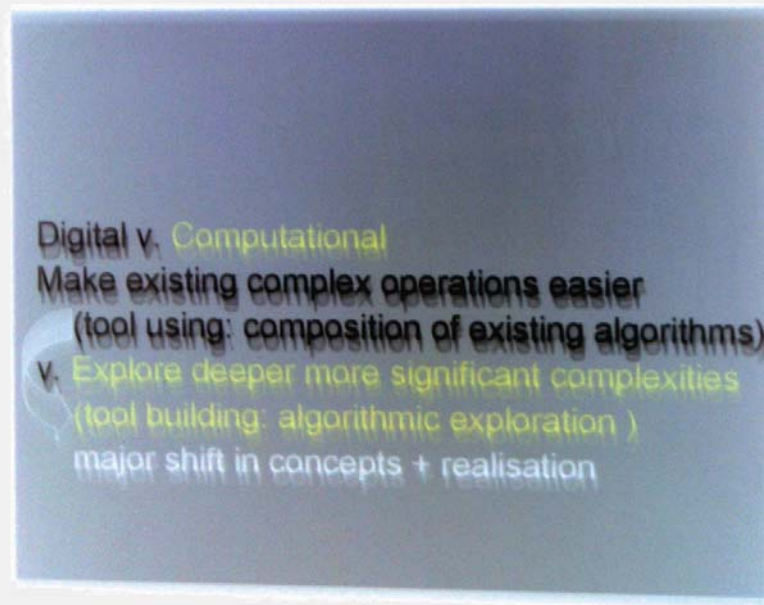
And Robert Aish at the Game Set and Match II Conference:

"Digital [...] makes existing complex operations easier".

"Computational [...] explores deeper more significant complexities".

Dank, R. (2006). ryugyong.org. Master thesis, Graz University of Technology.

Either draft comparatively straightforward and obtain a certain result. Or use the computer to combine raw scripting skills "with your enhanced creativity, and the result will be unique explorations of the digital medium that fully exploit its true character".



Alphanumeric code

Following Scott McCloud:

Scripting - converting into code - can be assumed to be the most abstract coevally most precise way of describing.

[McCloud, S. (1993). Understanding Comics. New York: Kitchen Sink Press.]

Scripting compels you to ponder thoroughly. It makes you distinguish between the hard and the soft facts - and their relationships. The way to a fully working digital sketch is never linear. It forces you to precisely formalize your general set-up and all your framework conditions. It opens up a large field of possibilities and does not just accelerate customary approaches. And if creativity is solely situated in the right cerebral hemisphere, it will also set your left mathematic-logical part on fire.

Algorithmic Thinking

I claim that **people who had first hand experience with typing their own Creative Code subsequently have higher control of their proceedings** and finally better understanding of their results even when planning on a sketch roll or out of their scrapbook.

How to get there?

Plaintext programming!

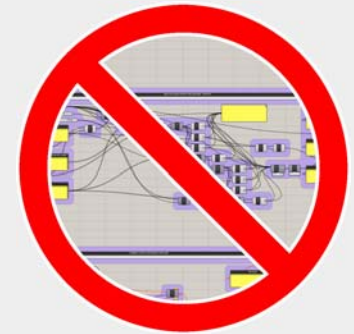
Not with: Graphical editors, tools or plugins.

The point I am trying to make in the end:

Scripting must be MANDATORY in any architects' education in this new millenium!

Demonstrate:

An effective, juicy and playful process to **take the first few steps into algorithmic design.**

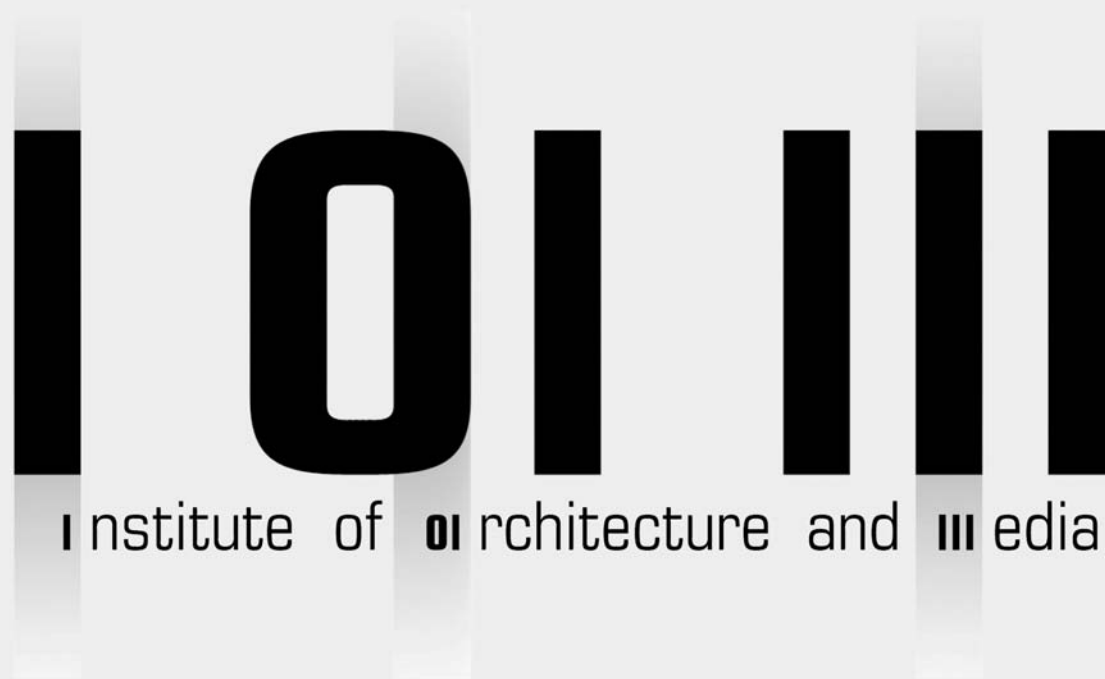


IAM

IAM

Institute of Architecture and Media

iam.tugraz.at



Focus of the IAM

The impact of **Algorithmic Design** on architecture.

How did, does and will the computer change the way architecture is produced AND perceived.

Profund knowledge in geometry, 3d-construction and rendering is the starting point. But **generative methods, iterative processes and parametric manufacturing** - or generally non-linear approaches with open and unbiased offsprings - are the aims beyond that. We try to explore the Turing machine's inherent opportunities and prospects.

We group our efforts in two focus areas:

"Augmented Architecture" - the ephemeral aspects, if you will - and **"Digital Fabrication"** - non-standard engineering.

Graz University of Technology

Faculty of Architecture consisting of 12 institutes.

~2000 (31% incoming) architecture students.

IAM's education at the bachelor program

Compulsory courses:

DG - Descriptive Geometry

DMO - Methods of Presentation

DM1 - Digital Methods of Presentation

DMLECT - Digital Methods Lecture

DM2 - Digital Design Methods

Elective courses:

WKS1 - Workshop 1

WKS2 - Workshop 2

WKS3 - Workshop 3

ESPEZ - Design of Specialised Topics

IAM's education at the master program

Compulsory courses:

STUDIO - Integral Design Studio

Elective courses:

ARCHFILM - Video Sense

ARCHIMG - Architectural Photography

ARCHVIS - Architecture Visualisation

DFAB - Digital Manufacture

DFORM - Digital Form and Motion

IM - Interdisciplinary Media Projects

INFOVIZ - Information Visualisation

SIMTECH - Simulation Technology

Digital Tools

In the end of each course second year students (and higher) should **have developed their own "digital tools"** - as we call them - for the realization of their projects. They need to originate their own applications - mainly (plain-text) scripted programs.

No preconceived strategies are desired - no predefined output is allowed. **Students must design the process and not the result.** (Though in the end a fully implemented working sample must be submitted.)

But the tools are only on the one hand digital. On the other they need to build/assemble the 'hardware' on their own, too - eg. lasercut, 3d-print or mill objects, scrutinize open-source electronic prototyps, (mis)use cutting-edge machines, ...

Build the tools you use ...

Master students at the IAM must "**build the tools they use and use the tools they built**" themselves. They need to establish their personal tool kit for their ideas.

We support them in finding ways off the beaten track. We point out that (digitally generated) **architecture should not be limited by existing software** and/or plugins.

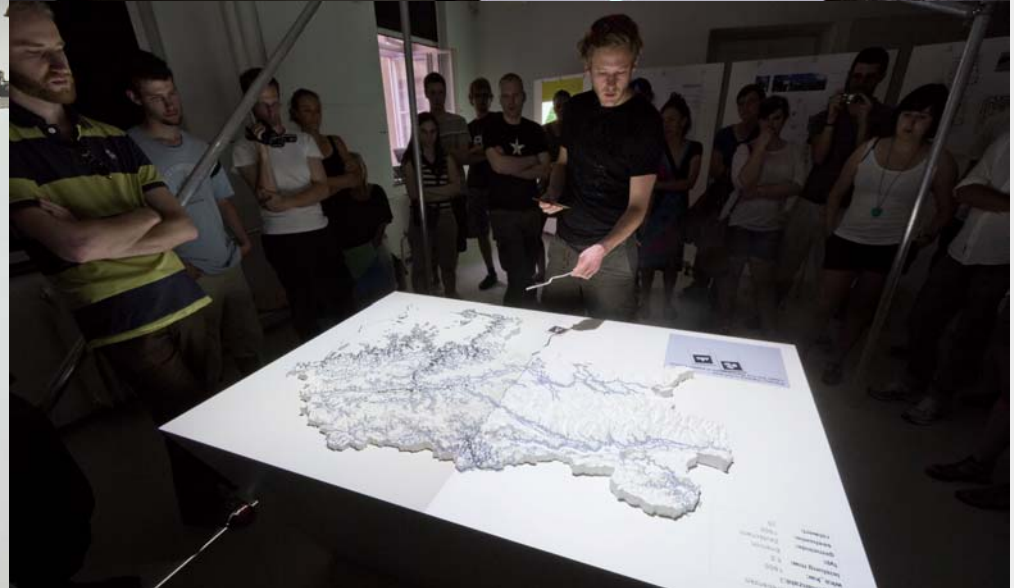
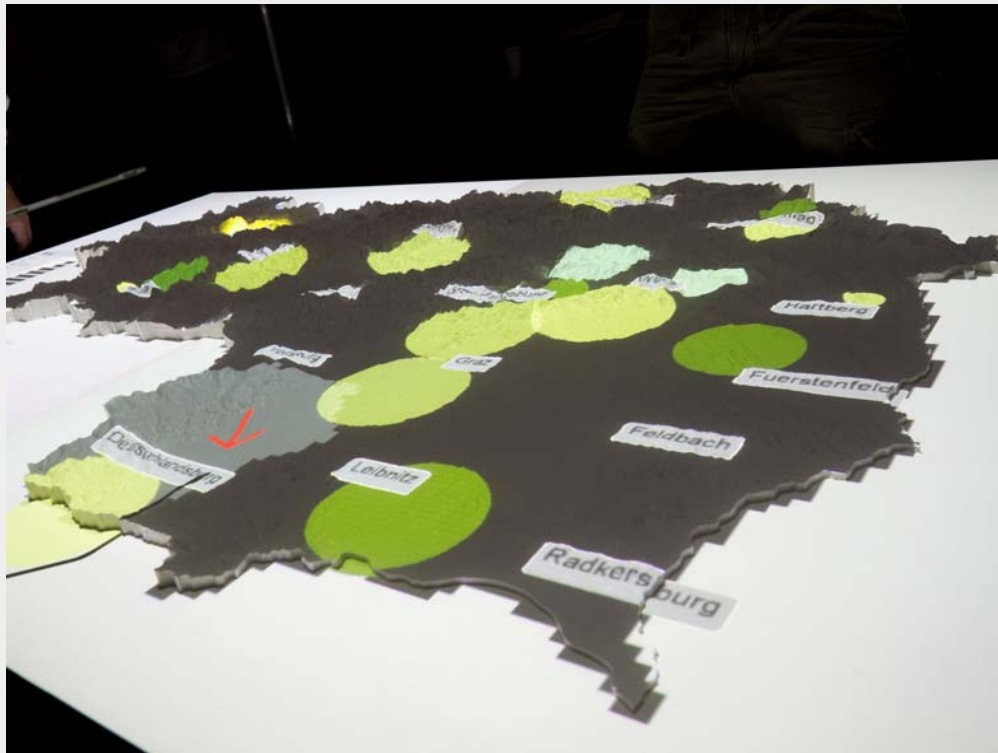
Algorithmic approaches bust those borders and restrict the possibilities only to their creativity and the stringency of their concepts.

But how could one be prepared for that?

"Augmented Styria Desk"

Design Master Studio 2010

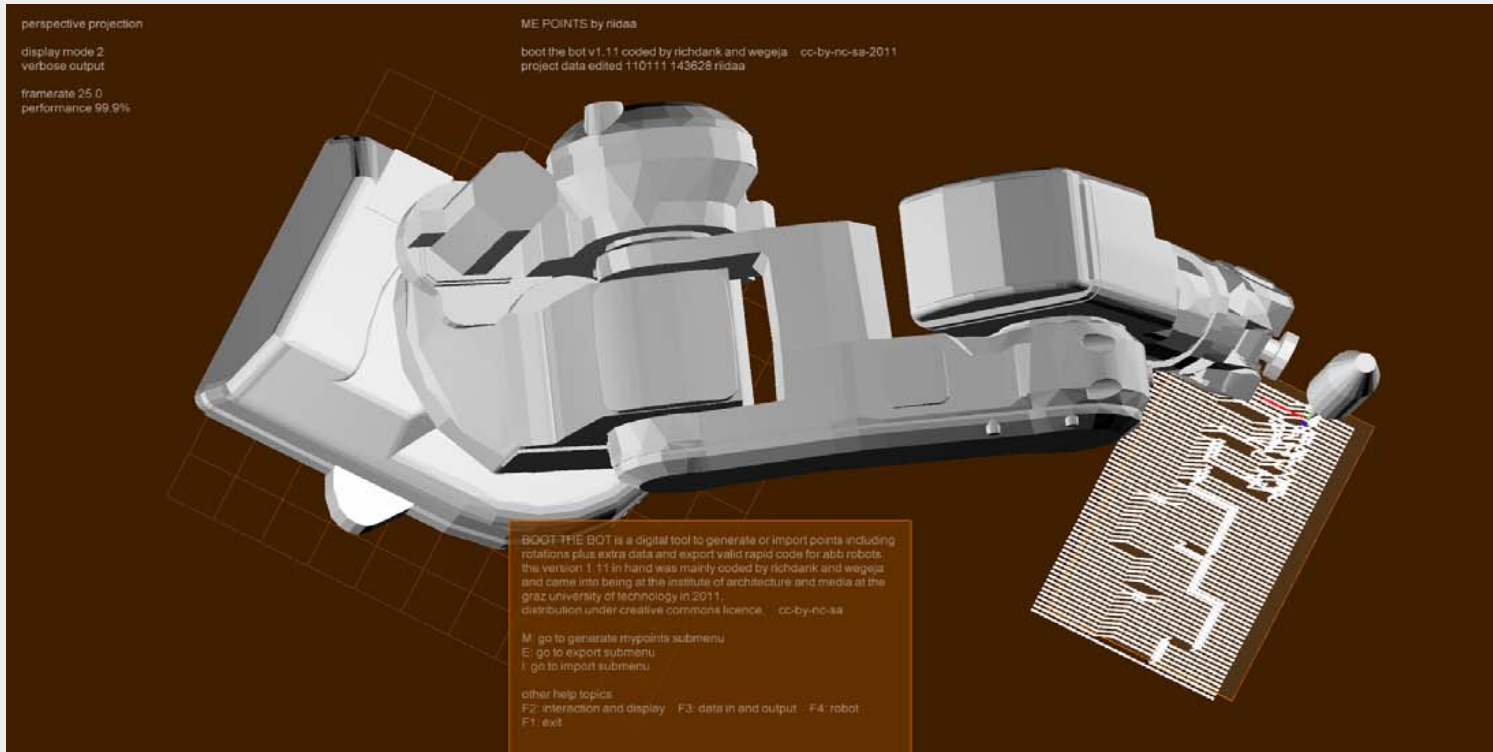
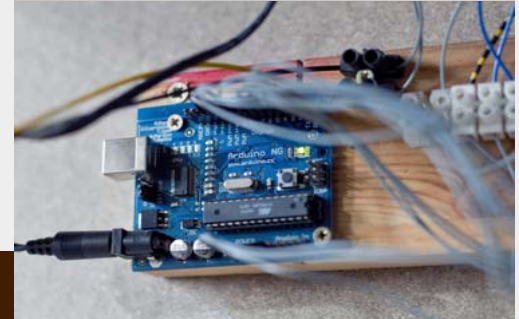
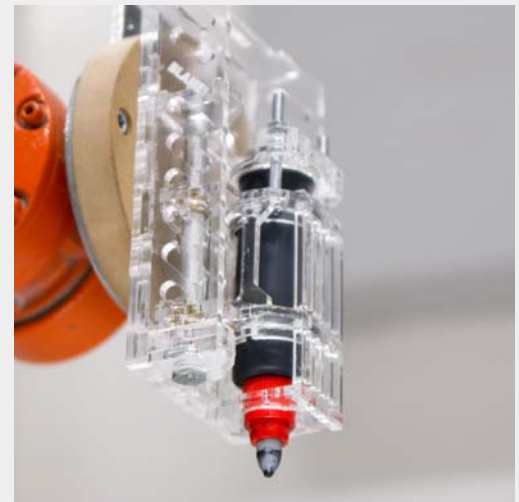
Augmented Architecture



"Boot the Bot"

Design Master Studio 2010/11

Digital Fabrication



Now seriously, why MEL?

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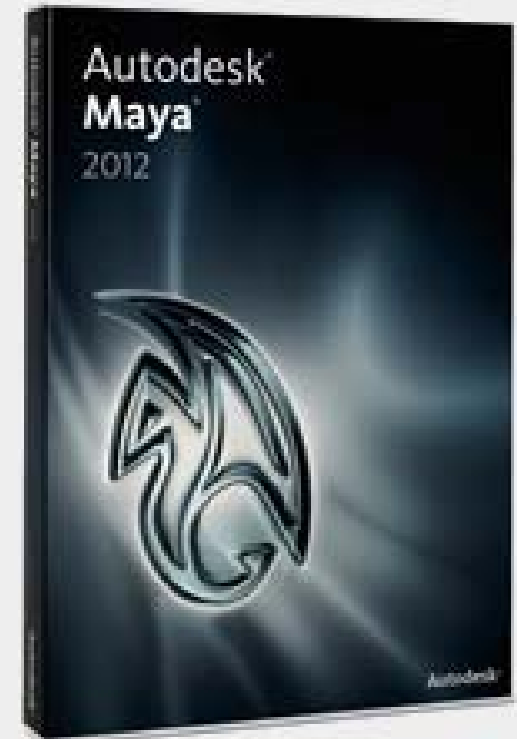
"MEL is a scripting language at the heart of Maya."

[Autodesk. (2010). MEL and Expressions. In: Maya Online Help.]

This means you can control the complete software package and even access advanced features, as opposed to many parametric graphical editors, which have their natural limits.

Above all the modus operandi and the syntax are rather universal, so one can easily switch to many other scripting and general-purpose languages. **MEL-dexterity scales big time!**

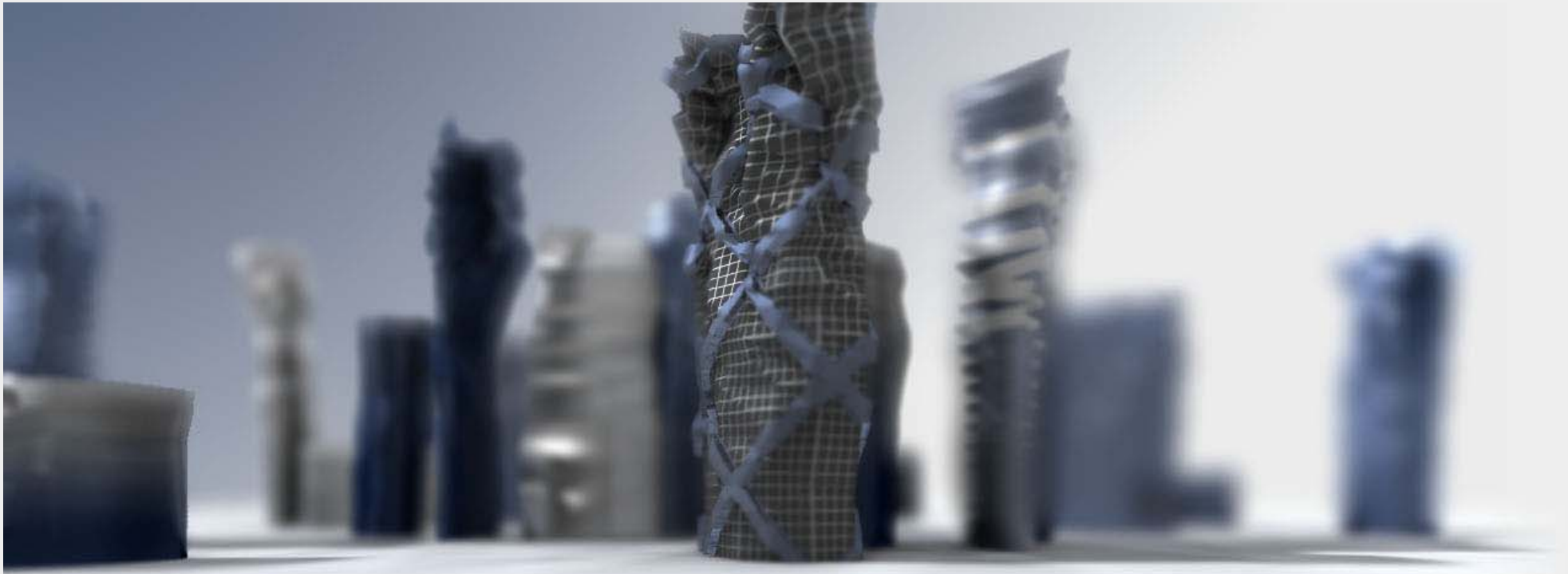
And finally it is apparent that **Maya is fitting architects' requirements perfectly** as it essentially is a 3D modeling, animation, and simulation application.



"TUERME.n"

"TUERME.n"

Digital Design Methods 2008/09



"TUERME.n"

That year we were experimenting with 370 students on **algorithmically generated high-rise constructions.**

"TUERME.n", a pun in German for "towering up" and furthermore indicating n (a whole lot of) towers.

The aims:

- Erect **virtual edifices** and **clad them with parametric panels.**
- The subjacent skeleton and the individual facades should be **interchangeable.**
- Hence **Creative Collaboration** was another demand.
- Most of all: **Scripting from scratch!**

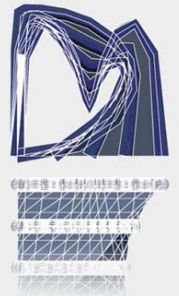
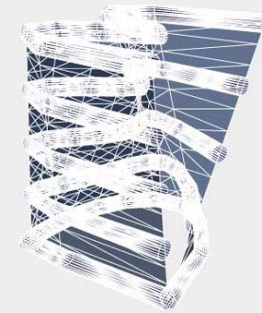
Block A

Maya - 1 seminar

Appetizer App to give a notion of the possibilities. Libraries and sourcing. **Generate basic skyscraper forms.**

"Morph"

MayaGUI (Prefs, Menu, Panels, Hotbox), Curves (QWERTY, ChannelEditor, MarkingMenu, Components), Animation (Blend), MEL (ScriptEditor, "nTowers.mel"), VectorRenderer



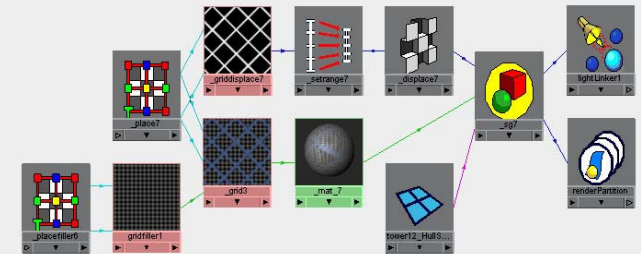
Block B

Mat+Map - 2 seminars

Introduction to Maya's attribute-node-coherence. Using the rendering capabilities and **shading network to produce facades.**

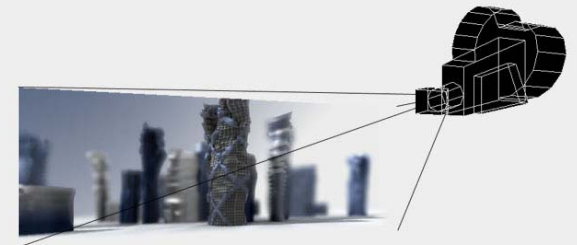
"Shading Network"

Polygons (Components, ConstructionHistory, Outliner), Materials (Hypershade, ConnectionEditor, AttributeEditor, ShadingNodes)



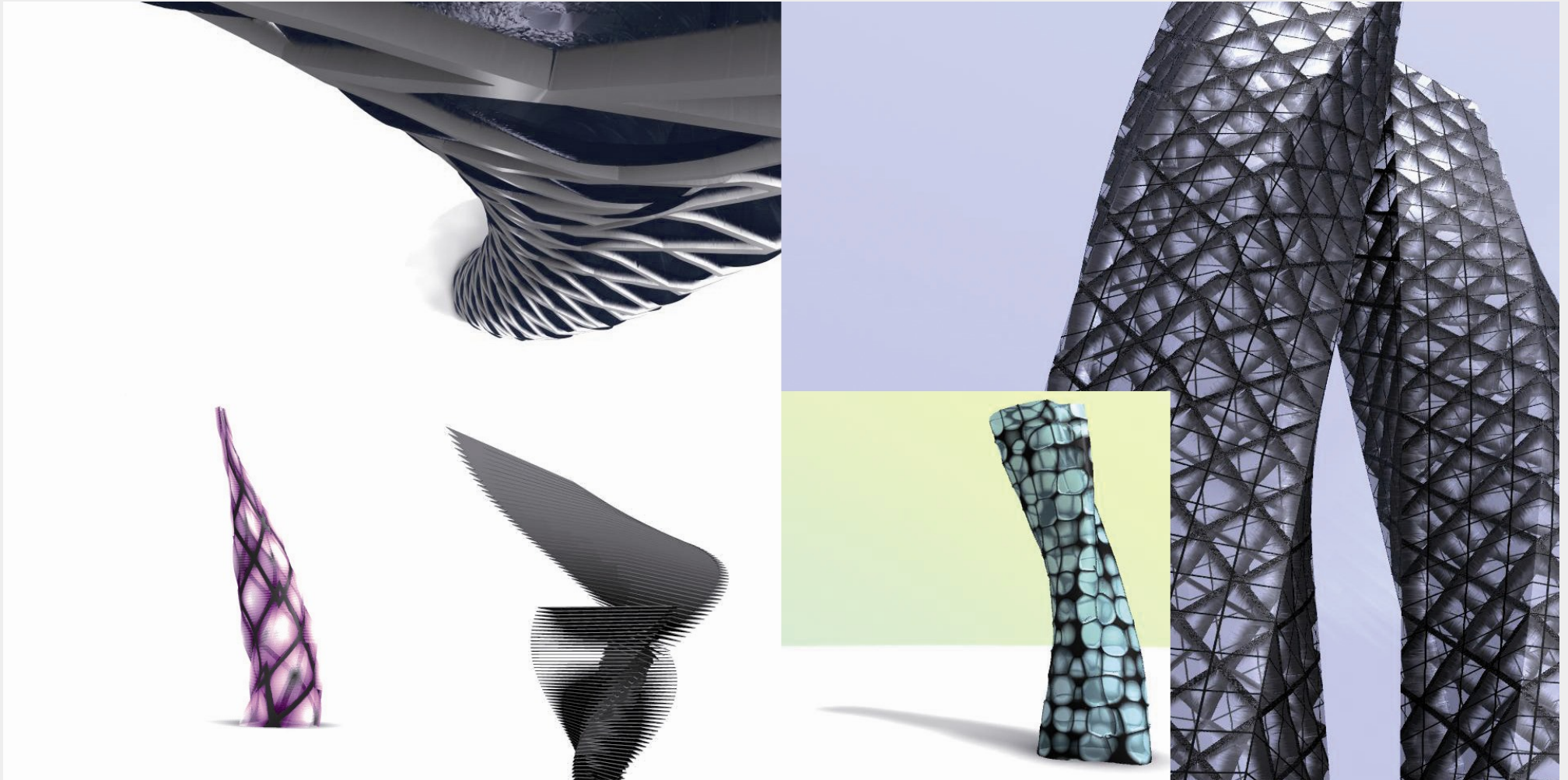
"Lights. Camera. Action."

Materials (ShadingNodes), Lighting (DirectionalLight, DepthMapShadows, RaytraceShadows, domeGI), Cameras (withAim, DepthOfField), MEL ("rbTowers.mel"), SoftwareRenderer



"Stack and Staple" + "rise high"

Assignment A + B



Block C

MEL - 3 seminars

The very basics of MEL. Variables and arrays, loops and conditions. **Prototyping panels, cladding the surface.**

"I00P"

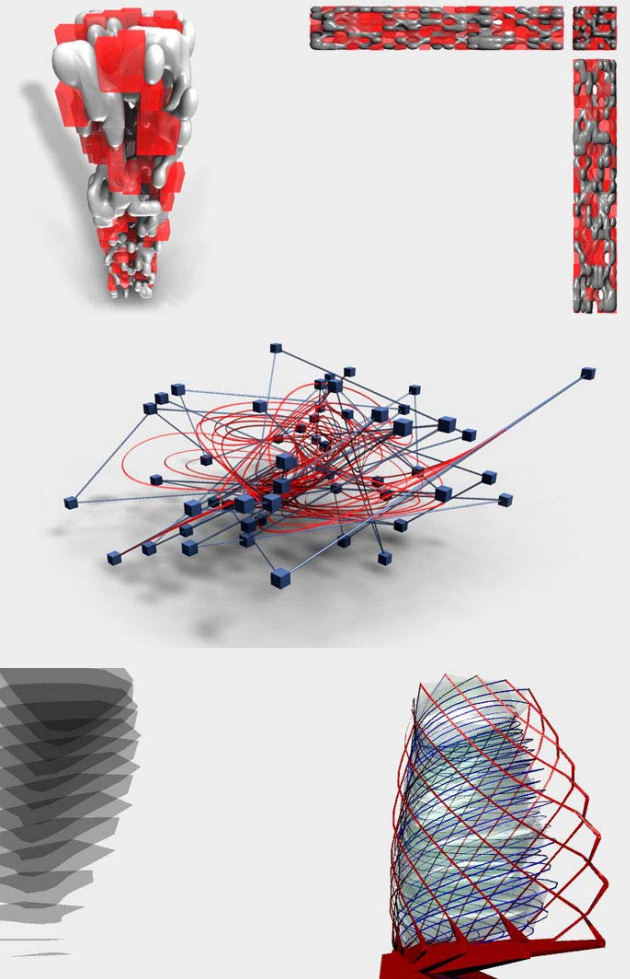
Introduction into MEL, ScriptingLogic, Variables (Type, Value), Loops (for), Conditions (if, else, Operators), MEL ("_library.mel")

"aRRay"

Variables (global, local), Eval, Arrays ([], size), Procedures (Arguments, Returning)

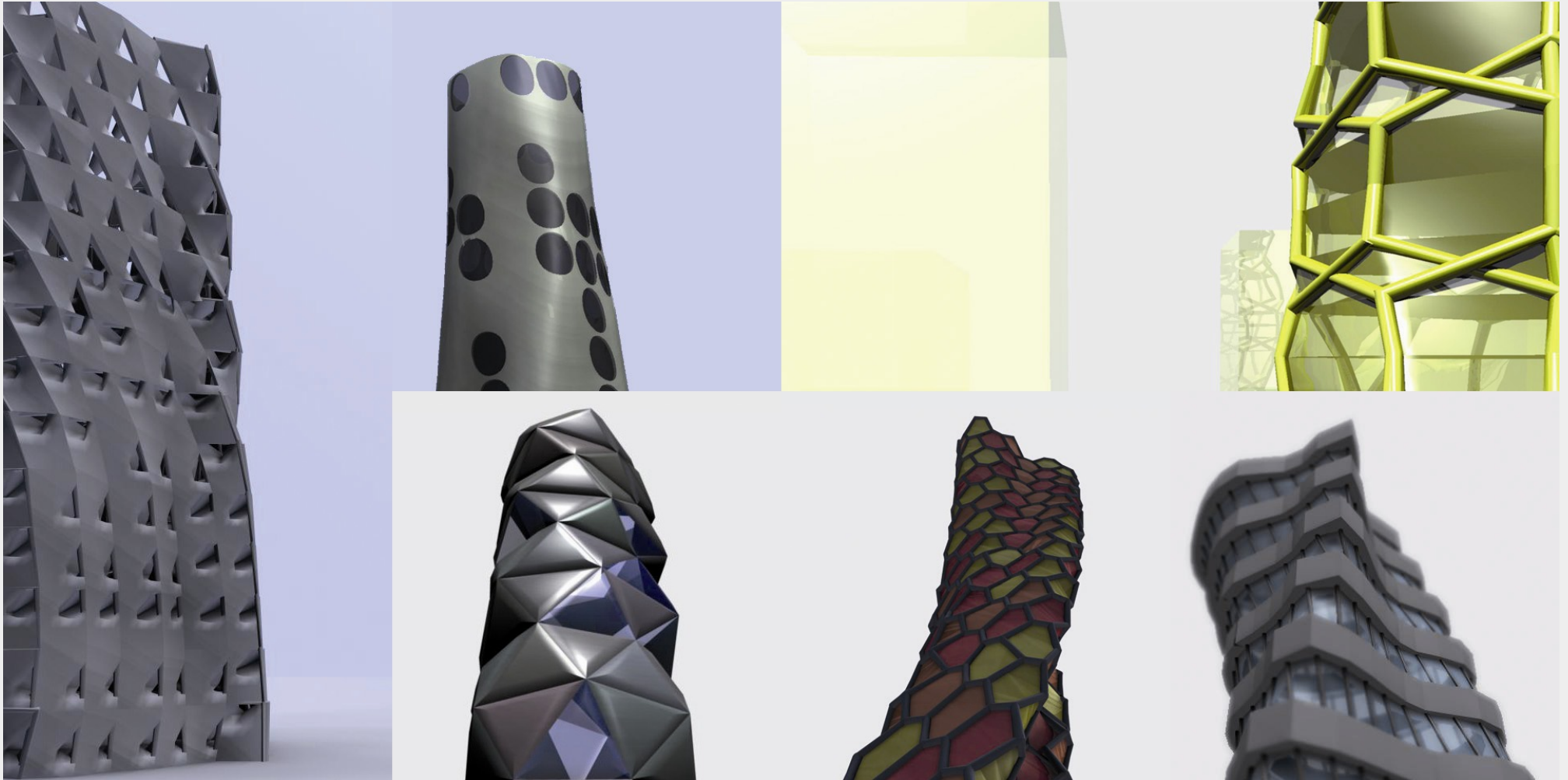
"MELism"

MEL SpecialCases, (noteable Banana Skins, Backticks, whatIs), xform, short Routines (Calculations, Angles, Coordinates, Lists, Curves, Surfaces), SampleScripts for Assignment C



"LIStProcessing"

Assignment C



Block D

MEL - 3 seminars

Procedures and expressions. **Making the façade responsive.**
Coded to be used "out of the box".

"Hands on Lists"

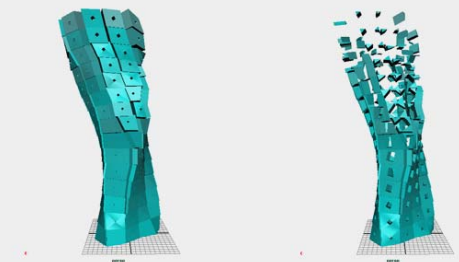
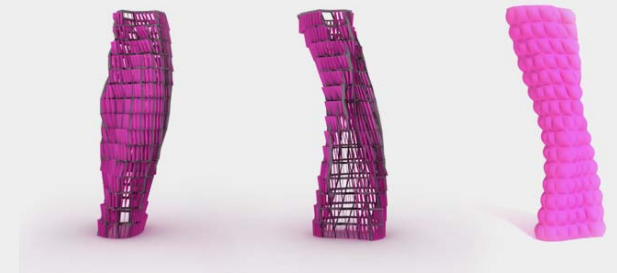
MEL (Repetition of Block C's contents, Developing own Routines, Access to Lists, "Kugler_und_so"), SampleScripts

"Interactive Panels I"

MEL (Repetition of Block C's contents, AttributeConnection, Expressions

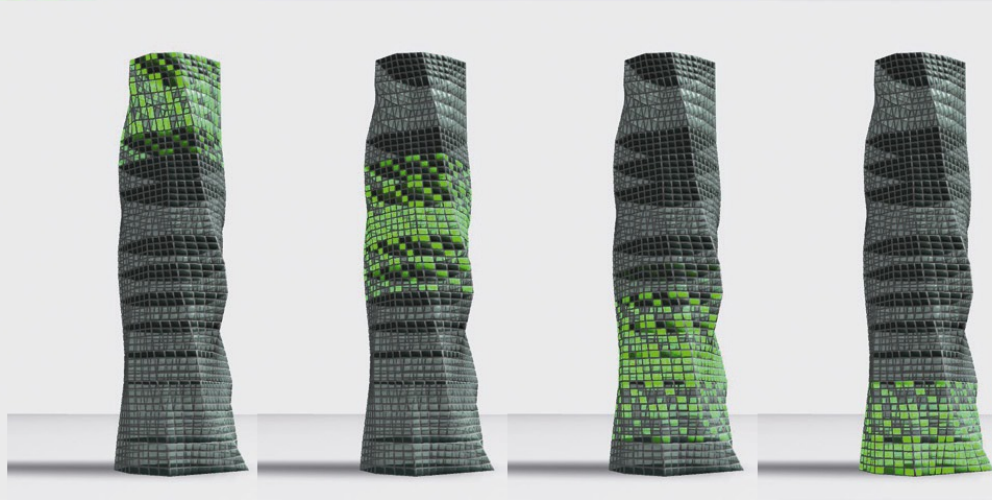
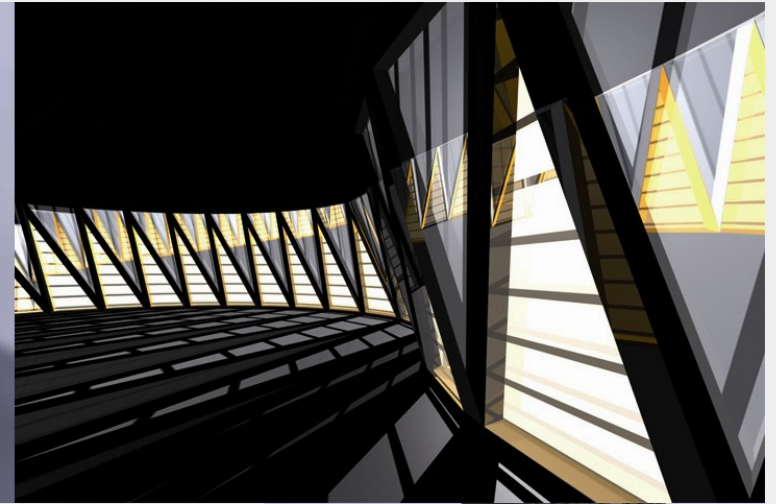
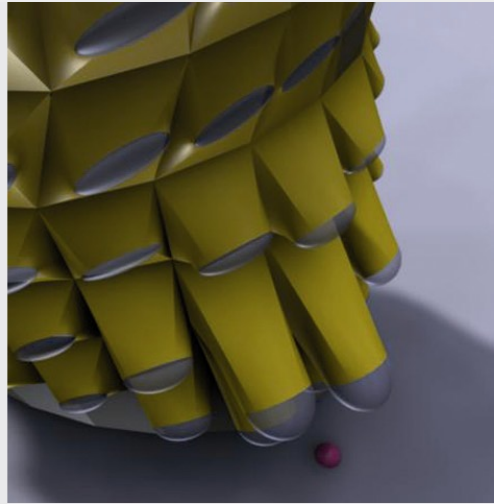
"Interactive Panels II"

theoretical and practical PreliminaryWork for Assignment D, 'LiveScripting', SampleScripts for Assignment D



"Parametric Panel"

Assignment D



Block E

Acrobat 3D - 3 seminars

A proper presentation with Acrobat 3D. **Documenting the evolution of the project.**

"OUT layers"

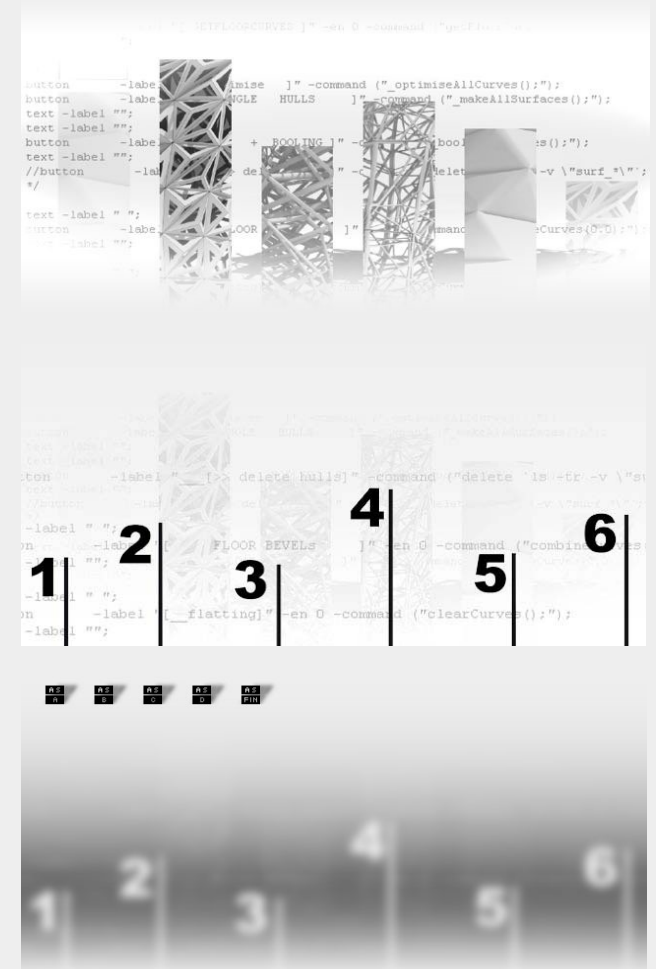
Illustrator (Introduction, Authoring, LayerOrganisation, Interpaly with CAD, PDF-Export), Acrobat3D (FormElements, Hyperlinks, Visibilities, Controls)

"ANI mate"

Maya (Grouping of Objects, DataExport), Acrobat3D (3D-DataImport, Configuration, Perspectives, Sections, Visibilities, JavaScript)

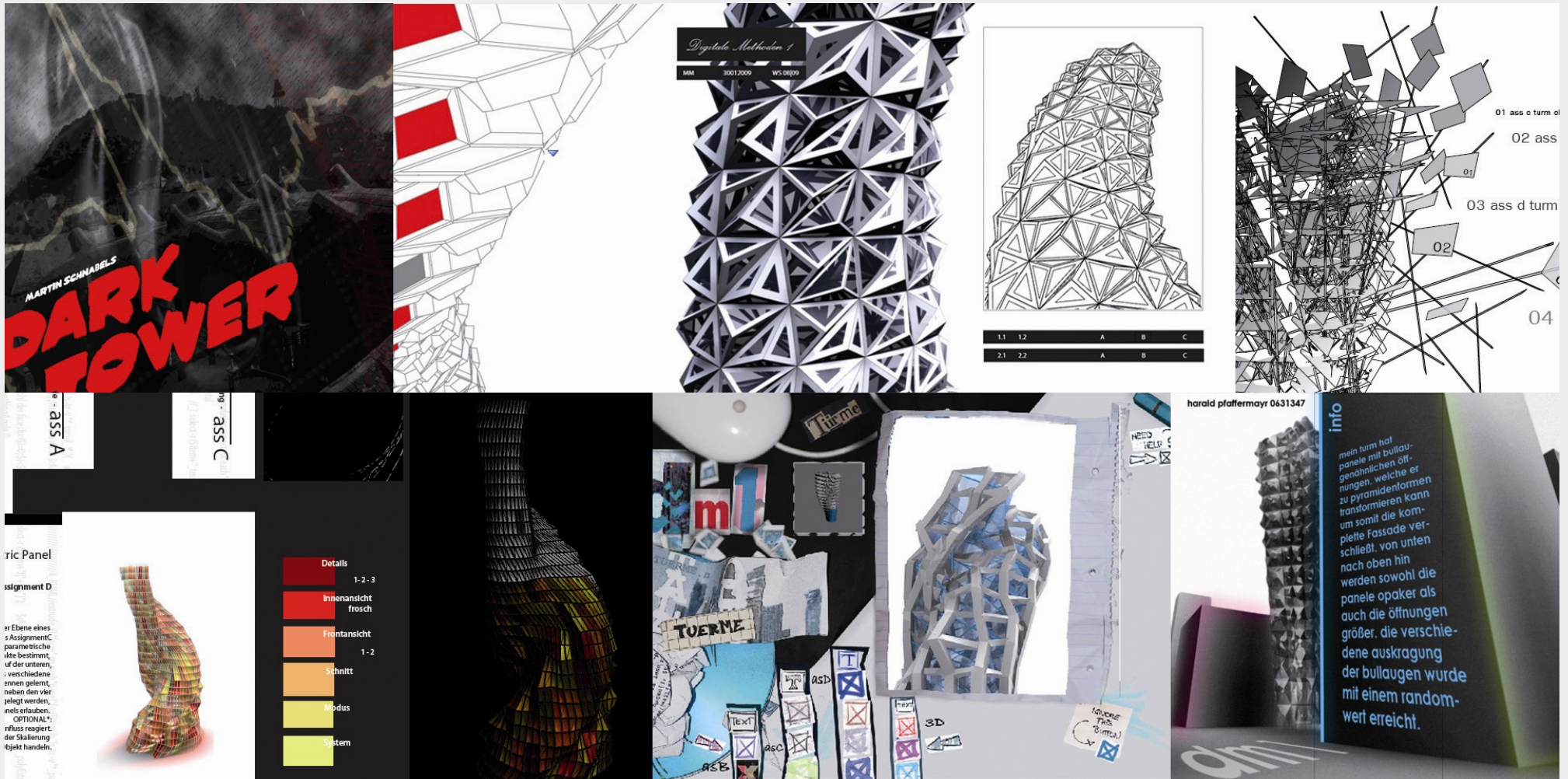
"Hyper-Narrative"

Acrobat3D (Repetition of the contents especially important for the Final Presentation), Maya (SpecialCases), Questions?



"Hyper-Portfolio"

Assignment Final



"parcours aventure"

"parcours aventure"

Digital Design Methods 2011/12



PARCOURS AVENTURE

"parcours aventure"

In the currently running semester we generate **bridges over ravines** - whereas "bridges" means any construction to cross a gap, and "ravines" are two points to be connected with the gap between. "parcours aventure" refers to the French term for a ropes course on the one and to the sport "parcours" - **focused on moving around obstacles with speed and efficiency** - on the other hand.

We use self-developed programs to be able to use **DEM-data and satellite-images to create the basic Maya-scene**. The sites selected are the Verdon Gorge, the Tycho Crater on the Moon, the San Andreas Fault and Manhattan's high-rise canyons.

The **final parametric connection must adapt directly** to the surrounding conditions - as the surface, the bridgeheads, ...

Workshops

New didactic system.

Instead of weekly input sessions and assignments that need to be done at home we condensed and intensified the approach. We teach two groups of students simultaneously - in "**Pair Programming**"-Mode with two lecturers in **four all-day-workshops**.

Friday and Saturday - **Episode0** and **Episode1**

the next Tuesday the week after - **Tutoring**

Friday and Saturday - **Episode2** and (final) **Episode3**

	DM2 W11		Wintersemester 2011/12		Mittwoch		Donnerstag		Freitag		Samstag		Sonntag	
Woche	08.00 - 09.00	09.00 - 10.00	08.00 - 09.00	09.00 - 10.00	08.00 - 09.00	09.00 - 10.00	08.00 - 09.00	09.00 - 10.00	08.00 - 09.00	09.00 - 10.00	08.00 - 09.00	09.00 - 10.00	08.00 - 09.00	09.00 - 10.00
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3.10.-7.10.11			VO						Block A Teil 0 Start		Teil 1			
10.10.-14.10.11			Block A Korrektur						Block A Teil 2		Teil 3 Final			
17.10.-21.10.11									Block B Teil 0 Start		Teil 1			
24.10.-28.10.11					Nationalfeiertag				Block C					

4 episodes plus 1 tutoring session

As we restructured the whole IAM-package the basics in plain Maya are no longer to be taught in DM2.

Episode0 - **scripting fundamentals** in MEL.

From variables and arrays to loops and conditions. Introducing our `_library.mel` and ending with addressing object-components.

Episode1 - **advanced strategies** in MEL.

Parametric generation of Maya objects and algorithmic assimilation of Rhino imported geometry.

Tutoring - additional **presentation and reviews** on the projects.

Almost two weeks for the students to enhance their work.

Episode2 - **final adaptations** in MEL, **rendering in Maxwell**.

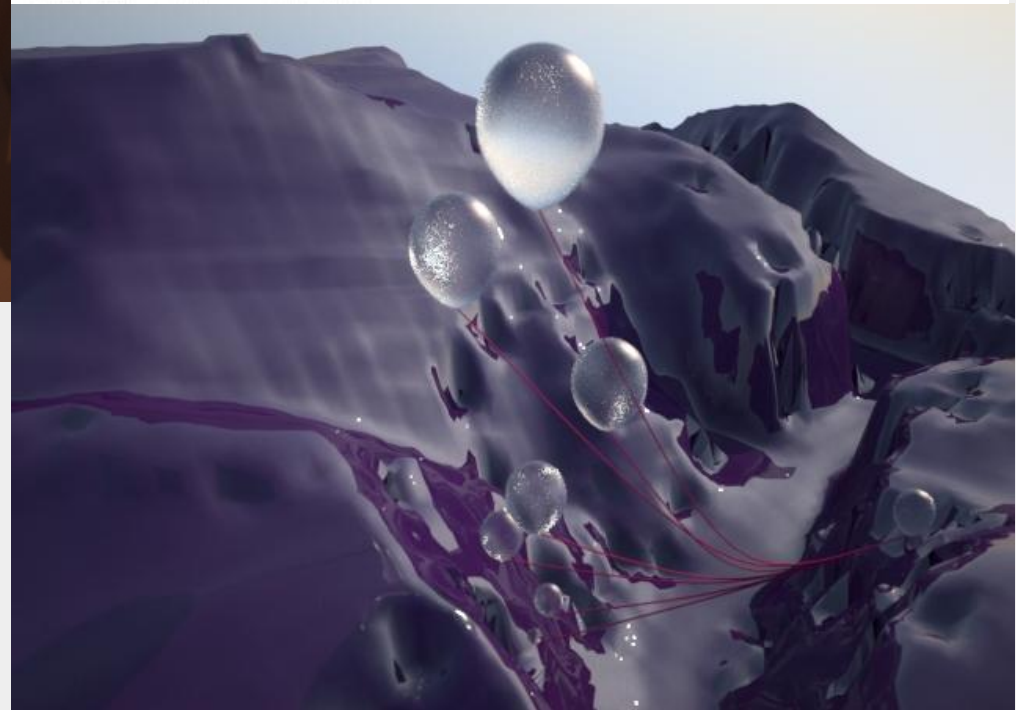
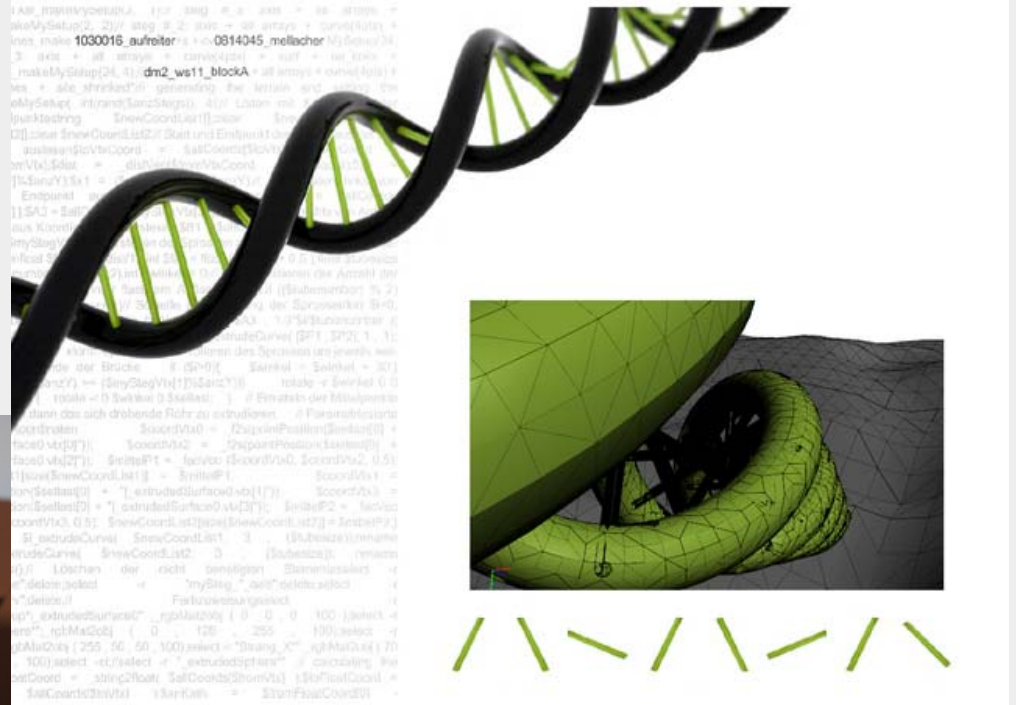
Using the cluster-nodes of the TU Graz to produce high-quality images of the projects.

Episode3 - **interactive 3D PDF and final presentation**.

Giving the hard work a proper windup.

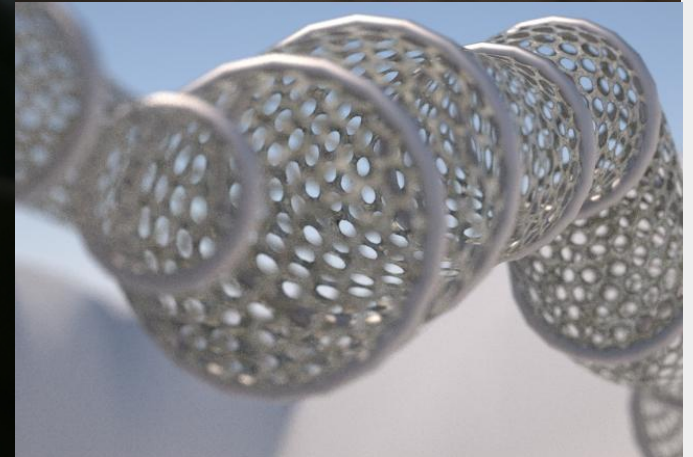
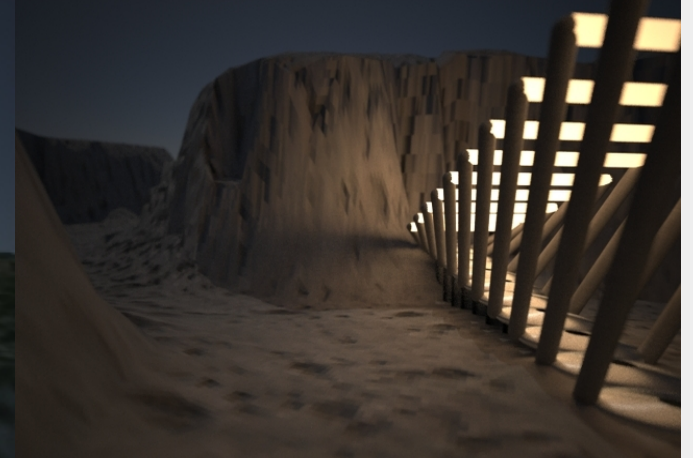
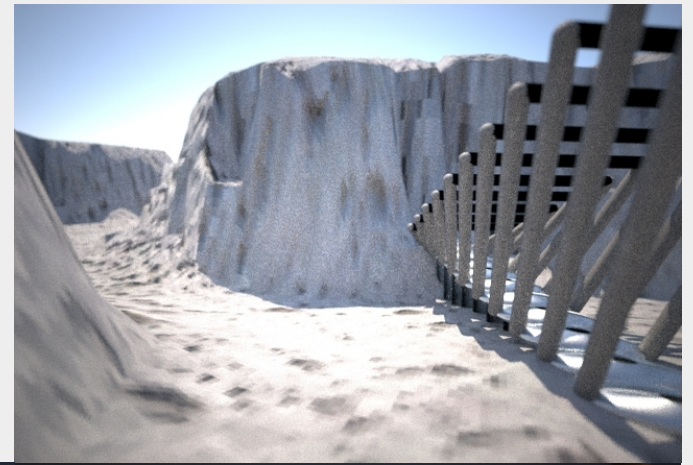
Verdon Gorge

Final projects



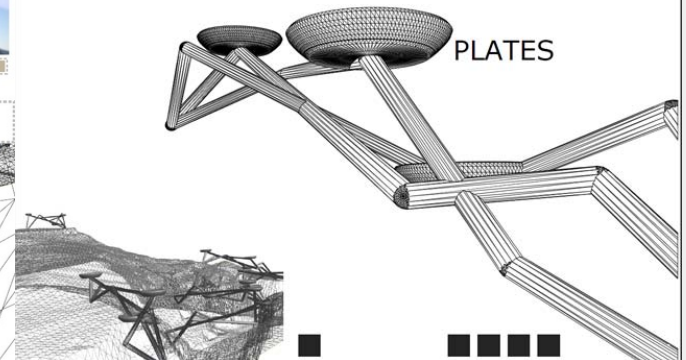
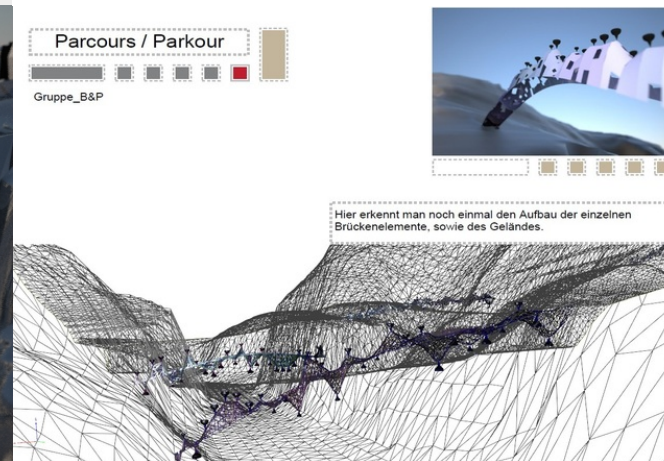
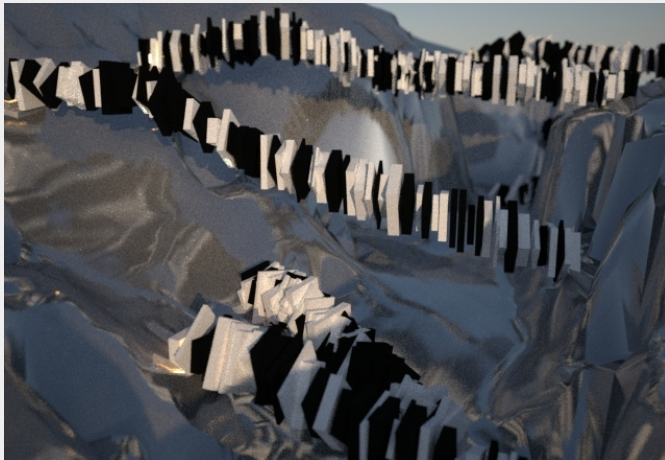
Verdon Gorge

Final projects



Verdon Gorge

Final projects



Conclusion

Conclusion

Bernhard Cache on Vitruvius' De Architectura:

The "author of the only treatise on architecture that has been handed down to us from antiquity" "**determined the different components of a building by means of numerical relations**".

[Cache, B. (2010). After Parametrics? In: GAM06: Nonstandard Structures. 50-61. Vienna: Springer.]

More than 2000 years later computers provide today's designers continually growing possibilities to effectively model and explore algorithmic approaches.

Future architects definitely must stand up to such sophisticated tasks. **They need to assimilate a deep, fundamental comprehension of Algorithmic Design.**

And that can only be grasped by **getting one's hands dirty - with raw code!**

ALGODE 2011

Why MEL?

Paperpresentation at the International Symposium on Algorithmic Design for Architecture and Urban Design

Recommended websites:

TUERME.n (German)

<http://iam2.tugraz.at/dm1/w08/>

parcours aventure (German)

<http://iam2.tugraz.at/dm2/w11/>

Digital Design Methods (German)

<http://iam.tugraz.at/dm2/>

Institute of Architecture and Media (English/German)

<http://iam.tugraz.at/>