If **sustainably** is an answer, what is the question?
Prototyping and protocolling modular timber architecture

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PART – Practice for Architecture, Research and Theory
Bespoke structures
Designed with top-down strategy
2015-2017

Aggregated structures
Designed with bottom-up strategy
2017-2018

Somatic modularity
Top-up-Bottom-down strategies
2018-…
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PART: Practice for Architecture, Research and Theory
Introduction
Theo van Doesburg
Rhythm of a Russian Dance
1918
Frank Gehry designs a concert hall to Springfield
The Simpsons
Season 16; Episode 14
Aired: 3 April 2005
Crumpling polygons instead of paper.
Siim Tuksam. PART Architects.
Modulation diagram.
2018
Mustamäe housing district, Tallinn, Estonia.
Window panel. Architects Voldemar Tippel, Toivo Kallas, Lidia Pettai. 1962

Acton Ostry Architects Inc. Brock Commons. 2017
Development of methodology: workflows
Production chain of architecture. Non-looping method.
Production chain of architecture. Looping method

Production chain of architecture. Non-looping method.
Common platform
A Camel is a Horse designed by Committee
Live geometry

Studies of strength fitness with cost calculations.
Final geometry.
Main elements
Technology: CNC Milled
Style: 10x10cm timber beams
Length: max 4m
Amount: 133 pieces

Horizontal elements
Technology: CNC Milled
Style: 10x10cm timber beams
Length: max 3m
Amount: 120 pieces

Diagonal elements
Technology: CNC Milled
Style: 10x10cm timber beams
Length: max 2.6m
Amount: 121 pieces

Combined
Technology: CNC Milled
Amount: 3744 kg
Alive Material

Body Building installation
Tallinn Architecture Biennale 2015
Bespoke structures

*Bespoke* [erilahenduslik]: a custom made solution for each product. Bespoke structures are systems, where all of the element is different and have non-repetitive yet similar assembly details and logic.
Bespoke Thinking Methodology:
from Proto-Sketch to Proto-Object

Initial sketch
Selected from the pool of ideas

Vocabulary and tools
Chosen geometric grammar

Formula
Abstracted design protocols defining the architecture

The Whole
Defined parameters for the collaborators. Distinguished parts in the current
remarking element form with the form of the whole, allowing customized solutions
within the logic.

Prototype of the Whole
Compressed model of ideas and parameters

Prototype of the Part
Bespoke elements, not exceeding the form, but technology

Assembly Protocols
Defining rigorous combinatorial rules

The Figure of the Methodology
Stages
Hidden connections
Hidden sequence
Rheologic Formations
Into the Valley music festival 2017
The concrete version has 63 m$^3$ Concrete with 150 €/m$^3$, Reinforcement 350 kg/m$^3$ with 1.2 €/kg, 305 m$^2$ Surface area with 250 €/m$^2$ Formwork (this is all relatively high values), this sums up to 112,500 €. I would add the 10,000 € for connection details as for the steel version. 122,500 €

The timber version has 59 m$^3$ (Accoya 2850 €/m$^3$), hollow cross sections – I think we need to add at least 15% of material which will be milled of the laminated parts, so this is 194,000 €. I would add the 10,000 € for connection details as for the steel version.

The steel version has a weight of 23 tons, plus 10% for ribs and connections ca 2 tons = 25 tons total, I think 5 €/kg should be right which is 125,000 €
SÕLMED

Vundamendi ühendus on lahnetatud liigendsõlmena. Detailide omavahelised kinnitusid toimivad uputatud teraslehtede ja poitidega, mis tagab jäiga monteeritava ühenduse. Kõrgepinge liini isolatorid kiintuvad konstruktsiooni külge läbistavate varrastega.

elemendid on ühendatud uputatud terasplaatidega

koha peal monteerimiseks pöltühendused
Electricity pylon. Bog Fox. 2020
Mega-components
Tartu pedestrian tunnel and bridge. 2016
under construction
UV kiirguse analüüs elementidel

Puidust elemendid. Eskiis

Vertikaalsed telliselemendid. Eelprojekt
Toonide värvid
TELLISPANEELID

Valge tellispaneel

Hall tellispaneel

Oranz tellispaneel

Punane tellispaneel
Bespoke systems

+ 
- Experimental and formally intriguing
- Raised attention and started collaborations
- Were pushing the envelope of production methods and technology available

- Overly expensive (standardised units still more feasible)
- Labor intensive sorting and assembly
- In case of complex systems, there is a need for architects participation
Aggregated structures

_Aggregated structure_ [liitstruktuur, agregeeritud struktuur]: spatial skeleton, formed from one or minimum amount of elements, this method enables participatory architectural structures, which remain rearrangeable.
Aggregated Thinking Methodology: from conceptual to built object

CONCEPTUAL STAGE

Initial sketch
Selected vision from the pool of ideas

Vocabulary and tools
Chosen geometric grammar

Stages
Hidden connections
Hidden sequence

Whole objects overview design

Whole functional

Part objects module design

Common platform is adjacent to the initial sketch

real scale model of a part
Digital Thicket installation
European Union Residency opening ceremony.
Freedom square. Tallinn. 2017
Aggregational Structures

“BEL:EST. A Laboratory for Europe in Brussels”
BOZAR, Brussels, Belgium. 2017
AAT

Bespoke Timber Architecture

exhibition at
Palazzo Bembo, Venice
Opening reception
24 May 6 p.m.
PART.icular - bespoke timber architecture
Time.Space.Existance exhibition
Venice Architecture Biennale 2018
Workflow diagram
Aggregational structures
Urban Jungle vertical park
T1 shopping mall, Tallinn
2018
RF-STEEL EC3 CA1
Ultimate Limit State: Cross-Section Design, Stability Design

Members Max Design Ratio: 0.93
Aggregated systems

+ standardised elements reduce production time and cost
  intelligent connection detail reduces necessity of metal connections
  fast and effective way of creating space filling systems

- the overall form is rigid and rather culled out grid
  spacegrid rigity is not adobpting different functions it inhabits
Somatic modularity [somaatiline modulaarsus, kehalik, lihaline]: variable modular system, where unified building components are based on discrete design system, guided by grid-based parameters and material based element details. Modular parts vary in size and shape, while keeping uniformal connection logic. This approach also proposes a distinct theoretical understanding of the design process that is essential to somatic modularity, which enables all scales and homogenous connection systems for heterogenous whole, a corporeal system for architecture.
Aggregated Thinking Methodology:
from conceptual to built object

CONCEPTUAL STAGE

Phases
- Conceptual
- Detailed
- Design
- Technical
- Construction
- Building

DESCRIPT DEVELOPMENT
exploring vocabulary and tools

Formulated design protocols

Whole objects overall design

Whole objects overall design

Scaled model of overall

Scaled down models

Building phase

Building phase

Real-scale prototype

Part objects module design

Real-scale model of a part
The façade of Santa Maria Novella, completed by Leon Battista Alberti in 1470. 2D parametric drawings define the relations between elements, but also between the detail (like pillar subdivisions) and thus guiding the overall composition.
Geometric parameters in the human body that define elements in a physical and subconscious way, enabling an understanding of the scale of elements at the scale of building elements. Drawings by Leonardo da Vinci—Vitruvian man (1490), Ernst Neufert Bauentwurfslehre (1936), and Le Corbusier—Modulor (1948).
Urban Jungle vertical park
T1 shopping mall, Tallinn
2018
Urban Jungle vertical park
T1 shoppingmall, Tallinn
2018
Pärnu Art Center
Honourable mention
2019
Võistluse 7 apartment building. Schematic design. 2018
multi-height apartment
Võistluse 7
Apartment building
Exterior views
Võistluse 7 apartment building. 3rd floor plan
Private house
Design development
Somatic modularity

Somatic modularity

+ reintroducing primitive geometries
+ various resolutions and scales in one system
+ perfect combination of quasi-automated industry and sustainable architecture

- no constructed case studies (yet)
THESE PROCESSES MUST BE SUSTAINABLE IN ARCHITECTURE
“What is design thinking, designing, materials, workflows, manufacturing, transportation, pre-assembly, site assembly, construction, maintenance and dismantling.”