LEARNING FROM DATA

Building Knowledge for Design

Lecturer:
Vertr.-Prof. Dr. Sven Schneider

DESIGN

An iterative process for creating functioning form

Form

(e.g. geometry, material, color, technology)

DESIGN

An iterative process for creating functioning form

Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

Form

(e.g. geometry, material, color, technology)

DESIGN

An iterative process for creating functioning form

Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

inseparably linked

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(e.g. geometry, material, color, technology)

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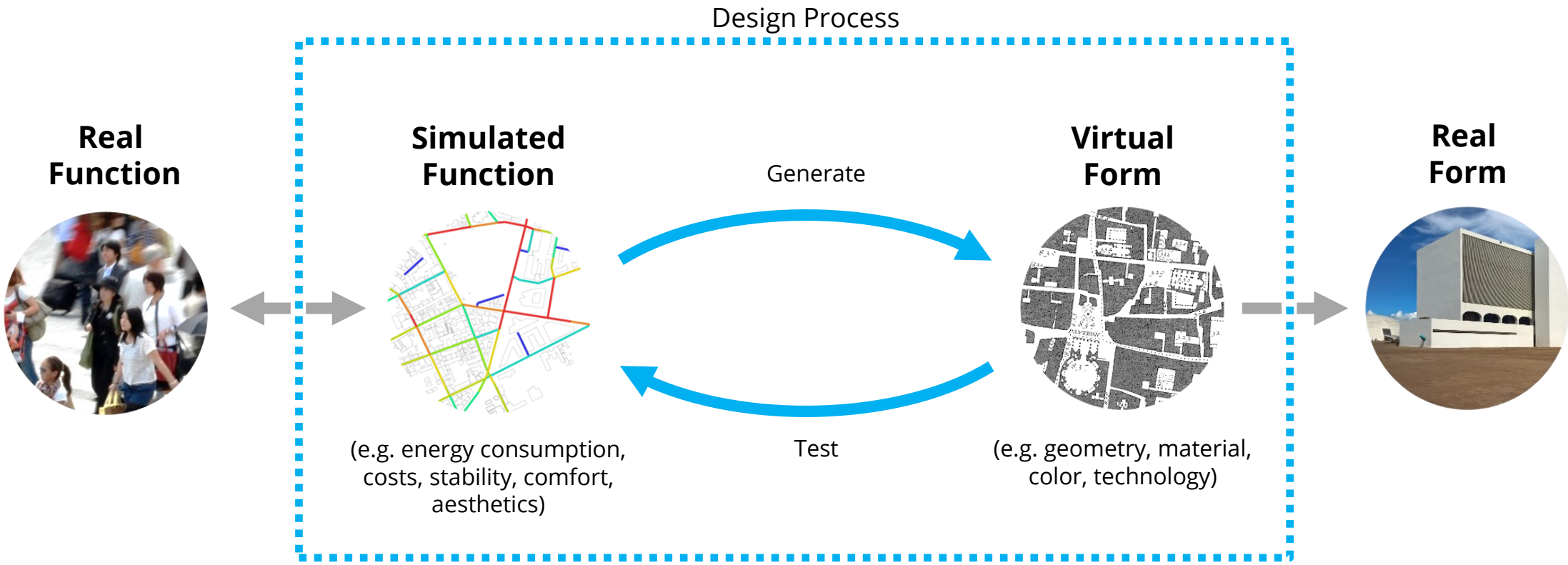
DESIGN

An iterative process for creating functioning form



BUILDING KNOWLEDGE FOR DESIGN

Understanding the relationships between form and function

Function

Real Function

Simulated Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

Relationship?

Form

Virtual Form

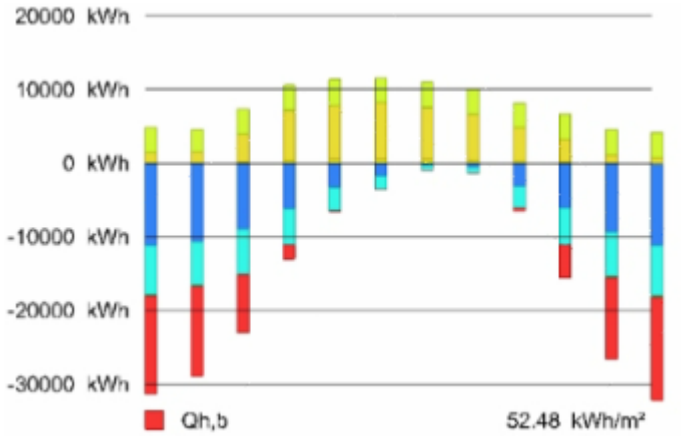
(e.g. geometry, material, color, technology)

Real Form

EXAMPLE

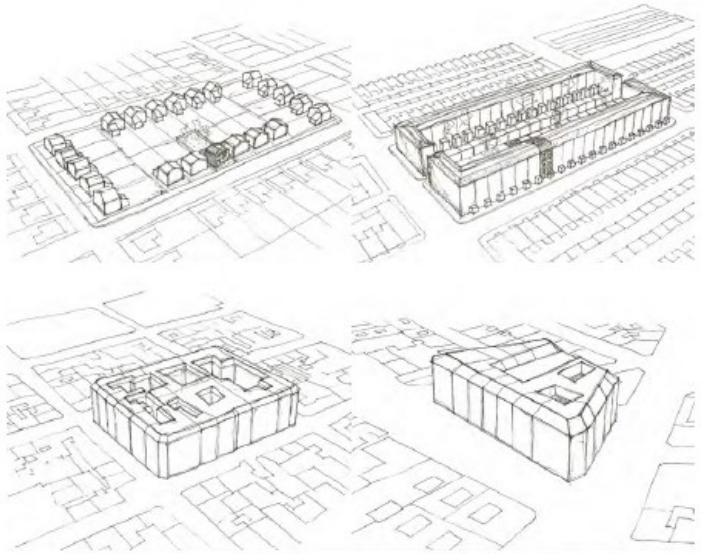
Urban Heat Energy Demand Study (LSE Cities, 2014)

Heat Energy Demand



Relationship?

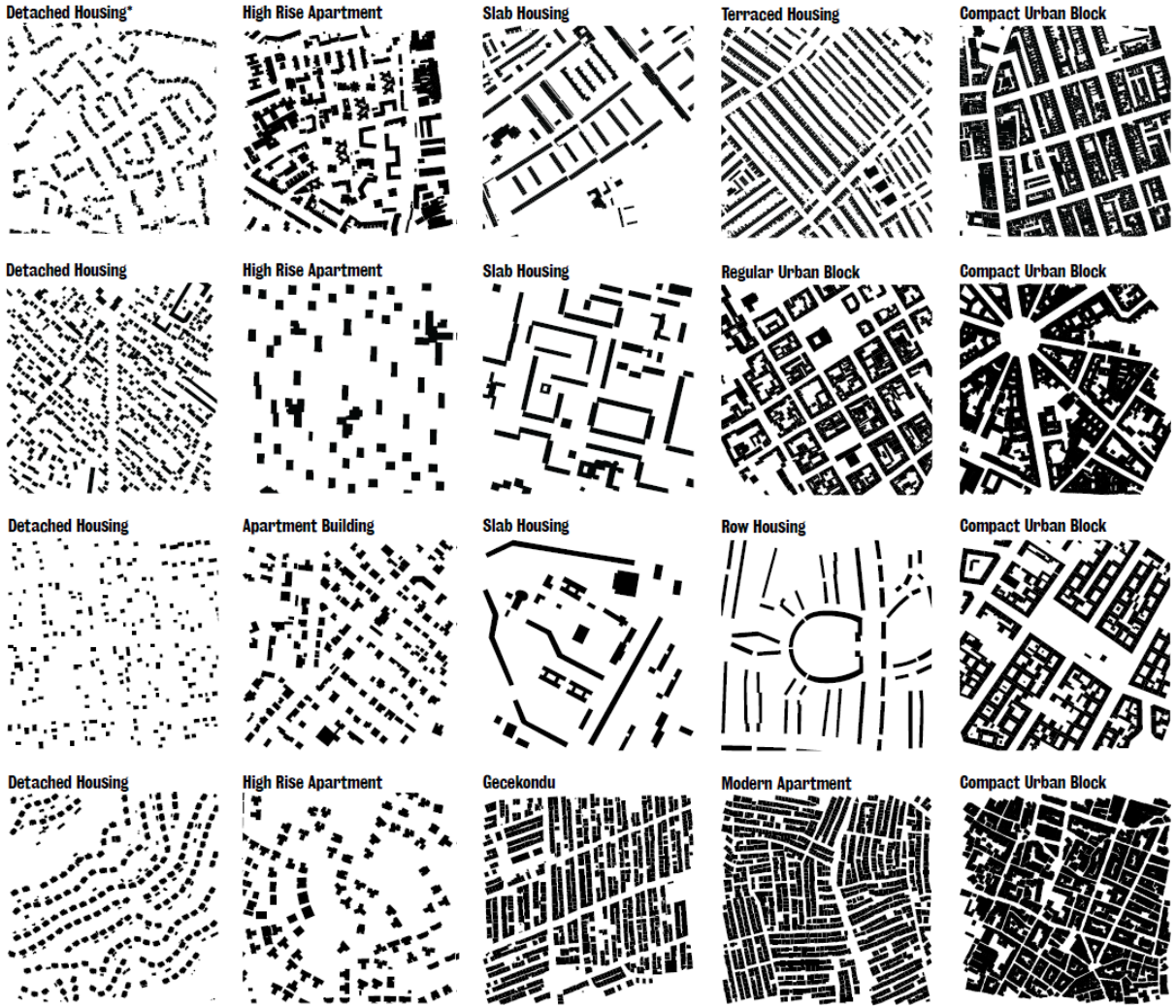
Urban Form



https://lsecities.net/publications/reports/cities-and-energy-urban-morphology-and-heat-energy-demand/

URBAN HEAT ENERGY DEMAND STUDY

Collect Data (Urban Form)



Urban Morphology and Heat Energy Demand

https://lsecities.net/publications/reports/cities-and-energy-urban-morphology-and-heat-energy-demand/

URBAN HEAT ENERGY DEMAND STUDY

Collect Data (Heat Energy Demand)

Primary heat energy demand [kWh/m²/year]

- < 50
- 51 - 75
- 76 - 100
- 101 - 125
- 126 - 150
- 151 - 175
- 176 - 200
- 201 - 225
- 226 - 250
- 251 - 275
- > 275

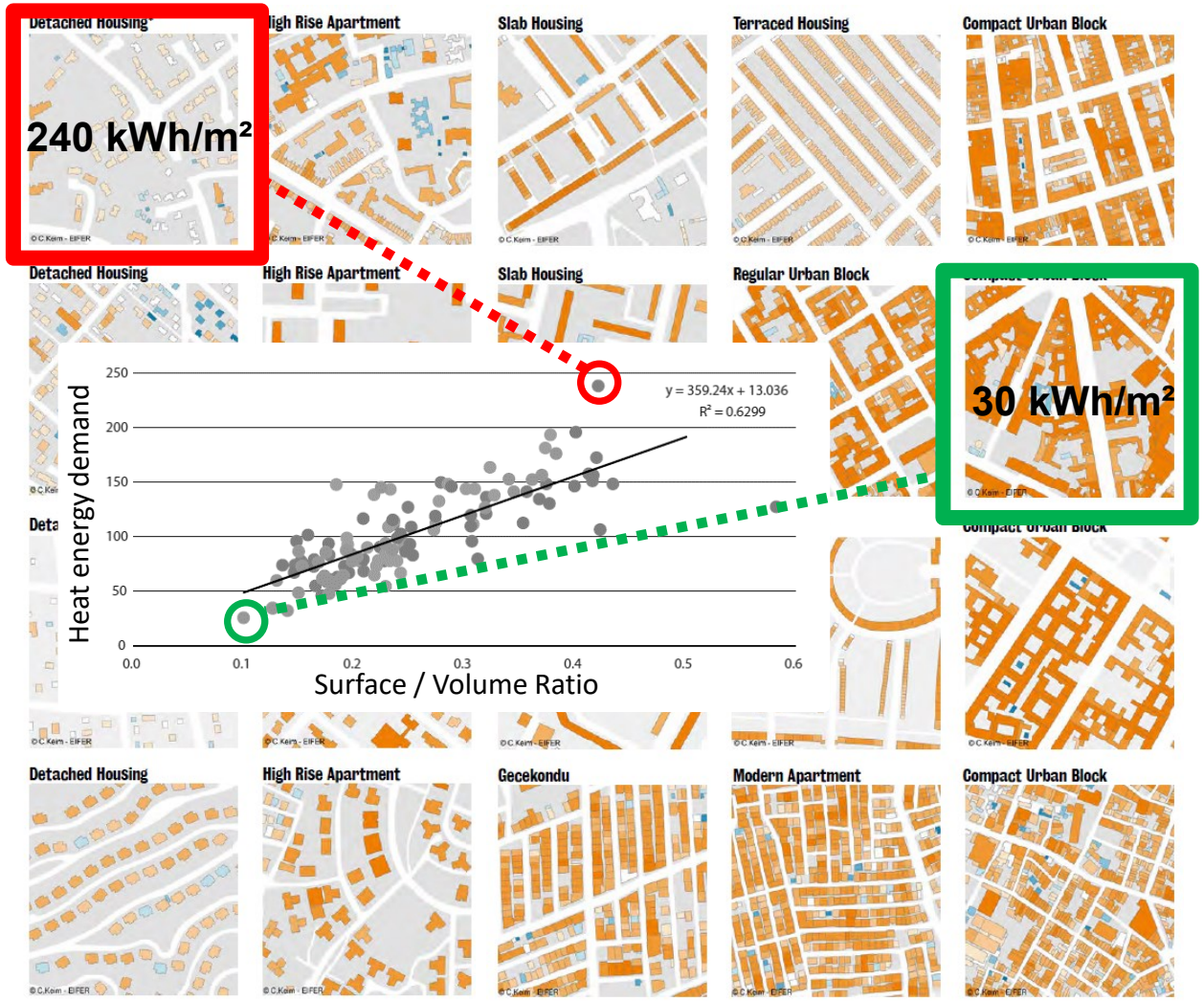
* Semi-detached housing has been put in the same category for this study as detached housing. Both are presented under 'Detached' housing.

Urban Morphology and Heat Energy Demand

https://lsecities.net/publications/reports/cities-and-energy-urban-morphology-and-heat-energy-demand/

URBAN HEAT ENERGY DEMAND STUDY

Analyse the data & Interpret the Results



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Urban Morphology and Heat Energy Demand

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URBAN HEAT ENERGY DEMAND STUDY

Relationships between what?

Function

Real Function

Simulated Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

Relationship?

Form

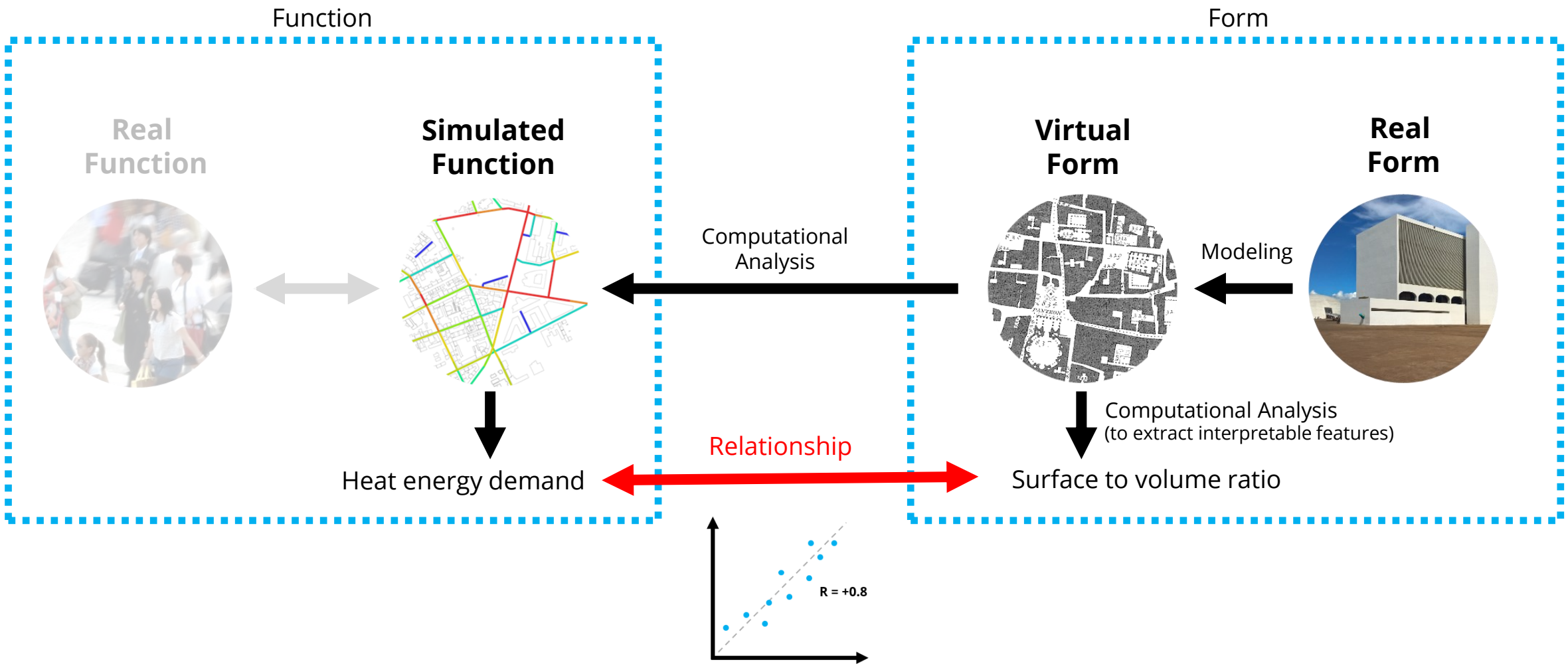
Virtual Form

Real Form

(e.g. geometry, material, color, technology)

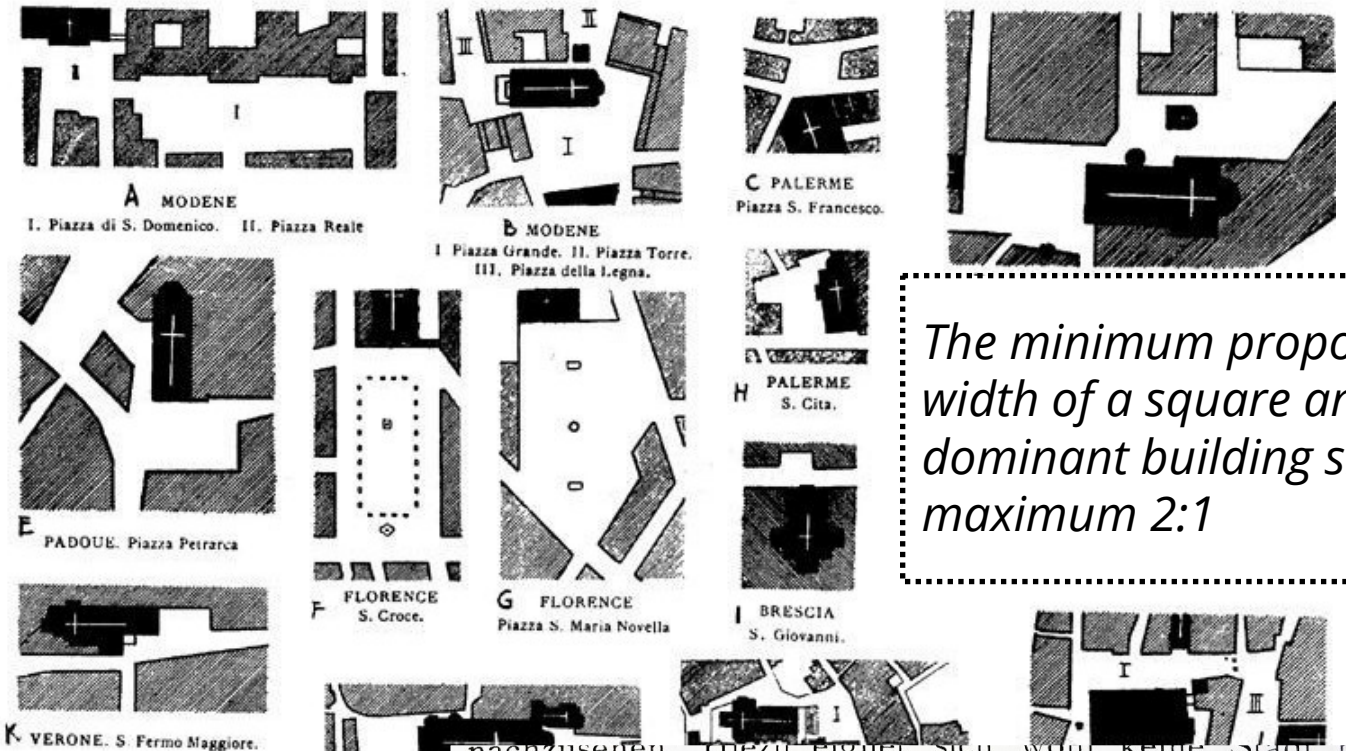
URBAN HEAT ENERGY DEMAND STUDY

Relationships between what?



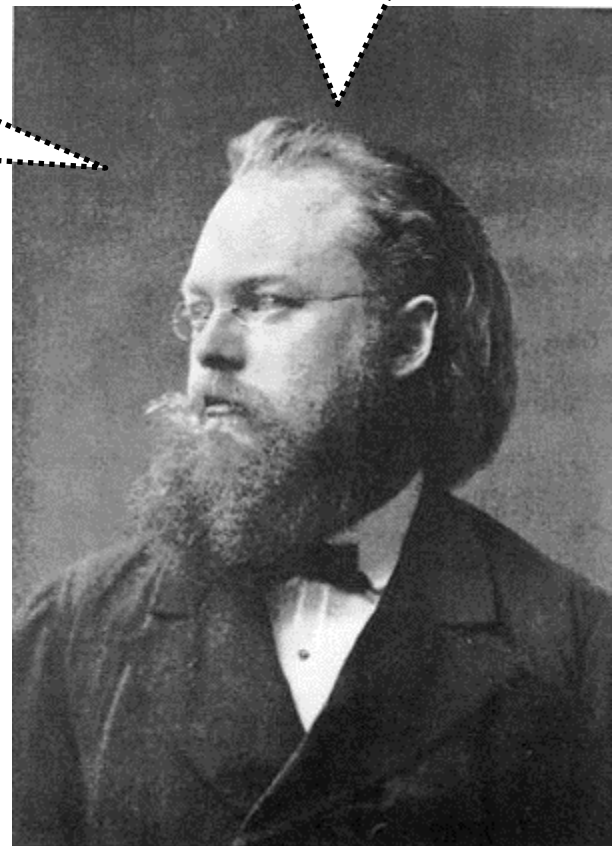
EXAMPLE

Beautiful Urban Squares (Camillo Sitte, 1889)



The biggest squares in old cities are about 57 by 143 meters. I recommend 137 meters as maximum size!

The minimum proportion between the width of a square and the height of the dominant building should 1:1 and the maximum 2:1



nachzusehen. Hiezu eignet sich wohl keine Stadt besser als Rom, mit seiner Fülle von hervorragenden Kirchenbauten. Das Ergebnis ist in der Tat überraschend, denn unter 255 Kirchen sind:

an einer Seite angebaut	..	41	Kirchen
» zwei Seiten »	..	96	»
» drei » »	..	110	»
» vier » verbaut	....	2	»
freistehend	.....	6	»
zusammen	..	255	Kirchen.

CAMILLO SITTE'S BEAUTIFUL URBAN SQUARES

Relationships between what?

Function

Real Function

Simulated Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

Relationship?

Form

Virtual Form

(e.g. geometry, material, color, technology)

Real Form

CAMILLO SITTE'S BEAUTIFUL URBAN SQUARES

Relationships between what?

Function

Form

Real Function

Simulated Function

Sitte's personal aesthetic judgement

Relationship

Virtual Form

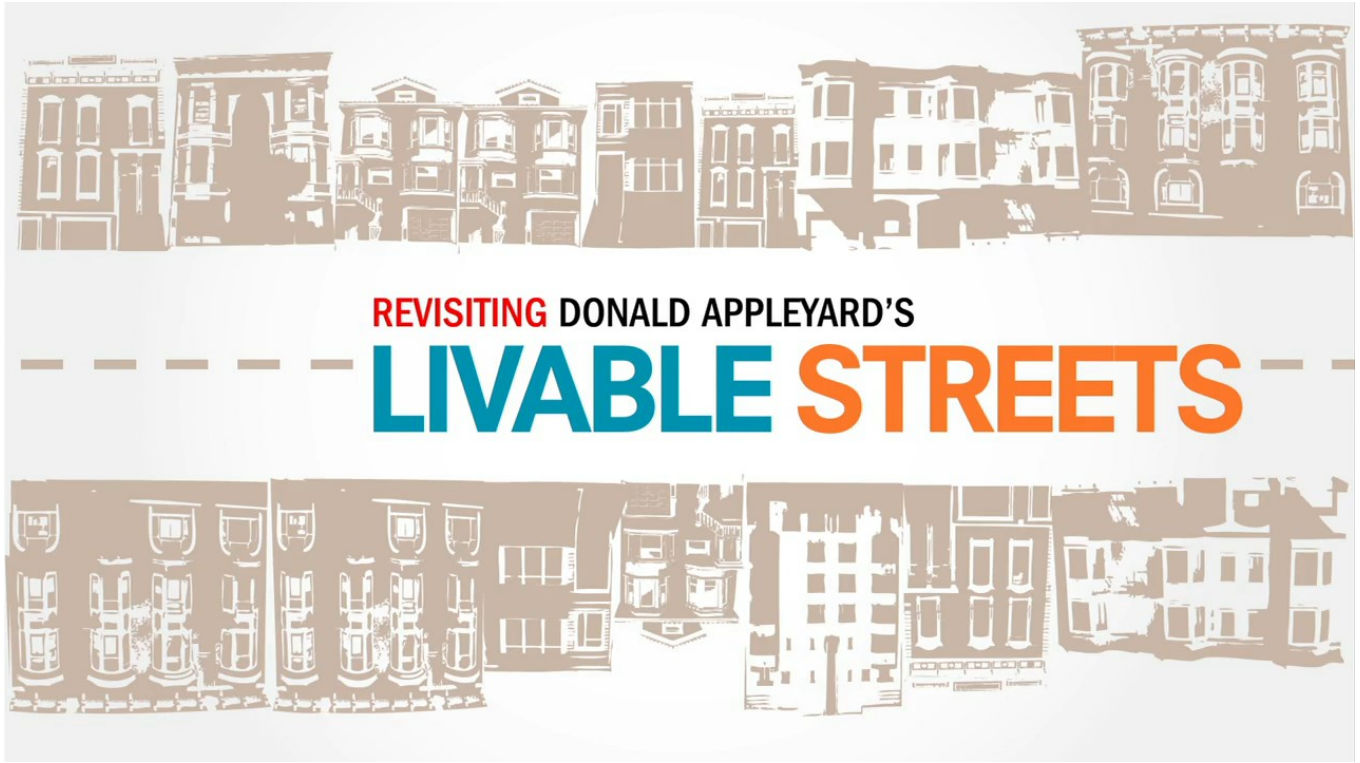
Convexity, Enclosure and Dimensions of Squares

Modeling

Real Form

EXAMPLE

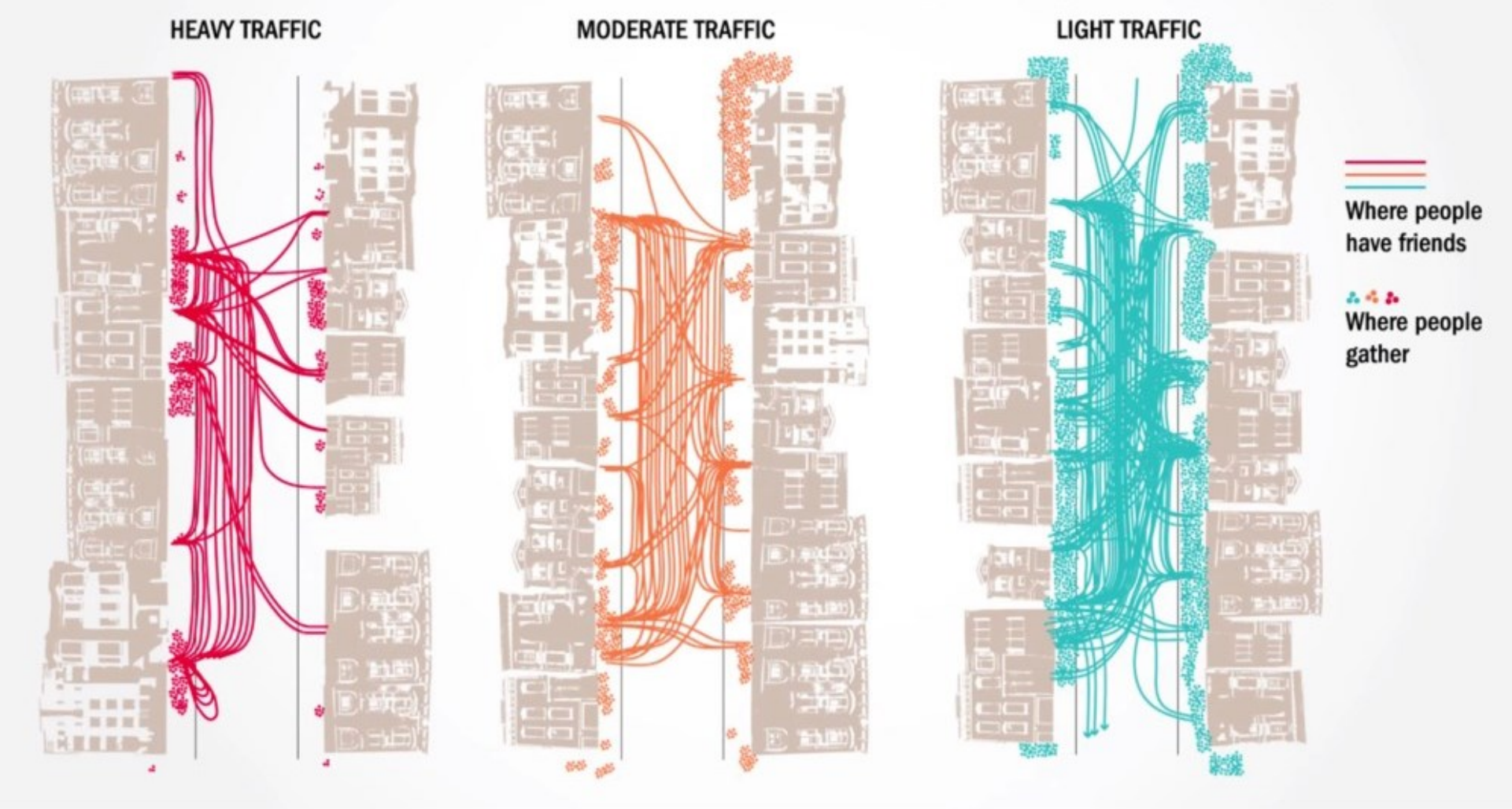
Urban Form & Social Interaction (Donald Appleyard, 1979)



https://vimeo.com/16399180

EXAMPLE

Urban Form & Social Interaction (Donald Appleyard, 1979)



https://kottke.org/tag/Donald%20Appleyard

DONALD APPLEYARD'S LIVABLE STREETS

Relationships between what?

Function

Real Function

Simulated Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

Relationship?

Form

Virtual Form

Real Form

(e.g. geometry, material, color, technology)

DONALD APPLEYARD'S LIVABLE STREETS

Relationships between what?

Function

Real Function

Social Interaction

Relationship

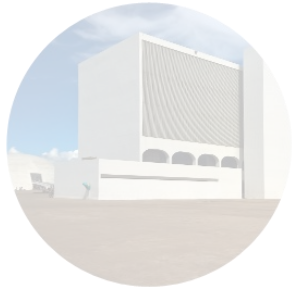
Traffic

Simulated Function

Form

Virtual Form

Real Form



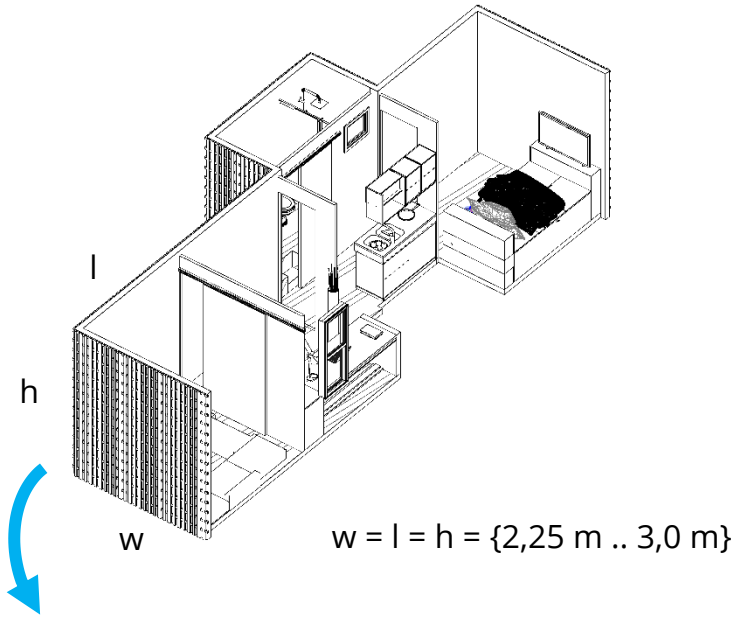
was kept constant
(by using similar streets)

EXAMPLE

Design-support oriented study

Design:

Micro-Home based on cubic modules



w = l = h = {2,25 m .. 3,0 m}

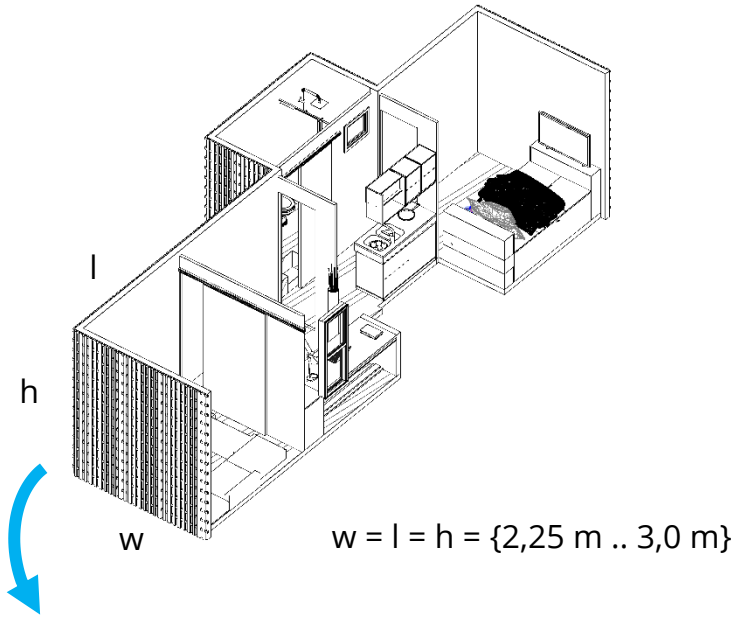
Research question:

What is the minimal side length of the cubic modules which still perceived as comfortable?

EXAMPLE

Design-support oriented study

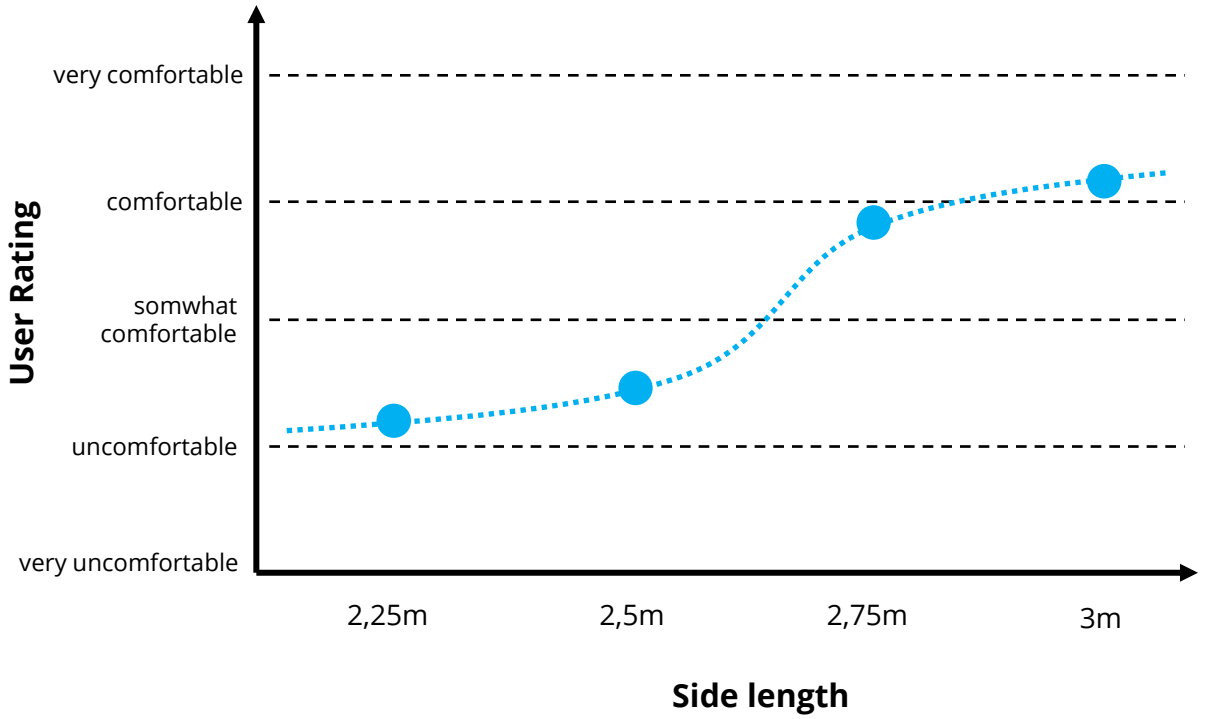
Design:
Micro-Home based on cubic modules



Research question:
What is the minimal side length of the cubic modules which still perceived as comfortable?

Method:
Testing different variants in a Virtual Reality User Study.

Expected Result:



MIRCO-HOME STUDY

Relationships between what?

Function

Real Function

Simulated Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

Relationship?

Form

Virtual Form

(e.g. geometry, material, color, technology)

Real Form

MIRCO-HOME STUDY

Relationships between what?

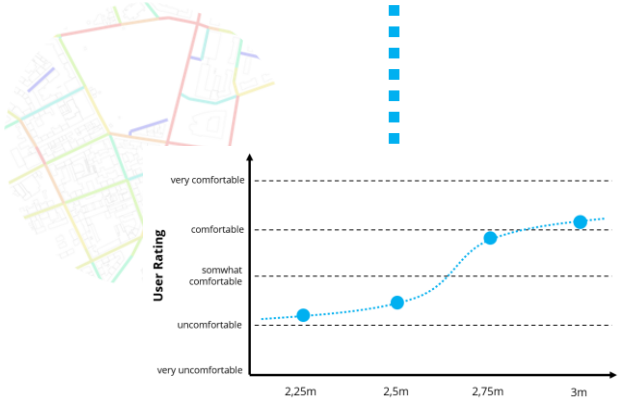
Function

Form

Real Function

Perceived Comfort

Simulated Function



Virtual Form

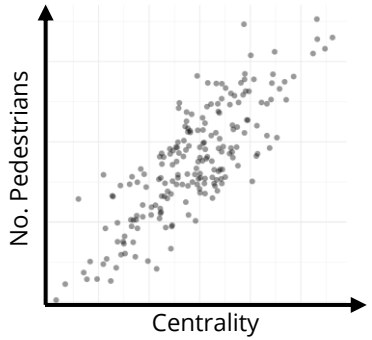
Side Length of a cubic space displayed in VR

Real Form

EXAMPLE

Space Syntax

Pedestrian frequency



Street Network Centrality

SPACE SYNTAX

Relationships between what?

Function

Real Function

Simulated Function

(e.g. energy consumption, costs, stability, comfort, aesthetics)

Relationship?

Form

Virtual Form

(e.g. geometry, material, color, technology)

Real Form

SPACE SYNTAX

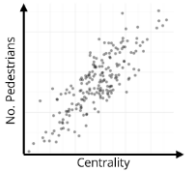
Relationships between what?

Function

Form

Real Function

Movement Frequency



Simulated Function

Street Network Centrality

Computational Analysis

Virtual Form

Real Form

(centrality can be seen as a simulation of movement flows)

SPACE SYNTAX

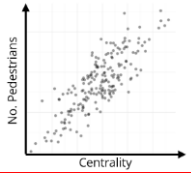
Relationships between what?

Function

Form

Real Function

Simulated Function



Movement Frequency

Virtual Form

Real Form

Computational Analysis
(to extract interpretable features)

Street Network Centrality

(centrality can also be seen as a feature to describe urban form, as space syntax does)

BUILDING KNOWLEDGE FOR DESIGN

Motivation

"... when you can measure what you are speaking about, and express it in numbers, you know something about it;

but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

Lord Kelvin