Smart Solutions for Spatial Planning

Aedas R&D [Computational Design Research]
Centre for Evolutionary Computing in Architecture [CECA @ UEL]
Knowledge Transfer [breaking silos]

* constructing consensus between stakeholders
  + planners
  + GIS
  + urban designers
  + computational models
  + architects

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Computational Urban Design

DON’T
- simulate urban design process
- mimic urban fabric patterns
- generate algorithmic patterns
- build total integration tool

DO
- knowledge transfer [urban design () computational design]
- synthesize urban design heuristics
- create assembly of methods into workflow
- align suite of methods to planning processes
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Survey → GIS mapping

DPD (AAP) → constraint briefing

Planning Procedure:
- Spatial Strategy
  - spatial analysis
  - urban structure scenarios
  - urban block scenarios
  - benchmark quantities

SSSP Procedure:

Process Alignment
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Planning Private Partners

DPD (AAP) | Spatial Strategy

SSSP

Masterplans

SCALES

*DPD*

Spatial Strategy

Sub-Areas

Development Sites

KEY ISSUES
- geographic isolation
- open space provision
- network connectivity
- mixed-size housing

CROSS CUTTING THEMES
- transport & movement
- open space
- services provision & accessibility
DPD (AAP) | Spatial Strategy

SSSP

Planning Inspectors
9 tests of ‘soundness’

TESTS
- environment
- social
- economic
- community strategy
- regional & gov’t policy
- ‘front loading’
- measure success of DPDs objectives
- flexibility to contextual change
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GIS data visualization & mapping

accessibility measure

network connectivity

routes & distances

urban blocks outline definition

land-use / mix allocation

block parcellation / plot definition

GIS data mappings

Survey [accessibility + connectivity + routes]

Urban structure outline

Evaluate [accessibility + connectivity + routes]

Land-use / Mix Secondary Circulation

Block definitions Plots & Ratios

Evaluate

Components & Workflow

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GIS Visualization & Mapping

* Lea River valley
* boundary conditions
* compiling disparate GIS data formats
**INPUT**

- OS mastermap [shape files]
- LLPG data sets [textual data]
- National Census [function coordinates sets]

**OUTPUT**

- joined OS mastermap shapes to polygons with tagged textual and census data
- differentiated data layers
- 1000 meter buffer included

unique OS ID number  text data from the LLGP  the points of this polygon

1000001911013744,"Land","Landform","Manmade",.....,537642.15,182503.50"
1000001911013744,"Land","Landform","Manmade",.....,537639.10,182509.70"
1000001911013744,"Land","Landform","Manmade",.....,537658.50,182520.05"
1000001911013744,"Land","Landform","Manmade",.....,537676.35,182529.15"
1000001911013744,"Land","Landform","Manmade",.....,537676.50,182528.85"
1000001911013744,"Land","Landform","Manmade",.....,537673.95,182527.45"
1000001911013744,"Land","Landform","Manmade",.....,537661.55,182518.40"
1000001911013744,"Land","Landform","Manmade",.....,537642.15,182503.50

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**INPUT**

(LLPG) Excel data sheet(s)
- feature to be mapped

**OUTPUT**

- intensity map of feature on site
- spatially located and interpreted data

GIS Visualization & Mapping
**INPUT**

- feature layered dxf
- site perimeter
- required condition
- adjacency radius to condition

**OUTPUT**

- intensity map of condition on site

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Accessibility & Routes [strategy]

* accessibility as main driver
* Public Transport Access Levels [PTAL]
* density indication
* output not accessible

source: Hammersmith & Fulham council
INPUT

- existing circulation network
- access points

OUTPUT

- walking distances to access points
- catchment areas
- colour gradient map
Network Connectivity

**INPUT**

- existing circulation network
- access points
- +
- shortcut radius
- time affordance

**OUTPUT**

- walking distances to access points
- +
- proposed new network connections
- optimized network connectivity

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INPUT
- building polygons
- access points
- grid size

OUTPUT
- all-2-all shortest routes & distances
- all-2-one shortest routes & times
- visibility network
Urban Block Outlines [strategy]

* urban design heuristic
+ connect activity points
+ adjust grid

* unfolding vistas
* axes extensions

source: Thamesmead Council

source: Urban Compendium I
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**INPUT**
- site outlines
- activity locations for connectivity

**OUTPUT**
- leanest connectivity network between activity locations
- urban blocks outlines

Urban Block Outlines
Urban Block Outlines

initial condition

added connections

conservation area & added connections

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Land-use / Mix Allocation [strategy]

source: Urban Task Force

source: Urban Compendium I

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INPUT

- urban block outlines
- land-use quantities
- adjacency preferences

OUTPUT

- distribution of land-uses
- secondary circulation
- density indication
- walking distance network

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Land-use / Mix Allocation

use distribution
accessibility levels
secondary circulation

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CASE 1
RESIDENTIAL 400 DOTS
COMMERCIAL 250 DOTS
PARK 150 DOTS
COMMERCIAL close to TRANSPORT HUBS
PARKS close to RIVER
RESIDENTIAL close to RIVER

CASE 2
RESIDENTIAL 400 DOTS
COMMERCIAL 250 DOTS
PARK 150 DOTS
COMMERCIAL close to TRANSPORT HUBS
RESIDENTIAL close to TRANSPORT HUBS
PARKS close to RIVER
RESIDENTIAL close to RIVER

CASE 3
RESIDENTIAL 600 DOTS
COMMERCIAL 250 DOTS
PARK 150 DOTS
COMMERCIAL close to TRANSPORT HUBS
RESIDENTIAL close to TRANSPORT HUBS
RESIDENTIAL away from MOTORWAY
PARKS close to RIVER
RESIDENTIAL close to RIVER
Block Parcellation / Plot Definition [strategy]

Smaller parcel and plot sub-divisions facilitate a greater diversity of forms and uses, and a more active street frontage.

source: UEL APO Europan 7

source: Urban Compendium I
**Input**

- block dimensions
- block geometry (4 sided)
- building depths (8-22 meters)

**Evaluation Criteria**

1. Residential units/Hectare
   - [400 with the average unit area = 75 m²]

2. Retail units
   - [20% of total ideal residential area, i.e.
     10,000 m² perimeter = 400*75 = 30,000m²
     of residential 20%= 6000m²]

3. Entrance into courtyard
   - [20% of total perimeter length]

4. Number of south facing residential units
   - [the higher the better]

**OUTPUT**

- massing geometry
- plot parcellation
- use allocation within block
- maximum south facing elevations
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massing: 0 cycles optimization

massing: 135 cycles optimization

Block Parcellation / Plot Definition
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Block Parcellation / Plot Definition

error reduction graph over 217 generations

Generations

Res error
Flat error
Block Parcellation / Plot Definition

resulting massing

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