FACTORY FOR GOOD

P4 presentation
1-June-2018
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design teacher - Mo Smit
BT teacher - Engbert van De Zaag
research teacher - David Peck
Introduction
context
problem statement
potential statement

Research
water and energy research
design objectives
site analysis

Design
urban scale
building systems - structure, water, energy
architectural design

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system limitations
system potentials
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Reflection
system limitations
system potentials
CONTEXT: INDONESIA
peri-urban industrial area
center of Indonesia’s textile production
CONTEXT: JAVA
peri-urban industrial area
center of Indonesia’s textile production
CONTEXT: BANDUNG

peri-urban industrial area

center of Indonesia’s textile production
CONTEXT: BANDUNG, INDONESIA
peri-urban industrial area
center of Indonesia’s textile production
CONTEXT: BANDUNG, INDONESIA
satellite maps of Bandung’s urbanization 1988-2017
Aerial photo of Cigondewah, Bandung

PT Kahatex (textile factory) with adjacent commercial street
high demand for cheap fashion

intensive manufacturing

separation of factory wall

lowered water table

sense of isolation/separation

increased flooding

land subsistence

deeper wells

rapid densification

lack of infrastructure

PROBLEM STATEMENT
Excessive resource extraction, pollution, exclusion

Does the factory have to be something unpleasant to the neighborhood?
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lack of infrastructure

PROBLEM STATEMENT
Excessive resource extraction, pollution, exclusion

Does the factory have to be something unpleasant to the neighborhood?
Excessive resource extraction, pollution, exclusion

Does the factory have to be something unpleasant to the neighborhood?
POTENTIAL STATEMENT

Fashion for good?
What/who are the drivers for a better factory environment?
POTENTIAL STATEMENT

Fashion for good?

What/who are the drivers for a better factory environment?

- UN sustainable development goals
- Integrated groundwater plan (2002)
- Pressure on factories
- Investment in sustainable technology
- Initiative of fashion industry (as a whole)
- Initiatives of individual fashion companies
- Zero Discharge of Hazardous Chemicals (ZDHC)
- Indonesian government
- 2013 Savar factory collapse, Bangladesh, 1134 dead
2013 Savar factory collapse, Bangladesh, 1134 dead

Ø ZDHC
Zero Discharge of Hazardous Chemicals

Pressure on factories

Integrated ground-water plan (2002)

Indonesian government

UN sustainable development goals

Investment in sustainable technology

Initiatives of individual fashion companies

Initiative of fashion industry (as a whole)

POTENTIAL STATEMENT

Fashion for good?
What/who are the drivers for a better factory environment?
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‘KAHAVILLE’
Research boundary
Textile factory neighborhood of population 26,000

PT Kahatex
0.18 km²

0.6 km²
26,000 workers
26,000 residents

Kampung Cigondewah
0.13 km²
KAHAVILLE WATER USAGE

- Factory: 439,200 m³/month
- Residential: 122,549 m³/month
KAHAVILLE ENERGY USAGE

Factory: 46,198,000 kWh/month
Residential: 2,756,000 kWh/month
WATER AND ENERGY SYSTEMS
Existing “off the grid” systems
WATER AND ENERGY SYSTEMS
Existing and proposed systems
Fitting proposed system onto site

How does the proposed system fit physically onto site? What will it look like architecturally?
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WHAT IS THE PURPOSE OF MY THESIS?
1. INTRODUCE NEW PROTOTYPE
how can this new prototype provide infrastructure to the neighborhood?

WATER + ENERGY + SOCIAL
1. INTRODUCE NEW PROTOTYPE
   how can this new prototype provide infrastructure to the neighborhood?

2. FIND LIMITATIONS OF PROTOTYPE
   what is limiting the amount of water / energy provided to the neighborhood?
INFORMAL NEIGHBORHOODS
TYPE A
BORDER CONDITION:
next to main commercial road
TYPE A
PUBLIC TOILET
for 500 people

HOUSING
for 24 people

MARKET
for 20 stoves

WATER KIOSK
for 500 people

---

Water usage reductions

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>factory water usage</td>
<td>m³/month</td>
<td>439200</td>
</tr>
<tr>
<td>RT water usage</td>
<td>m³/month</td>
<td>2581.375</td>
</tr>
<tr>
<td>type A water usage</td>
<td>m³/month</td>
<td>800</td>
</tr>
<tr>
<td>% factory reduction</td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>% kampung reduction</td>
<td></td>
<td>31</td>
</tr>
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</table>

Energy usage reductions

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT energy usage</td>
<td>kWh/month</td>
<td>11534</td>
</tr>
<tr>
<td>type A energy production</td>
<td>kWh/month</td>
<td>5240</td>
</tr>
<tr>
<td>% kampung reduction</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>
TYPE A
PUBLIC TOILET
for 500 people

HOUSING
for 24 people

MARKET
for 20 stoves

WATER KIOSK
for 500 people
TYPE B
BORDER CONDITION:
next to main commercial road and private land (L-shaped wall)
TYPE B
PUBLIC TOILET
for 250 people

HOUSING
for 12 people

MARKET
for 10 stoves

WATER KIOSK
for 500 people
TYPE B
PUBLIC TOILET
for 250 people

HOUSING
for 12 people

MARKET
for 10 stoves

WATER KIOSK
for 500 people
TYPE C

BORDER CONDITION:
next to village land
TYPE C
WATER KIOSK
for 1000 people
water tower

**worker housing**
shared toilet + shower

shared kitchen
rooms

wetland

**public program**
public toilet
courtyard
food market

biogas tanks

water storage
- toilets
- food stalls / kitchens
- biogas tanks
- wetland
- Kahatex water recycling facility
USER GROUPS

- street hawker
- housing resident
- public toilet user
- water kiosk user
- market-goer
- factory worker
USER GROUPS

Social - Infrastructure users

street hawker
housing resident
public toilet user
water kiosk user

market-goer
factory worker
USER GROUPS

Infrastructure users

- street hawker
- housing resident
- public toilet user
- water kiosk user

- market-goer
- factory worker
USER GROUPS

street hawker

housing resident

public toilet user

water kiosk user

220 kWh/month

4 m³/month

26 kWh/month

10 kWh/month

1.4 m³/month

10 kWh/month

0.06 m³/month
water storage

housing access
water usage: 800 m³/month
water filtration: 30m³ / month

energy usage: 440 kWh / month
wetland

Toilets + showers

Toilets + showers

Food stalls
water filtration: 30m³ / month

energy usage: 440 kWh / month

water usage: 60 m³ / month

energy usage: 440 kWh / month
Water filtration: 15m³/month

Energy production: 1700 kWh/month

x 30

x 7
wetland

food stalls + courtyard
water filtration: 30m³ / month

energy usage: 440 kWh / month

x 70

x 2
water filtration: 30m³/month

x 70

water usage: 210 m³/month

x 150
1. rainwater collected from factory roofs
2. underground water storage (weekly)
3. water pump
4. water tower storage (daily)
5. water distribution through central core
6. public toilet
7. underground sewage crawl-space
8. 
9. food waste inlet
10. biogas digester
11. biogas outlet
12. digestate outlet (and sewage pump)
13. digestate pumped to wetland
14. wetland inlet
15. wetland outlet (clean water recycled by factory)
1. rainwater collected from factory roofs
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11. biogas outlet
12. digestate outlet (and sewage pump)
13. digestate pumped to wetland
14. wetland inlet
15. wetland outlet (clean water recycled by Factory)
1. timber frame 15x150mm
2. plywood skidding 10mm
   thermal insulation 100mm
   plywood 10mm
   tile interior finish
3. brick bearing wall 410mm
4. soil 100mm
5. gravel 300mm
6. waterproof layer
7. thermal insulation 100mm
8. rainwater drain
9. screed 10mm
10. concrete floor slab
11. rainwater pipe
12. pre-cast concrete top
13. brick balustrade 200mm with steel reinforcement
D2 - MARKET + COURTYARD

10. wetland plants
   soil 500mm
   waterproof membrane
   screen (slope 1:2) 10mm
   concrete structure

11. service pipes (fresh water, bio-gas tank
    digestate, biogas)

12. brick bearing wall 205mm

13. concrete seating + services

14. bio-gas tank outlet
10. wetland plants  
  soil 500mm  
  water proof membrane  
  screen (slope 1%) 10mm  
  concrete structure  
11. service pipes (fresh water, bio-gas tank  
  digestate, biogas)  
12. brick bearing wall 205mm  
13. concrete seating + services  
14. bio-gas tank outlet
15. concrete column 250x250mm
16. brick facade (with metal ties to concrete column)
D3 - WATER TOWER
15. concrete column 250x250mm
16. brick facade (with metal ties to concrete column)
Potential to create construction material from waste. Up to 10-20% waste material can be incorporated while maintaining structural requirements.

**WHY BRICK?**

Potential to create construction material from waste. Up to 10-20% waste material can be incorporated while maintaining structural requirements.
WHY BRICK?
Potential for community engagement
low wages, construction as a communal activity
Diocletian’s Palace - Split, Croatia

300 AD - today
Diocletian’s Palace - Split, Croatia

300 AD - today
Fortifications of Xi’an - Xi’an, China
1300 AD - today
Fortifications of Xi’an - Xi’an, China
1300 AD - today
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<table>
<thead>
<tr>
<th>Users</th>
<th>Water Recycled (m³/month)</th>
<th>Energy Produced (kWh/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26000</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>35000</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>260000</td>
<td>7900</td>
<td></td>
</tr>
</tbody>
</table>

**SYSTEM LIMITATIONS**

Why couldn’t I reach the targets from the research phase?

What are the practical / physical limitations of the infrastructural prototype?
SYSTEM LIMITATIONS - ENERGY

Energy is limited by size of public toilet

nobody will walk for more than 1 minute to go to the toilet.
Energy is limited by size of public toilet.

Wetlands require a lot of space (more than the roof area of toilets).
Filtered rainwater for drinking

larger service population, potential revenue for factory, little space required
THANK YOU!
### Water usage calculations

<table>
<thead>
<tr>
<th>Resident requirements</th>
<th>Water storage calculations</th>
<th>Energy production calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong># housing residents</strong></td>
<td><strong>water tower requirements (capacity - daily storage)</strong></td>
<td><strong>energy produced</strong>&lt;br&gt;kWh/month</td>
</tr>
<tr>
<td>Drinking Water usage m3/month</td>
<td>water stored / day m3</td>
<td>5240</td>
</tr>
<tr>
<td>Shower m3/month</td>
<td>length m</td>
<td></td>
</tr>
<tr>
<td>Faucet m3/month</td>
<td>28.117 width m</td>
<td></td>
</tr>
<tr>
<td>Toilet m3/month</td>
<td>28.117 height m</td>
<td></td>
</tr>
<tr>
<td>Total water usage m3/month</td>
<td>33.741 underground storage requirements (capacity - weekly storage)</td>
<td></td>
</tr>
<tr>
<td><strong># users</strong></td>
<td><strong>water stored / week m3</strong></td>
<td></td>
</tr>
<tr>
<td>Total public toilet usage m3/month</td>
<td>91.595 water stored / week m3</td>
<td></td>
</tr>
<tr>
<td><strong>water kiosk user requirements</strong></td>
<td><strong>length m</strong></td>
<td></td>
</tr>
<tr>
<td># users</td>
<td><strong>width m</strong></td>
<td></td>
</tr>
<tr>
<td>Drinking water m3/month</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td><strong>Total requirements (housing + public toilet + kiosk)</strong></td>
<td><strong>height m</strong></td>
<td></td>
</tr>
<tr>
<td># users</td>
<td><strong>total water usage m3/month</strong></td>
<td></td>
</tr>
<tr>
<td>Roof area</td>
<td>1024</td>
<td></td>
</tr>
<tr>
<td>Water collected / m2 m3/month/m2</td>
<td>828.345 total water usage m3/month</td>
<td></td>
</tr>
<tr>
<td>Roof area required m2</td>
<td>5414.0</td>
<td></td>
</tr>
</tbody>
</table>

### Energy usage calculations

- **Housing**
  - Fuel usage per stove kWh/stove/month: 26
  - Total fuel usage kWh/month: 624
- **Public market**
  - Fuel usage per stove kWh/stove/month: 218.4
  - Total fuel usage kWh/month: 218.4

### Water usage reductions

- **Factory water usage** m3/month: 439200
- **RT water usage** m3/month: 2581.375
- **Type A water usage** m3/month: 800
- **Type B water usage** m3/month: 400
- **Type C water usage** m3/month: 170

### Energy usage reductions

- **RT energy usage** kWh/month: 11534
- **Type A energy production** kWh/month: 5240
- **Type B energy production** kWh/month: 2620

### User calculations

- **Housing resident**
  - Water usage m3/month: 4
  - Energy usage kWh/month: 26
  - Energy production kWh/month: 10
- **Public toilet user**
  - Water usage m3/month: 1.4
  - Energy production kWh/month: 10
- **Street hawker**
  - Energy usage kWh/month: 220
- **Water kiosk user**
  - Water usage m3/month: 0.068
### Water treatment calculations

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>wastewater generated (housing)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>grey water (shower, fauc)</td>
<td>m³/month</td>
<td>56.234</td>
</tr>
<tr>
<td>black water (toilet)</td>
<td>m³/month</td>
<td>35.361</td>
</tr>
<tr>
<td><strong>wastewater generated (public toilet)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>black water (toilet)</td>
<td>m³/month</td>
<td>703.000</td>
</tr>
<tr>
<td><strong>wetland (housing)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wetland for toilet</td>
<td>m²</td>
<td>19.2</td>
</tr>
<tr>
<td>wetland for showers</td>
<td>m²</td>
<td>14.4</td>
</tr>
<tr>
<td>total area</td>
<td>m²</td>
<td>33.6</td>
</tr>
<tr>
<td><strong>wetland (public toilet)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wetland for toilet</td>
<td>m²</td>
<td>400</td>
</tr>
<tr>
<td><strong>wetland (total)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total area</td>
<td>m²</td>
<td>433.6</td>
</tr>
<tr>
<td><strong>biogas (housing)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>retention time</td>
<td>days</td>
<td>15</td>
</tr>
<tr>
<td>volume required</td>
<td>m³</td>
<td>17.39</td>
</tr>
<tr>
<td>reactor height</td>
<td>m</td>
<td>3</td>
</tr>
<tr>
<td>radius required</td>
<td>m</td>
<td>1.4</td>
</tr>
<tr>
<td><strong>biogas (public toilet)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>retention time</td>
<td>days</td>
<td>15</td>
</tr>
<tr>
<td>volume required</td>
<td>m³</td>
<td>196.72</td>
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<tr>
<td>reactor height</td>
<td>m</td>
<td>3</td>
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<tr>
<td>radius required</td>
<td>m</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>biogas (total)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td># reactors</td>
<td>#</td>
<td>3</td>
</tr>
<tr>
<td>volume required / react</td>
<td>m³</td>
<td>71.37</td>
</tr>
<tr>
<td>reactor height</td>
<td>m</td>
<td>3</td>
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<tr>
<td>radius required</td>
<td>m</td>
<td>2.8</td>
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