City Recovery Garden
- Integrate Urban Farm into the AMC Amsterdam

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CONTENT

INTRO
Renovation of the AMC

PROBLEM
Future challenges for the AMC

OBJECTIVE
Changing position & identity

RESEARCH
Flow & urban farming

DESIGN
Space, technique, climate
Built 1981-1983
Used for 36 years
Area 560,000 m²
8,000 employees
15,000 people/day
Multifunctionality
City / machine-like
“Monumental” brutalism

University (UMC)
Inpatient bed tower
Hospital
AMC IS SHRINKING

Number of beds decreased from 1000 to 700

Dr. Emile Comans
Lower

1) Average length of stay &
2) Bed occupancy rate

in Acute care hospitals

OVERALL TREND OF SHRINKING

Figure 1. Average length of stay in acute care hospitals (WHO, 2018)

Figure 2. Bed occupancy rate in acute care hospitals (WHO, 2018)
"Over 70% consultations take place online" (Lambert, 2016)
FUTURE OF HOSPITALS

Traditional
centralized, exclusive, territorial

New
separated, shared, remote (E-health)

Hospitals: shrinking in size
“Medical care only account for 10% of health outcome.”

70% affected by Human behaviour, social environment & physical environment (food, etc.) (Stewart, 2016)

WIDEN SCOPE OF HEALTH

Medical Treatment + Health awareness & Illness prevention
Dominated by car
WHAT IS URBAN FARMING?
Urban farming = Farming in urban context

A cultivation practice in an urban environment, which involves growing or raising, processing and distribution of food and integrated into urban economy and ecology.
WHY URBAN FARMING IN HOSPITALS?
“People involved in a community garden were *3.5 times* more likely to take enough vegetables and fruits daily as recommended.”

(Alaimo et al., 2008)

“A healthy dietary pattern is pivotal for prevention of *obesity* and *chronic diseases*”

(van Rossum et al., 2011)

“Notion of “*care farming*”: farms could be utilized to promote mental and physical health”

(Dessein, 2008)

“Better meals contribute to *speedier recovery*”

(Cioci, Oilvan & Pinzauti, 2016)
<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Form</th>
<th>Production</th>
<th>Area</th>
<th>Mission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lankenau Medical Center</td>
<td>Wynnewood, PA, USA</td>
<td>Open-air organic farm on campus</td>
<td>&gt; 4,000 pounds since 2015</td>
<td>1/2 acre</td>
<td>Meals; “Learning laboratory”</td>
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<tr>
<td>Cancer Treatment Center of America</td>
<td>Phoenix, AZ, USA</td>
<td>On-site conventional farmland</td>
<td>Cover 90% of its menu locally</td>
<td>43 acres</td>
<td>Feed patients; Open to visitors</td>
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<tr>
<td>St. Joseph Mercy Health System</td>
<td>Ypsilanti, MI, USA</td>
<td>Farmlands + 2 hoop houses</td>
<td>Not given</td>
<td>25 acres</td>
<td>Market; Meals; Events; Retreats; Education; Therapy</td>
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<tr>
<td>Henry Ford West Bloomfield Hospital</td>
<td>Bloomfield Twsp, MI, USA</td>
<td>Hydroponic Greenhouse</td>
<td>Not given</td>
<td>1,500 ft²</td>
<td>Patient meals; Cafe; Market; Education; Events; Public tours</td>
</tr>
<tr>
<td>Island Hospital</td>
<td>Anacortes, WA, USA</td>
<td>Weekly farm stand</td>
<td>0 (Provided by local farmers)</td>
<td>Not given</td>
<td>Produce; Recipes; Nutrition tips; “Fresh to Go” bags</td>
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<tr>
<td>University of Vermont Medical Center</td>
<td>Burlington, VT, USA</td>
<td>Rooftop garden (plots)</td>
<td>Not given 100% for menu</td>
<td>64 ft²/plot</td>
<td>Education; Meals; Refuge from the hospital for long-term patients</td>
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<tr>
<td>Homestead Hospital</td>
<td>Homestead, FL, USA</td>
<td>Garden adjacent</td>
<td>30,000 pounds/year</td>
<td>10 acres</td>
<td>Meals; Education; Market</td>
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<tr>
<td>Boston Medical Center</td>
<td>Boston, MA, USA</td>
<td>Rooftop farm + 2 urban beehives</td>
<td>5,000 pounds/growing season</td>
<td>7,000 ft²</td>
<td>Meals; Teaching kitchen</td>
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<tr>
<td>Mad River Community Hospital</td>
<td>Arcata, CA, USA</td>
<td>On-site vegetable garden + 2 greenhouses</td>
<td>Not given</td>
<td>Not given</td>
<td>Meals</td>
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<tr>
<td>Stony Brook University Hospital</td>
<td>Stony Brook, NY, USA</td>
<td>Rooftop garden shared by community gardens</td>
<td>&gt; 550 pounds/season</td>
<td>2,200 ft²</td>
<td>Meals; view</td>
</tr>
</tbody>
</table>
**PROVIDE**
- Healthy food
- Recreational space
- Green scenery
- Extra insulation
- Shading

**PROMOTE**
- Healthy diet pattern
- Healthy lifestyle
- Circulation
- Connection with public
- Neighbourhood involvement
HOW WILL URBAN FARMS PHYSICALLY INFLUENCE HOSPITALS?
Sub questions:

1) What are the available urban farming technologies at present?
2) What are the flows in these possible types of urban farm?
3) What are the flows in hospitals (case: current flows in the AMC)?
4) How can urban farming optimize the flows in hospitals?
5) What are the involved technologies?
6) Specifically in the AMC, what technologies are feasible and where to employ?
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<th><img src="image" alt="Greenhouse (CEA)" /></th>
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<td><img src="image" alt="Soil-based" /></td>
<td><img src="image" alt="Hydroponics" /></td>
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<tr>
<td>Plant pattern</td>
<td><img src="image" alt="Horizontal" /></td>
<td><img src="image" alt="Vertical" /></td>
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<tr>
<td>Location</td>
<td><img src="image" alt="Ground" /></td>
<td><img src="image" alt="Facade" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Roof" /></td>
<td><img src="image" alt="Interior" /></td>
</tr>
<tr>
<td>Control</td>
<td>CEA*</td>
<td>Non - CEA</td>
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* Controlled Environment Agriculture technologies

- Soil-based:
  - Multitunnel greenhouse
  - Indoor vertical farm
  - Horizontal Greenhouse
  - Indoor horizontal farm

- Soilless:
  - Vertical Greenhouse
  - Hydroponic roof garden
  - Edible living wall
Soil-based multitunnel greenhouse

Open-air greenroof (soil-based)

Hydroponic roof garden (open-air)

Edible living wall*

Details in research paper
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Traditional soil-based greenhouse

- Natural light
- Large water need
- Low-tech (suppose no electricity need)
Rooftop vertical hydroponic greenhouse

- Natural light + artificial light
- Large heat (& insulation) need
- High-tech (high productivity, high consumption)
Indoor vertical hydroponic greenhouse

- Artificial light
- Insulated by building, heat from building users
- High-tech (high productivity, high consumption)
Electricity: 75,000,000 kWh
Heat: 200,000,000 kWh
Water: 1,174,200 L
O₂: 1,654,581 L
Vege & fruits: 694,732 kg

AMC

Boiler

HVAC system

Lighting

Computer & office

Medical services

Non-Medical services

Toilet

Bath

Cleaning & disinfection

Restaurant

Residual heat: 78,200,000 kWh
Grey water: 234,840 L
Black water: 939,000 L

*DHW: domestic hot water
**CWHC: cold water for human consumption
Vegetable 200g  Fruit 200g
/person /day suggested by Dutch Dietary Guidelines (2015)

350,000 outpatient visit / year open for 24h
Over 7000 people work here
1,500 research staff
2,500 students
Weekday 9:00 a.m. - 17:00 p.m.

24 h wards
single; double; four-bed room
officially 1,002 beds
2,600 patients admitted / year

694,732 kg/year

Breakfast 14%
Dinner 36%
Lunch 20%
In-between 30%

Outpatient & visitor
< 4h
20%

Staff & student
8h
50%

Inpatient
24h
100%

FOOD DEMAND IN THE AMC
Area need for food demand (694,732 kg) in the AMC (m²)

Yield

<table>
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<tr>
<th>Technology</th>
<th>Yield (kg/m²)</th>
<th>Source</th>
</tr>
</thead>
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<tr>
<td>Hydroponic vertical greenhouse</td>
<td>95</td>
<td><a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5001193/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5001193/</a></td>
</tr>
<tr>
<td>Hydroponic horizontal greenhouse</td>
<td>25</td>
<td>(Sanyé-Mengual et al., 2015)</td>
</tr>
<tr>
<td>Soil-based multi-tunnel greenhouse</td>
<td>16.5</td>
<td></td>
</tr>
<tr>
<td>Hydroponic rooftop open-air</td>
<td>19.53</td>
<td><a href="https://www.hb.edu/uploaded/Institute_for_21st_Century_Education/Sustainability/">https://www.hb.edu/uploaded/Institute_for_21st_Century_Education/Sustainability/</a></td>
</tr>
<tr>
<td>Soil-based (traditional)</td>
<td>9.16</td>
<td><a href="https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19920012131.pdf">https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19920012131.pdf</a></td>
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OPTIONS

for spatial arrangement of different technologies

Available roof area: 35,530 m²
Total floor area: 46,180 m²
The only “lunch park“

No paved pedestrian

Parking-like bare plaza

Entrance, domain of car

Bare roads, ruled by car

Car-dominant district
Espalier fruit tree for car park

Fruit tree landscape

Fruit tree near roads
SUNLIGHT CONDITION

Spring

Summer

Winter
ENTRANCE DOUBLE FACADE
SOUTH ROOFTOP OPEN-AIR FARM
RAINWATER COLLECTION
SOLAR PANELS
Double facade with plants in pots
Solar heat water panel
Multitunnel greenhouse
Open-air garden
Greenhouse
Vertical farming, Lightwell, Food delivery well
Lecture hall, exhibition etc.
Kitchen, canteen, etc.
Open-air garden
Double facade with plants in pots
Connected terrace
Private balcony
Circulation hub
Circulation

Source from: KCAP
Entrance detail

Ventilated opening at joint area

Ref.
GREENHOUSE ON NORTH ROOF
FORMATION OF UNIT

Traditional

Strong in one orientation

Square unit

Flexible for diverse combination

Opening for ventilation

Vary in size & direction
COMBINATION OPTIONS
ROOF PLAN
PRODUCTIVE GREENHOUSE
Food plant plan
Requirement of indoor climate

- 28-30 °C, 55-65%
- 22-26 °C, 65-85%
- 22-25 °C, 65-75%
- 24-32 °C, 55-75%
- 18-20 °C, 50-70%
- 22-26 °C, 65-85%
- 16-18 °C, 40-60%
DEMAND: 694,732 kg/year
Meet approx. 85%
AMS precipitation 766 mm/year
Roof area: 9,248 m²
Rainwater collected: 7,083,968 L/year
Total water need: 3,799,342 L/year
Polyethylene vs. Fibre glass

Max. 50,000 gallons (189,270 L)

Stronger - can bear load

Economical

Flexible - plastic

Ideal for large, custom-designed tank

Dark hue inhibiting growth of algae

Need internal lining for algae reduction
Water storage wall

Pipe with filter

Glass fibre + timber support

Outlet pipe with valve
Self-circulating stacks
(ref: Sky Green, Singapore)

Double layer - better use of space

Light supplement on core

Servant & served space
ROUTE OF GALLERY AREA
Original roof garden
- kept for patients
- connect to staircase
Natural ventilation + HVAC supplement
Opening detail
ATRIUM + ROOFTOP CONNECTION
Water supply from existing system

- Waste water tank: 30L per time, 3 times/day
- Flushing toilet
- Drainage

Drip System
- Nutrient Solution
- Water Pump
Plant holder
85/3mm polyethylene tube
50/5mm polyethylene tube supporter
Soft rubber water pipe attached
Bolted onto steel column

Bolted rod holder
OPEN-AIR + TRADITIONAL
Other ways of food production
Recreational area

- for staff / students / visitors who are familiar with AMC
Public visitors
Patients
Staffs
Existing staircase & lifts

Added & using existing

Indoor lift

Platform of indoor stairs

Glazing box staircase

Escaping staircase
Solar heat water panel - Halle pajol, Paris

BIPV transparent solar panel

Source from: Solar choice

GH roof: 2,375 m²
432,822 kWh/year

Electricity demand for food:
335,417 kWh/year
Pre-heated fresh air

Evaporation