Design for urban metabolism:
From 1950s–1970s Japanese metabolism to the post-oil city
design theory

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What new urban form and future urban systems would emerge from the operation of urban metabolism?

ETH Zurich - Singapore Future Cities Lab

Georgia Tech - Tongji Shanghai - Atlanta Sino-US Eco Urban Lab
Metabolism: The Proposal for New Urbanism, 1960

Kiyonori Kikutake
Kisho Kurokawa
Fukihimo Maki
“Metabolism” is the name of the group, in which each member proposes future designs of our coming world through his concrete designs and illustrations. We regard human society as a vital process—a continuous development from atom to nebula. The reason why we use such a biological word, the metabolism, is that, we believe, design and technology should be a denotation of human vitality.

We are not going to accept the metabolism as a natural historical process, but we are trying to encourage active metabolic development of our society through our proposals.

This volume mainly consists of the designs for our future cities proposed only by architects. From the next issue, however, the people in other fields such as designers, artists, engineers, scientists, and politicians, will participate in it, and already some of them are preparing for the next one.

In future, more will come to join “Metabolism” and some will go; that means a metabolic process will also take place in its membership.
Project Japan introduces history of Japanese Metabolism, “the last movement that changed architecture”.....Rem Koolhaas.
Urban metabolists in 1950s-1970s

Plan for Tokyo Bay 1960
Kenzo Tange
Tange’s housing systems in Boston Harbor, developed in MIT in 1959, presented at **World Design Congress in 1960** and later adapted to the Plan for Tokyo Bay in 1960.
Transplant: as visiting professor at MIT, Tange uses his students to design a floating housing system for Boston Harbor, which he then takes home with him to apply to Tokyo Bay.
Marine City
designed by Kiyonori Kikutake, 1963
Shinjuku Redevelopment
Fumihiko Maki, 1960
Maki’s Group Form Theory implies urban systems as bottom-up processes and patterns for incremental growth and development.
Hillside Terrace
A demonstration of group form and organic growth, from 1968 to present
Agora project, Singapore Republic Polytechnic
Fumihiko Maki, 2007
Hishino new town–designed by Kisho Kurokawa, 1966
Urban metabolists in 1950s-1970s – Kisho Kurokawa
Agriculture city, Kisho Kurokawa, 1960

How do we design a city, a spatial framework to accommodate ecological flows for metabolism, symbiosis relationship?
Agriculture city, Kisho Kurokawa, 1960
Design for Urban Metabolism

*Lessons learned from Japanese Metabolism 1950s-1970s?*

1. Architecture is beyond functional object of early modernism.
2. **Urban design for metabolism** provides a flexible framework for accommodating adaptable changes and managing growth.
3. Cities as super organism, with metabolic processes.
4. Cities are not ecological machines. Urban metabolism needs both a urban design framework that will require bottom-up processes from society.
Design for Urban Metabolism

Redefining urban metabolism: what’s new from 1970s to present?

1. Cities as **metabolic** processes and flows

2. Cities as complex **systems**, a panarchy structure

3. Cities as **landscape** forms, flows and processes
1. Cities as **metabolic** processes and flows of energy and matters

The metabolism of urban systems designates the physiological processes, transport and transformation of matters and energy, in anthropogenic ecological system. (P Baccini and F Oswald, 2003)
城市代谢
URBAN METABOLISM

将城市理解为动态的系统
从物质与流的角度解读并模拟该系统
将城市形态视作其代谢的基本组成和内在资源

Understand the city as a dynamic system
Read and model this system in terms of Stocks and Flows
Recognise Urban Stocks as basic elements of the urban metabolism and as locally available resources

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

FUTURE CITIES LABORATORY

Source: Richard Rogers, Cities for a Small Planet, 1996
2. Cities as complex *systems*, a panarchy structure

**Ecology in the City** v.s. **Ecology of the City**

- Ecology and evolution of organisms that happen to live within city boundaries;
- Cities as emerging phenomena of coupled human and natural processes

An example of relationships in a typical study of ecology *in* the city (left) and ecology *of* the city (right) (Marzluff et al., 2008)
Panarchy hypothesis

The idea of system resilience, the capacity of a system to absorb disturbances and impacts from flows at scales above and below, and its ability to reorganize itself.... (Walker et al, 2004; Yang 2013, in Journal of Architectural Engineering Technology)
3. Cities as landscape -- forms, flows and processes
Landscape as Flows & Cities as Flows

Landscape as Flows: Nanjing Tangshan 2008, right
Cities as Flows: Zhuhai City West 2011, left;

Perry Yang – Eco Systems Design Studio
Design for Urban Metabolism: Searching for Eco City 2.0
Design for Urban Metabolism

International Urban Design Studio 2015
- Shanghai Chongming Eco Island

Instructor: Perry Yang
Affiliated faculty: Alan Balfour, Richard Dagenhart, Catherine Ross, Steve French
TAs: Steven Quan, Yinan Zhou, Huifen Zou
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City planners expect Dongtan will eventually be home to half a million people.

- Mixed-use urban area built to a density of 280 people per hectare. Completion expected by 2040.
- Mixed-use urban area built to a density of 210 people per hectare. Completion expected by 2040.

Legend:
- Wildlife park
- Organic farmland
- Golf course
- Wetland Park
- Hotel
- Wind turbines
- Roads for all traffic
- Zero-emission vehicles only
- Canal and waterbus
Three studio teams
– Georgia Tech + Tongji University

1. School of City and Regional Planning and School of Architecture
   Georgia Institute of Technology
   Strategic Planning, urban design and modeling of urban metabolism.
   Instructor: Perry Yang

2. College of Architecture & Urban Planning, Tongji University
   Urban and architectural design. Instructor: Yi Wang

3. UNEP-IESD, Tongji University
   Project planning, field survey on social, institutional and environmental analysis.
   Instructors: Cheryl Chi, Xin Wang
Eco City 2.0 -- A hypothesis

1. Hyper performance ecology and super compact city: A landscape ecological framework

2. Cites as renewable and productive systems

3. Net zero performance urban structure
1. **Hyper Performance Ecology and Super Compact city**

- A landscape ecological framework for compact urban systems and development patterns
ecologically optimum landscape pattern

- dispersal funnel to distant area
- core area
- some interaction with adjacent area
- "drift fence" effect catches dispersing species

Land Mosaics
Richard T. T. Forman, 1995
2. Cites as renewable and productive systems
Energy intensity and scales mapping (Schulz, 2013)

Intensity of urban energy demand typically ranges from 10-100 W/m². In the case of Tokyo’s 23 Wards, it can go up to 1000 W/m², in which the solar influx is about 157 W/m² (Dhakal et al., 2013; Schulz et al., 2013).
Net zero performance urban structure
Agricultural City:
Guangzhou Foshan Farm City Competition 2010

Perry Yang, Paul Jones, Brian Peterka – Eco Systems Design Studio 2010
Thank you