

MIT Living Labs Workshop (MAS 552.J / 4.557J)

Post-Tsunami Japan

Designing New Resilient Cities

Changing Places Group, Media Lab

Instructors – Kent Larson, Ryan Chin

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Prerequisites – Permission of Instructor

Logistics – Wednesday 230pm-530pm ~ Spring 2012 ~ Room E14-525

Units (3-0-9)

This course will be coordinated with Shun Kanda's Spring Architecture Design Studio (4.154) held in the Department of Architecture (Tuesdays and Thursdays from 2-6pm).

First Class – Wednesday, February 8th

Class Website: <http://cp.media.mit.edu/education/classes>

Course Collaborators – Nicholas Pennycooke, Daniel Smithwick, Praveen Subramani, Jenny Broutin, Shaun Salzberg, Brandon Martin-Anderson, Tyrone Yang, Ira Winder, Jet SiZhi Zhou, Topper Carew, Sandra Richter, Sheng-Ying (Aithne) Pao, and Hasier Larrea Tamayo.

Class Description

The destruction from the events of 3.11 in Japan has forced communities to re-question the concept of resiliency. This class will focus on the design of resilient communities in Tokoku, Japan, by developing new and scaleable housing, mobility, and energy systems. These systems should be designed to be adaptive, robust, reconfigurable, redundant, and exhibit self-healing much like wireless mesh networks in computing. Participants of the course will have the opportunity to travel to Japan during spring break for a one-week design charrette. We will work with sponsors and Miyagi University to design "Living Lab" experiments that can be deployed and tested in Tohoku. Prior to going to Japan, teams will focus on developing key components of a resilient city – in a generalizable fashion – that could scale to new cities in China, India, and Latin America.

Innovations in Housing, Mobility, and Energy

Design research this term will be based a number of existing concepts developed by the Changing Places research group at the Media Lab. They include Mobility-on-Demand (MoD) Systems, the CityCar & Persuasive Electric Vehicle, and the CityHome project.

Mobility-on-Demand (MoD) systems consist of a fleet of Lightweight Electric Vehicles (LEVs) distributed at charging stations in an urban service area. Users can simply walk up to the closest charging station, swipe an credit card, and drive to any other station. MoD systems are essentially one-way rental schemes that tackle the "First and Last Mile" problem of public transit systems. The CityCar designed by the Changing Places group at the MIT Media lab is a LEV

designed specifically for MoD systems. The CityCar is a two-passenger LEV that utilizes robotic wheels that enable high maneuverability in tight spaces. It also can transform and fold to minimize parking footprint – an extremely valuable asset in cities.

As work becomes more distributed, mobile, and service-based, and companies become increasingly virtual, the workplace is rapidly evolving. Simultaneously, homes are becoming centers of production, entertainment, health care, commerce, energy production, and learning. The buildings that support these activities and the transportation systems that link them currently operate at unsustainable levels. The CityHome project focuses on developing live/work spaces for these changes. Like the CityCar, the CityHome transforms (by movable walls and furniture) in order to reconfigure itself into different live/work arrangements. Designed with highly optimized and reconfigurable housing modules, the CityHome incorporates urban farming, electric vehicle charging and parking, and new energy systems (like robotic facades and energy storage systems). The combination of MoD systems and the CityHome concept provides synergistic opportunities to build resilient and redundant urban systems for cities.

The Living Labs workshop will focus on building upon these concepts in six distinct research areas and applying them onto MIT's campus and Boston's Innovation district (described below).

Six Exploration Areas

Six exploration areas have been identified and are under investigation by our researchers. Students in the class can find where their own interests overlap with the research group and select an exploration area as a starting point.

1. Electric Mobility Ecosystem Design

Team Leader: Nicholas Pennycooke

Mobility on Demand (MoD) Systems provides a sustainable, efficient, and economically viable fleet of electric vehicles in a one-way shared use system. Several vehicles have been designed to work inside MoD, including the CityCar, RoboScooter, and the Persuasive Electric Vehicle (PEV). Combining MoD with well-planned public mass transit creates an entire mobility ecosystem that can service a population with as few vehicles as possible. In the effort to rebuild infrastructure in tsunami-devastated areas of Japan, there is a unique opportunity to integrate a cohesive mobility system which is built around the needs of the local population, incentivizes non-locals and tourists to move to the area or visit, and works with the planned urban re-densification and zoning of rebuilt centers of housing and commerce. The Mobility Ecosystem team will take the principles of MoD systems developed in the Changing Places group and design a multi-modal transport system that services the selected regions. There will be an emphasis on selecting appropriate vehicle types, inter/intra-city transit pathways, as well as topographical, cultural, and socio-economical factors. The integration of various light electric vehicles into the system will be encouraged.

2. Energy, Environment, & Entrepreneurship

Team Leader: Praveen Subramani

Rebuilding the devastated villages of post-tsunami Japan will necessitate new strategies for energy generation and distribution within cities. The energy team will focus on studying nascent technologies for renewable energy and applying relevant technologies to the site. In particular, we will encourage the development of energy networks that can be installed

and/or maintained by locals, promoting entrepreneurial growth from within the villages and creating new economic opportunities. Distributed systems of partially self-sufficient, local microgrids will be helpful in maintaining energy and autonomy for each urban cell in the event of future natural disasters. Students will learn about existing energy generation and distribution technologies as well as nascent areas such as Smart Grids, Vehicle-to-Grid (V2G) technologies, and grid energy storage. One key focus area that will be incorporated into this design is the application of grid storage systems or battery buffers to store energy from intermittent renewable sources and provide backup power during emergencies.

3. Personalized and Transformable CityHome

Team Leaders: Dan Smithwick, Shaun Salzberg, and Hasier Larrea Tamayo

The CityHome project focuses on developing urban housing to respond to the changing live/work patterns in today's cities and to serve the needs of different demographics. Changing Places has developed a chassis/infill system that standardizes key modular chassis components of the home (structural, mechanical and electrical systems) while allowing the infill components (walls, cabinetry, furniture, windows, etc.) to be personalized to individual occupant needs. Following the Japanese tradition of multi-use and shared-use spaces, this module – which has the square footage of a one-bedroom apartment – will have the ability to reconfigure into different designs, for instance: a one-bedroom with a guest suite, a workout area and studio, a home office for a start-up, a dining area for a party of 20, etc. We will explore how this strategy for creating personalized housing can accommodate advanced technologies related to energy, health, communication, etc.

4. Streetscape Architecture

Team Leaders: Ryan Chin and Tyrone Yang

We will develop block strategies for mixed-use spaces including shared office, housing, and facilities to support virtual companies, with a focus on creating human-scale streetscapes. The key modules that comprise this new block would include public spaces, small and large connecting streets, and variations of the CityHome including taller towers for high density living as well low-rise buildings that define the streetscape. The building types for these streets would consist of mixed use living/work spaces as well as facilities for commercial activity, farming, recreation, and vehicle storage.

Students should consider light access, vertical and horizontal circulation, heating/cooling, and urban integration, in designing a streetscape block strategy. In addition to buildings, this group should seek to develop morphologies of street types and their associated vehicles and charging infrastructure.

5. Urban Farming Design Strategies

Team Leader: Jenny Broutin

Agricultural products of the Tohoku region (Miyagi Prefecture) have been significantly devalued by the Fukushima nuclear disaster. Agricultural land has been destroyed by the Tsunami, for example, the rice fields have been ruined by salt water. In addition, there is larger society imperative to develop more sustainable agriculture. By 2100, the world population is projected to grow from 7 to 10 billion. The Green Revolution that gave birth to industrial agriculture has grown steadily since the 1960's but has not kept pace with the

population rise – per capita production has fallen from its peak in the mid-1980's. This is largely due to the degradation of arable land through pollution or urbanization. Our current agricultural system is not sustainable both due to yield and deleterious effects to the environment. This group will discuss the agricultural strategy developed during the Green Revolution leading into our current food system and then posit strategies for the future of food in cities.

Developing a resilient strategy for food production in Tohoku region of Japan is an opportunity to pilot a system that could serve as a basis for rethinking food in cities. We will consider and implement planning, programming and infrastructural strategies both physical and virtual that are necessary to sustain urban food production. We will look at new farming technologies that can aid in achieving more sustainable results. We will consider how food has the ability to serve as a platform to unite communities through collective participation and social responsibility. By bringing farming to urban areas, it is possible to short-circuit the opacity of large-scale agriculture and create a feedback cycle for healthier, sustainable living.

6. Empowering Community: Technology, Art, and Culture

Team Leaders: Topper Carew, Sandra Richter, and Sheng-Ying (Aithne) Pao

We will explore the following questions:

How can technology, art, and culture create a unique cultural vibrancy, identity, and aesthetic for the town? Can it enrich and elevate the quality of life for both the people who live in, and who visit the proposed new town? And, while giving due respect to the region's historic artistic tradition, how can we introduce technology into the exhibition, performance, and art education mix? How can art, technology, and culture inform urban design? Can it stimulate economic development, attract tourism, and help to create a vibrant place for young professionals and artists to live and work?

Class Structure

Students will work in small teams throughout the semester led by project liaisons from the Changing Places research group at the MIT Media Lab.

Projects will run throughout the term with several joint Living Labs and Architecture Studio reviews with invited academic and industry guests. With previous high-demand for the class, students will be required to apply and interview for placement into the Living Labs course. The course instructors will formulate teams based on student interest, background diversity, and skill sets.

Expected Student Deliverables

Students will collaborate in teams, work within existing problem spaces in the urban environment, and propose well-crafted design solutions that creatively address the problems. Students will be expected to propose design solutions through illustrations, building scale prototypes (working and non-working), back-of-the-envelope calculations, videos, and other types of media.

Requirements

All backgrounds are welcome to participate in the workshop. Both graduate and undergraduate students are encouraged to apply to the course. Backgrounds in Architecture, Computer Science, Electrical Engineering, Management, Material Science, Media Arts and Sciences, Mechanical Engineering, and Urban Planning are preferred.

Course Reading

Reinventing the Automobile: Personal Urban Mobility for the 21st Century by William J. Mitchell, Christopher Borroni-Bird, and Lawrence Burns.

Additional readings will be assigned throughout the term.

Schedule

MIT Living Labs will meet from 230-5:30pm, Room E14-525. (5th floor conference room). This course will coordinate with the Architecture Design Studio (4.154) taught by Prof. Shun Kanda, which meets from 2-6pm on Tuesday and Thursdays.

A typical class session will have a presentation by guest speakers, followed by student group discussions. Additional class time requirements include individual and team meetings with instructor(s) and team working meetings outside of class hours.

WEEK	DATE	SESSION OVERVIEW	Lectures
1	2.08.12	FIRST CLASS MEETING, 230PM Introductions and presentations by Changing Places Group Students will identify their top 3 interest areas Course Interviews on Thursday and Friday (Feb 9 and 10)	
2	2.15.12	Mega Team assignments and introductions In Class Brainstorming Review of results Hand out assignment # 1	Streetscapes (30 min.) Mobility (30 min.)
3	2.22.12	<i>Review of assignment # 1</i> <i>Breakout into Mega-groups (3)</i>	Art & culture (30 min.) CityHome (30 min.)
4	2.29.12	<i>Mega Group Review</i>	

5	3.07.12	Break up into individual teams (6) Assignment # 2	Energy Systems (30 min.) Urban Farming (30 min.)
6	3.14.12	Student work time	
7	3.21.12	Review Assignment # 2 Final Preparation for Japan trip <i>Leave for Japan at end of the week (March 23 or 24)</i>	
8	3.28.12	Japan Charrette On site Japan Workshop during Spring Break Monday – Thursday in Minamisanriku (Miyagi Prefecture) Friday – Review in Tokyo with sponsoring companies and Japanese ML Members. <i>Return to Boston (April 1)</i>	
9	4.04.12	Introduce Assignment # 3 Student Work Session	
10	4.11.12	Student Work Session Distribute Sponsor Week Poster specifications	
11	4.18.12	Review Assignment # 3 Prepare for Member's week	
12	4.25.12	Media Lab Sponsor/Members Week Class Poster Session	
13	5.2.12	Introduce final assignment Student Work Session	

14	5.9.12	Student Work Session	
15	5.16.12	Last Day of Class	
16	5.23.12	Final REVIEW Invited Critics: To be confirmed Joi Ito Hiroshi Ishii Jim Westcoat Dennis Frenchman Xavier Barrera Mel King Shun Kanda Larry Sass Ralph Gakenheimer Nigel Jacob Chris Osgood Stephen Connors	