Designing Sustainable Infrastructure: Materials, Methods, Technologies

Instructor: Dr. Max Hirsh
Time: Mondays 9am-1pm & 2-6pm and selected Fridays 2-6pm
Location: SDE 1 Exhibition Hall and on Zoom

OVERVIEW

Airports are essential for the movement of goods and people. Modern societies depend on rapid air transport for everyday necessities, such as fresh food and medicine. Airports also host billions of passengers each year: enhancing the wellbeing of leisure travelers, and connecting friends and relatives across great distances. Finally, airports facilitate the movement of students, business travelers, and skilled migrants, supporting knowledge creation and economic development on a global scale.

Unfortunately, airports also drive climate change. Air travel and the necessary support infrastructure—such as terminals, runways, and fuel farms—account for ca. 3% of global CO2 emissions, while also producing significant losses in air quality and biodiversity on the ground.

Airports therefore face an existential challenge. Without them, our society would not be able to function. But if we continue to design, build, and operate airport infrastructure as we have in the past, the environmental consequences will be severe. Facing mounting criticism, airports are therefore under growing pressure to become more sustainable.

Airports straddle three of the world's most carbon-intensive sectors: transportation, building construction, and energy production. With that in mind, this course proposes airports as a useful lens for investigating opportunities to adapt global infrastructure systems to the challenges of climate change. Focusing on sustainable design methods, materials, and technologies, we will research scalable, cost-effective design innovations, including:

- **low-carbon and bio-based building materials** that introduce economical alternatives into the design and construction process
- **circular construction methods** that reuse existing building materials in new construction projects, thereby reducing the need to remove waste and acquire new materials
- **nature-based landscape solutions** that enhance natural habitats in order to sequester carbon, support biodiversity recovery, detoxify runoff, and increase flood protection
- **automated building technologies** that leverage modular components and on-site construction methods

The course is led by Dr. Max Hirsh, a leading global expert on airports and urban development. A field trip to Thailand's Eastern Economic Corridor (EEC)—along with presentations by airport sustainability professionals—will enhance our understanding of both the opportunities and limits that we face in advancing sustainable infrastructural futures.

Students will draw on those insights to develop speculative design scenarios for sustainable infrastructure development in Thailand's EEC. Methodologically, we will rely on site analysis, mapping, interviews, and stakeholder engagement. These are both useful research methods—and much-needed skills in the workforce. Through a systematic design investigation of airports, the course aims to create new knowledge that advances sustainable design practices across multiple domains of infrastructure.

The semester-long studio is comprised of two projects:

PROJECT 1: GLOBAL PERSPECTIVES ON SUSTAINABLE INFRASTRUCTURE
We will begin by locating infrastructure development in Thailand's Eastern Economic Corridor in a broader global context. Investigating sustainable design practices at airports in Asia, Europe, and North America, we will focus on two questions:

- What are the key considerations that guide airports' climate mitigation and adaptation strategies? What are the trade-offs, in terms of design, finance, operations, and socio-economic development?
- What role does regulation play in driving sustainable design outcomes? How do airports in different regulatory environments address the universal challenge of climate change?

We will advance our understanding of these big-picture themes by mapping airports and aviation-linked infrastructures in the EEC, with a primary focus on Suvarnabhumi (BKK) and U-Tapao (UTP). Charting the relationship between airports and their resource hinterlands, we will investigate key questions, including:

- Where does the airport source its building materials and energy supply?
- Where does the airport dispose its waste?
- What kinds of local know-how and natural systems are available to support the transition to sustainable materials, methods, and technologies?
- What are the development opportunities for airports' resource hinterlands?

Project 1 is designed to help us prepare for our research trip to Thailand. Students will receive a detailed brief, including an overview of key deliverables, during the first week of instruction.

PROJECT 2: SUSTAINABLE INFRASTRUCTURAL FUTURES

In the second part of the semester, students will speculate on the future of the Eastern Economic Corridor by developing design scenarios that reimagine social, economic, and governance processes over the next 30 years. Within these speculative narratives, infrastructure is understood as an index of the existing landscape and an active instrument that constructs new worlds by reorganizing the physical landscape, its systems, operations, and governance. Students will explore how landscape interventions could potentially shape the focal sites by construction and testing various scenarios for sustainable outcomes.

Sites will be selected in consultation with the instructor. While the core focus is on airports themselves, students will also investigate aviation-linked infrastructure systems: including a high-speed railway designed to link up all three of Greater Bangkok's airports; as well as transport and energy corridors that connect the EEC's ports and airports to sites of agricultural and industrial production across the region.

In this studio, landscape representation is a crucial instrument to analyze and speculate on the futures of the EEC. Students will experiment with multiple forms of media to understand existing landscape processes, and then use this as the basis for design operations. Using digital and analogues modes of representation, these mapping exercises focus on the relationships between the social, economic, and governance processes that shape the physical and material landscape of airports and airport-linked infrastructures.

COURSE SCHEDULE

PROJECT 1: Global Perspectives on Sustainable Infrastructure

W1 **Course Introduction & Project 1 Launch**
15 Jan (M) 3-6PM on Zoom
19 Jan (F) 2-6PM at SDE

W2 **Materials, Regulations & People**
22 Jan (M) 3-6PM on Zoom
26 Jan (F) 4-6PM @ SDE

W3 **Mapping EEC Infrastructures**
29 Jan (M) 2-6PM on Zoom
02 Feb (F) 2-6PM @ SDE

W4 **PROJECT 1 INTERIM REVIEW**
05 Feb (M) All Day @ SDE

W5 **Public Holiday**
12 Feb (M) No Class

W6 **PROJECT 1 REVIEW**
19 Feb (M) All Day @ SDE

Studio Field Trip
20-23 Feb* Thailand *(*arrival/departure dates TBC)*

Recess Week (24 Feb-03 March)

PROJECT 2: Sustainable Infrastructural Futures

W7 **Project 2 Launch**
04 Mar (M) All Day

W8 11 Mar (M) All Day

W9 18 Mar (M) All Day

W10 25 Mar (M) All Day

W11 **PROJECT 2 INTERIM REVIEW**
01 Apr (M) All Day

W12 08 Apr (M) All Day

W13 15 Apr (M) All Day

W14 PROJECT 2 FINAL REVIEW
25 Apr (Th) All Day

NOTE: This schedule is subject to change at the instructor's discretion. Adjustments will be based on several factors, including student progress and the availability of guest speakers.

LEARNING OBJECTIVES

- Use landscape-based interventions as a powerful driver for sustainable planning and design strategies
- Understand how design and construction impact an infrastructure's environmental performance across all three stages of its life cycle
- Understand social, financial, governance, and environmental considerations that alternately enable and/or prevent sustainable planning and design outcomes
- Develop skills to collect, analyze, and synthesize original data using qualitative research methods
- Develop skills to present research findings and design proposals in a clear and convincing manner, both orally and visually

STUDIO FORMAT

Your work in the design studio will advance primarily through independent explorations with support from dialogues with your instructor and colleagues. The dialogues will take the form of ***desk critiques***, ***workshops***, ***pin-ups***, and ***reviews***. These explorations and dialogues will be supplemented through readings, lectures, site visits and field trips. Each student is expected to develop their project during studio class time and during evenings and weekends.

Desk Critiques (Desk Crits): The instructors will spend approximately 20-30 minutes with each student at their desk during studio class time. During this time, the instructor will review student progress on the design project through drawings, models or other representational means and offer critical feedback on the process and proposals. Progress MUST be demonstrated between each studio period. Instructors reserve the right to refuse a desk crit if there are no new drawings or models presented for the discussion. It would be helpful to present your progress through a concise and organized summary, showing all explorations and asking any questions that have arisen during the course of the design process. You should document all of your visual work on Miro on the designated project folder during desk crits.

Pin-ups: Informal group presentations of the student's project through graphic means to the rest of the studio, the instructor, and occasionally to guest critics. The purpose of pin-ups is to solicit feedback from your classmates and guest critics. All students are required to attend all pin-ups.

Reviews: Formal group presentations of each student's project to the studio members, instructors and guest critics. These typically occur at the conclusion of each project, and for longer projects, at mid-project. Each student must make a well-prepared and organized verbal presentation to accompany a full graphic description of their project to that point. The instructor will discuss with each student the minimal requirements for each review. All students are required to attend every review.

It is the responsibility of the student to develop a strategy for working through a design problem. It is critical that the student independently seek inspiration that will nurture creativity and to supplement their knowledge of landscape architecture beyond the classroom. Some examples of this include attending lectures, visiting museums and galleries, reading books and journals.

DATA ROOM

To encourage the sharing of information, students will develop a data room, which will serve as a common platform for storing all data and deliverables that students collect and produce throughout the studio. The data room is available here.

Students are expected to maintain the data room so that all resources can be easily searched and shared. When adding a new file, be sure to follow these guidelines:

Research Material

- except for deliverables (see below), all files should follow this naming convention: CATEGORY_ LOCATION_KEYWORDS.FILE FORMAT
- save the file in an existing folder, unless no appropriate folder already exists
- for Category, use one of the following descriptors:
    - Airport
    - Economy
    - Energy
    - People
    - Policy
    - Rail
    - Road
    - Sea
    - Water
- if no appropriate category descriptor exists, please consult the instructor
- if possible, limit the file description to no more than 5 keywords
- if appropriate, the keywords may include a date, which should be listed last
- for airports, use three-letter IATA codes (e.g. BKK for Suvarnabhumi, SIN for Changi).
- for locations with long names (e.g. Sattahip Commercial Port), use an abbreviation that all students can follow (e.g. SCP)
- if there is no appropriate location, use the document's author/source instead (e.g. IATA)

For example:

- a sustainability report published by Changi International Airport in 2023:
  Airport_SIN_Sustainability Report 2023.pdf
- a map of the Eastern Economic Corridor's high-speed rail network in the year 2045:
  Rail_EEC_High Speed Rail Map 2045.ai
- a group photo taken during a site visit to Laem Chabang Port:
  Sea_LCP_Site Visit Group Photo.jpg
- a chapter on sustainability from a manual published by the International Civil Aviation Organization (ICAO):
  Airport_ICAO_Airport Development Reference Manual Sustainability Chapter.pdf

Project Deliverables

- deliverables should follow this naming convention:
  PROJECT [#]_DELIVERABLE [#]_KEYWORDS_STUDENT SURNAMES.FILE FORMAT
- for example: Project 1_Deliverable 2_Spread 1 EU Sustainability Policies_Li Wu.pdf

A good data room is essential to ensure the smooth exchange of information and ideas. Failure to follow these guidelines will negatively impact the assessment of students' performance.

EVALUATION & ASSESSMENT

The instructor will evaluate student performance on the basis of the quality of interaction and production evidenced during ***desk critiques*** and ***project reviews***. This evaluation includes consideration of the following:

- Weekly progress of design project (20%)
- Quality of project content (30%)
- Verbal explanation and graphic representation during reviews and pin-ups (30%)
- Participation and contribution to seminars, discussions, and workshops (20%)

The projects will be weighted as follows:

- Project 1: 40%
- Project 2: 60%

The mere completion of requirements outlined in the project briefs will result in a base grade of C (Satisfactory). Late submissions will result in the reduction of 1 subgrade for the first week, and then additional subgrade per day. The instructor will issue warnings to students that are anticipated to receive a letter grade lower than C after recess week. Students should approach the instructor to discuss remedial work if necessary.

Attendance is required for the duration of all in-person studio sessions. More than 2 unexcused absences throughout the semester will result in the reduction of 1 subgrade of the final grade.

STATEMENT OF ACADEMIC CONDUCT

All written work in this course will be submitted for plagiarism review via Turnitin, for more information, see http://www.cit.nus.edu.sg/turnitin/. Clarification of the National University of Singapore's policies on plagiarism, as well as detailed descriptions of how to properly cite and source material in your written work and examinations is available at https://libguides.nus.edu.sg/new2nus/plagiarism. Plagiarism includes handing in the work of another as your own, and failure to appropriately cite your sources. Plagiarism is an academic misdemeanor, and may be considered grounds for failure from this course as well as further disciplinary action from the University.

INCLUSIVE CLASSROOM

This course welcomes individuals of all backgrounds, beliefs, ethnicities, national origins, gender identities, sexual orientations, religious and political affiliations – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class. Please speak with the instructors if this standard is not upheld.

DISABILITIES

NUS strives to provide an inclusive and nurturing campus environment for students with disabilities and special needs to achieve their fullest potential. If you have a documented disability, or any other problem you think may affect your ability to perform in class, please see the instructor early in the semester so that arrangements may be made to accommodate you. The Student Accessibility Unit (SAU) serves as a key touchpoint dedicated to supporting the range of access needs that students may have. For more information see: https://nus.edu.sg/osa/student-services/student-accessibility-unit