

Transportation and Infrastructure Concentration

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This area of concentration covers any form of infrastructure that is an important shaper of the built environment, particularly transportation, storm water, drinking water and sewage but also energy and telecommunications. Students are encouraged to take courses that examine infrastructure from a variety of perspectives, including:

1. Planning practice and policy
2. Analytic methods applied to infrastructure planning and operations
3. The physical design of infrastructure
4. The relationship between infrastructure and land use
5. Private infrastructure provision, regulation and finance
6. Specialized courses on particular modes of transportation or types of infrastructure

Attached is a list of about 20 courses at Harvard and MIT that might be used to fulfill the concentration requirement in infrastructure and transportation.

- Courses marked with a “*” are pre-approved for the area of concentration.
- Courses not marked with a “*” are likely to be approved but should be reviewed with us. These courses are either fairly specialized or not well known to us.

Several caveats about the list:

- The courses are listed by the six categories above but some could be included in several categories. Courses are classified in the category they fit best, but occasionally we have listed a course in more than one category.
- Within each category the courses are listed by school (GSD courses first, other Harvard courses next, then MIT) and then by course number. The order in which the courses are listed does not indicate their suitability. All the courses on the list are potentially suitable and those with a “*” are pre-approved.
- Many of the courses within a category overlap—be careful about taking more than one or two from a given category.
- We probably have overlooked some terrific courses and included others that are not suitable. Please feel free to suggest additions and deletions for future editions of this list.
- This list is based on the on-line catalogues for Harvard and MIT, but occasionally those catalogues are inaccurate or change. Note especially that the GSD and MIT had not released the complete 2017-18 academic year course lists when this guide was developed so we assumed the courses offered in 2016-17 would be offered again unless we had specific information otherwise.

Please note that course offerings often change, and new courses may be offered while these recommended courses may not be offered each year, particularly in the spring semester. This memo is subject to change depending on the availability of courses. Other courses may be approved with the permission of one of the Concentration Advisors.

Recommended basic courses:

The following courses are recommended to those interested in the concentration. They are introductory level courses that give a good overview of the topics and subject matter covered in more depth by other courses in the concentration:

GSD 5302: Transportation Policy and Planning (Fall)

GSD 5304: Transportation Planning and Development (Spring)

GSD 5376: Urban Transportation Planning and Implementation (Spring)

Approved courses include:

1. PLANNING PRACTICE AND POLICY

Courses that provide an overview of transportation or infrastructure planning practice and issues. Some of these courses overlap.

Fall

At the Kennedy School of Government:

HKS IGA-411: The Energy Climate Challenge

Lee, Holdren

“The greatest challenge at the intersection of science, technology, and public policy in the 21st century has arisen because society is getting 80 percent of the massive quantities of energy it needs using fuels and technologies that are disrupting global climate and the array of environmental goods and services that depend on it. This course will examine the character and magnitude of this challenge and the policy choices germane to meeting it, introducing and applying relevant concepts from environmental science, energy-technology assessment, policy design, and domestic and global politics.”

At MIT (Massachusetts Institute of Technology):

MIT 11.371J: Sustainable Energy

Golay

“Assessment of current and potential future energy systems. Covers resources, extraction, conversion, and end-use technologies... for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal) energy types...”

COMMENT: New to us—please let us know.

MIT 11.601: Introduction to Environmental Policy and Planning

Susskind

“First subject in the Environmental Policy and Planning sequence. Reviews philosophical debates concerning growth and scarcity vs. deep ecology. Examines the ongoing policy debate concerning "command-and-control" vs. market-oriented approaches to regulation. Considers the debate regarding the importance of expertise vs. indigenous knowledge. Emphasizes environmental planning techniques and strategies. Related topics include the management of

sustainability, the politics of ecosystem management, environmental governance and the changing role of civil society, ecological economics, integrated assessment (combining EIA and risk assessment), joint fact finding in science intensive policy disputes, environmental justice in poor communities of color, and environmental dispute resolution.”

COMMENT: Infrastructure raises many environmental issues and Susskind has a great reputation.

Spring

At the Graduate School of Design:

GSD 5376: Urban Transportation Planning and Implementation* Salvucci

This course provides a multi-faceted introduction to urban transportation: the technologies, the institutions, the politics, and the formal methods of transportation planning. The focus is primarily on the United States, with many examples from the Boston area, but comparisons will be made to other countries and much of the content is more broadly applicable.

2. ANALYTIC METHODS APPLIED TO INFRASTRUCTURE PLANNING

Infrastructure and transportation planning have long been influenced by engineers and economists who have applied economics, statistics, operations research and other analytic methods to the analysis of planning issues.

Fall

At the Graduate School of Design:

GSD 5302: Transportation Policy and Planning* Gomez-Ibanez

“Provides an overview of the issues involved in transportation policy and planning, as well as an introduction to the skills necessary for solving the various analytic and managerial problems that are peculiar to this area. The course is organized around six problems: analyzing the market for a service; costing and pricing; controlling congestion and pollution; transport and land use; investment evaluation; and the regulation of private carriers. Examples are drawn from both urban and inter-city passenger and freight transportation. Twenty of the 24 class sessions are case discussions. Basic understanding of microeconomics is presumed – see syllabus for details.

COMMENT: Differs from GSD-5304 in that it emphasizes the application of economics to transportation planning and considers freight and intercity transport as well as urban.

At Massachusetts Institute of Technology (MIT):

MIT 11.544J: Transportation Systems Analysis: Performance and Optimization* Osorio

“Problem-motivated introduction to methods, models and tools for the analysis and design of transportation networks including their planning, operations and control. Capacity of critical elements of transportation networks. Traffic flows and deterministic and probabilistic delay models. Formulation of optimization models for planning and scheduling of freight, transit and airline systems, and their solution using software packages. User- and system-optimal traffic assignment. Control of traffic flows on highways, urban grids, and airspace.”

COMMENT: GSD students who have taken it say it is a demanding and useful overview of simulation and optimization models commonly used in transport.

MIT 11.545J/1.201J: Transportation Systems Analysis: Demand and Economics* Ben-Akiva

Introduces transportation systems analysis, stressing demand and economic aspects. Covers the key principles governing transportation planning, investment, operations and maintenance. Introduces the microeconomic concepts central to transportation systems. Topics covered include economic theories of the firm, the consumer, and the market, demand models, discrete choice analysis, cost models and production functions, and pricing theory. Application to transportation systems include congestion pricing, technological change, resource allocation, market structure and regulation, revenue forecasting, public and private transportation finance, and project evaluation; covering urban passenger transportation, freight, aviation and intelligent transportation systems.

COMMENT: Assumes no prior economics and might satisfy MUP, micro economics requirement.

Spring

At the Kennedy School of Government:

HKS API-135: Fundamentals of Environmental Economics and Policy Stavins

“Provides a survey, from the perspective of economics, of public policy issues associated with environmental protection and natural resources management. Lectures on conceptual and methodological topics are combined with examinations of specific resource and environmental issues. Prerequisite: Introductory microeconomics. Also offered by the Department of Economics as Econ. 1661.”

COMMENT: Suitability of course for planners unclear; please advise if you take it.

At MIT (Massachusetts Institute of Technology):

MIT 1.202: Demand Modeling* TBD

“Theory and application of modeling and statistical methods for analysis and forecasting of demand for facilities, services, and products. Topics include review of probability and statistics, estimation and testing of linear regression models, theory of individual choice behavior, derivation, estimation, and testing of discrete choice models (including logit, nested logit, GEV, probit, and mixture models), estimation under various sample designs and data collection methods (including revealed and stated preferences), aggregate forecasting methods, and iterative proportional fitting and related methods. Lectures reinforced with case studies, which require specification, estimation, testing, and analysis of models using data sets from actual applications.”

COMMENT: An introduction to the methods of forecasting demand in transportation from a leader in the field. Presumes basic statistics. Very useful if you want to work in urban transportation planning but not for the faint of heart.

3. THE PHYSICAL DESIGN AND REQUIREMENTS OF INFRASTRUCTURE

Infrastructure often occupies a large part of a site or a city. Your required MUP core studio courses and the companion methods course provide an introduction to the physical requirements for infrastructure. These courses provide more detail.

Fall

At the Graduate School of Design:

GSD 3241: Theories of Landscape as Urbanism, Landscape as Infrastructure: Paradigms, Practices, Prospects Belanger

“Responding to contemporary urban patterns, ecological pressures and decaying infrastructures, this course brings together a series of influential thinkers and researchers from the design commons across North America to discuss different methods, models and measures of large scale, long range design for the 21st century.”

COMMENT: New course; please let us know how relevant it is to urban planning concerns. Due to course capacity restrictions, this course is only available to those students who are required to take it as part of the MLA or MDesS ULE curriculum. Students in dual degree programs who have been required to take 3241 may however count it toward this concentration.

GSD 9132: Ecology, Infrastructure, Power Belanger

“Extraction redefines our understanding of urbanism in the 21st century. If everything we build comes from the ground, then extraction is the process and practice that reshapes our assumptions about urban economies. From gold to gravel, copper to coltan, iron to uranium, geological resources support every single aspect of human life in the 21st century. In subway tunnels or on suburban streets, in electronic manufacturing or information media, on stock exchanges or in commodity markets, the geological materiality of contemporary urbanism is inescapable. Where do these materials come from? Where do they go? Who processes them? How are they moved?”

COMMENT: New course and unclear whether suitable for concentration. Please let us know if you take it.

4. THE RELATIONSHIP BETWEEN INFRASTRUCTURE AND LAND USE

Transportation and other types of infrastructure are often seen as important tools in influencing the location of residences and businesses.

Spring

At MIT (Massachusetts Institute of Technology):

Please consult with your concentration advisor for course approval

5. PRIVATE PROVIDERS, REGULATION AND FINANCE

In many countries, important transportation and infrastructure services are provided by private firms and/or financed on private capital markets. What role should private providers play and does the public sector need to regulate them? What are the options for financing infrastructure and how should those borrowings be repaid?

Fall

At the Kennedy School of Government:

HKS API-141: Finance

Deep

“This course provides a general survey of finance and investments. It emphasizes an intuitive, logically rigorous understanding of the theory and practice of financial markets, illustrating the concepts through examples and cases drawn from the public, private, and nonprofit sectors. Topics covered include: present value analysis and discounting; diversification; the trade-off between risk and return; market efficiency; pricing of stocks and bonds; the capital asset pricing model; the arbitrage pricing theory; term structure of interest rates; the principle of arbitrage; derivative securities such as forwards, futures, and options; use of derivatives for hedging; and risk management. Prerequisites: Assumes a knowledge of basic high school mathematics, familiarity with spreadsheets, and a course in microeconomics (such as API-101).”

COMMENT: Since infrastructure is capital-intensive, private infrastructure providers are very concerned about how to raise financing from capital markets. Excellent teacher and course is often oversubscribed.

HKS API-148: Advanced Risk Management and Infrastructure
Finance

Deep

“The course presents an advanced treatment of the theory of financial risk management and its application to infrastructure finance. The theory presented in the course covers the topics of economic and financial rate of return, measurement of risk exposure, cost of funds, capital structure, valuation methods, dynamic hedging using futures and swaps, and credit risk models and derivatives. Applications, discussed mostly in the form of infrastructure cases, will examine issues related to project finance, public-private partnerships, project appraisal, risk allocation, debt management, commodity, interest-rate and currency risk hedging, credit enhancement, regulation and privatization.”

Spring

At the Kennedy School of Government:

HKS DEV 209: Management, Finance, and the Regulation of
Public Infrastructure in Developing Countries*

Lee

“This course will look at efforts to privatize, finance, and regulate the transportation, telecommunication, water, and electricity infrastructure systems in developing countries. Issues to be discussed include when and how to privatize infrastructure, awarding concession contracts, project finance, contract and discretionary regulation, asset valuation, and managing the political context in which infrastructure decisions are made. The course will rely on case material taken from infrastructure programs in developing countries, including Brazil, Mexico, Thailand, Argentina, Philippines, and India, as well as key developed countries, including the United Kingdom and Australia.”

COMMENT: The why and how of private infrastructure mainly, but not exclusively, in developing countries. Popular, well-taught course; uses case method.

HKS MLD 410: State and Local Financial Policy

Chodos

“Provides an introduction to issues of financial management in state and local government. Explores three interrelated areas: (1) raising revenues — including the trade-offs associated with establishing a sustainable tax base; (2) raising capital — by borrowing in the capital markets; and (3) investing funds — in the context of both cash management and funding pension systems. Specific topics include: state and local tax policy, transit finance, school finance, privatization, economic development, debt management, and the roles of rating agencies, investment bankers, and investors. This course is policy focused and is not a substitute for courses in corporate finance, project finance, or the capital markets...”
COMMENT: Focus on US only. Very relevant for infrastructure finance.

At MIT (Massachusetts Institute of Technology):

MIT 11.487: Innovative Budgeting and Finance for the Public Sector

Carolini

“Examines globally relevant challenges of adequately and effectively attending to public sector responsibilities for basic services with limited resources, particularly in the contexts of fiscal crises, rapid population growth, as well as shrinkage, through: an introduction to methods and processes of budgeting, accounting, and financial mobilization in the public sector; use of case studies and practice exercises to explore revenue strategies and to gain fiscal analytical competencies; study of pioneering examples of promising budget and accounting processes as well as innovative funding mobilization via taxation, capital markets, and experimental experiences with mechanisms such as land-value capture. Students taking graduate version are expected to explore the subject in greater depth.”

6. SPECIALIZED COURSES ON A PARTICULAR FORM OF INFRASTRUCTURE OR

TRANSPORTATION: If you are very interested in a particular type of infrastructure, these courses may be appropriate.

Fall

At MIT (Massachusetts Institute of Technology):

MIT 1.232J: The Airline Industry

Belobaba, Barnett,
Barnhart, Odoni,
Hansman, Kochan

“Overview of the global airline industry, focusing on recent industry performance, current issues and challenges for the future. Fundamentals of airline industry structure, airline economics, operations planning, safety, labor relations, airports and air traffic control, marketing, and competitive strategies, with an emphasis on the interrelationships among major industry stakeholders. Recent research findings of the MIT Global Airline Industry Program are showcased ...”

COMMENT: For airline industry lovers. Excellent reputation but 1.234J may be better introduction (let us know).

MIT 1.260J: Logistics Systems

Sheffi, Caplice

“Introduction to supply chain management from both analytical and practical perspectives. ... Key logistics functions are covered to include demand planning, procurement, inventory theory and control, transportation planning and execution, reverse logistics, and flexible contracting. Concepts explored include postponement, portfolio management, dual sourcing, and others. Emphasis is placed on being able to recognize and manage risk, analyze various tradeoffs, and model logistics systems.”

COMMENT: Freight MIT offers almost a dozen courses on supply chain management and logistics but we think this is the introduction.

Spring

At MIT (Massachusetts Institute of Technology):

Please consult with your concentration advisor for course approval

Not Currently Offered: The courses listed here are not offered in 2017-18 but were offered in a recent year and students who took them in the past may petition to count them toward the concentration

GSD 5368: Urban Infrastructure, Environment and Sustainability

Lily Song

“This seminar course introduces a critical approach to urban infrastructure with a focus on three domains—(1) transportation/urban mobility, (2) green buildings and neighborhoods, and (3) natural resource extraction and management. Course objectives are twofold, to: (1) clarify the historical, institutional, and socio-spatial factors shaping existing infrastructural dilemmas, including racial, classed, and gendered patterns of infrastructural provision and access, and (2) explore the role of politics and strategic actions involving actors and institutions across levels government as well as sectors, organizations, and groups beyond it in advancing and sustaining policy changes in urban infrastructure.”

HKS IGA 410: Energy Policy: Technologies, Systems, and Markets*

Lee

“Energy ... plays an enormous role in environmental problems and solutions, in national security issues, and in science and technology policy. The course discusses the technological, economic, and policy dimensions of the energy choices needed to meet economic and environmental goals in both the near and long term. Energy-supply, end use–efficiency options, climate change impacts, and strategic energy policies will all be covered. The primary focus of the course will be international, but there will be some discussion of U.S. domestic programs and policies.”

COMMENT: Energy is critical to the environmental impacts of transportation and infrastructure

HKS MLD 411: Budgeting and Financial Management

Blimes

“This rigorous introductory course aims to demystify the budget process for those who are new to the world of budgeting. It covers the entire budget process, including budget formulation and execution, program development, cost and revenue estimation, budget strategies and tactics, and budget evaluation. The course will include performance-based budgets, performance measurement, variance analysis, activity-based costing, cost accounting, capital budgeting, and finance.”

MIT 1.203J: Logistical and Transportation Planning Methods

Larson, Odoni,
Barnett

“Quantitative techniques of operations research with emphasis on applications in transportation systems analysis (urban, air, ocean, highway, and pickup and delivery systems) and in the planning and design of logistically oriented urban service systems (e.g., fire and police departments, emergency medical services, and emergency repair services). Unified study of functions of random variables, geometrical probability, multi-server queuing theory, spatial location theory, network analysis and graph theory, and relevant methods of simulation. Computer exercises and discussions of implementation difficulties.”

COMMENT: Assumes statistics and calculus. 1.200J may be more appropriate for most GSD students.

MIT 1.254: Transport Modeling Course*

Murga

“Fosters practical experience with the concepts and approaches behind the analytical chain composed by GIS, 4-step planning and traffic models. Study conducted in Greater Boston. Students develop road and street, pedestrian and public transportation networks. The latest CTPP data, and Boston home travel survey used to understand travel behavior and calibrate model. Final project involves the design of alternative futures for the metropolitan area with different transportation and land use policies. Basic programming experience required.”

COMMENT: An excellent introduction to the standard urban travel demand modeling procedures used by planners. Let us know if you take it.

MIT 1.258J: Public Transportation Systems*

Wilson, Attanucci,
Koutsopoulos

“Evolution and role of urban public transportation modes, systems, and services, focusing on bus and rail. Description of technological characteristics and their impacts on capacity, service quality, and cost. Current practice and new methods for data collection and analysis, performance monitoring, route design, frequency determination, and vehicle and crew scheduling. Effect of pricing policy and service quality on ridership. Methods for estimating costs associated with proposed service changes.”

COMMENT: Teaches you how to design and run a transit service. Wilson is expert. May not be offered in 2017-18.

MIT 11.475: Navigating Power and Politics in Water and
Sanitation Planning

Carolini

“Water and sanitation services are increasingly inundated fields of both study and practice. From multi-level policy-makers, transnational corporations, international financial institutions, and specialized technical experts to advocacy groups, small-scale service providers, civil society organization, and end-users, the portfolio of stakeholder interests in these basic services is a veritable mosaic and some would say puzzle. This course aims to inform and prepare students to navigate the explicit and implicit power dynamics at play among (though also at times excluding) such stakeholders in decision-making processes that govern the planning and delivery of water and sanitation systems.”

MIT 11.479J Water and Sanitation Infrastructure in Developing Countries*

Murcott

“Principles of infrastructure planning in developing countries, with a focus on appropriate and sustainable technologies for water and sanitation. ... Upon completion, students are able to plan simple, yet reliable, water supply and sanitation systems for developing countries that are compatible with local customs and available human and material resources. ...

COMMENT: An excellent course in the past. Instructor new to us – let us know if you take it.

MIT 11.526J: Comparative Land Use and Transportation Planning*

Zegras

“Focuses on the integration of land use and transportation planning, drawing from cases in both industrialized and developing countries. Reviews underlying theories, analytical techniques, and the empirical evidence of the land use-transportation relationship at the metropolitan, intra-metropolitan, and micro-scales. Also covers the various ways of measuring urban structure, form, and the "built environment." Develops students’ skills to assess relevant policies, interventions and impacts.”

COMMENT: Gets high marks from GSD planning students.

MIT 11.630J: Environmental Law, Policy, and Economics:
Pollution Prevention and Control

Ashford

“Reviews and analyzes federal and state regulation of air and water pollution and hazardous wastes. Analyzes pollution as an economic problem and the failure of markets. Emphasizes use of legal mechanisms and alternative approaches (such as economic incentives and voluntary approaches) to control pollution and to encourage chemical accident and pollution prevention. Focuses on the major federal legislation, the underlying administrative system, and the common law in analyzing environmental policy, economic consequences, and the role of the courts. Discusses classical pollutants and toxic industrial chemicals, community right-to-know, and environmental justice. Also provides an introduction to basic legal skills.”

COMMENT: Sounds like MIT’s equivalent of HKS API 135.