

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 30 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.
- The text in quotation marks is the catalog description

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. 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 had not released the spring 2017 semester course lists when this guide was developed so we assumed the courses offered in spring 2016 would be offered again.

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 two courses are not required but strongly recommended as they give a good overview of the topics and subject matter covered in more depth by other courses in the concentration. Take at least one:

GSD 5304 Transportation Planning and Development (Schimek—Spring semester)
GSD 5302 Transportation Policy and Planning (Gomez-Ibanez—Fall semester))

Other pre-approved courses are marked with a “*” on the list below:

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-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

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 11.540J Urban Transportation Planning* Salvucci, Murga
“Studies the history, policy, practice and politics of urban transportation. Covers the role of the federal, state, and local government and the MPO, public transit in the auto era, analysis of current trends and pattern breaks; analytical tools for transportation planning, traffic engineering and policy analysis; the contribution of transportation to air pollution, social costs and climate change; land use and transportation interactions; traffic and place making; bicycles, pedestrians, and traffic calming. Examples from the Boston area and from Bilbao. ”
COMMENT: Very similar in intent to GSD 5304. Overview of urban transportation primarily from a US and European perspective. Salvucci was the key public official who persuaded Boston to do the Big Dig; Murga’s expertise is Europe.

MIT 11.601 Introduction to Environmental Policy and Planning Susskind
“Required introductory subject for graduate students pursuing environmental policy and planning as their specialization in the MCP Program. Also open to other graduate students interested in environmental policymaking and the practice of environmental planning. Taught comparatively, with numerous references to examples from around the world. Four major areas of focus: National Environmental Policymaking, Environmental Ethics, Environmental Forecasting and Analysis Techniques, and Strategies for Collaborative Decision-making.”
COMMENT: Infrastructure raises a lot of environmental issues and Susskind has a great reputation.

Spring

At the Graduate School of Design:

GSD 5304 Transportation Planning and Development* Schimek
“This is an introductory course that examines the complex relationship between transportation, land use and urban form, and the varied instruments available to planners seeking to influence this relationship. The course is divided into three parts: First, we take a historical look at how technological innovations, socio-demographic shifts and political decision-making shaped the way people and goods move around cities today...Second, the course provides an overview of alternatives available to transportation planners, as they attempt to (a) avoid long and unnecessary motorized travel, (b) shift the movement of people to socially efficient modes such as walking, biking, and public transit, and (c) improve the technology and operational management of transportation services...Third, the course looks at how transportation planners craft projects and policies that are both technically sound and politically feasible, introducing (and critiquing) some of the tools and skills used by professionals in this field.”
COMMENT: Overview of issues and practice in urban transportation planning in the United States.

At MIT (Massachusetts Institute of Technology):

MIT 11.543J Transportation Policy, the Environment and Livable Communities Coughlin
“Examines the economic and political conflict between transportation and the environment. Investigates the role of government regulation, green business and transportation policy as a facilitator of economic development and environmental sustainability. Analyzes a variety of international policy problems, including government-business relations, the role of interest groups, non-governmental organizations, and the public and media in the regulation of the automobile; sustainable development; global warming; politics of risk and siting of transport facilities; environmental justice; equity; as well as transportation and public health in the urban metropolis. Provides students with an opportunity to apply transportation and planning methods to develop policy alternatives in the context of environmental politics.”
COMMENT: How environmental issues have shaped transportation policy. Let us know what you think.

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. One-quarter of the classes are lectures and three-quarters are case discussions. Prerequisite: Microeconomics at the level of GSD 5203, KSG API-101 or KSG API-105 is assumed.”

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.

GSD 2129 Spatial Analytics of the Built Environment*

Sevtsuk

“The course will investigate a number of qualitative and quantitative methods to measure and analyze urban spatial problems relevant to contemporary urban planning practice. The course is based in part on literature on spatial analysis and in part on newly emerging topics in urban analytics. Aiming to offer students tools for integrating spatial information and decision making into planning and design solutions, the course is structured around four experiments:

- Pedestrian route choice analysis
- Understanding business location and patronage
- Mapping spatial inequality
- Making sense of big, aggregate data”

AT Massachusetts Institute of Technology (MIT):

MIT 11.381 Infrastructure Systems in Theory and Practice

Hsu

“Examines theories of infrastructure from science and technology studies, history, economics, and anthropology in order to understand the prospects for change for many new and existing infrastructure systems. Examines how these theories are then implemented within systems in the modern city, including but not limited to, energy, water, transportation, and telecommunications infrastructure. Seminar is conducted with intensive group research projects, in-class discussions and debates”

COMMENT: New course with expansive description—let us know what it really covers

M IT 11.482J Regional Socioeconomic Impact Analyses and Modelling Polenske
“Reviews regional economic theories and models and provides students with experience in using alternative economic impact assessment models on microcomputers. Problem sets are oriented around infrastructure, housing, energy, and environmental issues. Students work with a client generally in Boston and make a presentation to the client. Emphasis on written and oral presentation skills.”

NOTE: Not clear whether will be offered in fall 2016.

MIT 11.544J Transportation Systems Analysis: Performance and Optimization* Osorlo
“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: New instructor but past GSD students found it a demanding and useful overview of simulation and optimization models commonly used in transport.

MIT 11.545J 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: Teaches economics in the context of transportation and thus may be suitable for meeting MUP economics requirement.

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.

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*

Ben-Akiva

“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.

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 logically 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. 11.544J is 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 11.478J: Behavior and Policy: Connections in Transportation Zhao
“Examines the behavioral foundation for policy design, using urban transportation examples. Introduces multiple frameworks of understanding behavior, contrasting perspectives of classic economic theory with behavioral economics and social psychology, suggests corresponding policy interventions and establishes a mapping between behavior, theory, and policy. Presents a spectrum of instruments for positively influencing behavior and improving welfare. Challenges students to critique, design, implement and interpret experiments that nudge travel behavior. Brings behavioral insights to creative design of transport policies that are efficient and equitable as well as simple, consistent, transparent, acceptable, and adaptive to behavioral changes.”
COMMENT: A relatively new course that applies behavioral economics to transportation. Let us know if you take it.

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: In the past due to capacity restrictions, this course has been available only to 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. And if you manage to gain admission please let us know how relevant it is to urban planning concerns.

Spring

At Massachusetts Institute of Technology (MIT):

MIT 11.314J Water, Landscape and Urban Design Wescoat
“Workshop surveys how water affects the design of buildings, landscapes and cities in aesthetic, functional and symbolic ways. Combines the systematic study of water issues with urban design projects in South Asia and the US. Covers topics such as rainwater harvesting, water use efficiency, wastewater reuse, stormwater management, floodplain design,

constructed wetlands, and waterfront development. Students work together to integrate these design concepts at the site, urban, and international scales. Limited to 15."

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 the Graduate School of Design:

GSD 5421 Intro to Local Economic Development TBA
“Introduces students to local economic development from the perspective of urban planning. Students learn about the theories, analytic frameworks and indicators used in the creation of local economic development policies in the US, and the role of planners in linking these policies to built environment outcomes. Using the Boston region as a case study, students explore several different kinds of place-based strategies including the Seaport innovation district, the Downtown Crossing business improvement district, the BRA/EDIC Marine Industrial Park, and the Boston Convention and Exhibition Center. Students are also exposed to economic development finance including the fundamentals of bond finance, tax increment financing, among others.”

At MIT (Massachusetts Institute of Technology):

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.

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."

COMMENT: Demanding course requires API-141 or equivalent course on capital markets.

At MIT (Massachusetts Institute of Technology):

MIT 11.529J Innovative Transportation Finance

Zegras

"Focuses on the theory and practice of transportation system finance, examining the range of relevant topics including basic public finance, politics, institutional structures, externalities, pricing, and the role of advanced technologies. Primarily oriented around land-based, surface transportation, although in their research students are welcome to examine air and maritime modes according to their interests. Explores issues across a range of contexts, including North America, Europe, Latin America, and Asia."

COMMENT: New course looks like it will explore value capture and other forms of finance peculiar to transportation. Let us know if you take it.

Spring

At the Kennedy School of Government:

HKS PED-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-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.”

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 1231J Planning and Design of Airport Systems

de Neufville, Odoni

"Focuses on current practice, developing trends, and advanced concepts in airport design and planning. Considers economic, environmental, and other trade-offs related to airport location, as well as the impacts of emphasizing "green" measures. Includes an analysis of the effect of airline operations on airports. Topics include demand prediction, determination of airfield capacity, and estimation of levels of congestion; terminal design; the role of airports in the aviation and transportation system; access problems; optimal configuration of air transport networks and implications for airport development; and economics, financing, and institutional aspects. Special attention to international practice and development."

COMMENT: Usually offered every other year so probably will not be offered next year.

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: Excellent reputation but 1.234J may be better intro to industry (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):

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.

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.