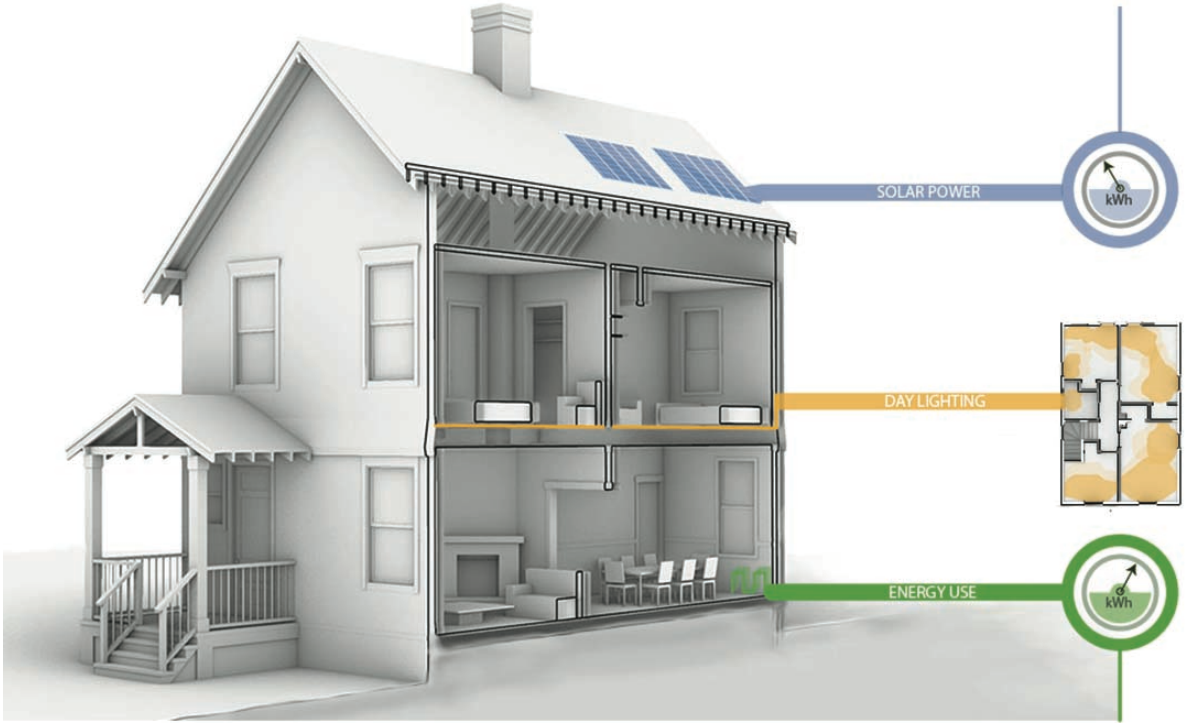


Welcome to Sustainable Building Design!

As you likely know, meeting growing global energy demand, while mitigating climate change and environmental impacts, requires a large-scale transition to clean, sustainable energy systems. Students and professionals like yourself are needed to realize this future energy landscape.

The building sector represents a large percentage of overall energy consumption, and contributes 40% of the carbon emissions driving climate change. Yet buildings also offer opportunities for substantial, economical energy efficiency gains. From retrofit projects to new construction, buildings require a context-specific design process that integrates efficiency strategies and technologies. In this course, you'll be introduced to a range of technologies and analysis techniques for designing comfortable, resource-efficient buildings.

The primary focus of this course is the study of the thermal and luminous behavior of buildings. You'll examine the basic scientific principles underlying these phenomena, and use computer-aided design software and climate data to explore the role light and energy can play in shaping architecture. These efficiency design elements are critical to the larger challenge of producing energy for a growing population while reducing carbon emissions.

Course Learning Goals

By the end of the course, you will:

- understand and apply the scientific principles underlying the thermal and luminous behavior of buildings,
- learn to evaluate the pros and cons of a range of technologies for creating comfortable indoor environments,
- conduct a series of design analysis workflows regarding climate, building energy use and daylighting,
- acquire the knowledge required to critically discuss/present the environmental concept of a building.

Below is the timeline for the course, including key concepts and assignments.

Please note: Despite Christoph's introductory video, the course consists of 10 weeks worth of content and assignments, followed by 2 weeks for the final design project and 1 week for grading the final projects, for a total of **13 weeks worth of work**. This allows for more time and flexibility on these assignments. To make your work more flexible, each module's set of assignments will be due at the specific Tuesday at 20:00 UTC instead of on a fixed, weekly basis. This is a change for those of you who have previously taken the course, and we hope it makes the work more manageable. However, keep in mind each "week" is approximately 8 - 12 hours of work, and manage your time accordingly.

The course is organized into 4 modules shown below. Each consists of 2-4 weeks worth of content and work. Each module's full content will be released at the same time on a specific Tuesday at 20:00 UTC (see below).

Benchmarking + Climate

Module 1

Accessible June 23 at 20:00 UTC
Assignments all due by July 14 at 20:00 UTC*

Week 1 – Energy Use in Buildings
Topics: Energy Use in Buildings

Week 2 – Understanding Climate
Topics: Radiation, Wind, Temperature, and Relative Humidity

***Assignment note:**
-Response due **July 14 at 20:00 UTC**
-Peer learner evaluations due **July 21 at 20:00 UTC**

Week 3 – Designing with Climate
Topics: Thermal Comfort

***Optional exercise note:**
-Response due **July 14 at 20:00 UTC**
-Peer learner evaluations due **July 21 at 20:00 UTC**

(Day)lighting

Module 2

Accessible July 14 at 20:00 UTC
Assignments due August 4 at 20:00 UTC

Week 4 – Daylighting
Topics: Active Solar, Light and Human Vision

Week 5 – Daylight Simulations
Topics: Daylighting Design Principles, Daylight Simulations

Week 6 – Electric Lighting
Topics: Visual Comfort, Electric Lighting and Occupant Behavior

Thermal Loads

Module 3

Accessible August 4 at 20:00 UTC
Assignments due September 1 at 20:00 UTC*

Week 7 – Heat Flow
Topics: Thermal Mass and Heat Flow, Insulation and Window Technologies

Week 8 – Thermal Loads
Topics: Shading and Integrated Façade Design, Ventilation

Week 9 – Thermal Simulations
Topics: Internal Gains and Load Calculations

***Assignment note:**
-Response due **September 1 at 20:00 UTC**
-Peer learner evaluations due **September 8 at 20:00 UTC**

Week 10 – Heating, Cooling, and Ventilation
Topics: HVAC for Large and Small Buildings

Low Energy Buildings

Module 4

Accessible September 1 at 20:00 UTC

Weeks 11 – 13 - Designing a Sustainable Building
Topics: Final design project

-Final projects due **September 15 at 20:00 UTC**
-Peer reviews of final projects due **September 22 at 20:00 UTC**

*Please note this timeline is subject to change

Course Mechanics

Each week's course content, including lectures, discussion boards, and graded comprehension questions and assignments, will become available at **20:00 UTC (coordinated universal time) on Tuesdays**.

- **Lectures** will provide the background information necessary to complete assignments, and are accompanied by ungraded quizzes that will help you gauge your understanding of the content. Lecture slides are available for review and download on MIT's OpenCourseWare*: https://ocw.mit.edu/courses/architecture/4-401-environmental-technologies-in-buildings-fall-2018/index.htm

  *Please note that some slides refer to residential course requirements and timetables, and do not apply to this online course.

- **Comprehension Questions** are questions that will help you further consider the content presented in the lectures, and gauge your comprehension of it.
- **Assignments** will include specific deadlines in their instructions. PLEASE NOTE that assignments are **NOT** necessarily due at the end of each week

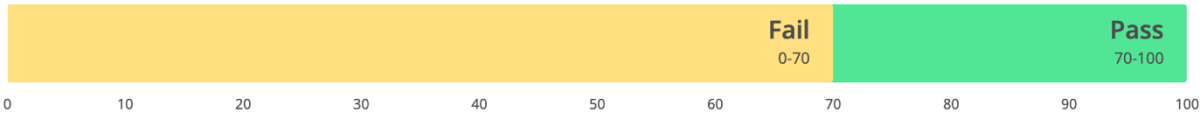
(Tuesdays at 20:00 UTC). Some assignments require you to submit work prior to the end of the week.

Late submissions will receive no credit. However, the lowest scoring weekly assignment will not count toward your final grade.

- **Discussion Boards** are available for each week for you to post questions and thoughts regarding the content and assignments. These discussion boards are monitored periodically by course staff. **NOTE:** If you have immediate questions regarding technical issues on edX, contact the edX Help Center: https://support.edx.org/hc/en-us

Your final grade for the course will be based on:
Comprehension Questions = 10% of final grade
Weekly assignments and quizzes = 70% of final grade
Final design project = 20% of final grade

Passing score is a 70%.



Verified Certificates

Verified Certificates are available from edX can provide proof for an employer, school, or other institution that you have successfully completed an online course. Verified certificates require you to verify your identity using a webcam and a photo identification card, so employers and schools know that you completed the course work. Click on the link to learn more.

This course's cutoff date for upgrading to a Verified Certificate is **July 21, 2020**.

Course Materials

Learning Tracks: Sustainable Building Design was developed for learners interested in tackling challenges related to energy and climate change, as well as for those interested specifically in building design and architecture.

Exercises and assignments have therefore been designed for **two different learning tracks:**

1. If you do not have access to licensed computer-aided design software, or access to a Windows computer with sufficient processing power, we will refer you to a variety of freely accessible online tools to complete course assignments.

- **ClimaPlus will be used consistently for Track 1,** and is a browser-based tool that allows you to explore climate data for thousands of sites throughout the world: http://climaplus.net/. NOTE: ClimaPlus has been tested for **Google Chrome** and **Firefox. It is not currently compatible with Safari and Internet Explorer.**

2. For learners who would like to engage professional-grade software, you may consider accessing trial versions of the following packages.

- **Rhinoceros3D:** Throughout the course, you will be learning how to conduct an energy and daylighting analysis of buildings for either design or retrofitting purposes. All example simulations will be conducted using either **DIVA-for-Rhino** or **ClimateStudio** (see below). Both programs are plugins for the Rhinoceros3D (Rhino) computer-aided design (CAD) modeler. While Rhino is available for both Windows and Mac, **the two plugins only run under Windows**. In order to use them, you will therefore need access to a newer **Windows computer** with Rhinoceros version 6 on it. A free 90-day trial version is available from https://www.rhino3d.com. While this class does not provide specific training for modeling in Rhino, lots of free training material is available at https://www.rhino3d.com/training.
- **DIVA-for-Rhino (DIVA)** is a commercial plug-in for daylighting and energy modeling in Rhino3D. DIVA is compatible with Windows computers only and allows users to carry out a series of environmental performance evaluations of individual buildings and urban landscapes including Radiation Maps, Photorealistic Renderings, Climate-Based Daylighting Metrics, Annual and Individual Time Step Glare Analysis, LEED and CHPS Daylighting Compliance, and Multi Thermal Zone Energy and Load Calculations. A free 90-day trial version is available from http://solemma.com. Once the software is downloaded, replace the existing license with this updated 90 day trial license. Extensive training material for DIVA, including hours of video tutorials, is available from the Solemma website at https://solemma.com/Training.html.
- **ClimateStudio** is Solemma's new environmental modeling software. Same as DIVA it is a plugin for Rhino under Windows. Compared to DIVA it is

significantly faster, easier to learn and features advanced results visualizations. Advanced learners are granted access to an exclusive, no-commercial pre-release version that will be active throughout the duration of this class. A custom installer for EdEx learners can be downloaded from EdEx4.464x Installer.

Prerequisites: This course is open to all learners. However, as a graduate-level course from MIT, learners will benefit from previous study of physics and advanced algebra and trigonometry, and strong English language skills. To review such content, you are encouraged to leverage MIT OpenCourseWare, a web-based publication of virtually all MIT course content (undergraduate, graduate, and introductory levels): https://ocw.mit.edu/about/

Supplementary content: To supplement your learning, you may also consider ordering Christoph Reinhart's textbooks (below). These textbooks are NOT necessary to complete this online course.

- Daylighting Handbook 1: https://www.amazon.com/Daylighting-Handbook-I-Christoph-Reinhart/dp/069220363X/ref=sr_1_1?keywords=daylighting+handbook&qid=1576259753&sr=8-1
- Daylighting Handbook 2: https://www.amazon.com/Daylighting-Handbook-II-Christoph-Reinhart/dp/0578407094/ref=sr_1_2?keywords=daylighting+handbook&qid=1576259783&sr=8-2