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# ENVIRONMENTAL ASPECTS OF THE BUILT ENVIRONMENT AG 2806 (7.5 HP)

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COURSE PM, 2021-10-21

## COORDINATOR:

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## TEACHING UNIT:

Department of Sustainable Development, Environmental Science and Engineering (SEED),  
School of Architecture and Built Environment.

VISITING ADDRESS: Teknikringen 10b. We encourage you to make an appointment before seeing us as we are often away from office.

WEBSITE: <https://www.seed.abe.kth.se/>

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## WELCOME TO THE COURSE!

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Please take your time and read this carefully. Read it twice! It contains important information about the course!

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## INTRODUCTION

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The overall aim of the course is to give you understanding about the interplay between humans, buildings and the surrounding environment as well as strategies for reducing environmental impacts from buildings. The course is designed to give you a profound understanding about the environmental impacts of the built environment in relation to specific settings and contexts and the ability to suggest and argue for relevant approaches for assessing and addressing the environmental impact in planning situations that you might encounter in your future profession.

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## COURSE OBJECTIVES

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After completing the course, you will be able to:

- Describe the potential environmental and health impacts caused by different stages in a building's life span.
- Be able to analytically discuss environmental hotspots regarding the built environment depending on local contexts and building types.
- Suggest relevant planning strategies to reduce the environmental impact both from new building developments and improvements of the existing building stock.
- Suggest relevant types of evaluation and assessment tools for decision contexts related to planning and management of buildings.
- Account for current national strategies to reduce the environmental impact of the built environment.

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## CANVAS

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We will use the Canvas web platform in the course. Please make sure that you get your KTH-ID (the same as your KTH email address) and that you get registered to the course as soon as possible so that you can log in to Canvas. The address to the course page on Canvas is:

<https://kth.instructure.com/courses/27844>

Most of the information you will need on Canvas will be organized in the Modules tab.

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## EXAMINATION

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The course is graded A-F. Examination of course objectives includes a two-part written take-home exam (graded A-F), a group project, (graded A-F), and a computer lab (graded Pass/Fail). The final grade is a weighted average of the written take-home exam and the project work in group. In order to receive a final grade, you must fulfil the requirements for an "E" for the written exam and project work, as well as achieving a "Pass" grade on the computer lab.

A grade denoted Fx is also included in the scale. It represents a failing grade at the boundary between pass/fail. In this case, you can write a complementary assignment to reach the grade E for the course.

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## WRITTEN TAKE-HOME EXAM

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The written take-home exam is in two parts. You will write Part 1 at the end of the course (see schedule below). Part 2 consists of a short essay and is written alongside the project work during the course. Don't wait until the end of the course to work on Part 2! Both parts are handed in together on Canvas before the deadline for the take-home exam at the end of the course (see the schedule at the end of this document).

The home exam is graded A-F overall. The grade Fx denotes a failed grade, but with the possibility to pass the home exam by oral examination. After the oral examination, a student previously awarded the grade Fx can only receive the grade E for the home exam. Re-exams will only be given to students who have missed or failed previous examination occasions.

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## COMPUTER LAB

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The computer lab includes an assignment that must be uploaded on Canvas. To pass, the computer lab assignment should be completed and handed in on time according to the instructions.

## PROJECT WORK AND GRADING

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Your project work will be graded A-F. Grading criteria will be given in the project memo.

## MEETINGS & LECTURES

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In this course, lectures take place in the form of course meetings. Rather than lectures in a traditional sense, these are designed as seminars around a number of core course themes. The teachers will introduce the themes, sometimes with lectures (including guest lecturers). However, course meetings will also be devoted to discussing or working with the course literature or the group assignments. You will be asked to prepare “meeting assignments” that should be uploaded before the meeting and will be discussed during the meeting. To get the most out of the course meetings and to make these run smoothly **it is important that you read the requested literature in advance**. The aim of the course meetings is to support you to actively work on the right tasks throughout the course. **Active preparation and participation during these meetings will greatly improve your ability to pass the course.**

## MEETING ASSIGNMENTS

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For four of the meetings (indicated below), **you are required to submit a prepared assignment** on CANVAS before the meeting. Assignments will be to some extent related to the project work. Make sure that you can access your assignment during the class since we will use assignments as the basis for discussions. In order to pass the course, at least 2 out of these 4 assignments should be submitted in time.

## MEETINGS, ASSIGNMENTS, DELIVERABLES

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### MEETING 1 – INTRODUCTION TO THE COURSE AND SOME CONCEPTS

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You will get an introduction to the course, important practical information and we will start elaborating on and working with the main topics of the course in seminar form.

#### **To read in advance:**

*The course PM*

*Swedish Environmental Protection Agency. (2018). Sweden's environmental objectives: an introduction. <http://www.swedishepa.se/Documents/publikationer6400/978-91-620-8820-0.pdf?pid=23427>. (the green text about each objective at the top of each page is essential. Other information on these pages can be skimmed).*

Note that meeting 2 happens shortly after meeting 1, so it is recommended to read the literature for meeting 2 before meeting 1.

### MEETING 2 – ENERGY AND MATERIAL FLOWS: HAZARDOUS SUBSTANCES

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This meeting will quickly introduce the topic of energy and material flows of the built environment (which will be dealt with also in the next meeting). The meeting will focus more particularly on flows of hazardous substances in construction materials, and how the related health and environmental impacts can be mitigated. Circular economy aspects of the built environment will also be discussed with help of an invited lecturer.

**To read in advance:**

*Pages 625-628 in Bokalders, V, Block, M. (2010). The Whole Building Handbook. How to design Healthy, Efficient and Sustainable Buildings. London: Earthscan. (11 p.)*

*Pages 75-77 in Dammann, S. (2004). Environmental indicators for buildings. Hörsholm, Denmark: By og Byg – Danish building and Urban Research. (9 p.)*

**Optional reading:**

*Malmqvist, Moncaster, Rasmussen, Birgisdottir. Circularity in the built environment – a call for a paradigm shift. In Handbook of the Circular Economy edited by Brandão, M., Lazarevic, D., Finnveden, G, 2021, Edward Elgar Publishing Ltd.*

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### MEETING 3 –ENERGY AND MATERIAL FLOWS: ENVIRONMENTAL IMPACTS

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This meeting aims to give a broad understanding of how the use of energy, water and materials in the building sector affects the environment, and to what extent these issues depend on the local context. The meeting will also address the issue of what aspects to prioritize when working with a building's environmental performance depending on the climate, building phase, scope etc. Strategies for reducing these problems will be briefly discussed.

**To read in advance:**

The **Executive Summary**, as well as sections **9.2, 9.3** and **9.4** in:

*Lucon, O., Ürge-Vorsatz, D., Zain Ahmed, A., Akbari, H., Bertoldi, P., Cabeza, L., ... Vilariño, M. V. (2014). Buildings. In Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. (pp. 671–738). Cambridge: Cambridge University Press. Retrieved from [http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc\\_wg3\\_ar5\\_chapter9.pdf](http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter9.pdf)*

*Pages 269-271, 278-281 in Bokalders, V, Block, M. (2010). The Whole Building Handbook. How to design Healthy, Efficient and Sustainable Buildings. London: Earthscan. (11 p.)*

**Recommended further reading:**

*Listen to the podcast episode by 99% Invisible – Built on Sand:*

<https://99percentinvisible.org/episode/built-on-sand/>

*United Nations Environment Programme, & International Energy Agency. (2017). Towards a zero-emission, efficient, and resilient buildings and construction sector. Global Status Report 2017. Retrieved from [https://www.worldgbc.org/sites/default/files/UNEP\\_188\\_GABC\\_en\(web\).pdf](https://www.worldgbc.org/sites/default/files/UNEP_188_GABC_en(web).pdf)*

**To prepare (Meeting 3 assignment):**

Consider the following examples of buildings:

- A high-rise office building in downtown Manila (Philippines).

- A single family house in the suburbs of Stockholm.

With help from the literature, briefly discuss the following points:

- To what extent might the buildings differ regarding their local and global environmental impacts (*type* of impact and/or *cause* of impact)?
- What kind of design solutions could be considered in order to minimize the environmental impacts arising from each building?
- What kinds of discomfort, nuisance or health risks might building users experience in- or around the building? Can the design of the building help mitigate these issues? Is there a risk that some measures to mitigate environmental impacts might negatively affect users?

If you need information that is not in the literature for meeting 2, consider using online searches. You are allowed to speculate, but you should make it clear whether what you write is based on verified facts or speculation.

Submit your answers (1-2 pages, concise answers or bullet points) to Canvas before the meeting and have them with you during the meeting. These notes will be used as a basis for group discussion during the meeting.

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#### MEETING 4 – URBAN NATURAL ENVIRONMENT – VALUES, THREATS, OPPORTUNITIES

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The meeting aims to give a broad understanding of significant environmental aspects related to how the built environment interacts with the surrounding non-built environment and vice versa. It will address how urban nature can mitigate local environmental problems, help reduce the urban environmental footprint and support the well-being of residents. An invited lecturer will zoom in on the climate impact/carbon sink of green space.

##### **To read in advance:**

*Bokalders, V and Block, M. (eds). 2016. Urban ecosystem services: Let nature do the work. A summary of c/o city. (Read pp 14-44)*

*Pedersen Zari. (2012). Ecosystem services analysis for the design of regenerative built environments. Building Research & Information, 40 (1), pp. 54-64 (10p).*

*Maas, J., Verheij, R. A., Groenewegen, P. P., de Vries, S., & Spreeuwenberg, P. (2006). Green space, urbanity, and health: how strong is the relation? Journal of Epidemiology & Community Health, 60, 587–592.*

*Depietri, Y and McPhearson, T. 2017. Integrating the grey, green and blue in cities: Nature-based solutions for climate change adaptation and risk reduction. Pp 91-109 in Kabisch et al. (eds) 2017. Nature-based solutions to climate change adaptation in urban areas. Linkages between science, policy and practice. Springer open. Open access here: <http://www.springer.com/la/book/9783319537504>*

##### **Optional reading:**

*Kabisch et al. (eds) 2017. Nature-based solutions to climate change adaptation in urban areas. Linkages between science, policy and practice. Springer open. Open access here: <http://www.springer.com/la/book/9783319537504>*

*Beatley, T and Newmann, P. (2013). Biophilic cities are sustainable, resilient cities. Sustainability, 5, pp. 3328-3345.*

*Tratalos, J et al. (2007). Urban form, biodiversity potential and ecosystem services. Landscape and Urban Planning, 83, pp. 308-317.*

*Pages 48-63 (chapter 3) in Halweil, B. & Nierenberg, D. (2007) Farming the Cities. In Worldwatch Institute (2007) 2007 State of the World: Our Urban Future. W.W. Norton & Company, London.*

#### **To prepare (Meeting 4 Assignment):**

Read the literature and answer the following questions (1-2 pages, bullet form is fine if you want) and bring it to the meeting. Also, bring one example (through a photo (can be on your computer or phone) of a “nature-based solution” somewhere in Stockholm or your close environment which you think has been implemented to enhance an ecosystem service in the city.

1. Which advantages are there/Why is it important to integrate nature into the built environment?
2. How can construction (of buildings or other material infrastructure) on green areas and natural environments have a negative effect on urban areas, people and ecosystems?

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### MEETING 5 – INDOOR ENVIRONMENTAL QUALITY AND HEALTH

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Buildings aim to provide us with shelter, work places, etc. We spend 90 % of our time indoors. The quality of the indoor environment is thus an important issue when talking about sustainable buildings. The aim of the meeting is to introduce the wide array of indoor environmental issues which may arise in buildings, their potential severity and their relation to buildings and the surrounding built environment.

#### **To read in advance:**

*Pages 469-472 in Malmqvist, T (2008). Environmental rating methods: selecting indoor environmental quality (IEQ) aspects and indicators. Building Research & Information 36 (5), pp. 466-485. (4 p.)*

*Pages 79-87 in Dammann, S. (2004). Environmental indicators for buildings. Hörsholm, Denmark: By og Byg – Danish building and Urban Research. (9 p.)*

*Pages 112-114 and 182-185 in Bokalders, V, Block, M. (2010). The Whole Building Handbook. How to design Healthy, Efficient and Sustainable Buildings. London: Earthscan. (7 p.)*

*Pages IX-XIV - English summary in Hult, M. (2002). Assessment and Assurance of Indoor Environment Qualities in Buildings during Program, Design and Management phases. Gothenburg: Chalmers University of Technology. PhD thesis in Swedish. (5 p.)*

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### MEETING 6 –INDICATORS AND APPROACHES FOR ASSESSING ENVIRONMENTAL IMPACTS AND CONSEQUENCES

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The meeting aims to introduce environmental indicators, the different ways in which they may be categorized, and in which situations different types of indicators may be more or less relevant. We will also work with how to formulate adequate environmental targets and activity plans, as well as indicators for target follow-up.

### To read in advance:

Smeets, E, Weterings, R. (1999). *Environmental indicators: Typology and overview*. Copenhagen: European Environmental Agency. (11 p.)

Finnveden, G, Moberg, Å. (2005). *Environmental systems analysis tools - an overview*. *Journal of Cleaner Production*, 13 (12), pp. 1165-1173. (9 p.)

Pages 322-324 - sections “perspectives on environmental indicators” and “procedure for choosing indicators” in Malmqvist, T, Glaumann, M. (2006). *Problem-related environmental indicators for housing management*. *Building Research & Information*, 34 (4), pp. 321-333. (4 p.)

### To prepare (Meeting 6 Assignment):

1. Read the text about DPSIR (Smeets and Weterings). Select two different indicators in the certification tool Miljöbyggnad (the document MB new buildings). For each one of them, reflect shortly on whether they are D, P, S, I or R indicators and argue for why you think that.
2. Read the text by Malmqvist and Glaumann. Which “endpoint problems” do you think the indicators intend to measure?
3. Discuss briefly how valid and costly you think the indicators are (also based on the definition of Validity and Cost in the text for today by Malmqvist and Glaumann)

Submit your answers (1-2 pages, concise answers or bullet points) to Canvas before the meeting and bring your notes to the meeting. These notes will be used as a basis for group discussion during the meeting.

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## MEETING 7 - LIFE CYCLE APPROACHES




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The meeting aims to introduce life cycle thinking and life cycle assessment (LCA). Furthermore, it will give insights into how life cycle approaches can be used to assess environmental impacts from buildings, and the challenges this entails.

### Basic literature:

Hauschild, M. Z., Rosenbaum, R. K., & Olsen, S. I. (2017). *Life Cycle Assessment: Theory and Practice*. *Life Cycle Assessment: Theory and Practice*. Springer International Publishing.  
<https://doi.org/10.1007/978-3-319-56475-3>

Read only the following chapters:

- [Chapter 2](#)  – Main Characteristics of LCA
- [Chapter 6](#)  – Introduction to LCA Methodology
- [Chapter 28](#)  – LCA of Buildings and the Built Environment
  - You can skip section 28.3 if you're short on time.

If you already know about LCA, you can skim very quickly through chapters 2 and 6. If you are already very familiar with building LCA, if you have extra time, or if you have already read this literature, read the articles below.

### State of the art of building LCA:



Anand, C. K., & Amor, B. (2017). Recent developments, future challenges and new research directions in LCA of buildings: A critical review. *Renewable & Sustainable Energy Reviews*, 67, 408-416. <https://doi.org/10.1016/j.rser.2016.09.058>

Dossche, C., Boel, V., & De Corte, W. (2017). Use of Life Cycle Assessments in the Construction Sector: Critical Review. *Procedia Engineering*, 171, 302–311. <https://doi.org/10.1016/J.PROENG.2017.01.338>

#### **Example of recent study:**

Larsson, M., Erlandsson, M., Malmqvist, T., & Kellner, J. (2017). *Constructing an apartment building with exterior walls and frames of cross-laminated timber - the Strandparken residential tower* (Report No. B2260-PEng). Stockholm, Sweden: IVL Swedish environmental research institute.

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### **MEETING 8 – HOW CAN YOU TELL IF A CITY IS SUSTAINABLE OR NOT?**

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The aim of this meeting is to provide an understanding of environmental aspects at the level of a city or a city district, i.e. what is a sustainable city? What aspects need to be considered when talking about sustainability of cities. Is it really all about CO<sub>2</sub>? How should we define the system boundaries for a city or a city district? However, all change processes need to consider not only what to change, but also who is responsible for these changes. How then can we drive sustainability issues in urban development projects?

#### **To read in advance:**

Kramers, A., Wangel, J., Johansson, S., Höjer, M., Finnveden, G., Brandt, N. (2013) *Towards a comprehensive system of methodological considerations for cities' climate targets*. *Energy Policy* 62, pp. 1276–1287 (11 p)

Wangel, J., Wallhagen, M., Malmqvist, T., Finnveden, G. (2015) *Certification systems for sustainable neighbourhoods: What do they really certify?* *Environmental Impact Assessment Review* 56, pp. 200-213. DOI: 10.1016/j.eiar.2015.10.003

Kennedy, C., Pincetl, S., Bunje, P. (2011) *The study of urban metabolism and its application to urban planning and design*. *Environmental Pollution* 159, pp. 1965-1973.

#### **Recommended further reading:**

Wachsmuth D. (2012) Three ecologies: urban metabolism and the society-nature opposition. *The sociological quarterly* 53, pp. 506-523.

Williams, K. & Dair, C. (2007). A framework for assessing the sustainability of brownfield developments. *Journal of Environmental Planning and Management* 50(1), pp. 23-40. (18 p)

Holman, N. (2009) Incorporating local sustainability indicators into structures of local governance: a review of the literature. *Local Environment*, Vol. 14 (4), pp. 365-375. (10 p.)

#### **To prepare (Meeting 8 Assignment):**

Each one of you shall search for a cutting-edge practical example of a completed or ongoing sustainable neighborhood project. Try to find documentation in the form of a sustainability/environmental program for the project or similar. Prepare a 1-2 page reflection concerning the following questions:



- How are sustainability aspects assessed, evaluated and followed up?
- Do you think there are any useful examples of targets and indicators that you can use in your project work? Which?
- Comment briefly also on if you consider the case to be “sustainable” or not.

Submit your answers (1-2 pages, concise answers or bullet points) to Canvas before the meeting and bring your notes to the meeting. These notes will be used as a basis for group discussion during the meeting.

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## WRITTEN EXAM

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Part 1 of the exam will cover what we have brought up in the course meetings. It is a take-home exam which will be posted on Canvas at 9 am on Monday January 10<sup>th</sup> 2022. You can upload your answers by **17.00 on Wednesday January 12<sup>th</sup> 2022 at the latest**.

Part 2 of the exam takes the form of a short essay that relates to topics you deal with in the project work and that are brought up in meetings and project seminars. This part of the exam is presented at the end of the final seminar in December. However, the written instruction is available at Canvas from the beginning of the course. This means that you can work on this essay at any time you wish during the course. Students’ answers to both parts 1 and 2 of the exam should be submitted together no later than **17.00 on Wednesday January 12<sup>th</sup> 2022**.

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## COMPUTER LAB

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The computer lab gives you practical experience of using a tool for environmental assessment of building renovation measures. The tool will be introduced during the lab session which also comprises an assignment which you carry out with the help of the tool. In order to pass the course you need to upload the assignment to Canvas no later than the deadline given in the course schedule below.

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## PROJECT WORK

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The project work connects theory to practice by working with a specific urban development case. The teachers form groups of 4-6 people but your group is free to decide on a case within certain frames. These are the important activities of the group work:

- Team work and individual work, student led
- 2 project seminars and 1 occasion for group supervision
- Final seminar with presentations and discussion of results
- Revision of reports after final seminar

You are required to deliver a number of items in order to pass the project work:

- Project work plan
- Draft group report
- Revised group report
- A critical review of another group’s work
- An individual reflection on your group work

**Read through the document “Project work instructions” on Canvas carefully. It contains all important information about the project work!**

## PROJECT SEMINARS AND SUPERVISION

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Compulsory project seminars and supervision will help you in your project work. You will be introduced to the task and work steps, work together with group exercises that support the project work, receive relevant background information and get an opportunity to discuss your project issues with course mates and teachers. Make sure you prepare well before the seminars and supervision as you will all benefit from this. Detailed instructions on what to read and prepare are found in the document “Project work instructions” on Canvas.

## FINAL SEMINAR

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Project reports are presented at a final seminar. After the seminar, your teacher will send comments and required revisions of the report by email. The final draft of the report shall be posted on Canvas no later than the deadline given in the course schedule below. Detailed instructions on what to prepare before the seminar are found in the document “Project work instructions” on Canvas.

## SCHEDULE

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The course will take place on campus if the corona situation will not change much, but a few lecturers will participate through zoom. We will try to organise the possibility to participate on zoom if you have symptoms and can't make it to campus, but then only in a very low-tech manner. Links to zoom meetings will be posted directly under Modules on Canvas.

Day	Date	Start time	End time	Description	Room	Teaching staff
Mon	2021-11-01	09:00	12:00	Meeting 1: Introduction to the course and some key concepts	L21	TM
Thu	2021-11-04	09:00	12:00	Meeting 2: Resource and material flows - hazardous substances, circularity	B22	TM, JB
Fri	2021-11-05	09:00	12:00	Project seminar 1	B26	TM
Mon	2021-11-08	09:00	12:00	Meeting 3: Resource and material flows - environmental impacts	Q13	NF, ?
Thu	2021-11-11	09:00	12:00	Meeting 4: Urban natural environment – values, threats and opportunities	B22	TM, PW, MG
Fri	2021-11-12	09:00	12:00	Meeting 5: Indoor environmental quality	B26	TM
Mon	2021-11-15	09:00	12:00	Project seminar 2	Q2	TM
Tue	2021-11-16		17:00	Deadline project workplan		
Thu	2021-11-18	09:00	12:00	Meeting 6: Indicators and approaches for assessing environmental impacts	V12	TM

Fri	2021-11-19	09:00	12:00	Meeting 7: Life cycle approaches – LCA	K53	NF
Mon	2021-11-22	13:00	16:00	Meeting 8: How can you tell if a city is sustainable or not?	B22	JL
Thu	2021-11-25	09:00	16:00	Spare time - lecture	B23	
Fri	2021-11-26	09:00	12:00	Project supervision	L31	TM, NF, ..
Thu	2021-12-02	09:00	12:00	Time for work in project groups		
Fri	2021-12-03	09:00	16:00	Computer lab	E31	NF, (AA)
Mon	2021-12-06	09:00	17:00	Time for work in project groups		
Mon	2021-12-06		17:00	Deadline submission computer lab report		
Wed	2021-12-08		23:00	Deadline: submission report draft		
Mon			09:00	Deadline: Individual critical review of another group report		
Mon	2021-12-13	09:00	13:00	Final seminar	Lallertedt + Salon gen 1	TM, NF, ..
Fri	2021-12-17		12:00	Deadline for submission of final project report		
Mon	2022-01-10	9:00		Home exam part 1 is posted to Canvas		
Wed	2022-01-12		17:00	Deadline for uploading home exam parts 1 and 2 to Canvas		

Meetings and project seminars include the ‘academic quarter’ – i.e. they start at 15 minutes past the hour at the times shown.

TM: Tove Malmqvist

NF: Nicolas Francart

JB: Johanna Brismark

AA: Ahmad Al-Najjar

MG: Mauritz Glaumann

PW: Peter Wiborn

JL: Jonas Lind

Directions to most classrooms can be found through the classroom finder: [www.kth.se/places](http://www.kth.se/places)