

Version 2.0 April 2018

# Cookbook Education Spaces

Requirements for Education Spaces TU Delft campus

# Cookbook Education Spaces

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ESA = Directory of Education & Student Affairs

CRE = Directory of Campus Real Estate

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TU Delft internal use only: scientific references have been removed!

This updated Cookbook Education Spaces version 2.0 builds forth on earlier versions 1.0 and 1.1.

Gained insights, lessons learned, and experiences with architects and builders were added to refine the design guidelines and sharpen used definitions.

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Cover photo by G. Schoonewille

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# Summary

Education spaces at Delft University of Technology (TU Delft) are organized in a central pool in order to use and maintain education spaces of the several faculties with a higher efficiency. It is important that centrally time-scheduled education spaces follow standardized functionality, installations and identical operation guidelines. A diversity of teachers, instructors, students and staff has in close collaboration defined a generic set of requirements for the education spaces as described within this Cookbook.

## How the Cookbook Education Spaces came into being

The Cookbook Education Spaces has been drawn up in close co-operation with teaching staff, students and supporting staff. Teachers who represent faculties have been bringing in their thoughts about education space classifications during workshops and in meetings with the advice council Education Spaces, chaired by the vice-chancellor. Subsequent steps have been taken to come to a generally accepted Cookbook:

1. Set-up for classification of education spaces (accepted by advice council Education Spaces)
2. Consultative group of instructors and students
  - a. Workshop per space classification (collection of requirements)
  - b. Reflection per space classification (accepted by consultative group)
3. First draft of Cookbook describing the specific space classes including general requirements
4. Addition of requirements from departments of CRE and ICT & FM
5. Approved by Advice council Education Spaces
6. Specification of functional requirements
7. Specification of technical requirements

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### **Cookbook Education Spaces has a multifaceted objective:**

- To provide an overview of education spaces and related teaching practices for instructors and lecturers
- To offer requirements per education space as checklist for designers and other external parties
- To set guidelines for standardization, operation and usability for AV and support staff

The Cookbook provides functionalities and affordances for instructors that remain the same while in course of time ICT and AV technologies are updated. This Cookbook Education Spaces is a dynamic document that is regularly monitored and updated.



## Classification of teaching practices

Several teaching practices have been clustered and analysed to define education spaces from there. The following teaching practices were distinguished: (within a course often a combination of these is applied)

**Frontal Teaching** is teacher-centred. The lecturer situated at the front elaborates on a subject, shows a presentation on the screen or chalks a formula on the board. The expert explains and elaborates about a topic, and the students take home individual work or group assignments. Active learning components are gradually being brought into these practices, such as direct interaction with a feedback tool.



**Mixed Practice** is student-centred. Students follow classes with alternating practices, such as a frontal introduction and subsequently working in student groups on assignments. The teacher and assistants walk around to help where needed.



**Collaborating** focuses on team work and group assignments. Students have to apply their knowledge in projects and learn to communicate, collaborate and cooperate in teams while they are coached by the instructor.



**Testing** is for students to demonstrate what they have learned. Digital testing has the advantage to support both campus exams and tests for online classes and MOOCs. Digital exam halls can also be used for computer practical.



*Note: Specialised spaces, such as lab spaces, studios and workrooms that are typically faculty-bound, are accounted for by the faculty and are therefore not discussed within this Cookbook Education Spaces.*

## Education space typologies and requirements

The several teaching practices are translated into a diversity of education space typologies. In the space typologies, there is a differentiation in basic facilities and advanced facility options. The advanced facilities can differ in interior settings, in teaching technology, in streaming and in recording facilities. Combinations of different advanced facilities are possible.

The following space types are distinguished dependent on the size of the student groups:

Seat capacity	X Small < 30	Small 30-60	Medium 60-90	Large 90-150	X Large 150-350+
Teaching practice					
<b>Frontal teaching</b>	X	<b>Instruction room</b> Flat-level floor Furniture in rows	<b>Lecture hall</b> Tiered floor Furniture in rows	<b>Lecture hall</b> Tiered floor Furniture in rows	<b>Lecture hall</b> Tiered floor Furniture in rows
<b>Mixed practice</b>	X	<b>Instruction room</b> Flat-level floor Flexible furniture arrangement in rows and groups	<b>Instruction room</b> Flat-level floor Flexible furniture arrangement in rows and groups	<b>Instruction hall</b> Terraced floor Flexible furniture arrangement in rows and groups	X
<b>Collaborating</b>	<b>Project room</b> Flat-level floor Furniture in groups	<b>Project room / Advanced instruction room</b> Flat-level floor Furniture in groups	<b>Project room / Advanced instruction room</b> Flat-level floor Furniture in groups	<b>Project hall / Advanced instruction hall</b> Flat-level floor Furniture in groups	X
<b>Testing (paper)</b>	X	<b>Instruction room</b> Flat-level floor Furniture in rows	<b>Instruction room</b> Flat-level floor Furniture in rows	<b>Instruction hall</b> Flat-level floor Furniture in rows	<b>Exam hall</b> Flat-level floor Furniture in rows
<b>Digital testing</b>	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall / Advanced exam hall</b> Flat-level floor Furniture in rows

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The Cookbook Education Spaces provides guidelines for the **teaching environment**, such as:

- Writing surface and teaching practice
- Proper relation between space typology, flexibility and its uses
- Audio-visual installation and lighting
- Service & support

The Cookbook Education Spaces also provides guidelines for the **learning environment**, such as:

- Readability of presentation screens and writing boards
- Furniture and moving space for the students

The Cookbook Education Spaces provides **general descriptions** for:

- Basic space indicators
- Climate, lighting, acoustics & electrification
- Safety & security

# Why this Cookbook

## **Cookbook Education Spaces has a multifaceted objective:**

- To provide an overview of education spaces and related teaching practices for instructors and lecturers
- To offer requirements per education space as checklist for designers and other external parties
- To set guidelines for standardization, operation and usability for AV integrators and support staff

At Delft University of Technology (TU Delft) student numbers have grown drastically in the last decade. Nowadays teachers often need to give their course in several education spaces over campus within different buildings. Moving around the campus has been revealing that education spaces in the different buildings were divergent and often outdated. Moreover, problems have arisen because of different audio-visual (AV) systems and deviant teacher support resulting in delayed lectures and complaining staff.

Several education developments, such as blended practices, online courses, response systems and flipped classrooms have confronted TU Delft with a situation that curricula are changing while outdated learning spaces remain. The university has been urged to start streamlining the present lecture halls and classrooms in order to facilitate the education practices of tomorrow while maintaining those of today.

This Cookbook Education Spaces recognises the given teaching practices of today and those of the coming years and presents four main classes of education spaces with their corresponding affordances. It is composed from out of practical experiences, evaluation insights, and empirical evidence. Education space parameters have been discussed with a variety of teaching practitioners.

The departments of Campus Real Estate (CRE), Education and Student Affairs (ESA) and ICT and Campus Facility Management (ICT&CFM) have recognised that interdisciplinary cooperation is vital to realise futureproof education spaces, which sustain the inevitable education change. In line with the “Roadmap Education Spaces” (June 2014) and “Transformation Development Plan Education Spaces” (January 2016) this Cookbook Education Spaces is developed under guidance of the Taskforce Education Spaces.

*NB 1: New Media Centre of TU Delft has been closely involved for this updated cookbook version (April 2018).*

*NB 2: Taskforce Education Spaces has been renamed into Program Group Education Spaces and Study Places.*

# How to use this Cookbook

The Cookbook Education Spaces informs several stakeholders within and around TU Delft. The document contains a clear structure with recognizable tabs on each page in order to find the relevant information easily.

## Part A - Classification of teaching practices

An introduction to common teaching practices within TU Delft

Target group: Teaching staff and education support staff

## Part B - Education space typologies

Projection of teaching practices onto space typology

Target group: Teaching staff, education support staff, designers and advisors

## Part C - Education space requirements

Compulsory and optional guidelines per space typology

Target group: Designers and advisors, suppliers and technical support staff

## Part D – Study places

Compulsory and optional guidelines per study place typology

Target group: Designers and advisors, suppliers and technical support staff

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A consistent colour scheme is used throughout the Cookbook to identify teaching practices and study places:



Frontal teaching



Mixed practice



Collaborating



Testing



Silent study places



Touchdown study places



Meeting places



A

# Classification of Teaching Practices





# Classification - Frontal Teaching

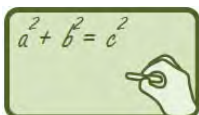
Frontal teaching practices are teacher-centered. The lecturer situated at the front elaborates on a subject, shows a presentation on the screen or chalks a complex formula on the board while talking-writing its structure. The expert explains and elaborates about a topic, and individual learning happens during homework and other out of place assignments. Lectures expect a “practice and drill” follow-up from students to internalise the subject matter. Active learning components are gradually being brought into these practices to retain the attention, such as introducing more short breaks in the program, implementing short group assignments in the lecture and direct interaction with for example the tool ‘feedback fruits’ (in which students can vote on multiple choice questions).

Frontal teaching is suitable for large groups. However, when groups grow larger, interaction between teacher and students becomes more difficult. A tiered space like a theatre is necessary to make sure that everyone has good sight on the presented information and lecturer.

In general, halls exceed the capacity of 120 seats, up to an average of around 300 seats. Often such halls are arranged in rows of joint seats and pathways on either side of the space. The seats are fixed to the floor.

Characteristics of Frontal teaching:

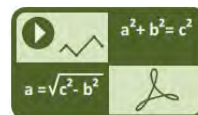
- **Writing surface (chalkboard / whiteboard) is used to teach reasoning and know-how**
- **Training and repetition during homework is used for internalisation of knowledge**
- **Frontal teaching becomes more active**
- **An advanced teaching environment can be equipped with digital chalk and four parallel video signals to enrich and easily share the subject matter being taught**
- **Spaces with advanced options can be equipped with streaming, conference and recording facilities**



Talking-writing teaching



Seats in (tiered) rows



Advanced option:  
digital writing and four-  
quadrant teaching



Advanced option:  
streaming, conference  
and recording facilities





### Writing surface (chalkboard / whiteboard) is used to teach reasoning and know-how

Chalkboards are often used by teachers at the TU Delft. It provides teachers their “talking-writing” way of reasoning. While thinking aloud they simultaneously produce and write arguments in successive order on the board. In such way their reasoning becomes visible; students see the process and structure of the several step-by-step arguments that appear on the board.

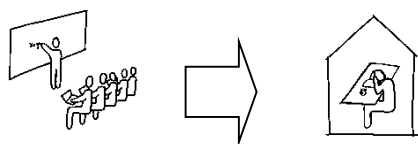


Example of chalkboard teaching (Aula, photo by M. Krijger)

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### Training and repetition during homework is used for internalisation of scientific knowledge

Frontal teaching is only one part of the learning objective. Students listen to the lecturer and take notes about a subject. The explanation, argumentation and reasoning within the lecture hall are for the students' comprehension. The second part of the learning objective is to internalise the discoursed method or technique by training and repetition during homework.





### Frontal teaching becomes more active

Education is changing into more active classes. Flipped and inverted classes focus more on practicing homework assignments in class in attendance of a coaching lecturer. This demands classroom layouts that facilitate a more collaborating setting between students. In the next chapter mixed teaching practices will be introduced. Additional practices were introduced to make lectures a more active learning experience. Teachers may make use of response clicker tools, such as 'feedback fruits' in order to measure the students' knowledge level. Another method is introducing periodical pauses to increase the students' activity: each fifteen minutes students have to clarify their notes with a companion in a two-minute break.

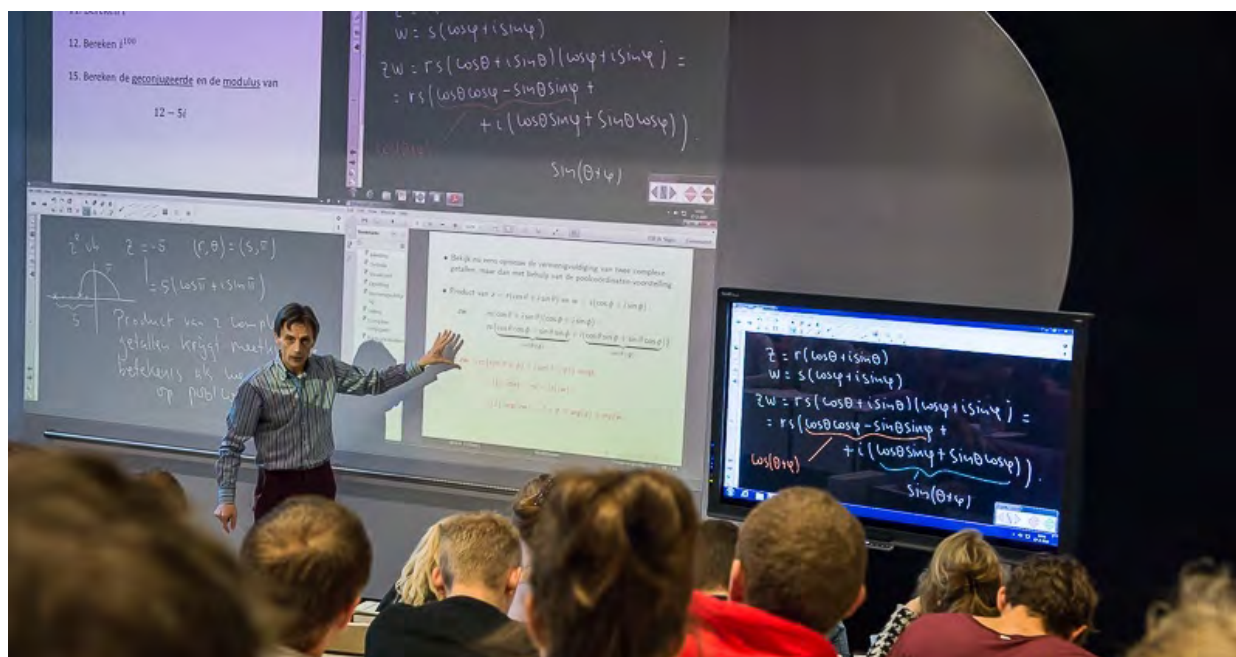


*Students listening to lecture (photo by M. Blommaert)*

### An advanced teaching environment can be equipped with digital chalk and four parallel video signals to enrich and easily share the subject matter being taught

Courses at TU Delft become more blended. Sometimes on-campus lectures can be used in online education tracks. Several computer applications are used in teaching practices to do in-between demonstration, animation, simulation, presentation or intervention. Such applications can be alternately presented in class, one by one or simultaneously.

An advanced AV-IT system is able to present several video signals simultaneously. Within the TU Delft a system for four-quadrant teaching is developed, with an interactive SMARTboard as teacher's input and navigation console, but first of all as digital chalkboard. The feel and touch of such interactive SMARTboard for digital chalk should be close to their physical chalk experience. The relative small writeable SMARTboard surface has been overcome with the introduction of four parallel video signals.



Example of Quad Video Signal System with Interactive SMARTboard (Faculty 3ME, photo by A. van der Kuil)

### Spaces with advanced options can be equipped with streaming, conference and recording facilities

Streaming and recording facilities enhance the possibility to address larger classes. Streaming provides live classes regardless of place, and recording facilities provide time and place independency.

Lecture capture is used to record what instructors do in their classes and to make it available for students to look it back afterwards. It records the movements of the teacher (and, if applicable, chalkboard) together with audio from microphone and computer. These signals are combined with the computer's data signal such as a PowerPoint presentation. The compound audio-visual signal can be live-streamed over the Internet to be followed at a remote location or made available at a university portal for replay.

Sometimes the seat capacity of a lecture hall is insufficient for the number of students. In such case two or more lecture halls are combined and facilitated with audio-visual streaming capabilities or hard-wired signal distribution.

Videoconference is used when two or more classrooms at different locations want to communicate simultaneously. There is a huge difference in signal quality between dedicated videoconference systems and software add-on's for laptop or computer. Add-on software is more suitable for personal and temporary use while dedicated codecs have high quality streams for a more permanent installation.



# Classification - Mixed Practice

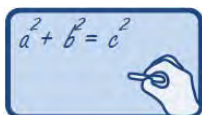
Mixed Practice is student-centred. It focuses on classes with alternating practices, such as frontal introduction about a topic and subsequently tutoring student groups while working in groups on assignments. Student-centred teaching has an all-in-one learning objective. Students have to understand a certain criterion, method or technique and have to apply it within the assignment. Mixed Practice demands classroom layouts that facilitate collaborating settings for students.

Therefore, classrooms for Mixed Practice are flat levelled and have moveable furniture to be arranged for several education practices, such as alternating between frontal and group layouts, different group settings or debating arrangements. The capacity for small groups is up to 60 and for moderate groups up to 90 seats. Sometimes flat-level spaces are demanded even for larger groups up to 150 seats. However, such larger spaces need special care for sightlines and acoustics and are therefore in need of several floor levels (terraces). Hence, the maximum capacity for flat level classrooms is advised to be about 90 seats.

## Characteristics of Mixed Practice:

- **The lecturer's role alternates between frontal instruction and group coaching**
- **Flipped classes attempt to enhance the quality of contact hours**
- **Peer-learning is important for cognitive and communication skills**
- **Project assignments are useful for students to develop problem solving skills**

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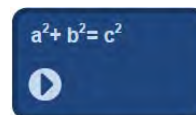
**Frontal instruction**



**Seats arranged in rows**  
(frontal instruction)



**Alternating to seats arranged in groups**  
(group work)



Advanced option:  
**Digital writing**

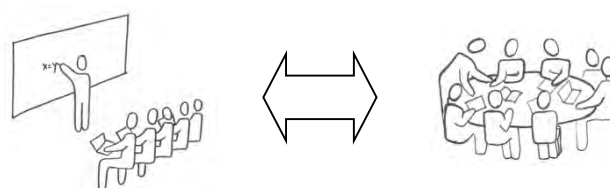




## The lecturer's role alternates between frontal instruction and group coaching

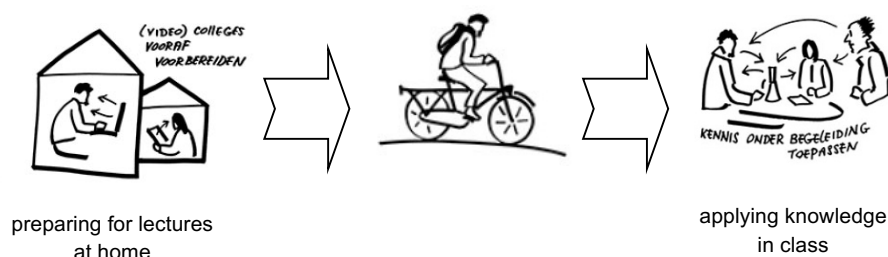
Mixed practice focuses on classes with alternating practices, such as frontal introduction about a topic and subsequently tutoring student groups while working in teams on assignments. Mixed teaching practices have built-in activities for understanding and deep learning, which are designed around themes and try to improve the engagement of the participating students.

The instructor fulfils different roles when the teaching practice changes in the classroom; sometimes as lecturer when a topic is treated in-depth or elaborated further on the chalkboard, and sometimes as coach wandering through class when students work at assignments.



## Flipped Classes attempt to enhance the quality of contact hours

Flipped classroom scenarios reform the traditional transmissive lecture. The teacher-centric lecture is replaced by short videos and made available for online homework. Students need to take notice of the online materials in advance and may post questions about subjects that are hard to understand. Successively in class, the difficult study materials are extensively explained by instructor or student-assistants. At the same time students practice the learning objectives more in-depth through assignments, both personal and in groups. In such way contact hours are used intensively and more specifically focussed on the taught topic.



(illustration by Mark van Huystee)

## Peer-Learning is important for cognitive and communication skills

Classrooms with flexible furniture can facilitate arrangements in which students work together, be it to train techniques personally or to work out group assignments in teams. Especially practices where students work together have additional learning objectives, often called peer learning.



## Project assignments are useful to develop problem solving skills

Tables and chairs in group layout facilitate active and collaborative practices in which students' master skills to collect and select alternatives for ill-structured problems.



*Example of a basic education space for mixed practice (Building 26, hall 1). Table rows with smaller tops (60cm) and broader tops (80cm) for easy switch from rows to groups. Only chairs have to be turned to work in groups.*

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*Example of an advanced education space for mixed practice (Wim Crouwel hall Industrial Design). Flexible furniture (Flexstool) which can be changed from rows to groups by turning one's chair and table.*





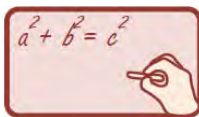
# Classification - Collaborating

Collaborating focuses on team work and group assignments. Students work on problem-based scenarios and learn to communicate, collaborate and cooperate in teams. The co-creation in mono- and multidisciplinary collaboration, under the supervision of a teacher/coach, will provide the student with valuable information about these sorts of processes.

Education spaces facilitate one or several groups up to about 10 participants. When in need, students may use available lockers nearby to leave their project stuff.

Characteristics of Collaborating:

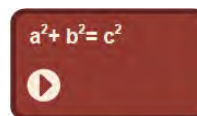
- **Communication and collaboration skills can be developed and trained through groupwork assignments**



**Writing facility per group**



**Group table(s)**



Advanced option:  
**virtual writing**



Advanced option:  
**conference facility**



## Communication and collaboration skills can be developed and trained through groupwork assignments

Information and communication technologies are integrated in today's learning processes. Changing and emerging skills are shared decision-making, (online) information sharing, (online) collaboration, continuing innovation, speed and agility.

Collaborative skills are trained when students work together in order to accomplish group tasks. Students can learn about subject matter and develop interpersonal skills and at the same time working with peers in teams. They learn about communication, leadership and conflict management during such cooperative learning sessions.



*Example of basic education space for Collaborating (photo by M. Krijger)*



*Example of students collaborating in advanced project room (Drebbelweg, photo by M. Blommaert)*

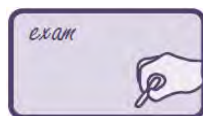


# Classification - Testing

Education spaces for Testing are the situations where students demonstrate what they have learned. It is about knowledge, understanding and application, and about comparing their personal construct with the TU Delft's learning objectives. It is an instrument for determining the students' progress. Computer halls often facilitate both practicals and digital exams.

Characteristics of Testing:

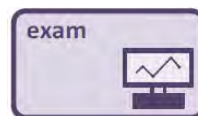
- **Large groups doing exams are in need of silence**
- **The demand for digital exams is growing**



**Paper exam**



**Separate tables in rows**



Advanced option:  
**digital exam**



Advanced option:  
**computer practical**





### Large groups doing exams are in need of silence

Paper exams are easy to facilitate. Large halls with sufficient lighting, clear sightlines and acoustic protection for environmental sounds will do. Tables and chairs are arranged in separate rows and columns. Silence during the test is obligatory and long aisles provide the invigilator to walk slowly around the hall to prevent cheating.

Multiple synchronised clocks inside and outside the hall are necessary. Of course, signage with information about the planned exams is required.



*Example of basic exam hall (Drebbelweg, photo by M. Blommaert)*



*Paper exam (Drebbelweg, photo by M. Blommaert)*



### The demand for digital exams is growing

Digital assessment is growing. Initially the growth was only due to summative exams. Now formative exams are gaining a serious part because of its possibility to enlarge the students' success rate. Furthermore, the increasing numbers of students at the university asks for more efficient exam procedures.

It is important to assess both student and instructor experiences with respect to security, reliability and question type.



*Example of advanced exam hall for digital exams (Drebbelweg)*





B

# Education Space Typologies

From teaching practice to space typology



# Education Space Typologies

The four teaching practices, which are distinguished in part A, request different education space typologies.

In this chapter, the teaching practices are translated into several types of spaces that facilitate the different teaching practices best, with seat capacity as a determining variable.

Seat capacity					
Teaching practice	X Small < 30	Small 30-60	Medium 60-90	Large 90-150	X Large 150-350+
<b>Frontal teaching</b>	X	<b>Instruction room</b> Flat-level floor Furniture in rows	<b>Lecture hall</b> Tiered floor Furniture in rows	<b>Lecture hall</b> Tiered floor Furniture in rows	<b>Lecture hall</b> Tiered floor Furniture in rows
<b>Mixed practice</b>	X	<b>Instruction room</b> Flat-level floor Flexible furniture arrangement in rows and groups	<b>Instruction room</b> Flat-level floor Flexible furniture arrangement in rows and groups	<b>Instruction hall</b> Terraced floor Flexible furniture arrangement in rows and groups	X
<b>Collaborating</b>	<b>Project room</b> Flat-level floor Furniture in groups	<b>Project room / Advanced instruction room</b> Flat-level floor Furniture in groups	<b>Project room / Advanced instruction room</b> Flat-level floor Furniture in groups	<b>Project hall / Advanced instruction hall</b> Flat-level floor Furniture in groups	X
<b>Testing (paper)</b>	X	<b>Instruction room</b> Flat-level floor Furniture in rows	<b>Instruction room</b> Flat-level floor Furniture in rows	<b>Instruction hall</b> Flat-level floor Furniture in rows	<b>Exam hall</b> Flat-level floor Furniture in rows
<b>Digital testing</b>	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall</b> Flat-level floor Furniture in rows or groups	<b>PC-hall / Advanced exam hall</b> Flat-level floor Furniture in rows

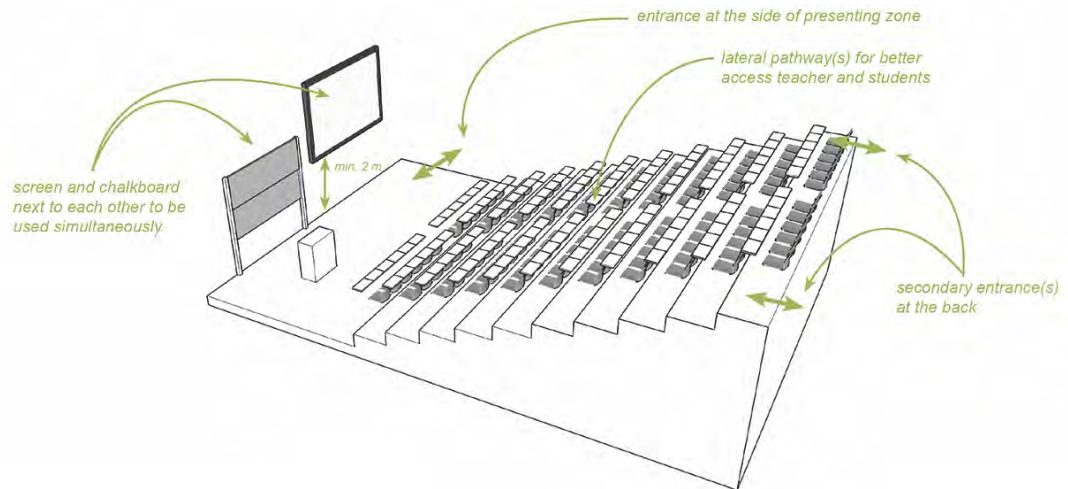
Table: Space typologies differentiated by teaching practice and seat capacity

Each space typology is differentiated into a basic and an advanced format for AV-IT installation and interior design. On the following pages the different space typologies are visualised per teaching practice and capacity.

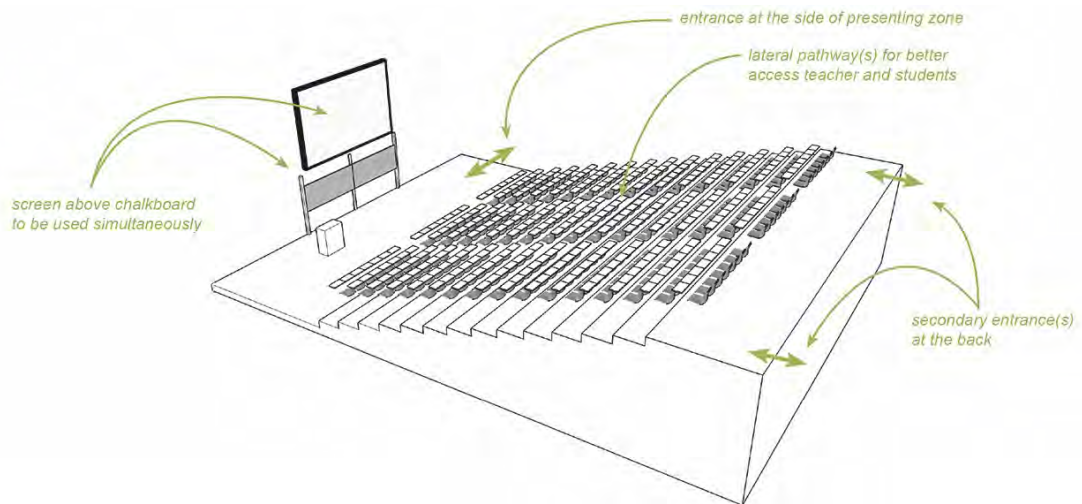


## Space typologies Frontal teaching

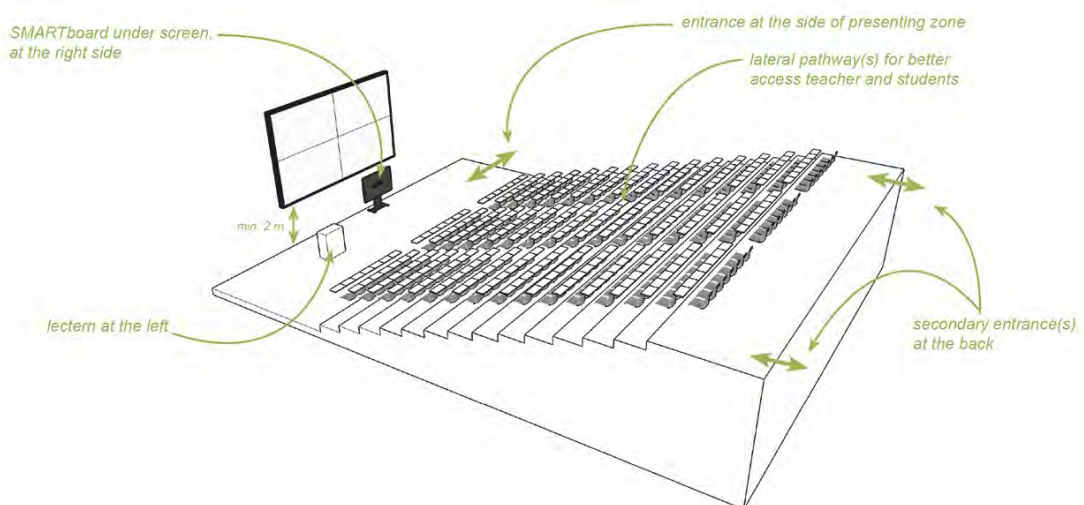
Lecture hall – Basic – M L



Lecture hall – Basic – XL



Lecture hall – Advanced - XL





## Space typologies Mixed practice

Instruction room – Basic – XS S M

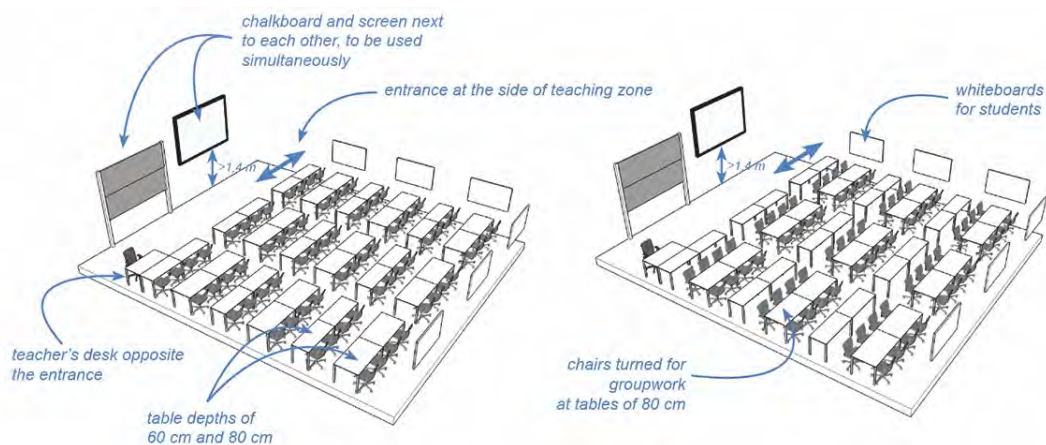
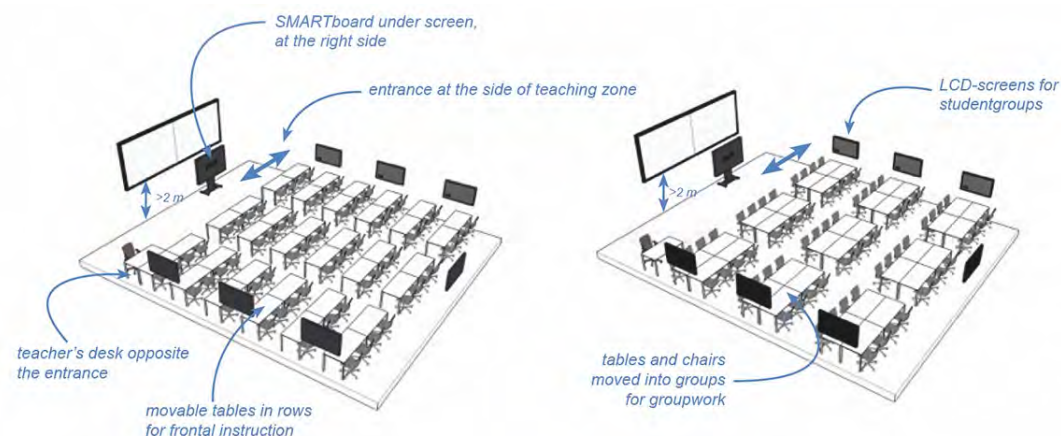


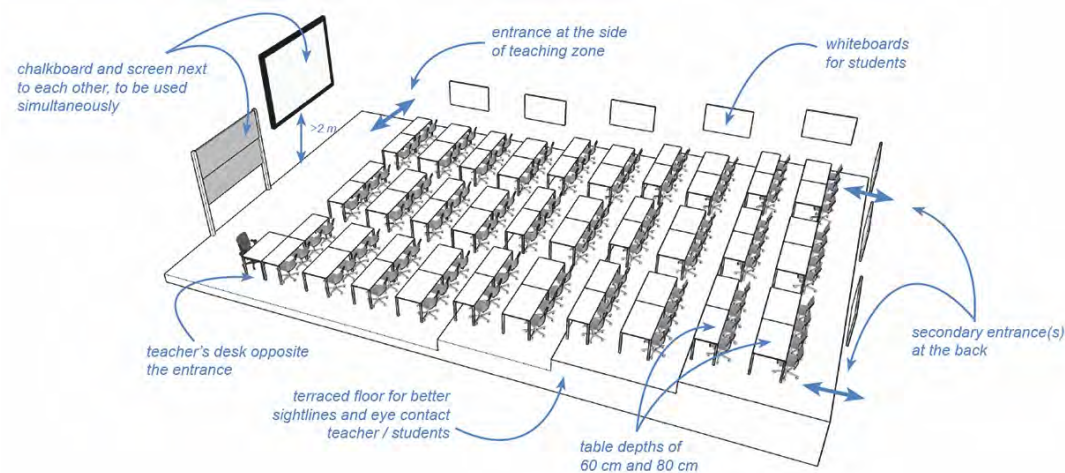
Table rows are fixed. Only chairs have to be turned for working in groups.

Instruction room – Adv. – XS S M



Tables and chairs have to be rearranged for group layout

Instruction hall – Basic – L



Frontal layout with fixed table rows.





## Space typologies Mixed practice

Instruction hall – Basic – L

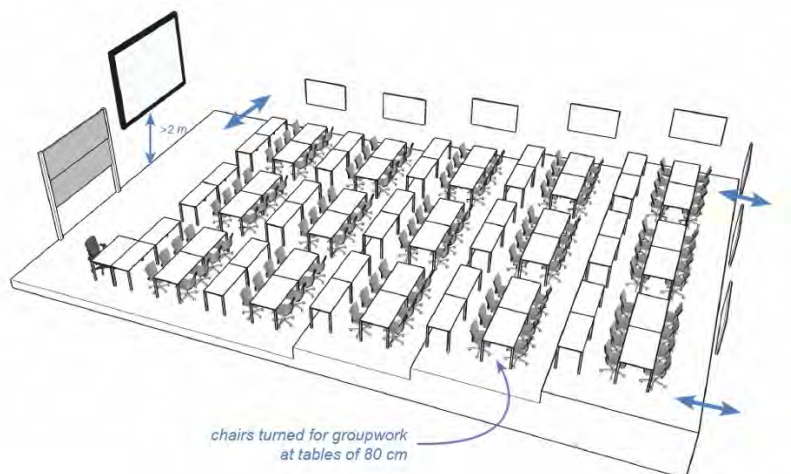
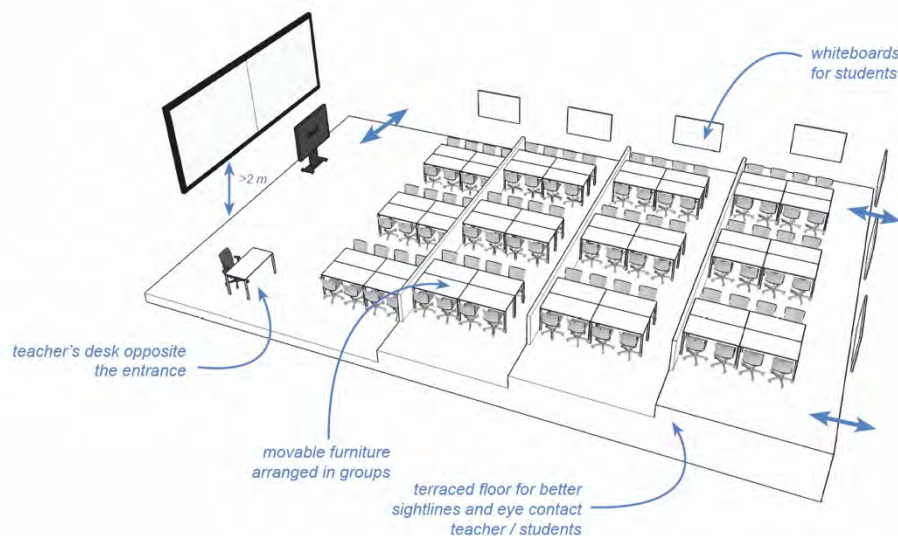


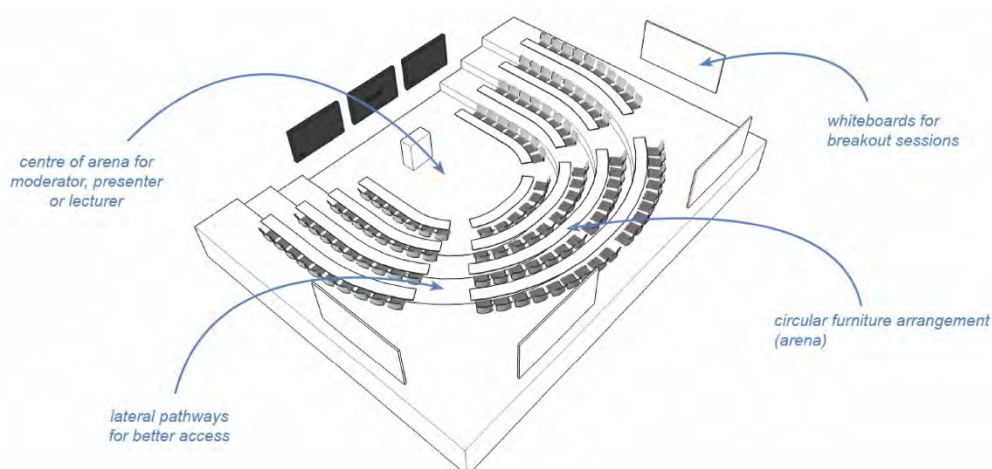
Table rows are fixed. Only chairs have to be turned for working in groups.

Instruction hall – Adv. – L



Tables and chairs have to be rearranged for group layout

Special – Advanced - L

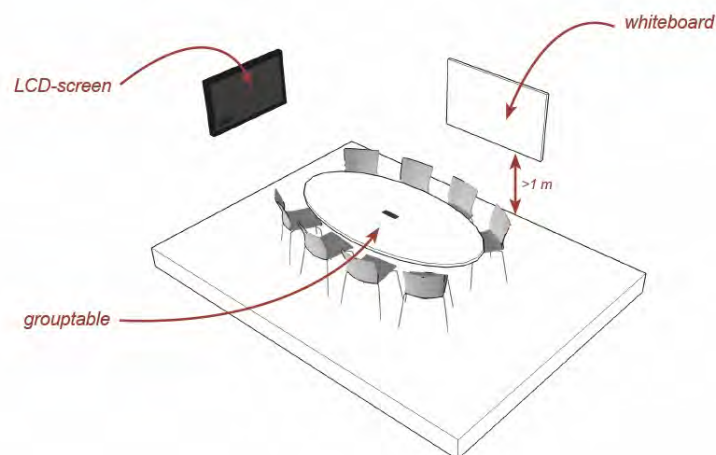


Debating arrangement

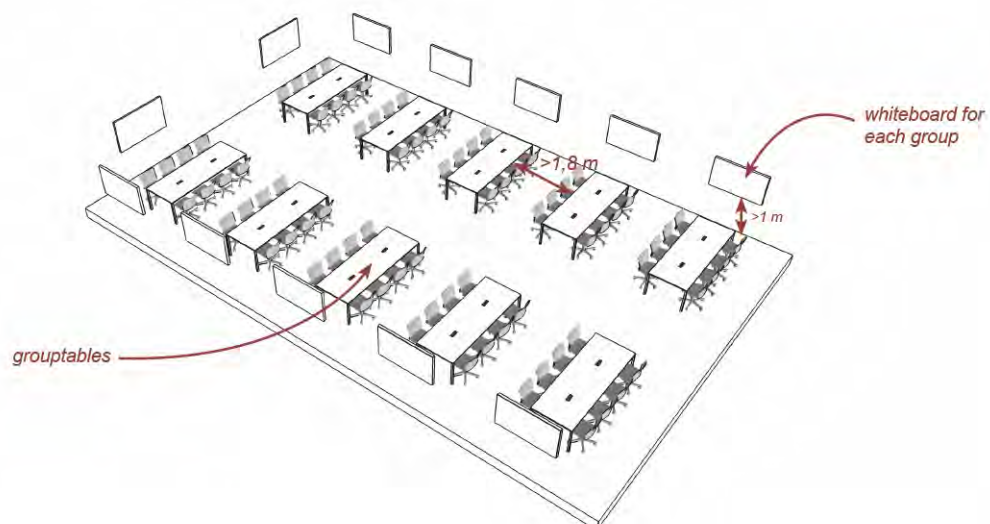


## Space typologies Collaborating

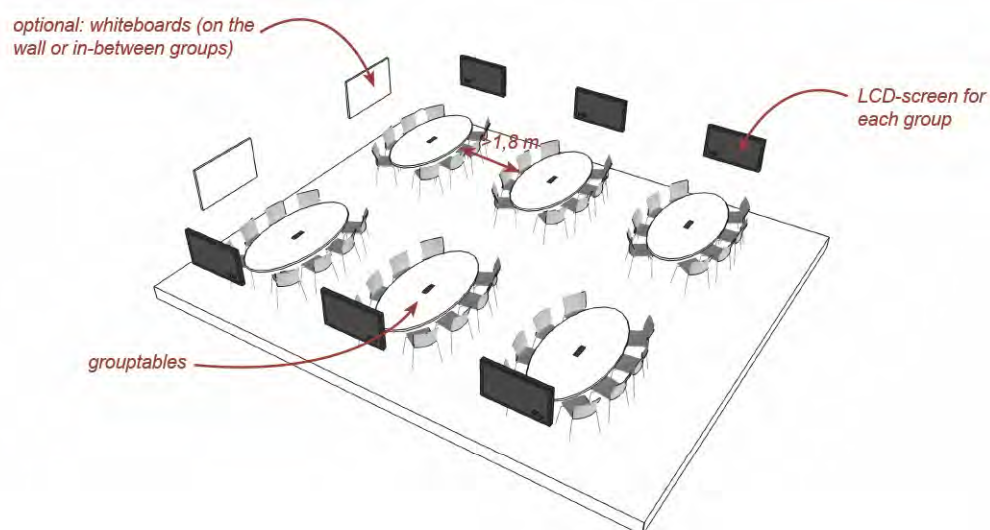
Project room – Adv. - XS



Project room – Basic, – S M L



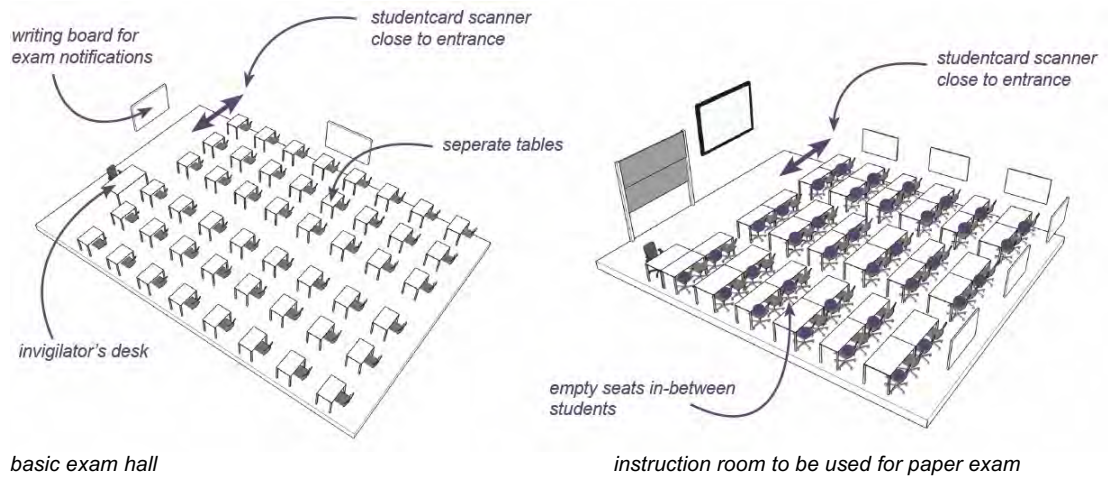
Project room – Adv. – S M L



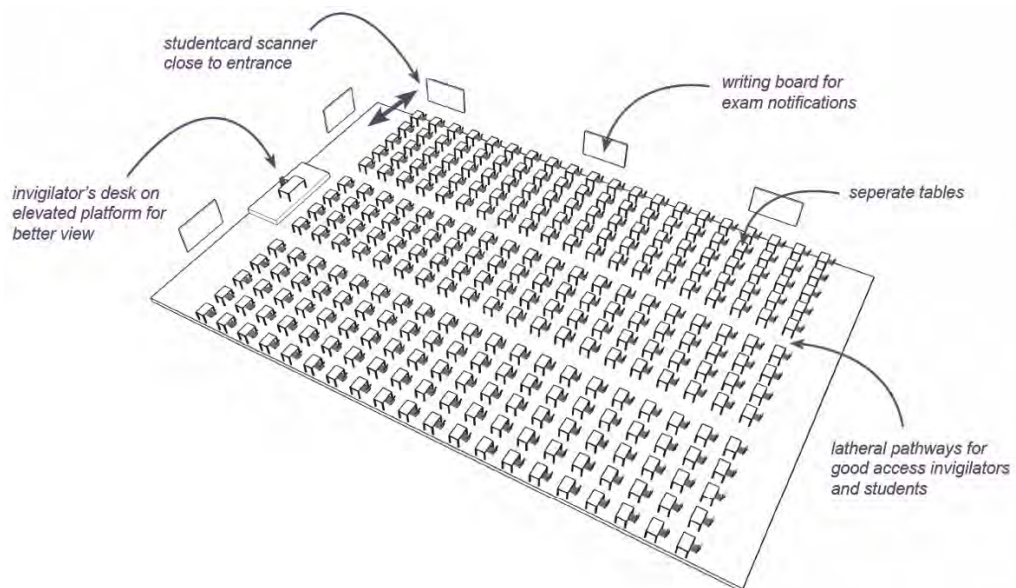


## Space typologies Exams

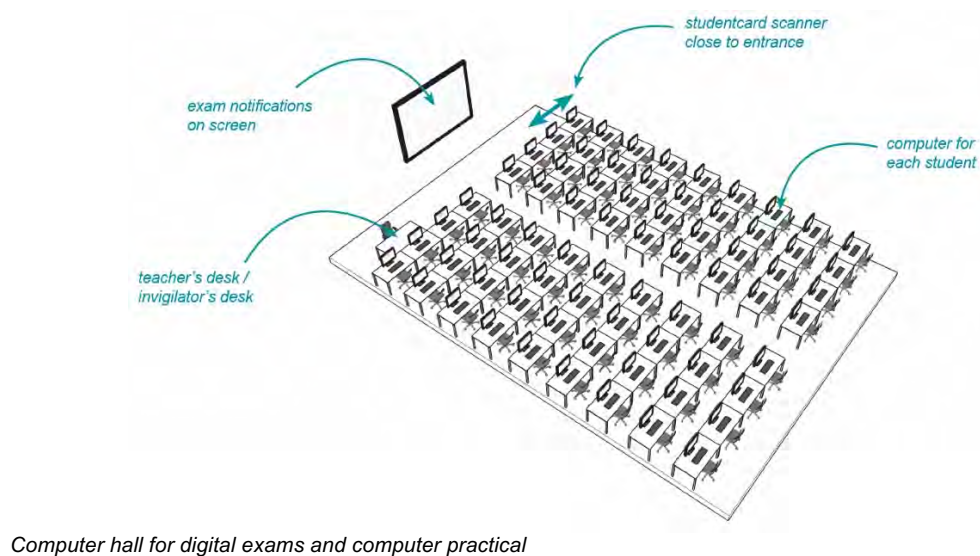
Instruction room – Basic – S M L



Exam hall – Basic - XL



PC hall – Advanced – S M L





## Multifunctional Space Typologies

Education spaces can be arranged in such a way that several teaching practices could be supported in a single space. In the text below logical combinations are proposed.

When requirements for a multifunctional space are too divergent, the most demanding education practice requirements get priority.

A small or medium sized instruction room for Mixed practice is able to facilitate Frontal teaching and Testing (paper). Seat capacity for testing could be less, because of the space needed in-between students.



Large sized instruction halls for Mixed Practice can be made suitable for paper exams. Due to flat-leveled floors in combination with space depth, large instruction halls are less suitable for Frontal Teaching.



8

Instruction rooms for Mixed Practice can also be used as project rooms for Collaborating when its furniture is arranged in group mode.



Computer-halls can be used for computer practical and digital exams.



## Examples of education spaces at the TU Delft campus

### Lecture halls

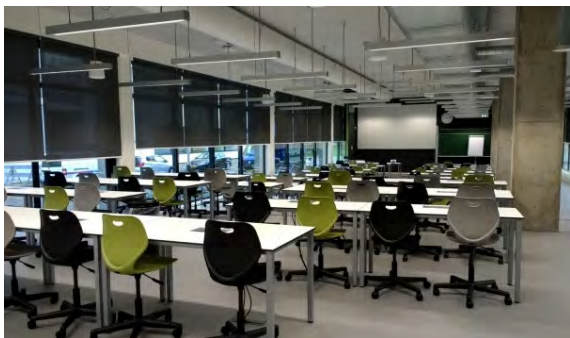


*Aerospace Engineering – Hall A  
Advanced option: digital writing*



*Architecture – Hall A  
Advanced option: double projection*

### Instruction rooms



*Building 26 – Hall 1: terraced floors*



*Applied Sciences – Franklin hall  
Advanced option: digital writing*



*Aerospace engineering – Hall K*



*Civil Engineering & Geosciences – Hall 1.95  
Advanced option: digital writing*

## Project spaces



*Fellowship – Project room 3*



*Drebbelweg – Project room 5  
Advanced option: LCD-screen*

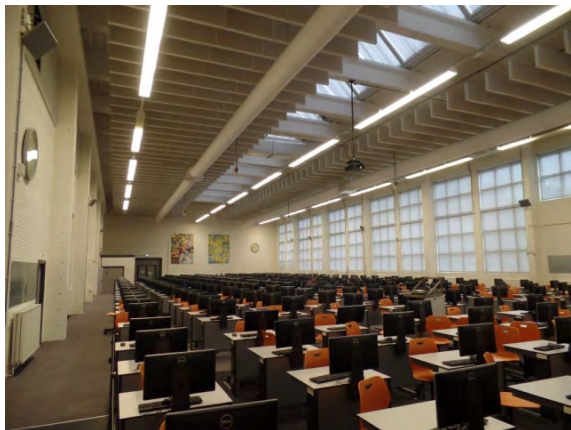


*Drebbelweg – PC-hall 1*



*Applied Sciences – Studio classroom 1*

## Exam halls



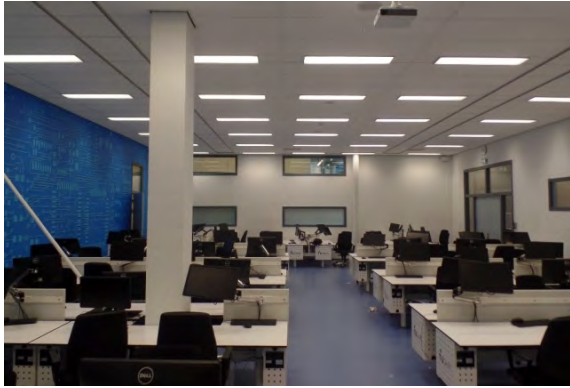
*Drebbelweg – Hall 1  
Flexible furniture for paper exams and digital exams*



*Drebbelweg – Hall 2  
Paper exams*



## Computer-halls



*Industrial Design Engineering – Shift*



*Civil Engineering – Computer hall 1.97*

## Special



*Industrial Design Engineering – IDE Arena  
Special arrangement for debating*





# Education Space Requirements

Compulsory and optional guidelines per space typology





# Requirements - Common

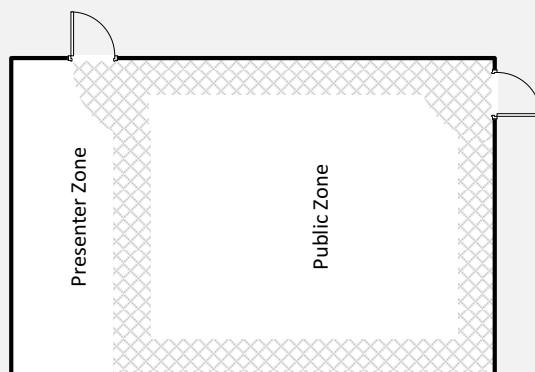
The following guidelines apply for all education spaces:

## Architecture

- Daylight is strongly recommended but dependent on the education space and its specific projected image quality. An ANSI contrast value of 5:1 is considered to be a minimum value for our education spaces.

NB: ANSI contrast values of lecture halls and classrooms must be 7:1 to comply with the Passive Viewing category of Projected Image Standard Contrast Ratio (PISCR) values. These values are produced and maintained by the worldwide trade organisation AVIXA (Audio Visual Integrated Experience Association), see standard ANSI/INFOCOMM 3M-2011.

- In general education spaces are divided in presenter (teacher) and public (student) zones.



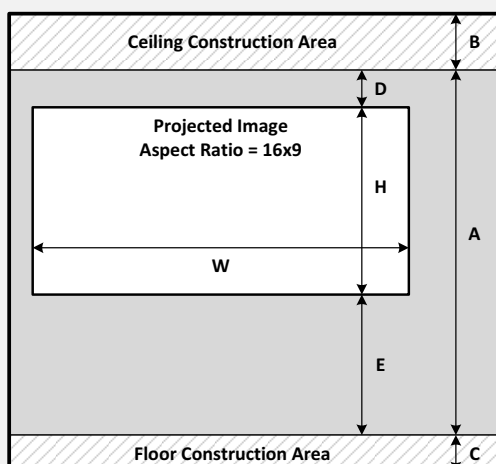
Entrances are preferably situated in the presenter zone to avoid wasting entrance space within the seating area of public zones. One or more entrances may be added at the back dependent on space size.

Lighting and its operation follow the same separation for presenter and public zones. Further description is in the "Climate, electrification, acoustics & lighting" section.

- Clear height is defined as the open space between finalised floor and room ceiling, thus without additional restrictions of HVAC systems, hung lights, construction elements, lowered ceilings or added floor construction elements.

Clear height is related to maximum reading distance, student sight lines, projection screen and writing board dimensions. Dimensions of an education space's presentation wall are:

## Education Space Presentation Wall



- A = Clear height
- B = Space for ceiling installations (e.g. HVAC)
- C = Space for floor installations (e.g. sockets)
- D = Assembly and/or projection frame space
- E = Height from floor to underside screen
- H = Projected image height (frame excluded)
- W = Projected image width (frame excluded)

Presentation wall preferably has a dark colour (night shade blue or dark grey), to contrast the projected image for better quality and readability.



- No doors, windows or other interruptions in presentation wall.
- Silent closing doors.
- Window in or next to entrance door, to see if education space is vacant or occupied. It must be high enough for standing persons and low enough for people in wheelchairs.
- Storage possibilities in direct vicinity of education space for all sorts of equipment (moveable chalkboard, whiteboards, LCD-screens, exam paper).
- Advised maximum distance to last row is about 24 m due to screen dimensions and projector costs.
- Space materialization and detailing are optimized for easy cleaning and low maintenance.
- Sink and tap available in case of chalkboards.

## Readability of screens and boards

### Presentation screens

- Screen dimensions follow the Display Image Size for 2D Content in Audiovisual Systems (DISCAS) standard of AVIXA for Passive Viewing category, which is the worldwide Audio Visual Integrated Experience Association, see AVIXA standard V202.01:2016 (formerly ANSI/INFOCOMM V202.01:2016).
- Projection screen's aspect ratio is 16:9.
- Projection screen and writing boards are positioned adjacent to or above each other to be used simultaneously.
- Writing boards are preferably placed at the window or daylight side of an education space. Projection systems are rather placed at the darker side for better image contrast.
- Fixed projection screens (preferably no drop-down projection screens to prevent out-of-focus images).
- Presentation screen's underside (Height E in Figure Presentation Wall) is approximately 210 cm above floor level. Lecturer and boards should not be in projector's beam interrupting the projected image.
- LED display's underside (Height E in Figure Presentation Wall) at least 140 cm above floor level in flat-level education spaces, preferably higher. Persons sitting in front of each other should not interrupt sight to the projected image.
- Written characters are preferably presented white on a dark background (also on LED displays).
- Written and presented character heights must be between 17 and 20 arc minutes (17'-20') for proper readability, i.e. character recognition, not word recognition. See Table "Advised minimum dimensions for projected image at given reading distances".

NB: Larger screen dimensions are sometimes preferred for esthetical reasons or for easier reading.

Table 1a: Advised minimum dimensions for projected image at given reading distances

Max. Reading Distance	Projected Character Height (17'-20')	Minimum Projected Image Dimensions*	Minimum Ceiling Height in Tiered Lecture Halls**	Minimum Ceiling Height in Flat Level Lecture Halls**
8 m	4.0 - 4.7 cm	180 * 101 cm	-	100 + 140 + 20 = 260 cm
10 m	4.9 - 5.8 cm	240 * 135 cm	-	135 + 140 + 20 = 295 cm
12 m	5.9 - 7.0 cm	280 * 158 cm	158 + 210 + 20 = 388 cm	160 + 140 + 20 = 320 cm
14 m	6.9 - 8.1 cm	330 * 186 cm	186 + 210 + 20 = 416 cm	190 + 140 + 20 = 350 cm
16 m	7.9 - 9.3 cm	380 * 214 cm	214 + 210 + 20 = 444 cm	215 + 140 + 20 = 375 cm
18 m	8.9 - 10.5 cm	430 * 242 cm	242 + 210 + 20 = 472 cm	-
20 m	9.9 - 11.6 cm	480 * 270 cm	270 + 210 + 20 = 500 cm	-
22 m	10.9 - 12.8 cm	530 * 298 cm	298 + 210 + 20 = 528 cm	-
24 m	11.9 - 14.0 cm	580 * 326 cm	326 + 210 + 20 = 556 cm	-

\* Table shows projected image dimensions without frame

\*\* Minimum ceiling height is the result of the following sum:  
Minimum height of projected image + Minimum height from floor to underside screen  
+ About 20 cm extra height for frame and screen assembly



Table 1b: Advised minimum dimensions for LED screen at given reading distances

Max. Reading Distance	Displayed Character Height (14')	LED Diagonal for Excel, drawings, etc.	LED Diagonal for PowerPoint
3 m	1.2 cm	70"	32"
4 m	1.6 cm	84"	46"
5 m	2.0 cm	98"	55"
6 m	2.4 cm	-	70"
7 m	2.9 cm	-	84"
8 m	3.3 cm	-	98"
> 8 m ***			

\*\*\* Consult Manager of Education Spaces when reading distance is larger than 8 m

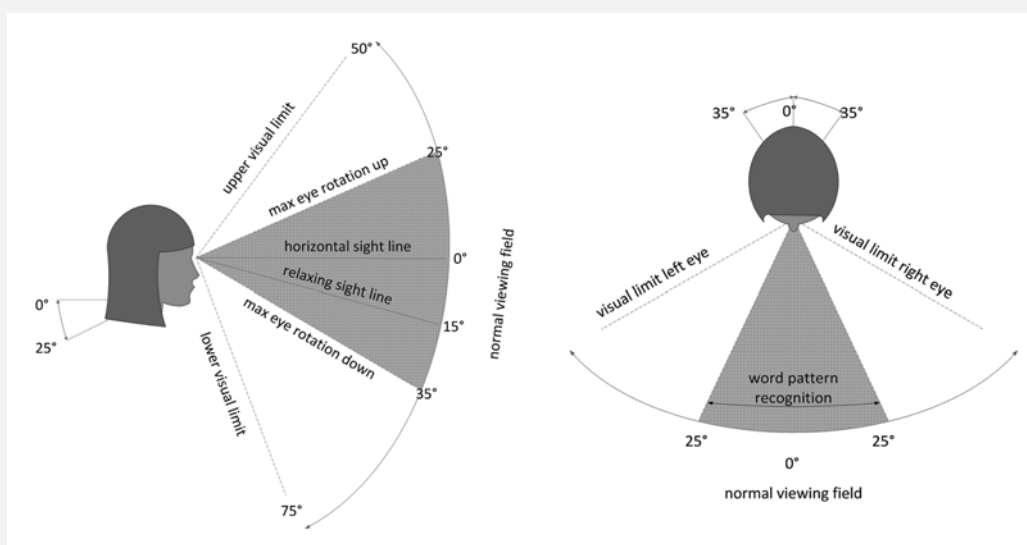
### Writing boards

- Writing boards are height adjustable.
- Double column chalkboards or whiteboards for maximum writing surface.
- SMARTboard is positioned at right side of presentation screen; most teachers are right handed.
- SMARTboard signal is to be projected on a screen for reading distances larger than about 10 m.

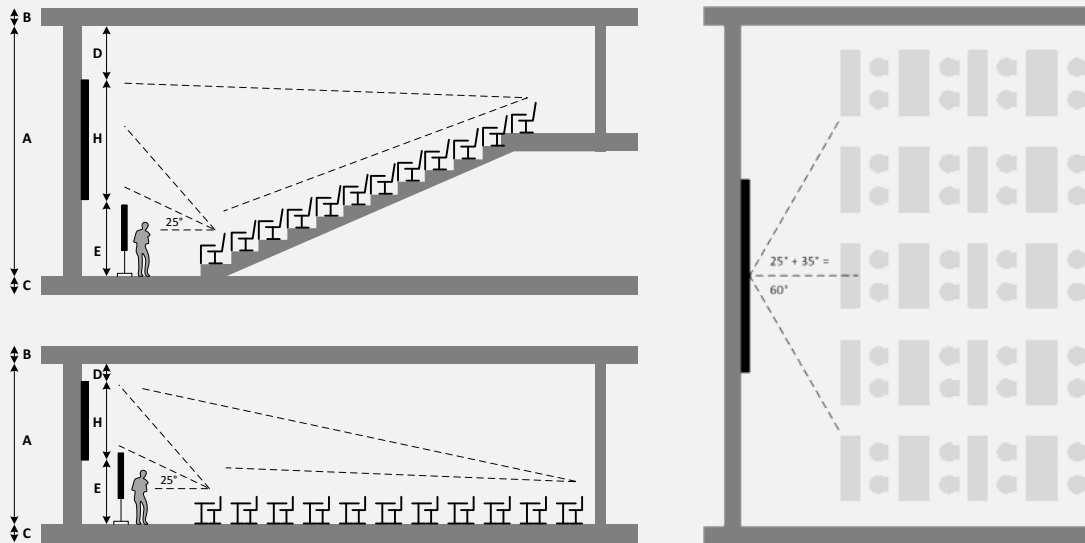
NB: Chalkboards are still readable from a distance of 30 m, erasable whiteboards only up to 8 m.

### Sightlines

- No construction elements within sight lines of students and lecturer. Dependent on situation it is sometimes tolerated that projector, speaker or camera are partly within sightlines.
- Sight lines are based on ergonomic figures for vertical and horizontal head and eye movements:
  - Vertical viewing angle to centre of presentation screen at first row is preferably about 25 degrees due to neck tilting angle. The "maximum eye rotation up" may stretch this angle a little further upwards.
  - Horizontal viewing angle to presentation screen and writing boards at the first row are 60 degrees maximum left and right, i.e. neck swivel angle combined with word pattern recognition angle.







NB: Both teachers and students prefer one central projection screen above multiple screens with similar images. Sometimes multiple screens are chosen due to ergonomic reasons and sightlines but teachers become confused, hence preferably one central projection screen.

#### Furniture & accessories

- Materials of furniture resistant to food and drinks.
- Coat rack for teacher.
- Bins inside and outside the education space.
- Synchronised KNX-clock with hands at sidewall within education space and adjacent corridors. Visible for both instructor and students.
- In case chalkboards are deployed: dust-free chalk in several colours, board eraser, sponge, ruler, drafting compass.

#### AV & IT

##### Computer & laptop

- Classroom computer available with touch-enabled monitor display.
- Standardised operation panel and connection assembly with:
  - 5" touch enabled operation panel
  - key lock
  - 2 \* USB connector to classroom computer
  - connectors for one laptop, i.e. VGA with audio, HDMI and miniDisplayPort (prepare to exchange VGA for USB-C in near future)
  - 1 \* network connector
  - 2 \* power socket
  - light control buttons



5" panel assembly dimensions: width = 80 cm, height = 13.65 cm, depth = 12.5 cm

- AV-IT operation behind key lock.
- 19" AV-rack close to or under lectern and desk (19"\*12HE, ca 52x52x60/45 cm bxdxh).



### Image Projection

- LED/LASER projector(s) or LED display(s), default 1920\*1080 pixels.
- Projector's illumination for ANSI Contrast value at least 5:1, preferably higher than 7:1.
- Image mute available (to mute projection screen) for in between interventions.

### Sound

- Speech intelligibility greater than 0.6 (see STIPA table in "Climate, electrification, acoustics & lighting") should be leading for decision to apply permanent voice amplification or voice lift.
- Ear-worn microphone availability is dependent on speech intelligibility (STIPA) and on recording demands.
- Loudspeaker type is dependent on space dimensions. Tiered lecture halls may have beam steering loudspeaker arrays; terraced halls may have line array drivers, and flat level spaces may have speakers at front and optional in ceiling.
- Ducking is default (when talking in microphone then other sound sources are suppressed for two seconds).

### Cameras:

- AV-IT control units and cameras are connected to network (IP-enabled) for remote monitoring, service and control.
- Recording cameras preferably are remote controlled, have PTZ (pan-tilt-zoom) possibilities, have FHD 1080p resolution with sufficient framerate (60 fps), and NDI (Network Device Interface) interface. These cameras can also be used for remote monitoring.

### Infrastructural

- Wi-Fi in each education space, for specifications see 'Blueprint TU Delft Wireless Network'.
- Network data cabling at least UTP CAT6A, for specifications see 'Basis Network Voorziening Directorate ICT'.
- Network fibre must be single core OS2, for specifications see 'Basis Network Voorziening Directorate ICT'.
- AV installation able to be shut down with master sweep pulse.
- AV installation connected to building safety system.
- AV cabling is dependent on installation, for specifications refer to AV integrator.
- Telephone with fixed line for instant help.

## Climate, electrification, acoustics & lighting

- Sufficient climate dependent on capacity of education space (fresh air, CO2, temperature). For specifications see 'Ruimtematrix TU Delft version 3.0' by Campus & Real Estate (CRE).
- Electrification preferably from sidewalls. In some cases, and larger spaces, electrification from robust floor units is more suitable, but covers of those floor outlets must be able to be closed when in use.
- Spatial acoustics must be tuned for speech with:
  - Reverberation time R60 preferably between 0.5 and 0.7.
  - Speech intelligibility based on IEC 60268-16 norm with STI values preferably > 0.6.

Table 2: STIPA (Speech Transmission Index for Public Address systems) values

Category	Nominal STI value	Examples of typical uses
A+	> 0.76	Recording studios
A	0.72 – 0.76	Theatres, speech auditoria, parliaments, courts, assistive hearing systems
B	0.68 – 0.72	Theatres, speech auditoria, parliaments, courts
C	0.64 – 0.68	Teleconference, theatres
D	0.60 – 0.64	Lecture theatres, classrooms, concert halls
E	0.56 – 0.60	Concert halls, modern churches
F	0.52 – 0.56	PA systems in shopping malls, public building offices, cathedrals
G	0.48 – 0.52	Shopping malls, public building offices



- Acoustic insulation from surroundings for the moment based on standard NEN values plus an extra 20 dB due to increased sound levels of active learning practices (hallway, adjacent education space). For specifications see 'Ruimtematrix TU Delft version 3.0' by CRE.
- Operation of lighting with pre-set buttons and lighting scenes both at door and lecturer's desk. At least two separate lighting scenes and two separate lighting zones i.e. presenter zone and public zone. For specifications see 'Ruimtematrix TU Delft version 3.0' by CRE.

Standardized Lighting & Blinds Operation Panel		
-<	Lighting of Public Zone	>+
-<	Lighting of Presenter Zone	>+
^	Blinds / shades	v
On	All lighting	Off

- Lighting sensor has retention time of about 60 minutes.
- Lighting to be shut down with master sweep pulse.
- Lighting has to be switched to full in alarming situations.
- Blinds and/or shades are dependent on sun and daylight circumstances. Operating buttons are both at door and lecturer's desk.
- Blinds and shades to be opened with master sweep pulse.
- Blinds and shades to be opened in alarming situations.

## Service & support

- Names and direction of lecture halls and classrooms at building entrance and follow-up signage through the building (in English).
- Functional pictograms and seat capacity indication at space entrance, preferably digital.
- Preferably a service bag at Service Desk holding key for operation panel, HDMI cable, VGA+audio cable, miniDisplayPort cable, (optional) USB-C to HDMI convertor cable, presentation tool, laser pointer, fresh whiteboard markers (4 colours): otherwise available in class.
- Every morning cleaned space, floor and furniture. Extra service rounds during the day.
- Cleaned or erased chalk- and whiteboards after each class (instructions for lecturer to leave a clean board).
- When sink is not available: fresh water bucket with sponge to erase chalkboards.
- List of direct telephone numbers for instant support close to telephone.
- Bilingual support standby to avoid delay in beginning of class, professional and reliable (hospitality).
- Clear and simple instructions for AV-IT near teacher's desk
- Floorplan of education space with standard furniture arrangement on the wall.
- Information about lecture hall or classroom available on <http://educationrooms.tudelft.nl/>.
- Standardised documentation of education space AV-IT installations, space dimensions, diagrams, data sheets and program sources at service department.

## Safety & security

- No loose cables and wirings.
- Doors of education space are preferably locked electronically; entrance with RFID card.
- Standardised protocol available how to handle in alarming situations.
- Emergency factsheet available with help numbers.
- Guidelines for evacuation available.
- An emergency situation switches lighting to full, opens blinds and shades, and shuts down the AV-IT installation.



# Requirements - Frontal pedagogy

Space indicators	Advanced options
<ul style="list-style-type: none"> <li>• Space width-depth ratio preferably 2:3.</li> <li>• Capacity 30 - 90 seats: flat level floor (see Mixed Practice).</li> <li>• Capacity 90 - 350+ seats: tiered floor.</li> <li>• Learning Place Area <math>\approx 1,0 \text{ m}^2</math> per student (i.e. Functioneel Nuttig Oppervlak FNO) in case of fixed furniture.</li> <li>• Maximum distance to last row is about 24 m.</li> <li>• Large lecture halls must have storage possibility in direct vicinity for equipment (moveable chalkboard, whiteboards, LCD-screens).</li> </ul>	<ul style="list-style-type: none"> <li>• Learning Place Area <math>\approx 1,2 \text{ m}^2</math> (i.e. Functioneel Nuttig Oppervlak FNO) in case of fixed furniture.</li> <li>• AV equipment to be placed in nearby lockable and air-conditioned cabinet with electrification, network connections, lighting. Its entrance should be from general area.</li> </ul>
Furniture & accessories	Advanced options
<ul style="list-style-type: none"> <li>• Pathways on either side of the space.</li> <li>• Lateral pathways for easy accessibility and moving space for lecturer.</li> </ul> <p><b>Student facilities</b></p> <ul style="list-style-type: none"> <li>• Rows of folding seats and folding table tops over multiple levels.</li> <li>• Row distance &gt; 95 cm.</li> <li>• Row passage &gt; 45 cm.</li> <li>• Seats fixed to the floor.</li> <li>• Centre-to-centre distance seats <math>\approx 55 \text{ cm}</math>.</li> <li>• Table surface large enough for laptop and notebook (depth <math>\approx 40 \text{ cm}</math>, width <math>\approx 50 \text{ cm}</math>).</li> <li>• One power socket per 1 or 2 students.</li> <li>• Provision for one or two wheelchairs dependent on space capacity. Places for wheelchairs should be integrated in space planning with good sight on lecturer, boards and screens. A folding table for person in wheelchair is to be considered including power socket.</li> </ul> <p><b>Lecturer's facilities</b></p> <ul style="list-style-type: none"> <li>• Lectern or desk normally positioned at the side (not in line with or in front of projection screen due to strong projector beam).</li> <li>• In case of large tiered lecture hall:             <ul style="list-style-type: none"> <li>◦ Lectern with workspace of min. 80x60 cm.</li> </ul> </li> <li>• In case of smaller, flat level halls:             <ul style="list-style-type: none"> <li>◦ Height adjustable chair on casters.</li> <li>◦ Desk 140 x 70 cm prepared for standardized control panel, computer display, keyboard and mouse.</li> <li>◦ Optional: table skirt.</li> </ul> </li> <li>• Optional: (movable) table available for demonstration purposes.</li> </ul>	<ul style="list-style-type: none"> <li>• Larger row distance &gt; 100 cm.</li> <li>• Larger row passage &gt; 50 cm.</li> <li>• Broader seats with finer upholstery.</li> <li>• Larger table surface.</li> <li>• Fixed (no folding) tables, so that laptop and notebook can be left during break.</li> <li>• Luxurious interior design for special events and inauguration festivities.</li> <li>• Special halls may have possibility to place panel furniture for conference, discussion or other event (including audio and lighting/spots provisions).</li> </ul>






Writing boards & screens	Advanced options
<ul style="list-style-type: none"> <li>• Projection screen, see Common Requirements.</li> <li>• Double, height adjustable chalkboards or whiteboards. As large as possible (6 m<sup>2</sup> - 16 m<sup>2</sup>), dependent on space possibilities.</li> </ul>	<ul style="list-style-type: none"> <li>• Digital writing with interactive SMARTboard and quad signal projection (see AV &amp; IT)</li> </ul> <p>NB: A possible chalkboard on wheels as fall-back scenario.</p>
AV & IT	Advanced options
<ul style="list-style-type: none"> <li>• LED Laser projector 1920*1080 pixels.</li> <li>• Operation panel, see Common Requirements</li> <li>• Computer display on desk for lecturer to see projected slides during lecture.</li> <li>• Optional: additional feedback monitor dependent on hall situation.</li> <li>• Provision for the hearing-impaired dependent on education space.</li> <li>• Provision for the vision-impaired dependent on education space.</li> </ul>	<ul style="list-style-type: none"> <li>• Digital writing: <ul style="list-style-type: none"> <li>◦ Interactive SMARTboard (1920*1080 pixels)</li> <li>◦ Quad signal projection screen (see Table 3)</li> <li>◦ UHD projector (3840*2160).</li> <li>◦ Advanced operation assembly with: 10" panel, key lock, USB connectors, power sockets, light buttons and connectors for two laptops, i.e. 1*network, VGA with Audio, HDMI, and miniDisplayPort (prepare to exchange VGA for USB-C in near future). Dimensions: w=116 cm, h=20.25 cm, d=17 cm.</li> </ul> </li> </ul>  <ul style="list-style-type: none"> <li>• Lecture capture and recording. Camera position depends on room size, height and type, tiered or flat-level floor. Ideal camera positioning is camera 3 meters above floor, 3/4 distance from screen, in the middle of the room, minimum distance of 8 meters to presenter, and projector not in sightline of camera.</li> <li>• Second ear-worn microphone and/or handheld microphone.</li> <li>• Catch box microphone for students in large lecture halls.</li> <li>• 3D Visualizer (document camera).</li> <li>• AV streaming capabilities.</li> <li>• Video conferencing facilities.</li> </ul>
Safety & security	Advanced options
<ul style="list-style-type: none"> <li>• Tiered lecture halls have guiding lights on stair steps.</li> <li>• Precaution and safety arrangements in case of an elevated teacher platform.</li> </ul>	



Table 3: Advised minimum dimensions for quad projection screen images at given distances

Max. Reading Distance	Projected Character Height (14'-17')	Minimum Projected Image Dimensions*	Minimum Ceiling Height for 4Q Lecture Halls**
12 m	4.9 - 5.9 cm	409 * 230 cm	230 + 200 + 20 = 450 cm
14 m	5.7 - 6.9 cm	477 * 268 cm	268 + 200 + 20 = 488 cm
16 m	6.5 - 7.9 cm	545 * 307 cm	307 + 200 + 20 = 527 cm
18 m	7.3 - 8.9 cm	613 * 345 cm	345 + 200 + 20 = 565 cm
20 m	8.1 - 9.9 cm	681 * 383 cm	383 + 200 + 20 = 603 cm
22 m	9.0 - 10.9 cm	750 * 422 cm	422 + 200 + 20 = 642 cm
24 m	9.8 - 11.9 cm	818 * 460 cm	460 + 200 + 20 = 680 cm

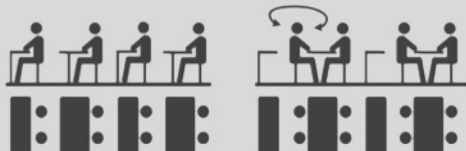
\* Table shows projected image dimensions without frame

\*\* Minimum ceiling height is the result of the following sum:

Minimum height of projected image + Minimum height from floor to underside screen  
+ About 20 cm extra height for frame and screen assembly



# Requirements - Mixed pedagogy

Space indicators	Advanced options
<ul style="list-style-type: none"> <li>Space width-depth ratio preferably 3:4.</li> <li>Capacity 30 - 90 seats: flat level floor.</li> <li>Capacity 90 - 150 seats: terraced floor.</li> <li>Learning Place Area <math>\approx 2,2 \text{ m}^2</math> per student (i.e. Functioneel Nuttig Oppervlak FNO).</li> </ul>	<ul style="list-style-type: none"> <li>Learning Place Area <math>\approx 2,5 \text{ m}^2</math> (i.e. Functioneel Nuttig Oppervlak FNO).</li> <li>When space is dedicated for debate, student seats may be arranged in U-shape with tiered floor.</li> </ul>
Furniture & accessories	Advanced options
<p><b>Student facilities</b> Furniture must facilitate different arrangements (rows, groups, U-shape) for different teaching practices.</p> <p>Example A:</p> <ul style="list-style-type: none"> <li>Table rows with smaller tops (60cm) and table rows with broader tops (80cm) for easy switch between rows (frontal instruction) and groupwork. Only chairs have to be turned. <ul style="list-style-type: none"> <li>Revolving chairs on casters, height adjustable, no arm rests.</li> <li>Simple tables that can be used from both sides, table legs at side, cable cubby on the side of table top</li> <li>Tables are not to be moved by students, cables only to be (dis)connected by support staff.</li> </ul> </li> </ul>  <p>Example B:</p> <ul style="list-style-type: none"> <li>Movable tables and chairs to facilitate maximum flexibility <ul style="list-style-type: none"> <li>Stackable chairs</li> <li>Lightweight tables on two casters, cable cubby in table top</li> <li>Cables from table to be (dis)connected by students themselves. Easy access to power sockets in walls and floor.</li> </ul> </li> <li>Distance between rows of tables is 80-90 cm.</li> <li>Table surface large enough for laptop and notes (preferably 80 x 60 cm for single seat, 140 x 70 cm for double seats).</li> <li>At least 1 power socket per student</li> <li>Lateral pathways for safer entrance and easier teacher access to students, preferably 90 cm.</li> <li>In case of terraced floor levels: first 4 to 6 rows on floor level, followed by double table rows and seats per terrace level.</li> </ul>	<ul style="list-style-type: none"> <li>More comfortable seats with finer upholstery</li> <li>Larger tables and more space between them</li> <li>Grid of electrical outlets in the floor for maximum flexibility of furniture arrangements.</li> <li>FlexStool furniture.</li> </ul>



- In halls with capacity > 100 seats: furniture should be arranged in such a way that chairs do not have to be fixed on floor or connected to each other, see Bouwbesluit article 7.13.

#### Lecturer's facilities

- Height adjustable chair on casters.
- Desk at least 140 x 70 cm prepared for standardized control panel, with computer display, keyboard and mouse.
- Optional: table skirt in case of open free-standing desk, e.g. a front panel that prevents sight to cables, 90" rack, teacher's legs.
- Desk positioned at the side, opposite the entrance, preferably near window and chalkboard, but not in line with or in front of projection screen.
- Optional: movable table available for demonstration purposes.

### Boards & screens

#### Advanced options

- Projection screen or LED screen, see Common Requirements.
- Chalkboard or whiteboard for teacher (be aware: readability of whiteboard is < 8m).
- Multiple erasable whiteboards or continuous whiteboard strip on sidewalls for break-out sessions. Underside is at 100 cm from floor level, height of whiteboard (strip) is about 100 to 125 cm.  
Optional: additional movable whiteboards.

- Digital writing with interactive SMARTboard (scaled to 1920\*1080 pixels) combined with LED display or double projection dependent on reading distance to last row. NB As fall-back scenario traditional chalkboards can be provided too.
- One or more feedback displays for teacher to see projected slides during lecture when facing the students.
- LED displays on side walls per student group to facilitate groupwork.

### AV & IT

#### Advanced options

- LED laser projector 1920\*1080 pixels with ANSI contrast of at least 5:1, up to 15:1, see standard ANSI/INFOCOMM 3M-2011.

- Second ear-worn microphone or handheld microphone.
- 3D Visualizer (document camera).
- Recording facilities, for example for teaching presentation skills.

### Other

#### Advanced options

- Optional: Classroom available as informal workspace for in between and after teaching hours.



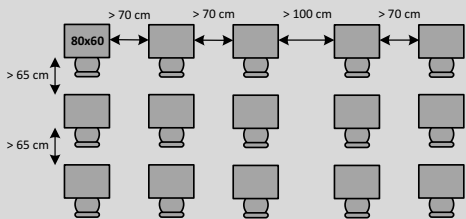
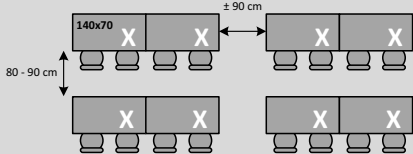


# Requirements - Collaborating

Space indicators	Advanced options
<ul style="list-style-type: none"> <li>• Space width-depth ratio preferably 3:4.</li> <li>• Flat level floor.</li> <li>• Learning Place Area <math>\approx 2,7 \text{ m}^2</math> (i.e. Functioneel Nuttig Oppervlak FNO).</li> </ul>	<ul style="list-style-type: none"> <li>• Learning Place Area <math>\approx 2,8 \text{ m}^2</math> (i.e. Functioneel Nuttig Oppervlak FNO).</li> </ul>
Furniture & accessories	Advanced options
<ul style="list-style-type: none"> <li>• Single group-table for 6-10 persons. Several group-tables in case of larger project spaces.</li> <li>• Cable cubby in centre of table (attention to cable management).</li> <li>• At least 1 power socket per participant.</li> <li>• Table top at least 80 cm, table(s) may be moveable.</li> <li>• Simple chairs.</li> <li>• Centre-to-centre distance of chairs is at least 55 cm (dependent on seat width).</li> <li>• No teacher's facilities.</li> </ul>	<ul style="list-style-type: none"> <li>• Wider distance between seats.</li> <li>• More comfortable seats with finer upholstery.</li> <li>• Sitting / standing desks</li> </ul>
Boards & screens	Advanced options
<ul style="list-style-type: none"> <li>• Sufficient writing surface (about <math>2 \text{ m}^2</math>) per group table (whiteboard and/or flip-chart), fixed on wall or moveable. NB: Maximum reading distance of whiteboards <math>\approx 8 \text{ m}</math></li> <li>• No writing board for teacher.</li> </ul>	<ul style="list-style-type: none"> <li>• LED display per group-table for presentations. For dimensions see Table 1b in Common Requirements.</li> </ul>
AV & IT	Advanced options
<ul style="list-style-type: none"> <li>• No classroom computer.</li> </ul>	<ul style="list-style-type: none"> <li>• Video conferencing facilities.</li> <li>• SMARTboard in combination with LED display for interactive sessions.</li> </ul>
Other	Advanced options
<ul style="list-style-type: none"> <li>• Optional: Classroom available as informal workspace in between and after teaching hours</li> </ul>	



# Requirements - Testing

Space indicators	Advanced options
<ul style="list-style-type: none"> <li>Robust flat level floor, e.g. no computer floor (because of acoustics and floor movements).</li> <li>Learning Place Area <math>\approx 2,5 \text{ m}^2</math> (i.e. Functioneel Nuttig Oppervlak FNO).</li> <li>Clear sight lines and multiple aisles for invigilators.</li> <li>Students enter preferably at one end (entrance) and leave at another (exit) in larger exam halls. Such fixed route is easier to control and less disturbing.</li> <li>Optional: elevated platform at the front for invigilators to provide them a better view in large exam halls.</li> </ul>	
Furniture & accessories	Advanced options
<p><b>Student facilities</b></p> <p>In case of single tables:</p> <ul style="list-style-type: none"> <li>Height adjustable chair</li> <li>Single person table min. 80 x 60 cm</li> <li>Min. 70 cm aisle left and right from table</li> <li>Min. 65 cm sitting space behind table</li> <li>A few wider aisles (&gt;100 cm) for better access and for invigilators to walk around.</li> </ul>  <p>NB: Often testing takes place in an instruction room (i.e. mixed practice space) with double tables. In order to prevent fraud only one person takes place at a table for two seats, unfortunately lowering the space capacity.</p>  <p><b>Invigilator's facilities</b></p> <ul style="list-style-type: none"> <li>Height adjustable chair on casters.</li> <li>Desk 140 x 70 cm.</li> <li>Table skirts in case of open free-standing desk, e.g. a front panel that prevents sight to cables, 90" rack, teacher's legs.</li> <li>Locker to store paper exams.</li> </ul>	<ul style="list-style-type: none"> <li>Preferably one locker per student to store phone, bag and computer in vicinity of exam hall.</li> </ul> <p><b>Computer instruction, practical and exams:</b></p> <ul style="list-style-type: none"> <li>Teacher's / invigilator's desk 140 x 70 cm prepared for standardized control panel.</li> <li>A common size for student tables for computer practical is 180x80 cm for two persons. In case of a digital exam only half of the space capacity can be used in order to prevent fraud. When the table width is 220 cm (110 cm per person), then the full capacity can be used for digital exams.</li> <li>Tables can be multifunctional for paper exams and digital exams (monitor, keyboard and mouse stored in table top. For example Drebbelweg Hall 1)</li> </ul>



Boards & screens	Advanced options
<ul style="list-style-type: none"> <li>Whiteboard or chalkboard available for exam information (inside and outside the hall). Multiple information screens in larger halls.</li> </ul>	<ul style="list-style-type: none"> <li>Projection screen or LED-display in case of computer testing or computer instruction.</li> </ul>
AV & IT	Advanced options
<ul style="list-style-type: none"> <li>Automatic entrance control (card readers) for authorized exam taking.</li> </ul>	<p><b>Digital testing and computer instruction:</b></p> <ul style="list-style-type: none"> <li>Wired network and power (no Wi-Fi).</li> <li>Secured environment.</li> <li>Possibility for instructor to take over all computers' displays during computer practical.</li> <li>Projector with specific colour lens in order to project the proper functional colours clearly which are used within computer programming applications.</li> </ul>
Climate, acoustics & lighting:	Advanced options
<ul style="list-style-type: none"> <li>Exam halls must be acoustically dim. For specifications see 'Ruimtematrix TU Delft version 3.0' by Campus &amp; Real Estate (CRE).</li> <li>Sound amplification in exam halls larger than 60 seats.</li> <li>Acoustics should lock out disturbing environmental noises, also between education spaces. For specifications see 'Ruimtematrix TU Delft version 3.0' by Campus &amp; Real Estate (CRE).</li> <li>Hall doors should close softly and silently.</li> </ul>	
Safety & security	Advanced options
<ul style="list-style-type: none"> <li>Invigilators must be trained how to handle in alarming situations.</li> <li>Emergency aid (BHV) must be present during exam periods, also in temporary halls.</li> <li>Guidelines for evacuation available, especially in temporary halls.</li> </ul>	
Service & support	Advanced options
<ul style="list-style-type: none"> <li>Finished paper exams are collected by invigilators at the exit door.</li> <li>Students with disabilities should be name-placed in quiet zones.</li> </ul>	<ul style="list-style-type: none"> <li>Protocols available how to proceed with digital exams in case of power failures.</li> <li>ICT support present during digital exams.</li> </ul>
Other	Advanced options
<ul style="list-style-type: none"> <li>During exams no disturbing noisy events may take place.</li> <li>Catering services nearby.</li> <li>Sufficient number of toilets nearby. Certainly with large cohorts.</li> <li>Copying services in the vicinity (e.g. to print paper exams in case of computer failure).</li> <li>Bilingual invigilators or proctors (Dutch and English).</li> </ul>	<ul style="list-style-type: none"> <li>Spare time of around half an hour before and after exam for facility management to convert or clean the exam hall for instance from paper exam to digital exam.</li> </ul>



- Spaces that are temporarily used for exams (such as Sports Hall) need special arrangements for logistics, entrance, silent zones, etc.
- During exam periods an officially 'loading and unloading zone' must be declared near the entrance of every building to bring paper exams.





# Study Places



# Study places

This part about different study work places for students was originally published in Dutch in November 2015. It was called “Studiewerkplekwijzer” (Study Places Guide) and it seemed only logical to combine the formal education spaces of the Cookbook with these informal study places.

The Study Places Guide has been initiated by the working group ‘Study Places’ and composed by Kelvin Berghorst (CRE), Catelijne Elissen (CRE), Paul Uiterdijk (CRE), Dennis Cruijen (CFM), Liesbeth Mantel (Library) and Iris van Loon (ESA), in collaboration with student union’s representatives Suzanne Janssen and Bram de Kruijff (SR 2014-2015).

## Classification of study places

Three types of study places are distinguished, which facilitate different uses.



### **Type A - Silent study places**

Study workplaces to study individually for many hours in a silent area.



### **Type B: Touchdown study places**

Study workplaces for temporary self-study or short-term group work.



### **Type C: Meeting places**

Multifunctional places for various social encounters, such as informal meetings or conversation. Such a study place counts half a study place for capacity planning.

Across the TU campus most study places are type B or type C. Type C study places are situated in restaurants and coffee corners all over campus. Type B study places can be found in faculties and education buildings, mainly in or close to the circulation areas. Type A study places are concentrated at the Library and faculty buildings. These study places are very popular during exam periods and overcrowded in such peak times. To bring about type A study places or upgrading existing study places up to type A demands not only proper furniture but also building adjustments in order to create silent, enclosed areas.



# Requirements

## Type A - Silent study places

Study workplaces to study individually for many hours in a silent area.



Library TU Delft (photo J. van der Heul)



EEMCS TU Delft (photo Gispenn.nl)



Fontys Eindhoven (photo Gispenn.nl)

### Space indicators & location

- Learning Place Area  $\approx 4,0 \text{ m}^2$  (i.e. Functioneel Nuttig Oppervlak FNO)
- Direct daylight, preferably located next to exterior facade
- Preferably situated in a silent and enclosed area. Otherwise situated in a quiet zone in the building.
- Preferably placed on ground floor or 1<sup>st</sup> floor, considering opening hours in the evening.

### Furniture & accessories

- Table top large enough for laptop and notes for student, min. 100 x 80 cm per person.
- Height adjustable chair with adjustable armrests
- At least 1 power socket per place
- Partitions between places for privacy and clear demarcation

### AV & IT

- WiFi
- Sometimes silent study places are provided with a desktop computer or monitor.

### Climate, electrification, acoustics & lighting

- Sufficient climate. For specifications see 'Ruimtematrix TU Delft version 3.0' by Campus & Real Estate (CRE).
- Noise reduction measures are required (e.g. partitions).

### Other

- Printer in close vicinity (no disturbing noise)



- Coffee nearby
- Lockers nearby
- Toilets nearby





## Type B – Touchdown study places

Study workplaces for temporary self-study or short-term group work.



CEG TU Delft (photo M. Blommaert)



IDE TU Delft (photo M. Sleeuwits)



Library TU Delft (photo G. Schoonewille)

### Space indicators & location

- Learning Place Area  $\approx 2,5 \text{ m}^2$  (i.e. Functioneel Nuttig Oppervlak FNO).
- Daylight.
- Easy to reach and easy to find. For example in or along a main hallway.
- Preferably situated close to education spaces, entrance or other significant facility.
- Preferably situated on ground floor or 1<sup>st</sup> floor, considering opening hours in the evening.

### Furniture & accessories

- Variation of arrangements, group or individual.
- Table top surface large enough for laptop and notes for student, min. 80 x 60 cm per person.
- Normal or height adjustable chair.
- At least 1 power socket per 2 places.
- Optional: high table or sitting/standing table.

### AV & IT

- WiFi.
- Sometimes touchdown study places are provided with a desktop computer or monitor.
- In case of a separate space for group work there may be a LED-display on the wall.

### Climate, electrification, acoustics & lighting

- Sufficient climate. For specifications see 'Ruimtematrix TU Delft version 3.0' by Campus & Real Estate (CRE).
- Noise reduction measures are required.

### Other

- Printer in close vicinity (no disturbing noise)
- Coffee nearby
- Lockers nearby
- Toilets nearby



## Type C – Meeting places

Multifunctional places for various social encounters, such as informal meetings or conversation. Such a study place counts half a study place for capacity planning.



Architecture TU Delft (photo R. 't Hart)



EEMCS TU Delft (photo M. Blommaert)



Fellowship TU Delft (photo T. Bogerd)

### Space indicators & location

- Learning Place Area  $\approx 2,0 \text{ m}^2$  (FNO, user space)
- Direct or indirect daylight
- In combination with Food and Beverages spots: the seats can be used as study places outside regular breaks.
- Couches and (lounge)seats in corridors

### Furniture & accessories

- Variation of arrangements
- Chair, bench or stool
- Power socket nearby

### AV & IT

- WiFi

### Climate, electrification, acoustics & lighting

- Sufficient climate. For specifications see 'Ruimtematrix TU Delft version 3.0' by Campus & Real Estate (CRE).
- Noise reduction measures are required.

### Other

- Toilets nearby