

NORDIC JAPANESE HARMONY

TECHNICAL SUPPLEMENT

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This section is a technical supplement to report, presenting a more detailed description of practical, technical, and acoustic solutions of the project.

Final Space Program

Entrance

Functions / Reception + Cloak room - 30 m²
 Area for arrival/ performance intermission - 160 m²
 2 Toilets - 13 m², 1 Handicap toilet - 5 m²

Size / 212 m²

Feeling / Open and welcoming, human scale
 Clear to find functions and easy to reach them

Light / South, East

View / Water, mountains

Accessibility / Very open

Knowledge Area

Functions / Reading/ Study - 210 m²
 Listening to music/relax area - 115 m²
 Storage - 131 m²
 3 Toilets - 25 m², 1 Handicap toilet - 5 m²

Size / 486 m²

Feeling / Relaxed tranquil feeling by seclusion, open-planned

Light / East, South

View / Water, mountains

Accessibility / Open

Rehearsal Area

Functions / Medium rehearsal room, 10 persons - 100 m²
 Large rehearsal room, 20 persons - 155 m²
 1 x 70 m² Large Group rooms, <10 persons - 70 m²
 2 x 33 m² Small Group rooms, <5 persons - 66 m²
 5 x 16 m² Teaching rooms, < 3 persons - 80 m²
 1 x 18 Teaching rooms, < 3 persons - 18 m²
 8 Toilets - 40 m², 2 Handicap toilet - 20 m²
 Storage - 129 m²

Size / 660 m²

Feeling / Focused, concentrated, basic acoustics elements

Light / North

Connection / Courtyards, cliff, framed views

Accessibility / Less open

Cafe

Functions/ Kitchen - 73 m²
 Storage - 70 m²
 Jam and relax area - 362 m²
 1 Toilets - 8 m², 1 Handicap toilet - 10 m²

Size/ 523 m²

Feeling / Relaxed, transparent, easy to see and access

Light / South

View / Courtyards, cliff, water

Accessibility / Very open

Administration

Functions/ 5 workplaces - 70 m²
 1 Print room - 6 m²
 2 Toilets - 9,5 m²
 Kitchen - 9,5 m²

Size/ 96 m²

Feeling / Welcoming

Light / North

Accessibility / Less open

Performance Hall

Functions/ Stage - 70 m²
 Audience - 377 m²
 Technical room - 23 m²

Size/ 470 m²

Seating for an audience of 430

Feeling / Acoustics, earnestness, stimulating, impressive
 music (brass, woodwind, strings, piano, percussion,
 acoustic instruments)

Accessibility / Open

Backstage

Functions/ 2 Dressing rooms, make-up, styling - 35 m²
 Storage - 7 m²
 Preparation / relax area - 100 m²
 2 Toilets - 8 m², 1 Handicap toilet - 5 m²

Size/ 155 m²

Feeling / Focused, concentrated

Light / North

Connection / Garden, calm areas (e.g. roof/private area)

Accessibility / Closed

Total Area / 5736 m²

ACOUSTICS

Performance Hall

Aimed T30 values / The generally acceptable values for Reverberation time (T30) at 1 kHz for music halls range from 1.4 to 2.4 seconds. The Reverberation time in Oslo Opera House is 1.7 seconds [Stand, 2008, p.180]. DR concert hall has a reverberation time of 1.8 to 2.4 seconds. DR Orchestra hall, similar in size to the Music House's performance hall, has a reverberation time varying from 1.1 to 1.7 seconds [www.dr.dk, 11 March 09]. Therefore the aimed reverberation time is from around 1.6 seconds.

Results of CATT Acoustics model / The demo version of CATT only allows for half the recommended amount of sound rays (1000 rays) for audience area mapping (to determine the SPL distribution), therefore the prediction is less reliable. Changes in the outcome value occurs because the limited amount of rays are sent along varying paths each time a calculation is made. An average of values for T30 and D50 can be seen in [174].

SPL distribution / The sound pressure level distribution is very even along a majority of the audience plane in the hall, with the exception of a few areas with a lower SPL.

Echo / This is only heard if the sound is heard more than 50ms after the original sound, otherwise the echo actually strengthens the sound. [176] shows sound reflections over time. It is important that the first sound lines occur within 50 ms, which can be seen here. Therefore echo is not detected.

T30 (secs) D50 (%)

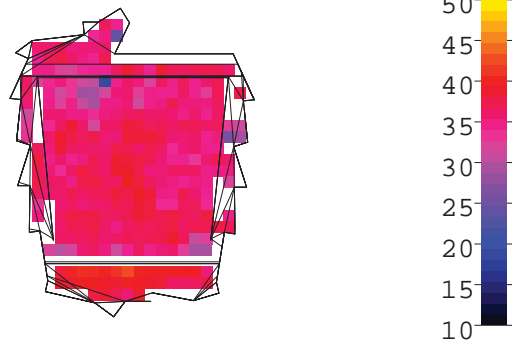
1.61	40.4
1.62	42.9
1.65	38.2
1.67	41.2
1.69	45.3
1.72	43
1.68	43.4

Average 1.66 42.1%

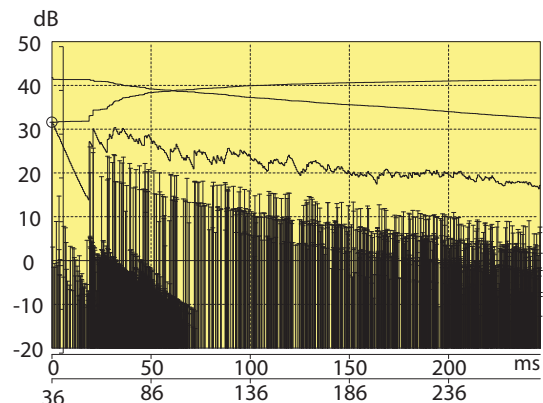
[174] Average results of T30 & D50

SPL [dB] 1kHz

20<t<50ms



[175] SPL distribution at 1 kHz



[176] Early Echogram

Following is a summary of the materials used in the Performance Hall. Absorption Coefficients for each material are listed according to the following sound frequencies (Hz):

< 125 Hz 250 Hz 500 Hz 1000 Hz 2000 Hz 4000 Hz >

Ceiling / 19mm Plywood
Paneling, airspace, light bracing
< 20 18 15 12 10 10 >

Panels / 3mm plywood paneling
over 31.7mm airspace
< 15 25 12 8 8 8 >

Back wall / 19mm Plywood
Paneling, airspace, light bracing
< 20 18 15 12 10 10 >

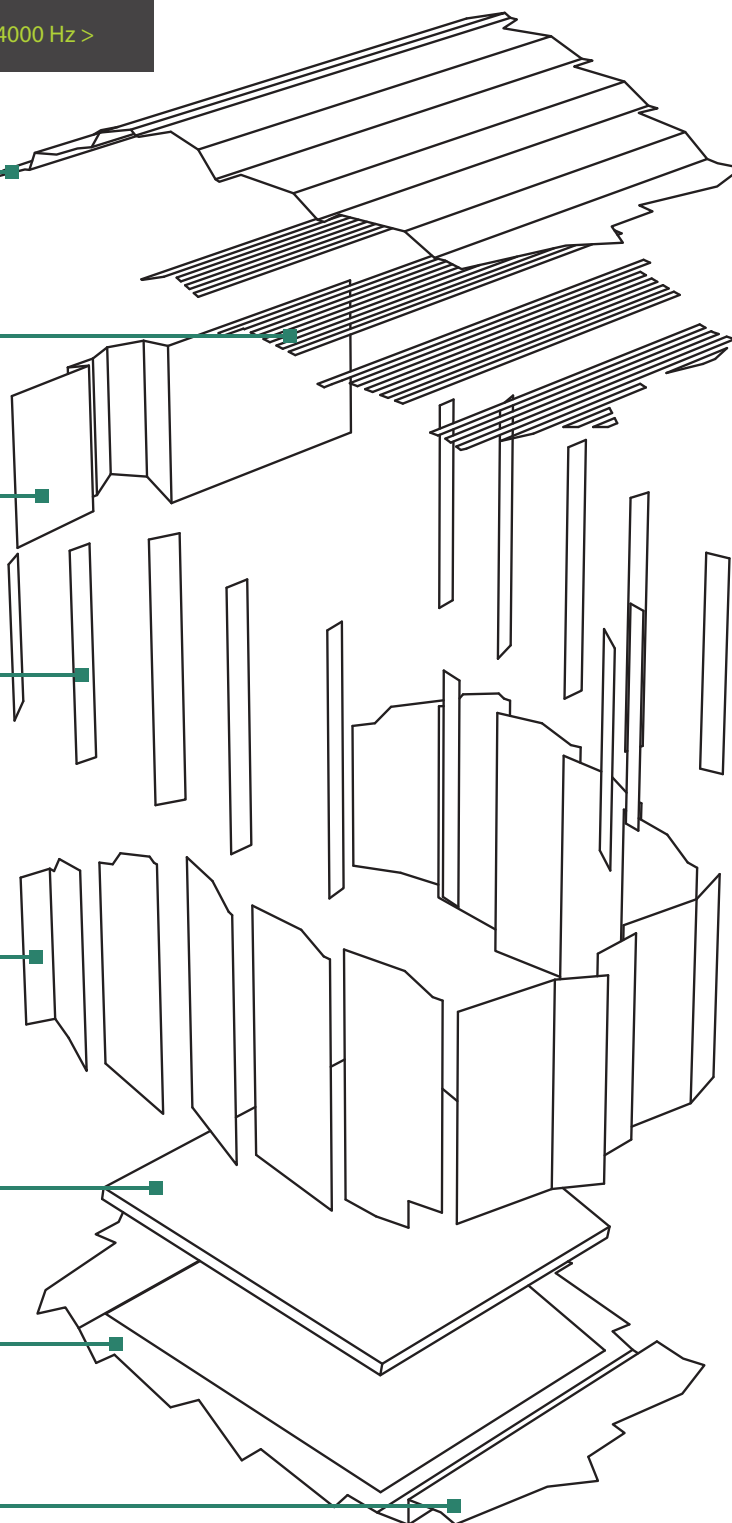
Acoustic transparent glass /
similar absorption coefficient to
softwood
< 42 21 10 8 6 6 >

Front and side Walls / 3mm
plywood paneling over 31.7mm
airspace
< 15 25 12 8 8 8 >

Theatre seats / material with same
absorption coefficient as human
< 40 50 60 70 80 80 >

Floor / 3mm plywood paneling
over 31.7mm airspace
< 15 25 12 8 8 8 >

Stage / 3mm plywood paneling
over 31.7mm airspace
< 15 25 12 8 8 8 >



Rehearsal Areas

The reverberation time (T30) required for the rehearsal rooms ranges from 1.2 to 1.6 seconds. The value is are slightly lower than that of the Performance Hall due to its smaller volume and amount of users playing music. [Egan, 2007, p.64]. Sound pressure level (SPL) distribution should be less than 10dB in sound difference. Deutlichkeit (Clarity, D50) should be over 40%.

To achieve these values, a combination of the following materials are used. Materials accompanied by images contribute to the aesthetic expression of the rooms. Values were taken from [Egan, 2007, p.p.52-53], [Bies & Hansen, 1988, p.p.172-173], [www.saecollege.de]. Absorption Coefficients for each material are listed according to the following sound frequencies (Hz):

< 125 Hz 250 Hz 500 Hz 1000 Hz 2000 Hz 4000 Hz >



European Oak
Hardwood
<42 21 10 8 6 6>



Translucent Acoustic Glass
< 42 21 10 8 6 6>



Translucent wooden panels
offset from normal glass
< 33 70 45 23 15 23>

Regular wall materials /

Glass
< 18 6 4 3 2 2 >

Plywood 19 mm
Panels with airspace
More absorptive
< 20 18 15 12 10 10 >

Plywood 5 mm
Panels with 50mm airspace
More absorptive
< 38 24 17 10 8 5 >

Plasterboard walls 12 mm



Parquet 3 mm
Hardwood
<15 25 12 8 8 8 >

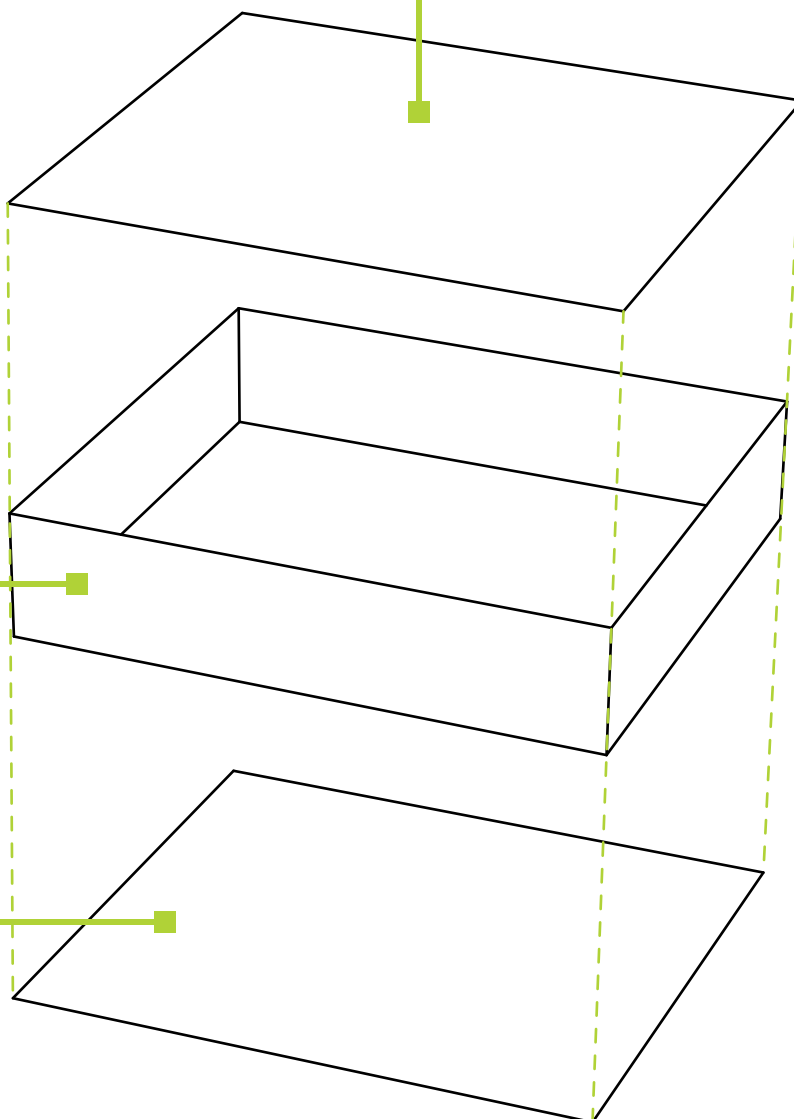
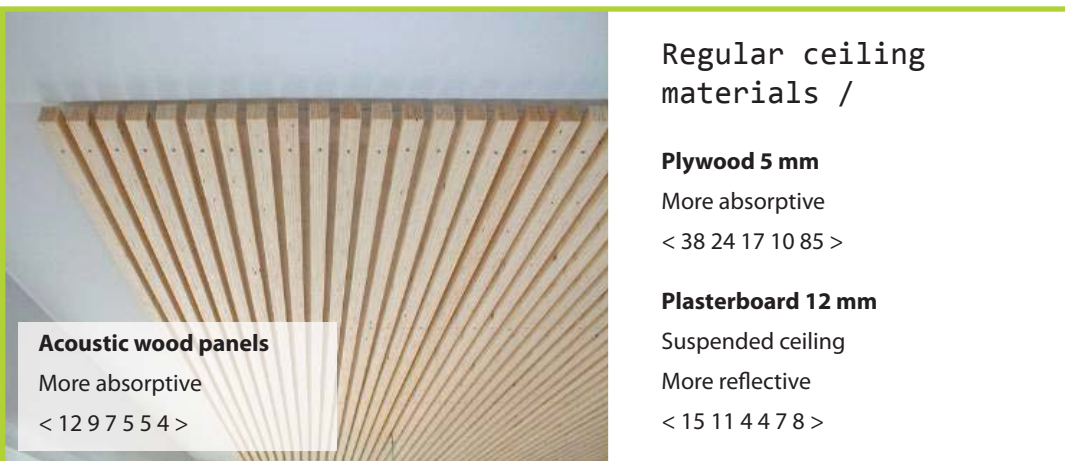


European Larch
Softwood
< 15 11 10 7 6 7 >

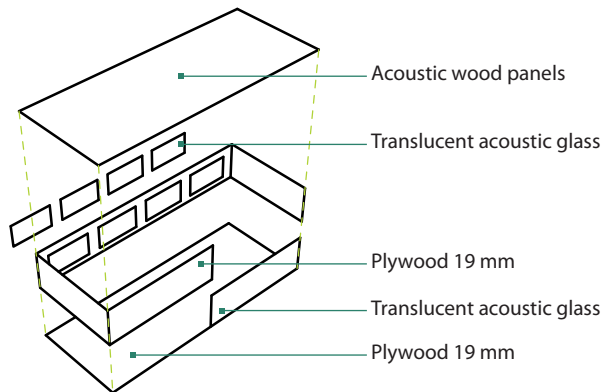


Plywood 19 mm
Softwood
< 20 18 15 12 10 10 >

Varying hardnesses of wooden floors make a significant change in the acoustic quality of a room. The selected floors vary in hardness and thickness but their surfaces are finished in the same way to give a uniform expression throughout the rooms of the Music House.



REHEARSAL 1



Dimensions 19.7 m x 7.9 m

Area 155 m²

T30 1.59 secs

D50 43.5 %

SPL Range 84 - 87 dB

REHEARSAL 2



Dimensions 5.4 m x 5.9 m

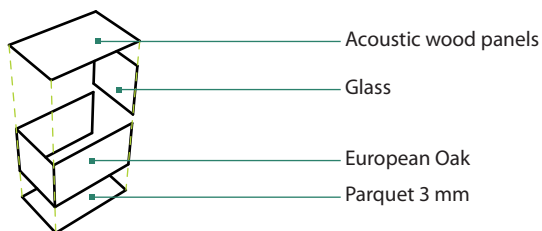
Area 32 m²

T30 1.42 secs

Clarity D50 40.1 %

SPL Range 91 - 94 dB

REHEARSAL 3



Dimensions 9.4 m x 10.5 m

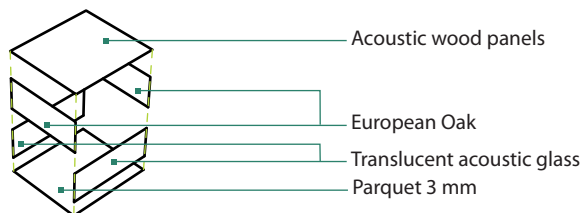
Area 19 m²

T30 1.42 secs

D50 41.9 %

SPL Range 94 - 96 dB

REHEARSAL 4A 4B



Dimensions 8.8 m x 7.9 m

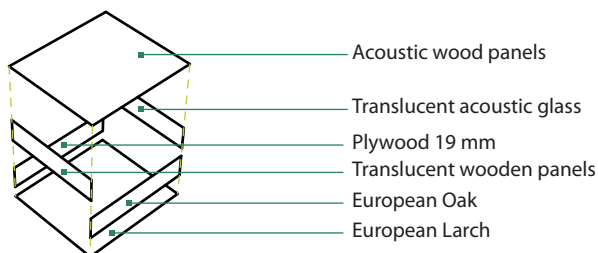
Area 70 m²

T30 1.36 secs

D50 42.3 %

SPL Range 88 - 92 dB

REHEARSAL 5



Dimensions 9.4 m x 10.5 m

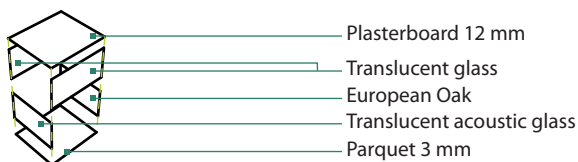
Area 100 m²

T30 1.55 secs

D50 42.8 %

SPL Range 88 - 90 dB

REHEARSAL 6A/6B/6C/6D



Dimensions 3.7 m x 4.2 m

Area 16 m²

T30 1.36 secs

D50 42 %

SPL Range 97 - 98 dB

Following is a summary of the results of the Reverberation time (T30), Clarity (D50) and Sound Pressure Level distribution (SPL) at $0 < t < 20$ ms for all rehearsal rooms in the Music House. Refer to the previous page for material properties.





Lervigsveien

Delivery

Promenade

Water

Kvitsøygata

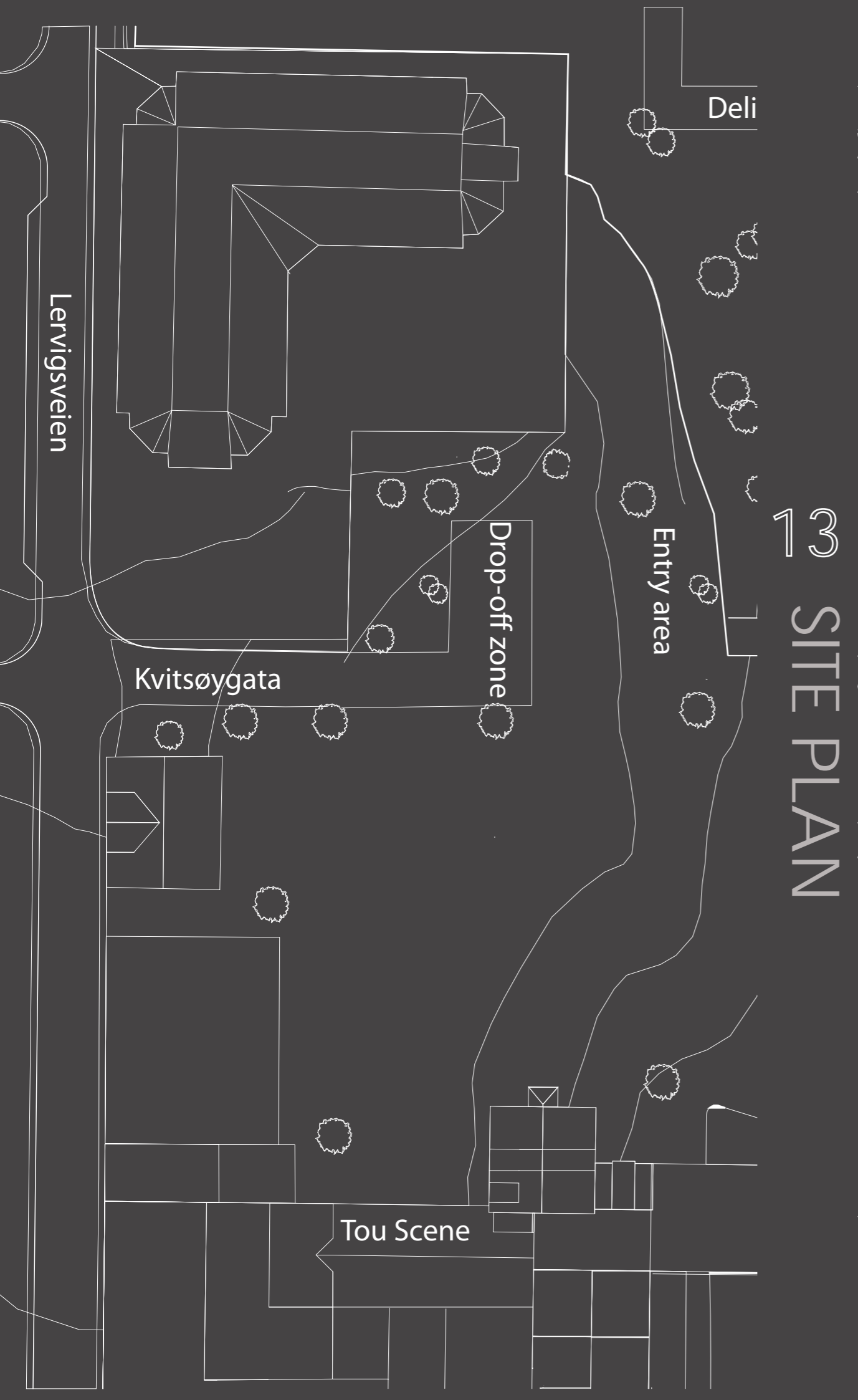
Drop-off zone

Entry area

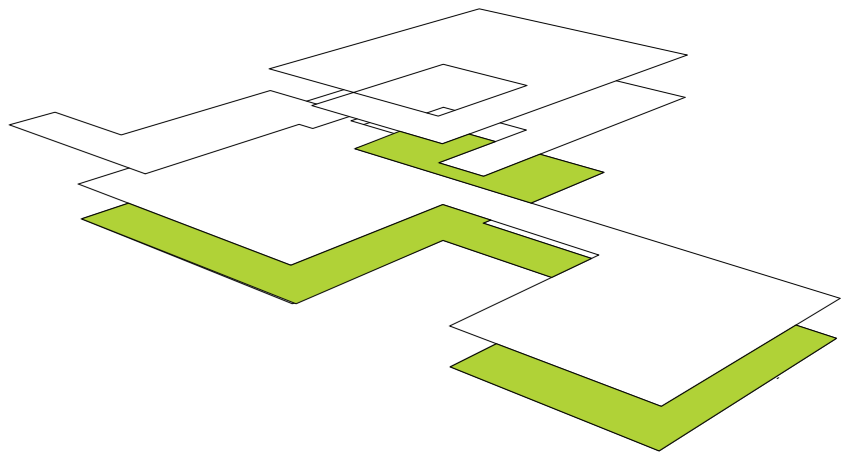
Culture Park

Tou Scene

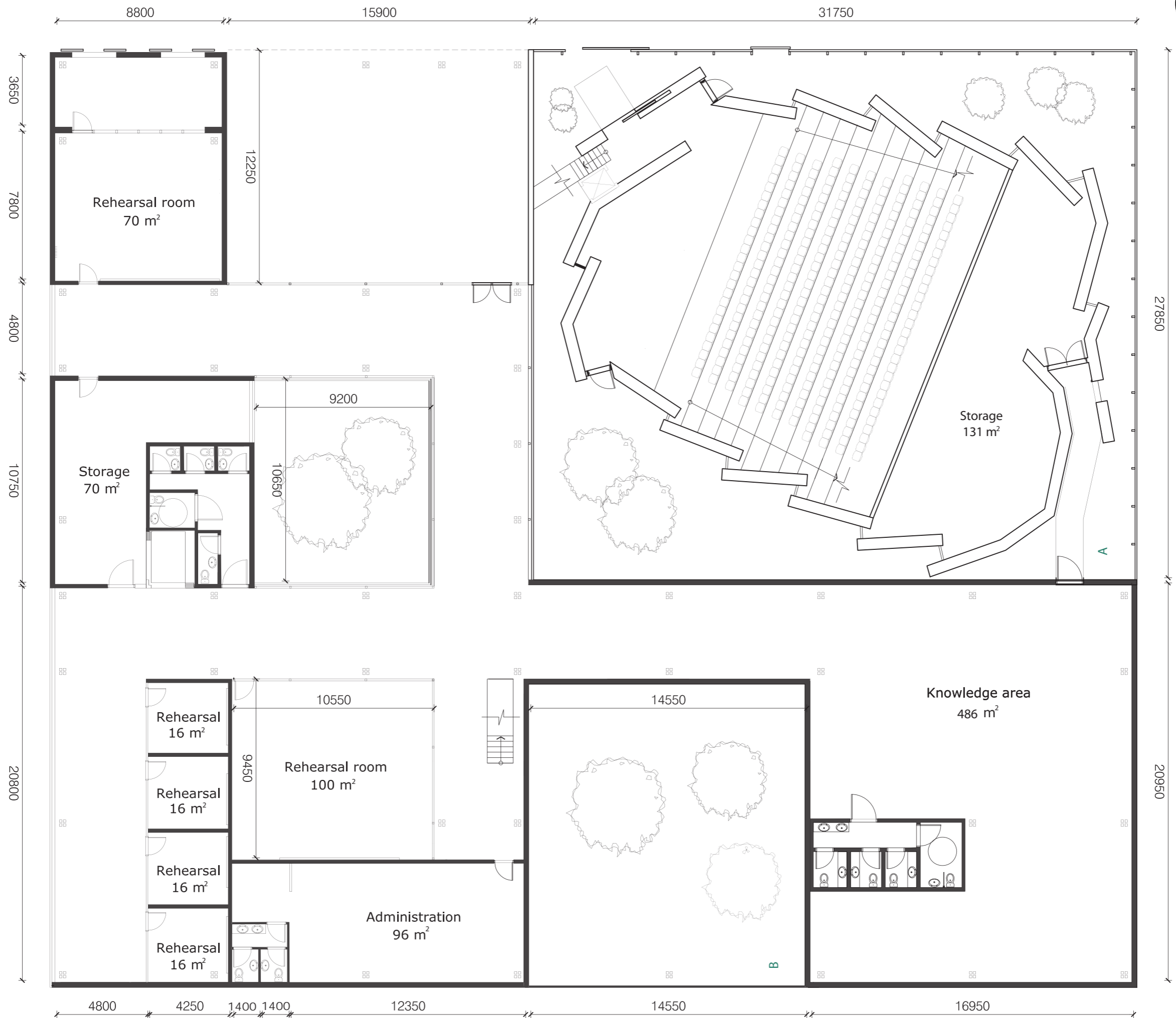
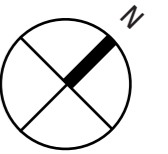
Title	Scale
Nordic Japanese Harmony	1:500
Drawing	Drawing Nr.
Site Plan	1
Group	
Mette Bebe Juel	
Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

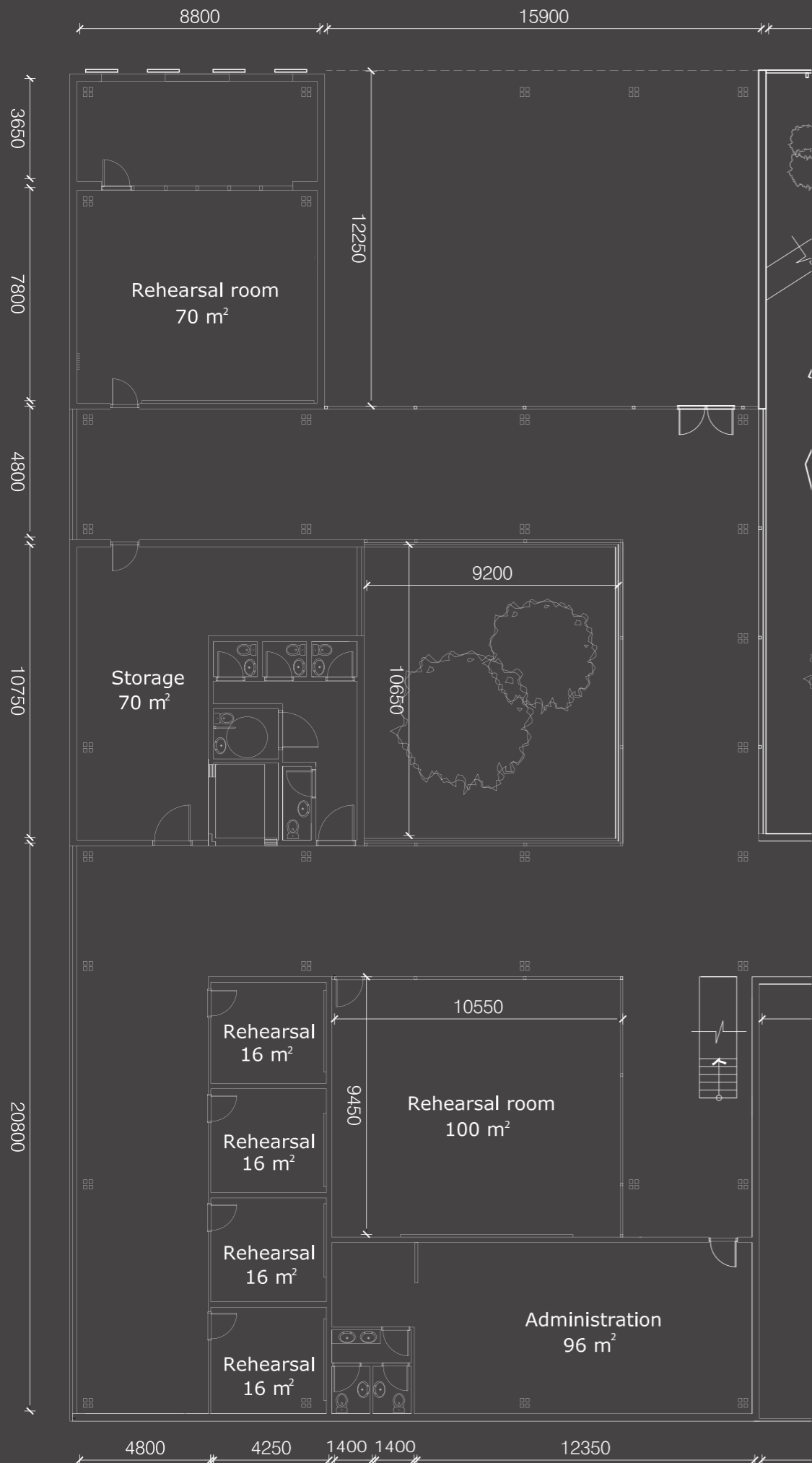


3 SITE PLAN

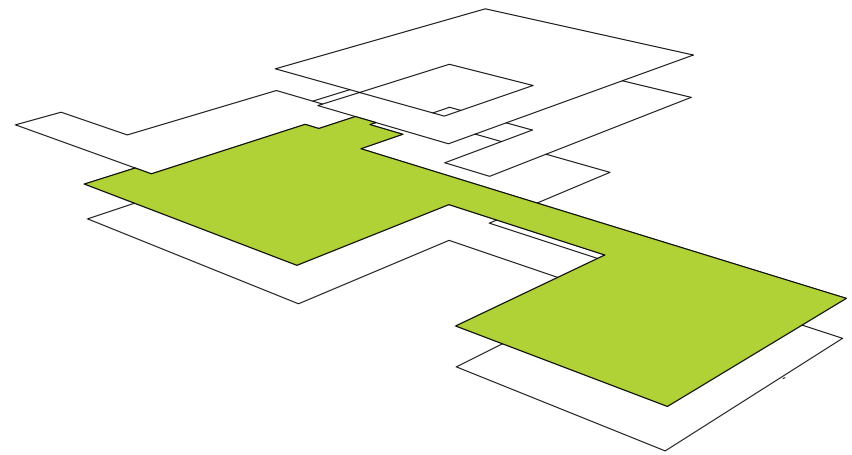


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
Ground Floor	2
Group	
Mette Bebe Juel	
Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

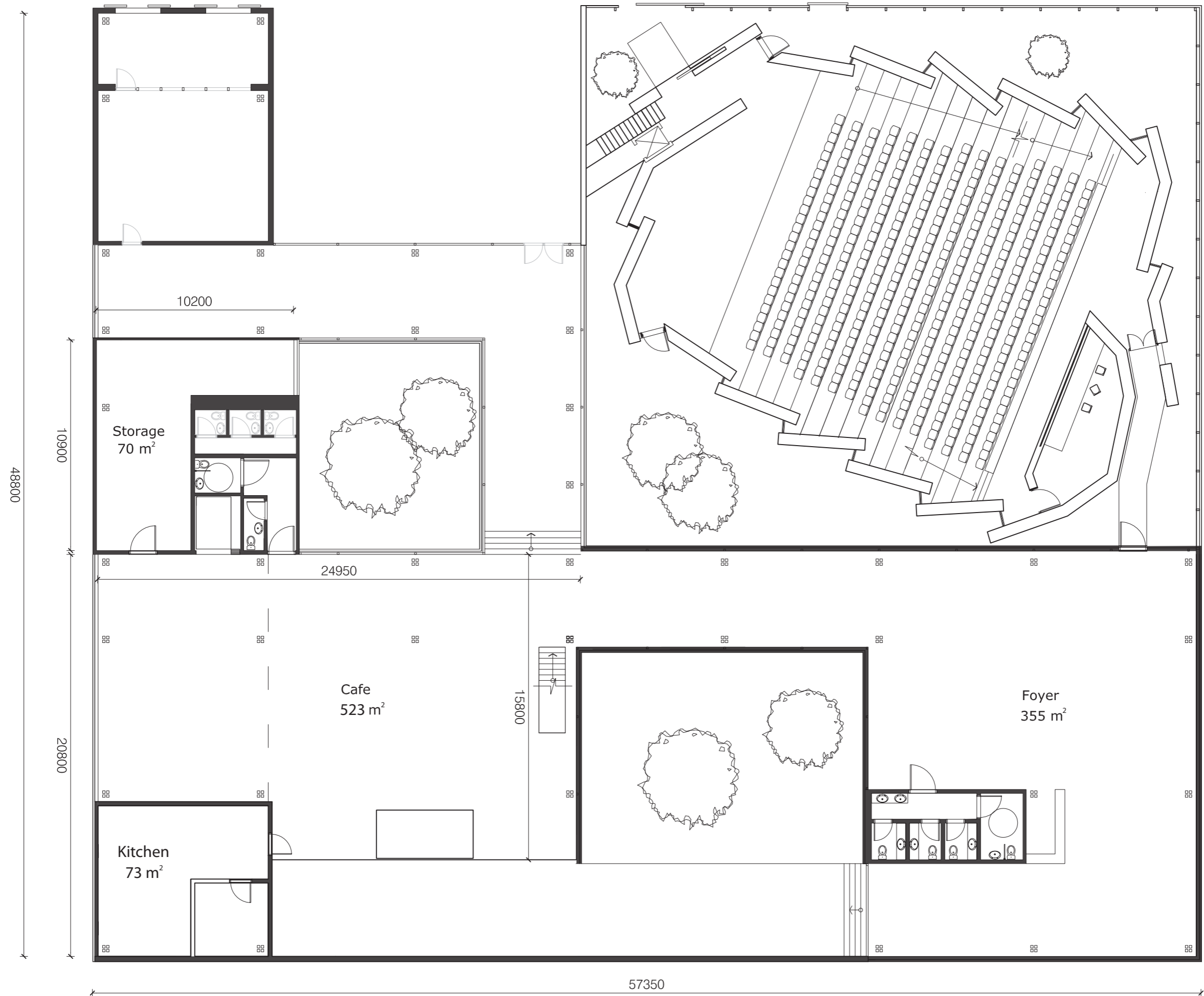
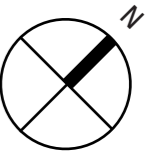


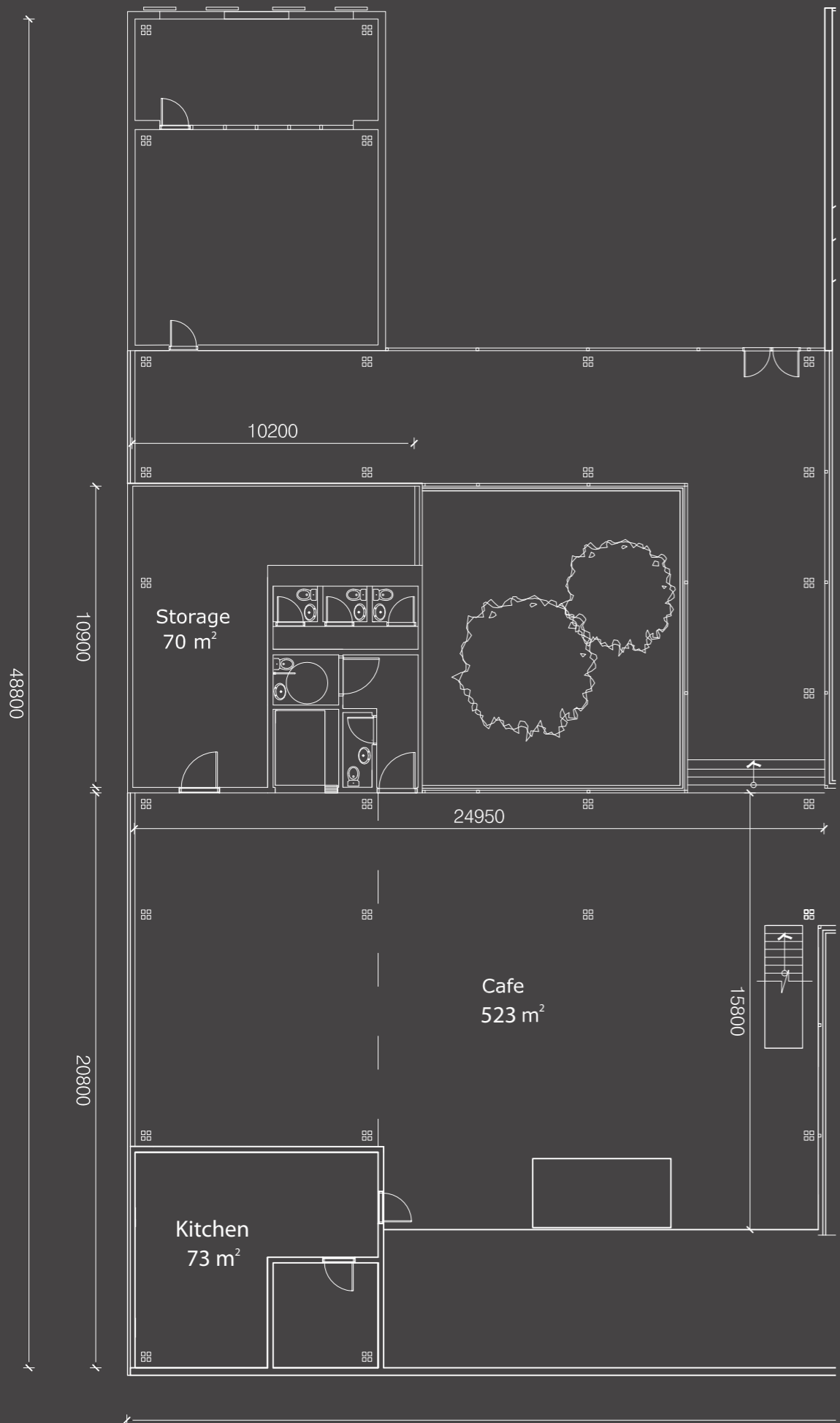


15 GROUND FLOOR PLAN

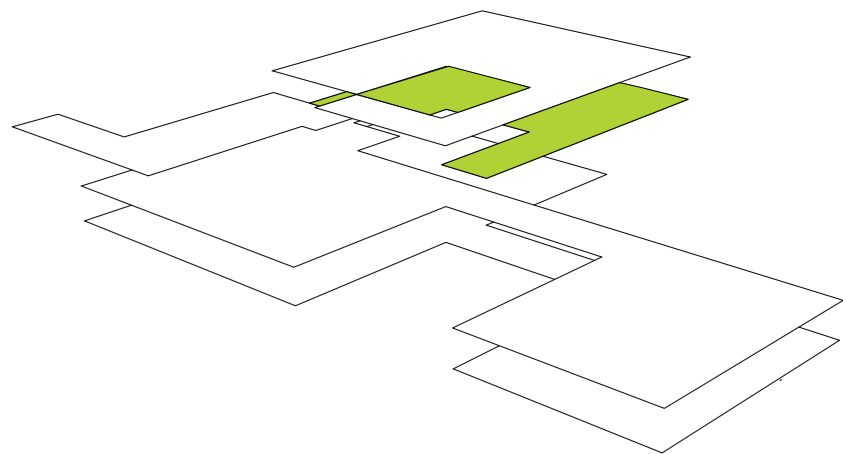


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
1.st Floor	3
Group	
Mette Bebe Juel	
Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

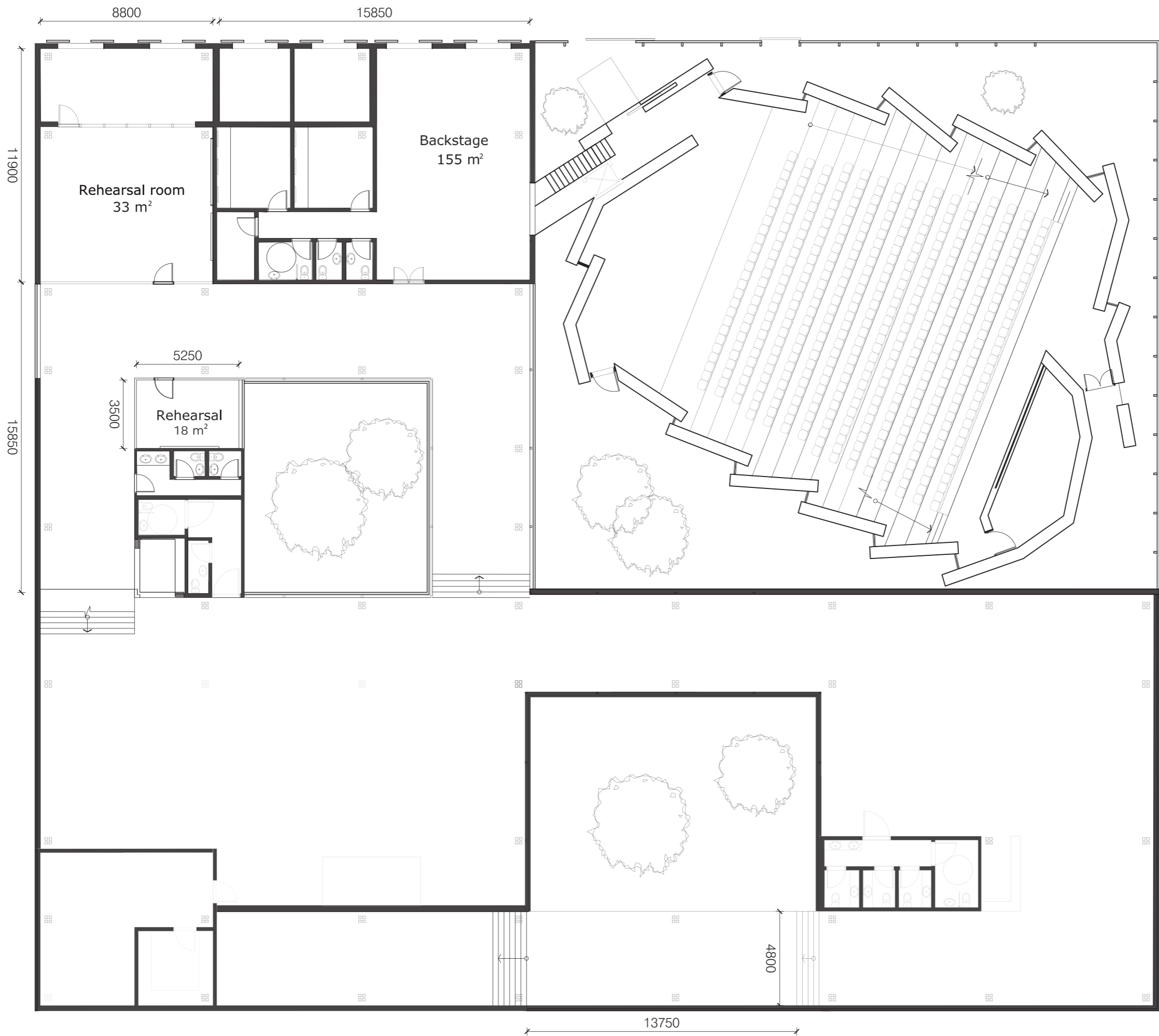
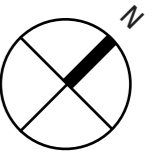


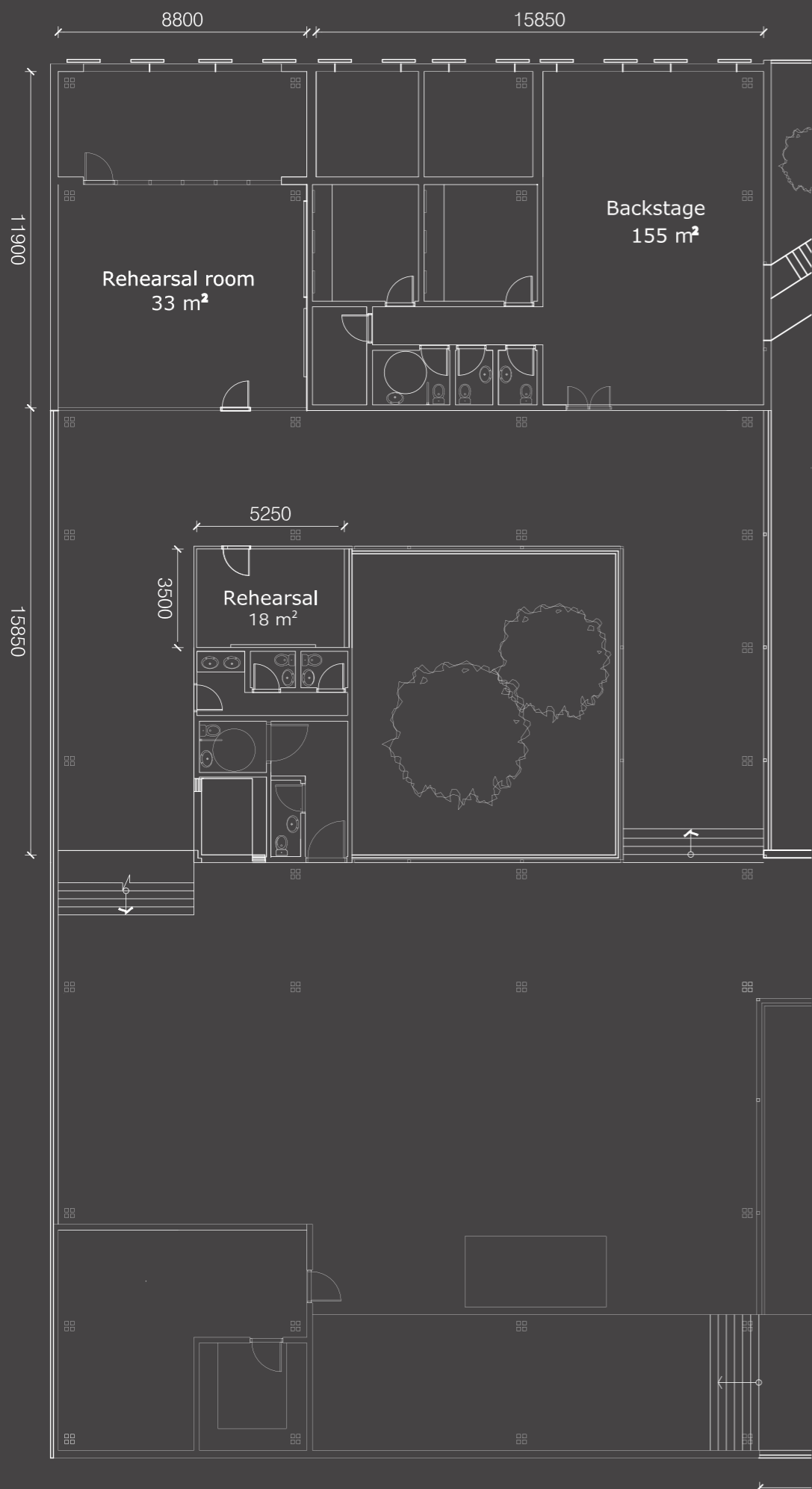


17 1ST FLOOR PLAN

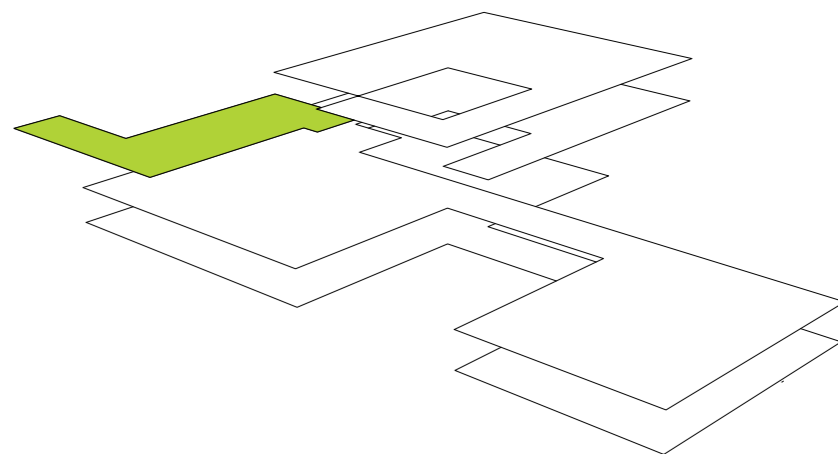


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
1A Floor	4
Group	
Mette Bebe Juel	
Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

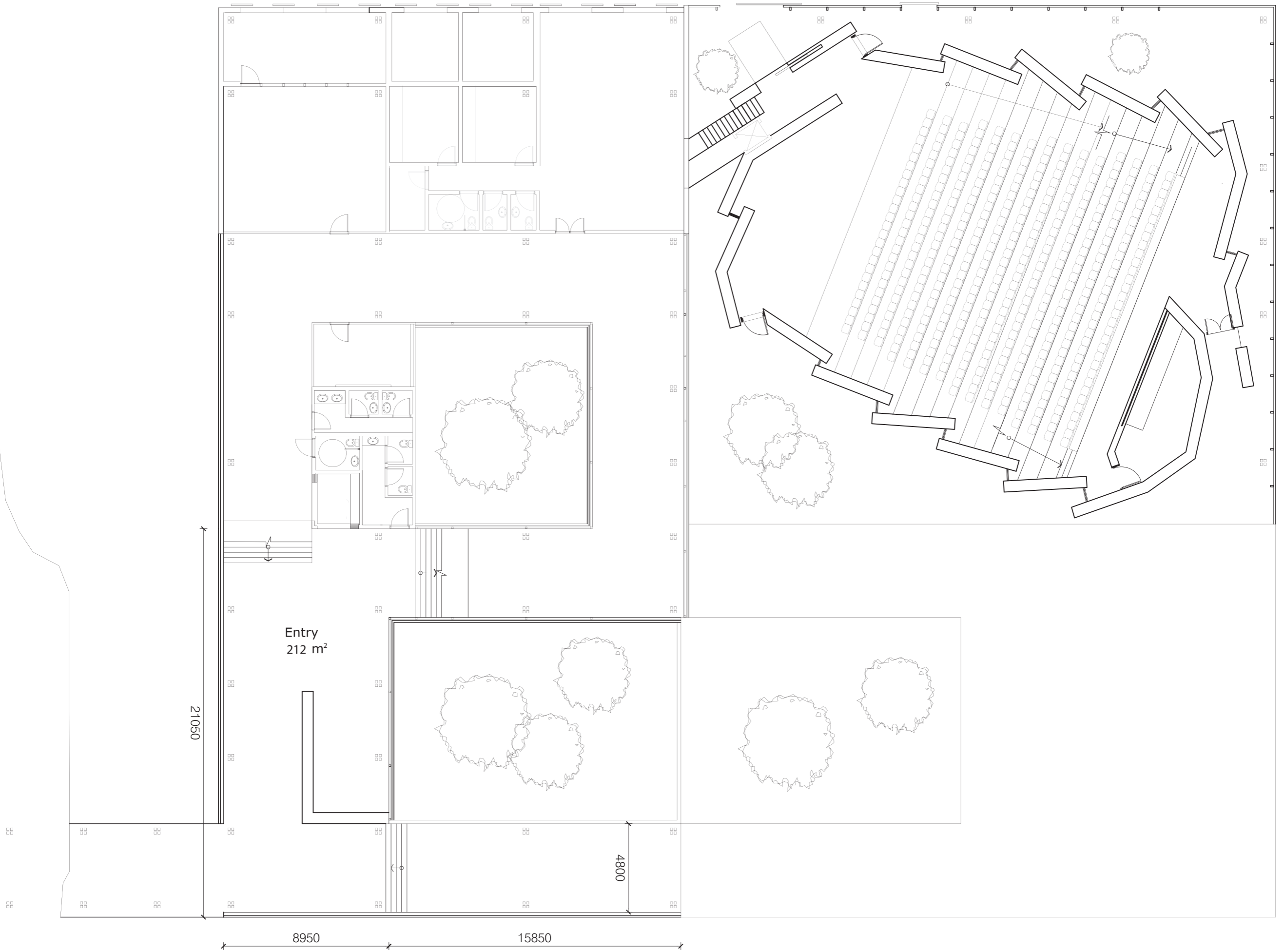
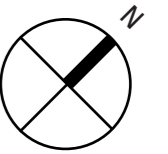


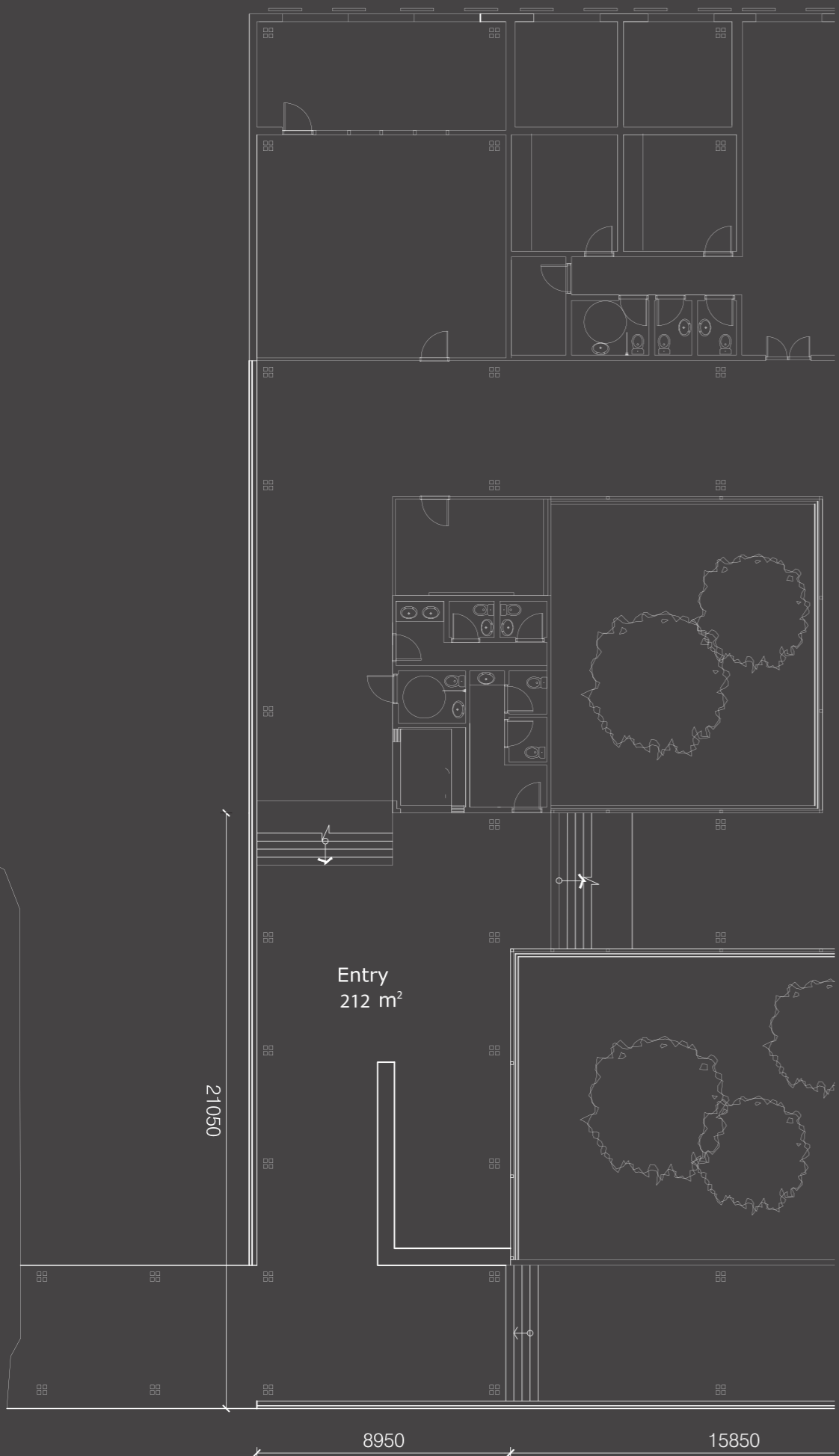


19 1.A FLOOR PLAN

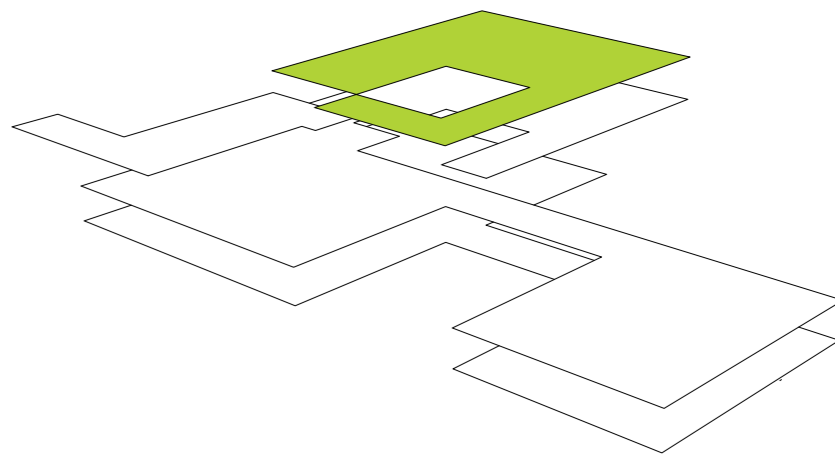


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
2nd Floor	5
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen 10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

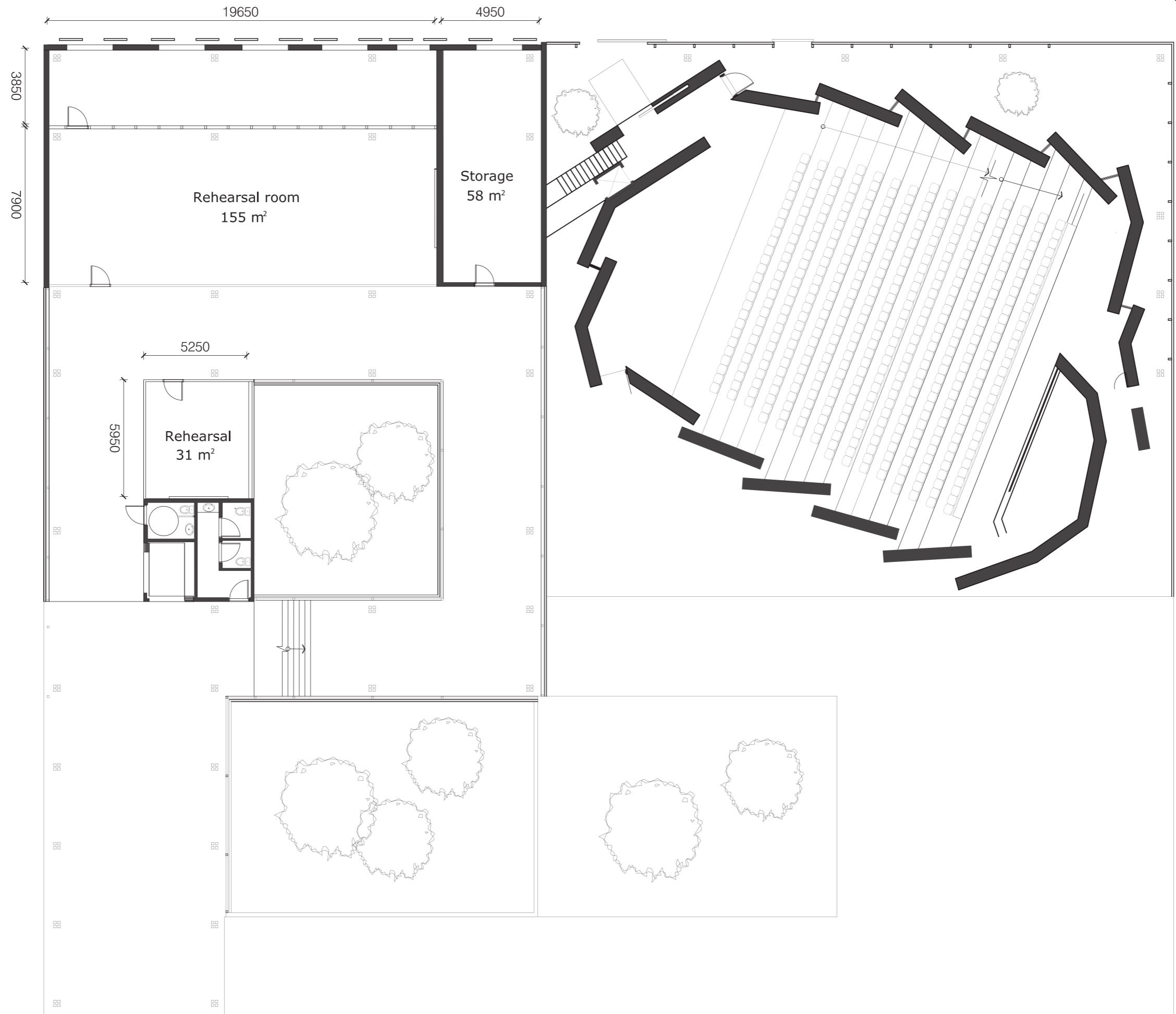
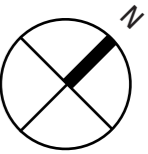


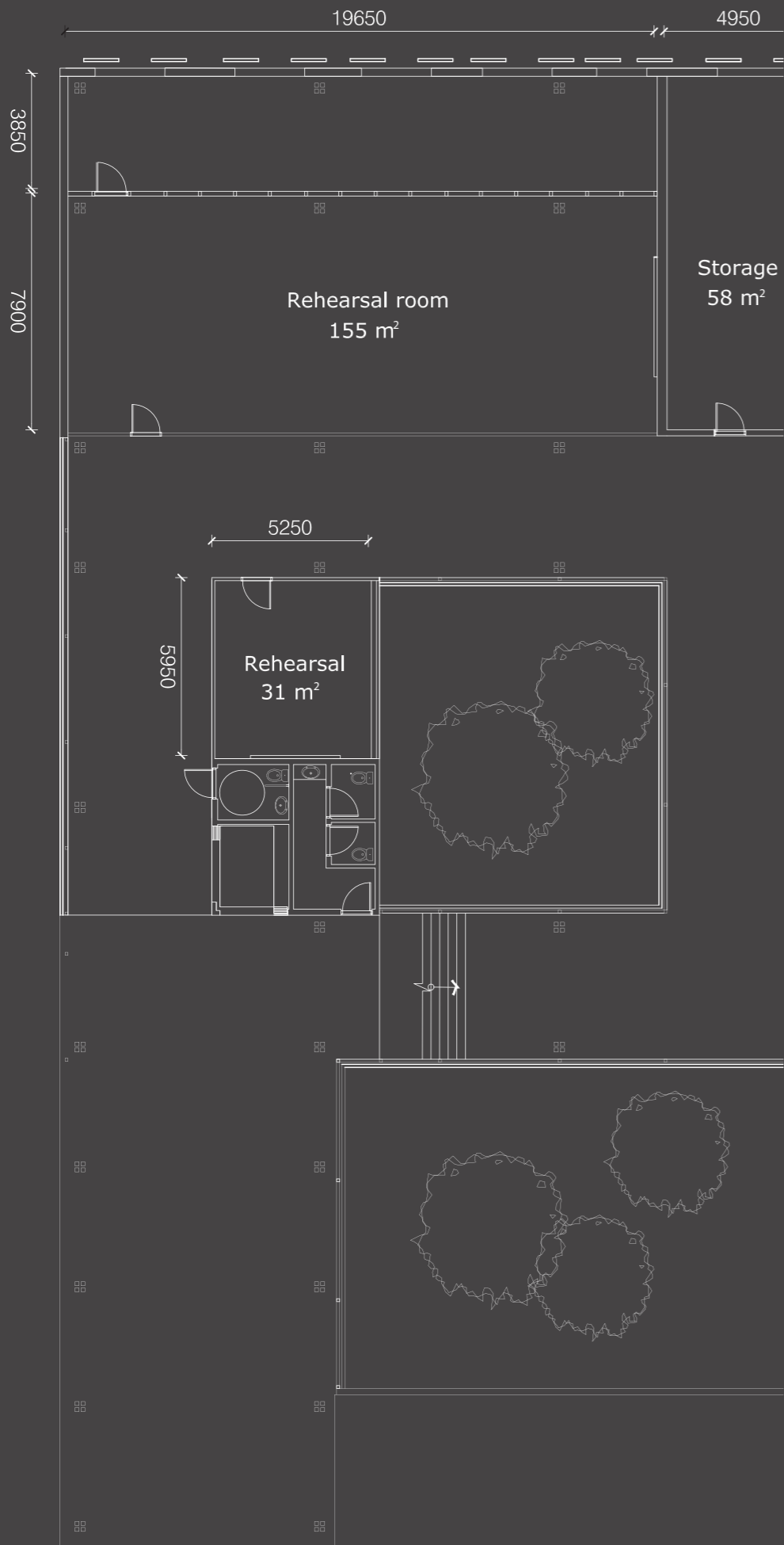


21 2ND FLOOR PLAN



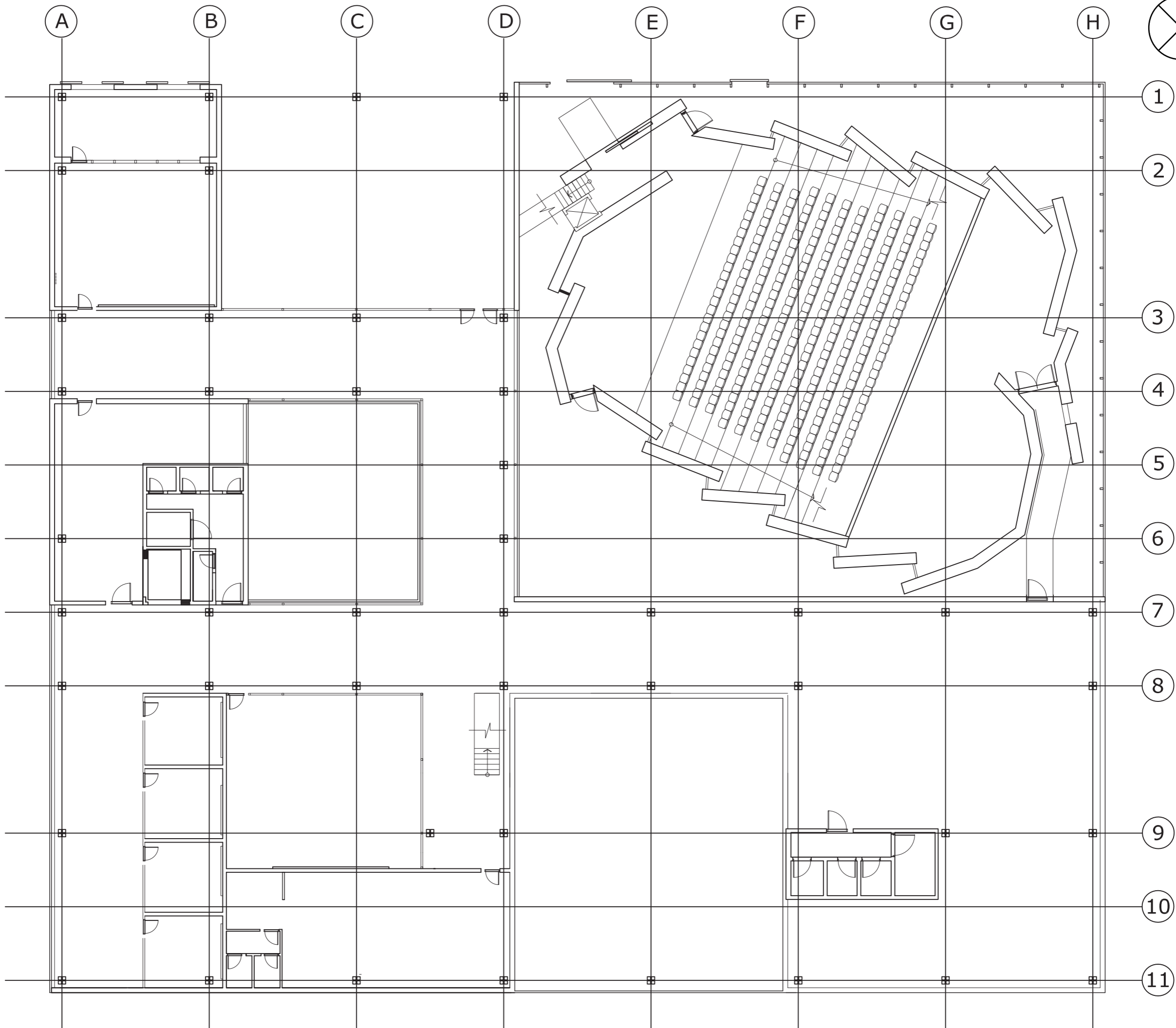
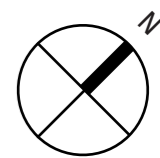
Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
3rd Floor	6
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen 10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

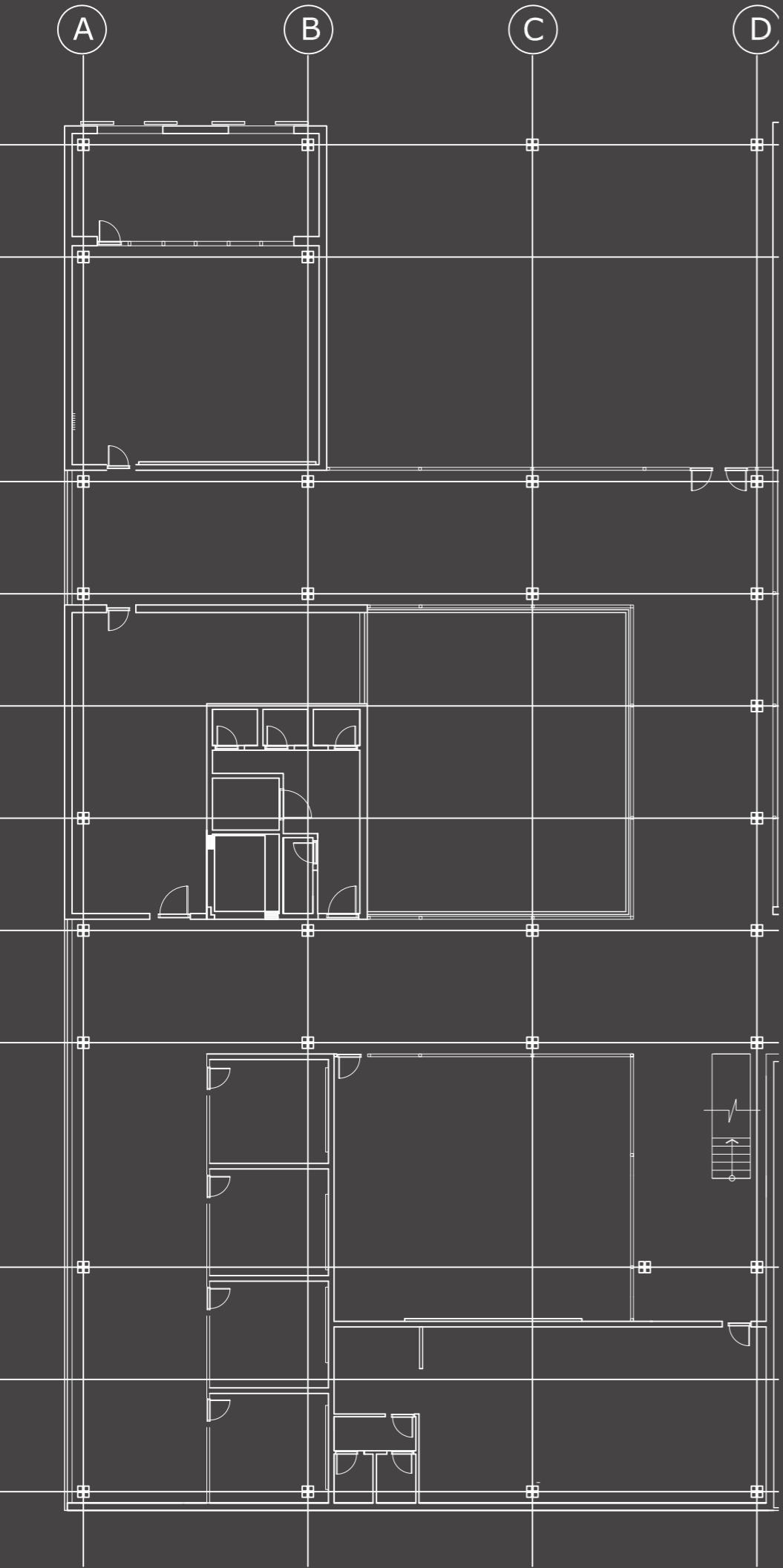




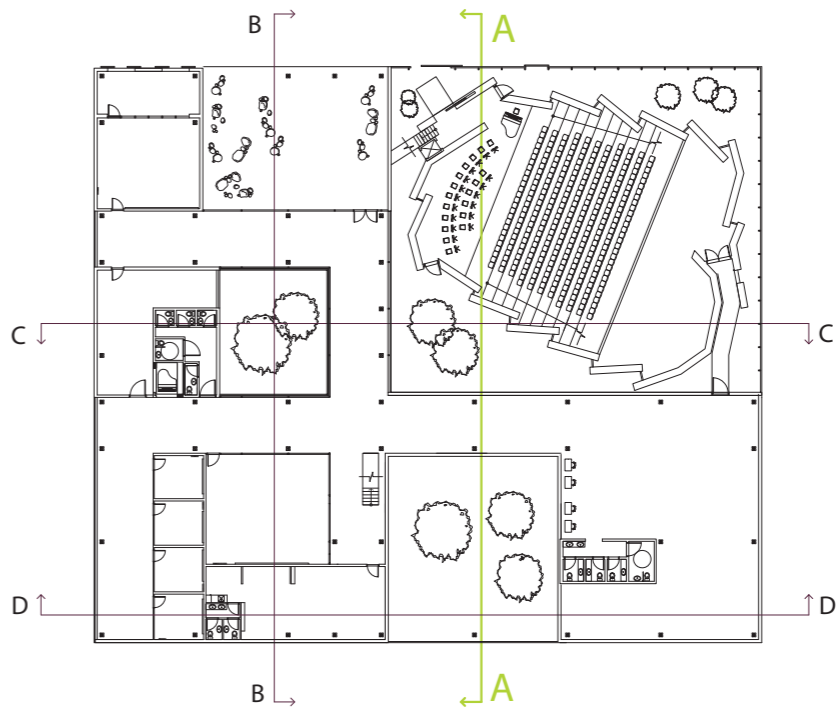
23 3RD FLOOR PLAN

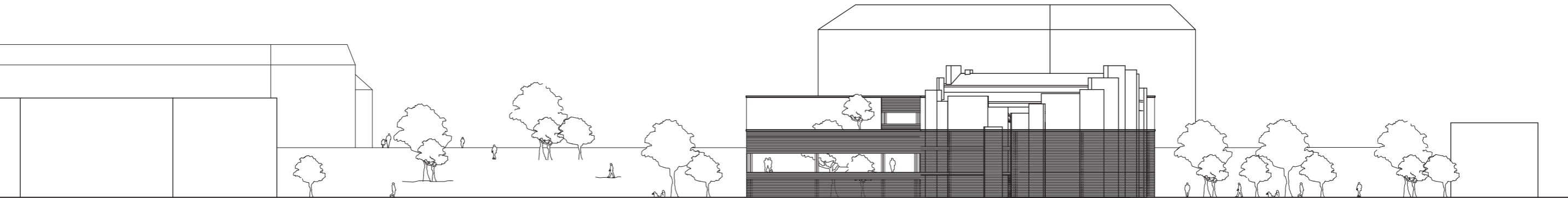
Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
Post and beam grid	7
Group	
Mette Bebe Juel	
Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	



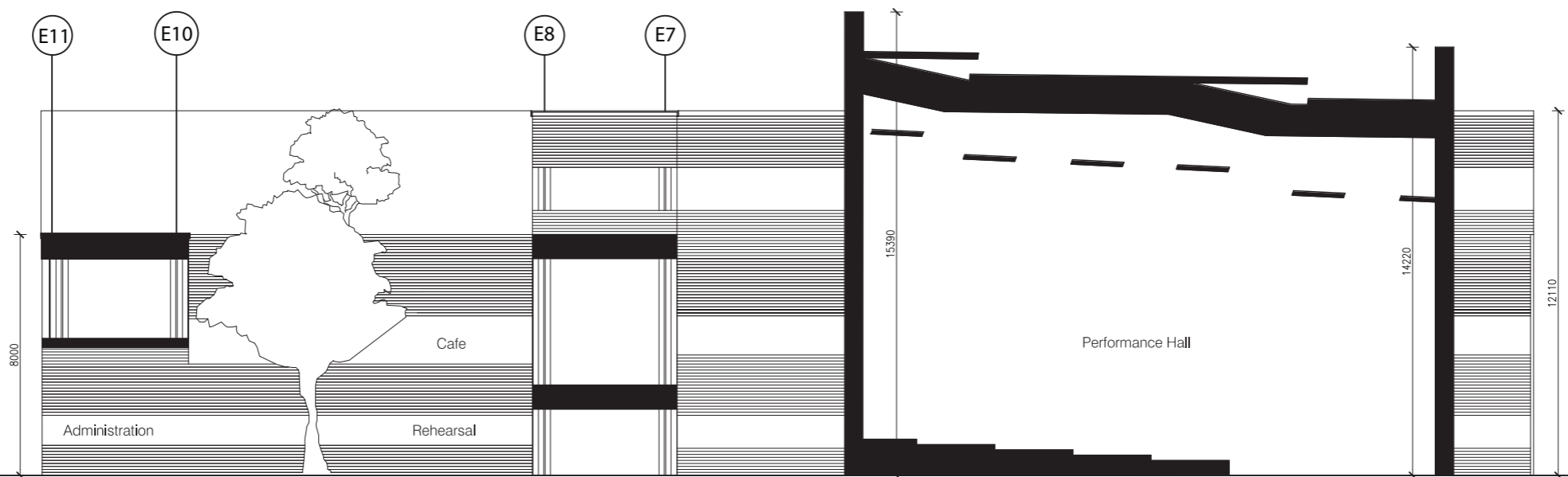


25 POST & BEAM GRID





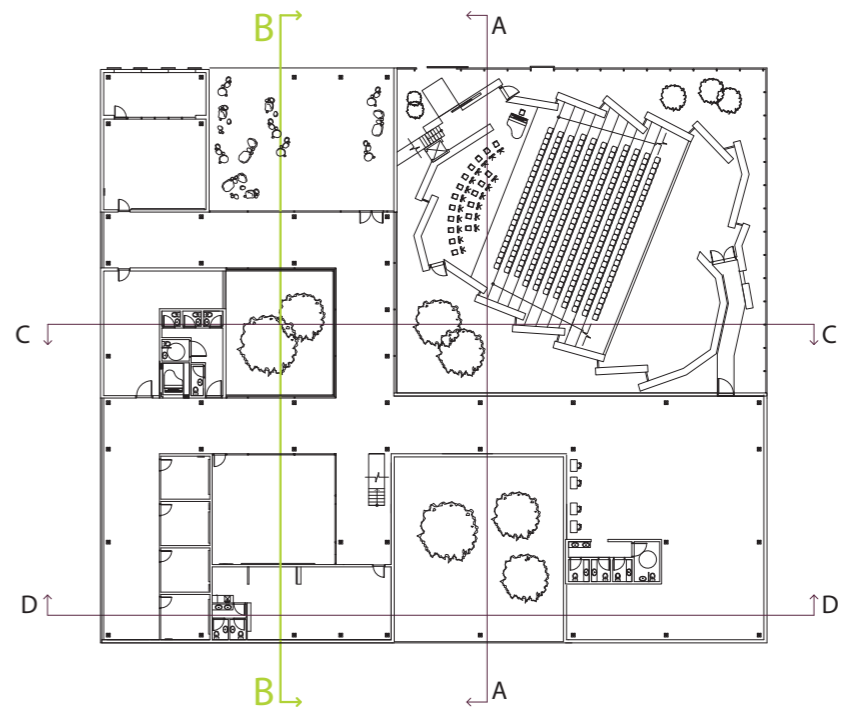
Title	Scale
Nordic Japanese Harmony	1:500
Drawing	Drawing Nr.
Elevation N-E	8
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

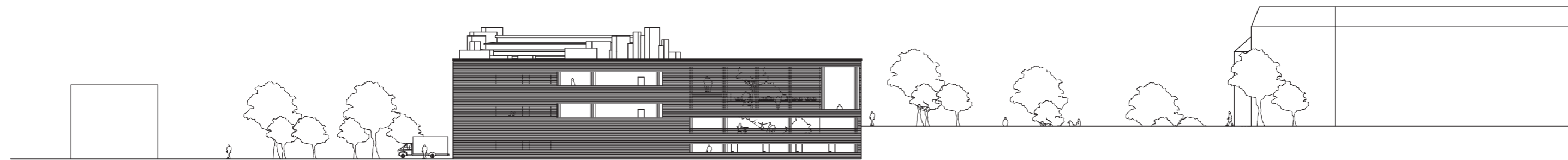


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
Section AA	9
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

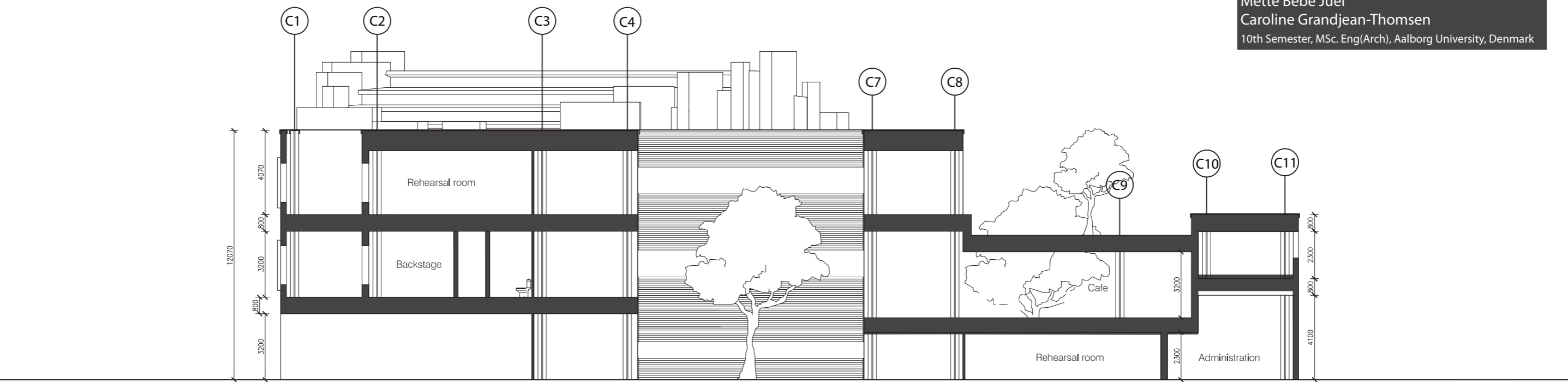


27 ELEVATION / SECTION





Title	Scale
Nordic Japanese Harmony	1:500
Drawing	Drawing Nr.
Elevation S-W	10
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen 10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

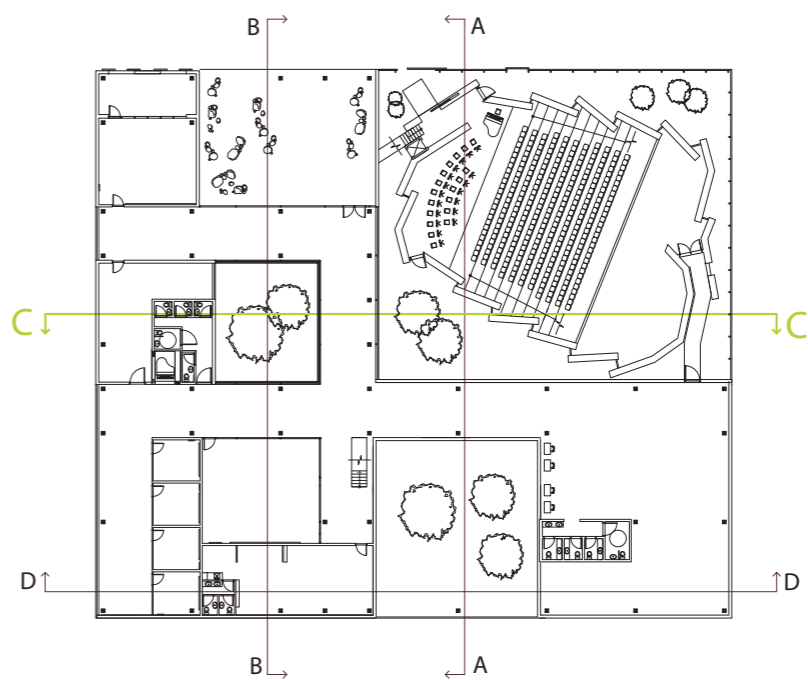
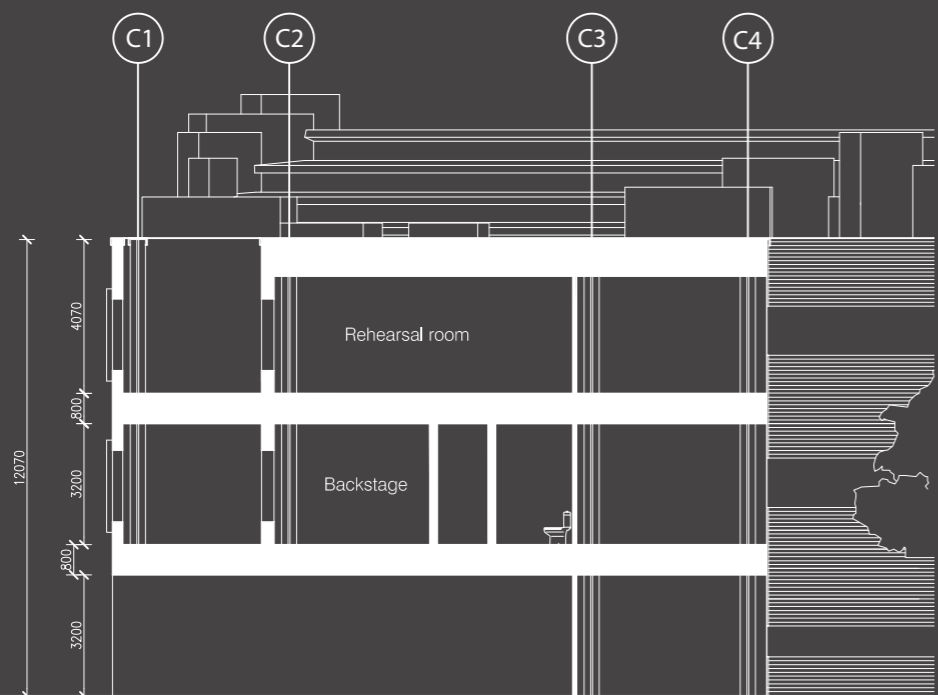


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
Section BB	11
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen 10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	



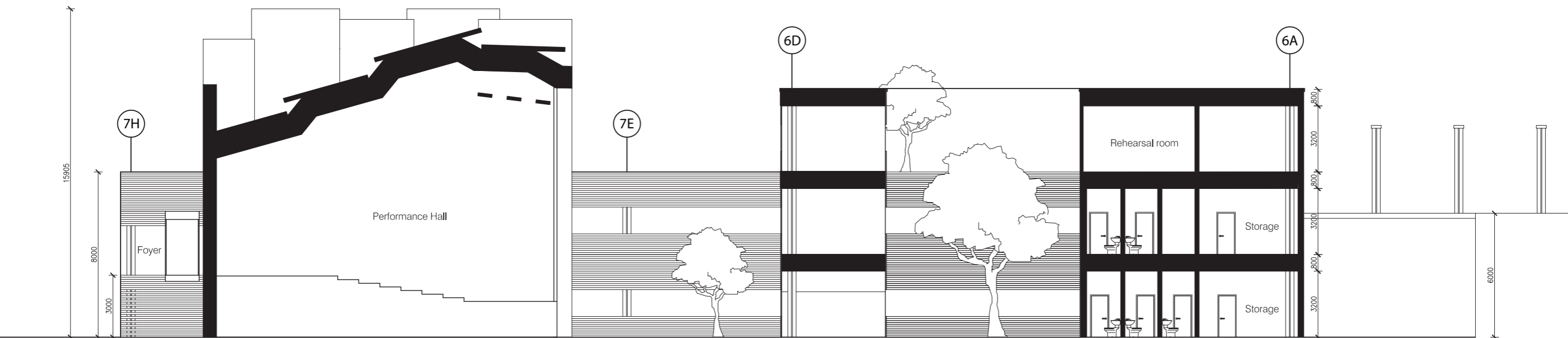
29

ELEVATION / SECTION

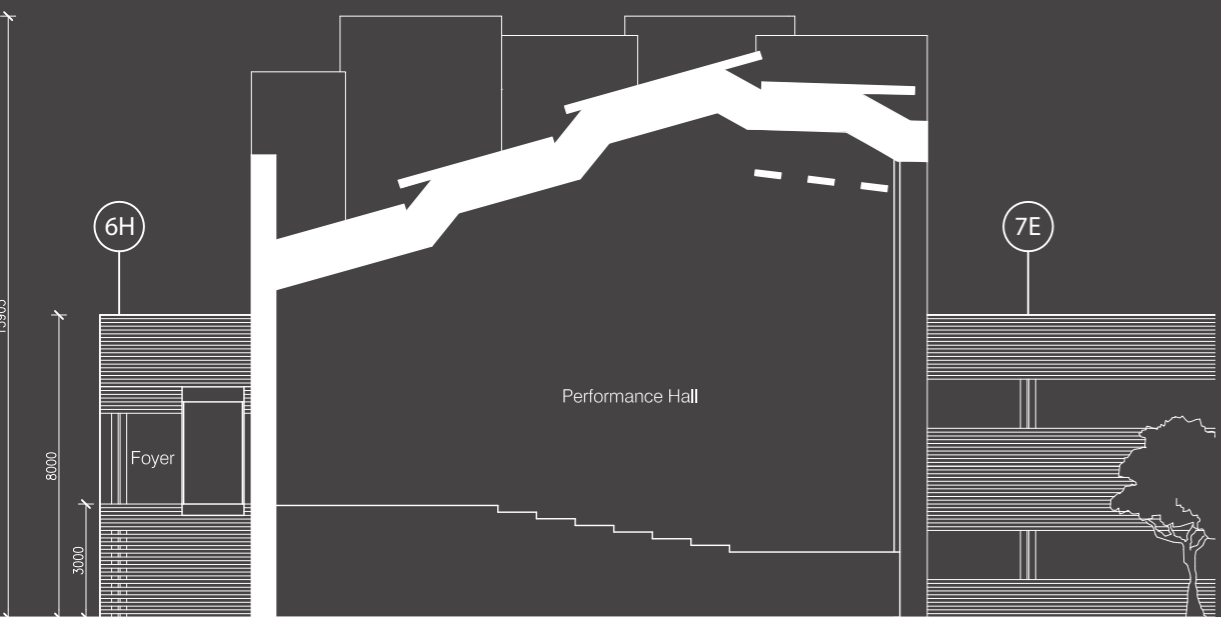
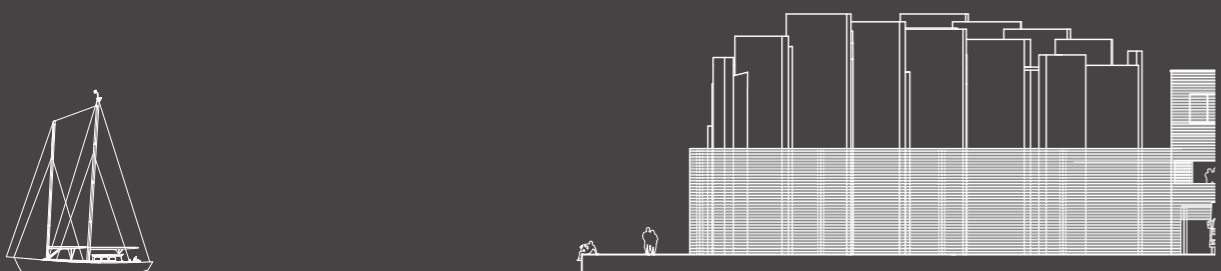




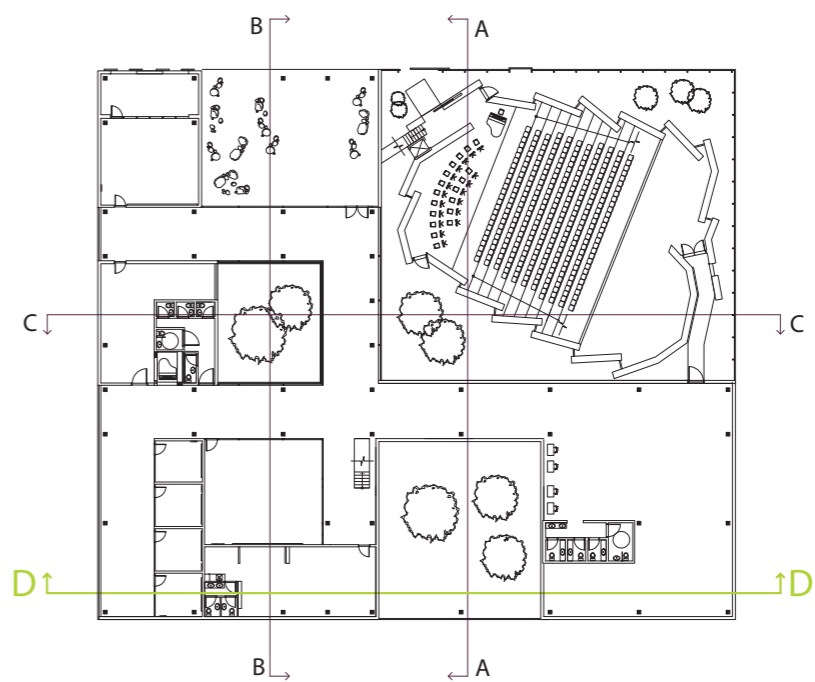
Title	Scale
Nordic Japanese Harmony	1:500
Drawing	Drawing Nr.
Elevation N-W	12
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

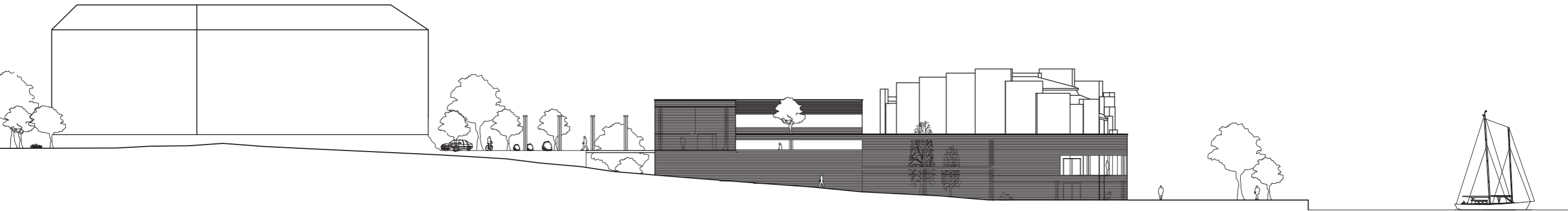


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
Section CC	13
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

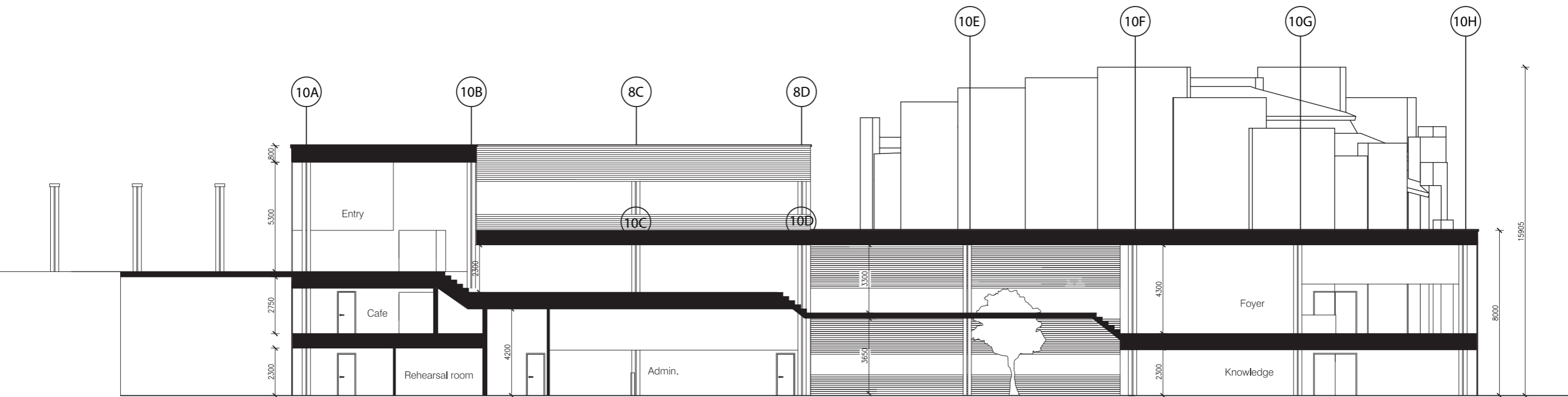


31 ELEVATION / SECTION

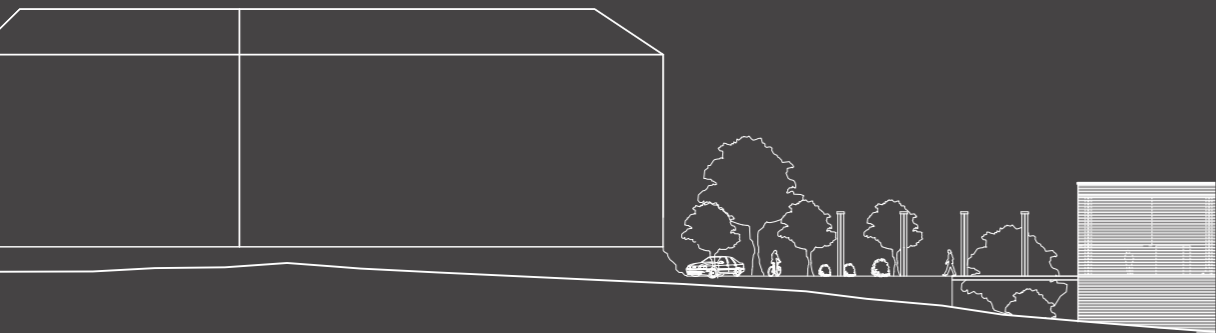




Title	Scale
Nordic Japanese Harmony	1:500
Drawing	Drawing Nr.
Elevation S-E	14
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen 10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

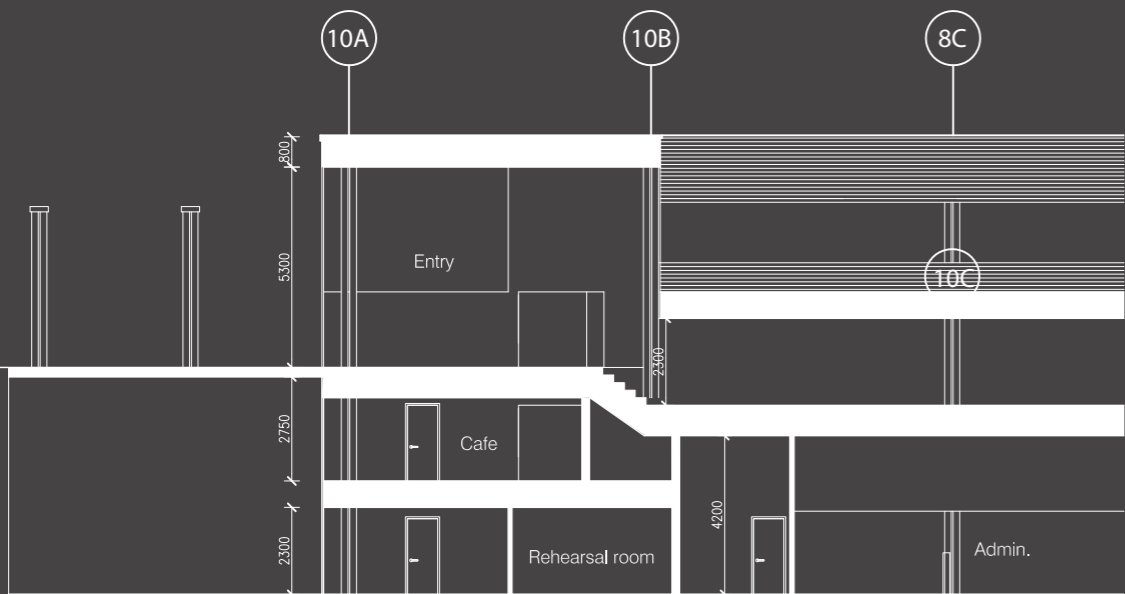


Title	Scale
Nordic Japanese Harmony	1:200
Drawing	Drawing Nr.
Section DD	15
Group	
Mette Bebe Juel Caroline Grandjean-Thomsen 10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	



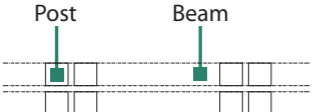
33

ELEVATION / SECTION



Title	Scale
Nordic Japanese Harmony	1:50
Drawing	Drawing Nr.
Detail drawing	16
Group	
Mette Bebe Juel	
Caroline Grandjean-Thomsen	
10th Semester, MSc. Eng(Arch), Aalborg University, Denmark	

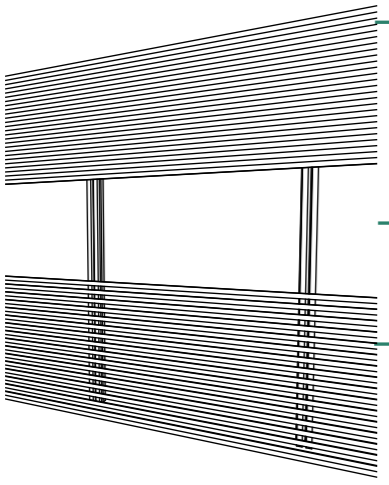
Post and beams /
Obtain the loads from roof, ceiling
and floor slab
185 x 185 mm glue laminated beams
700 mm x 185 mm beams



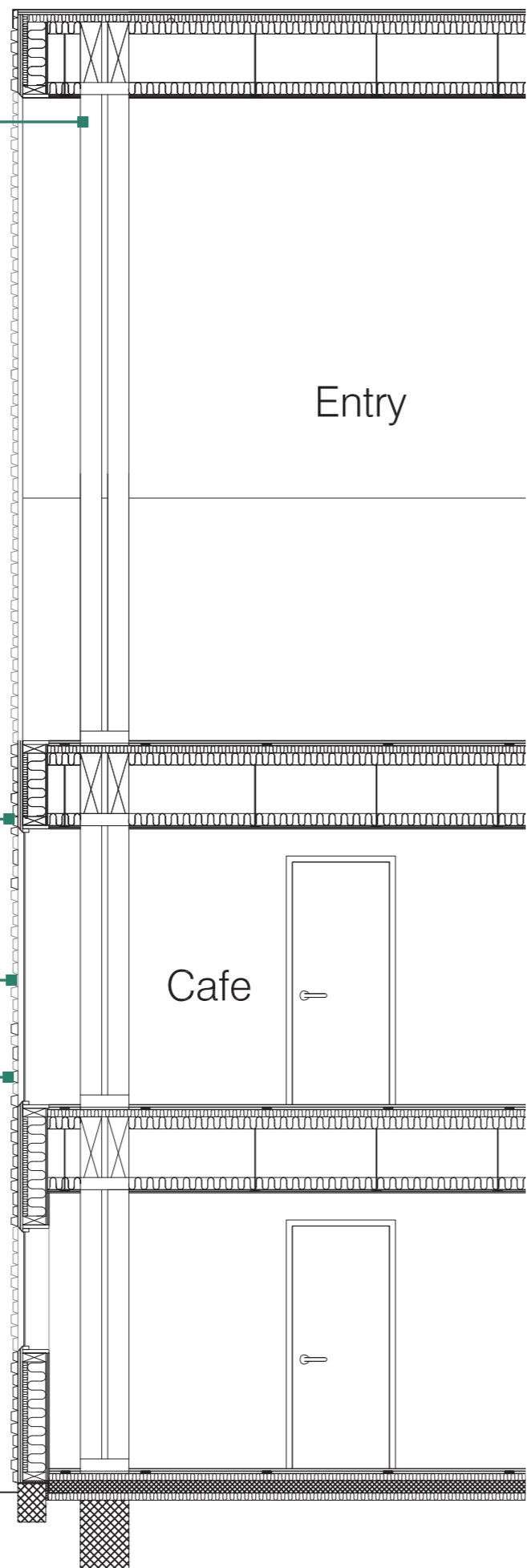
The column dimensions have been
estimated :

Area
No. of columns
times a load safety factor of 1,5
times loads, 4 kN/m ²

Teknisk Ståbi p. 311 shows a table
with load carrying capacity, and the
dimension is found.



The outer walls are clad with cedar
panels and appear in three different
ways:
- Solid
- Transparent
- Translucent, every other wooden
panel is removed



Ceiling /
100 mm insulation
2 x 12 mm plaster

Roof Cladding /
Zinc
Distance panel
60 mm insulation
100 mm insulation
700 mm glue-laminated beam

Floor slab / To reduce impact sound the
following is installed:
25 mm wooden floor on joists and
rubber
60 mm insulation
100 mm insulation
Air gap
100 mm insulation

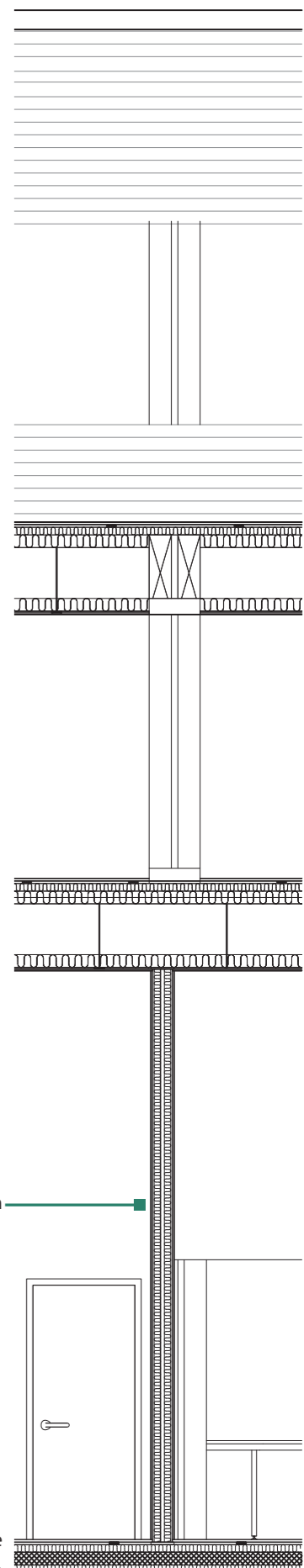
This meets the standard for the reduction
of impact sound for rooms of high noise
levels (39 dB). Furthermore it meets
the standard for reducing transmission
sound (60 dB).

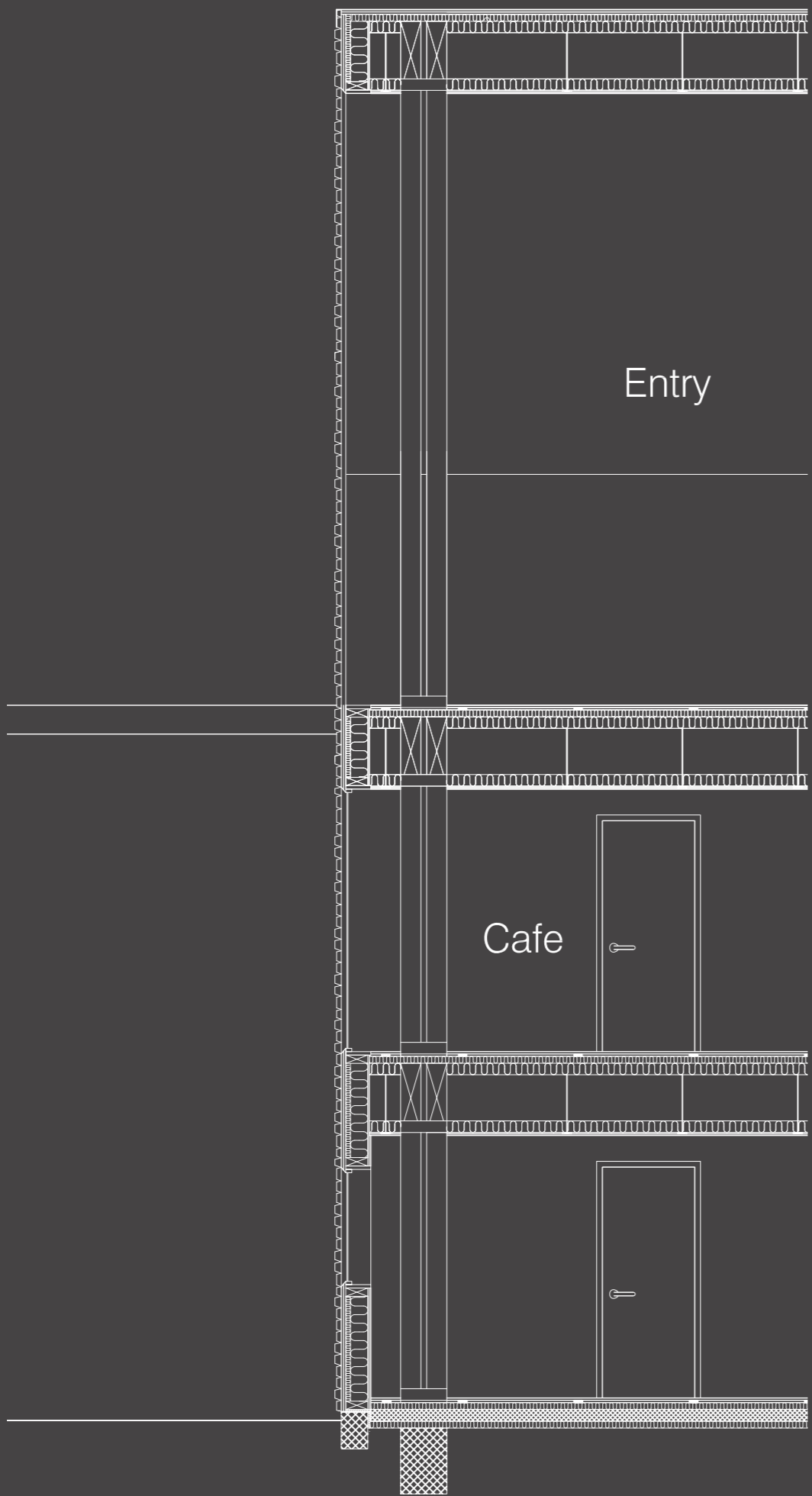
Transparent glass wall / Transparent walls
are used in the rehearsals rooms. To reduce
transmission sound, double layered acoustic
glass is installed:
40 mm acoustic glass
20 mm air gap
40 mm acoustic glass

This gives a sound reduction of at least 50 dB.

Solid inner wall / To reduce transmission
sound following is installed:
Wooden cladding
13 mm plaster
60 mm insulation
30 mm Air gab
60 mm insulation
13 mm plaster
Wooden cladding

This meets the standard for the
reduction of transmission sound (60
dB)





35 DETAILING