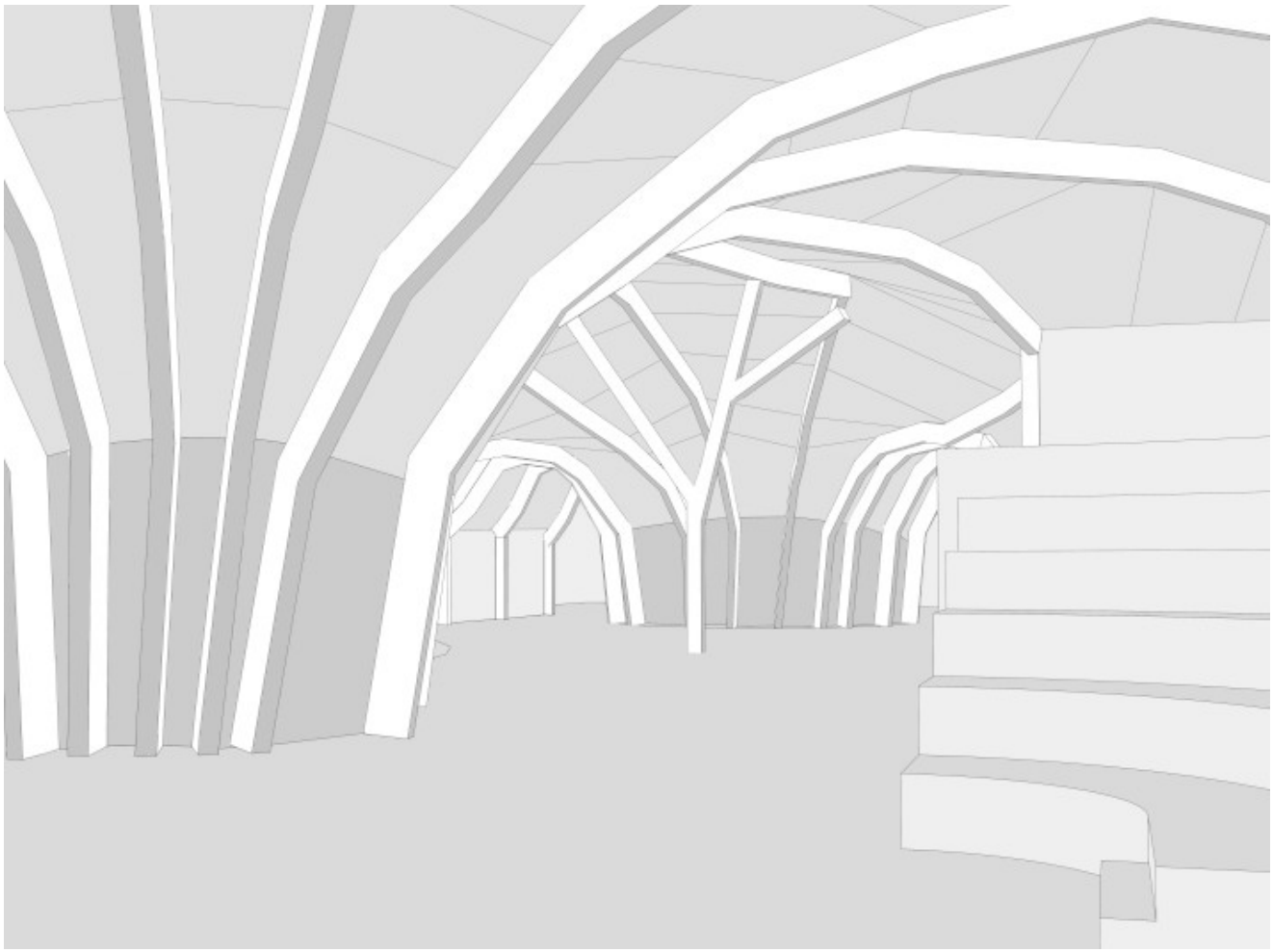

Cornille Martin

Technology analysis

Architecture and society January 2025

School

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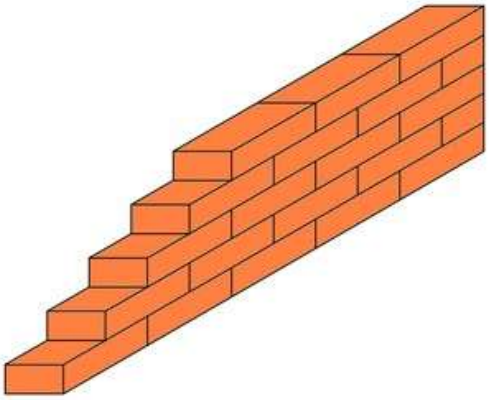
Structure

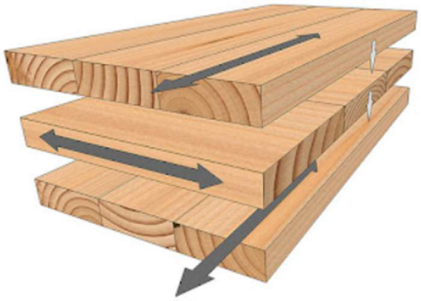
Introduction

In this school the main materials are Bricks and wood. Brick is going to be used for walls and wooden beams and planks for levels and the roof. As the roof as a particular shape I will use cross-laminated Timber for the beams.

There is two main structural system. One that works with parallel lines, the walls, and the other works in circle, the beams. There is four circles, each one is an inner courtyard. From this courtyard the beams go from the ground and connect to the walls working almost like arches.



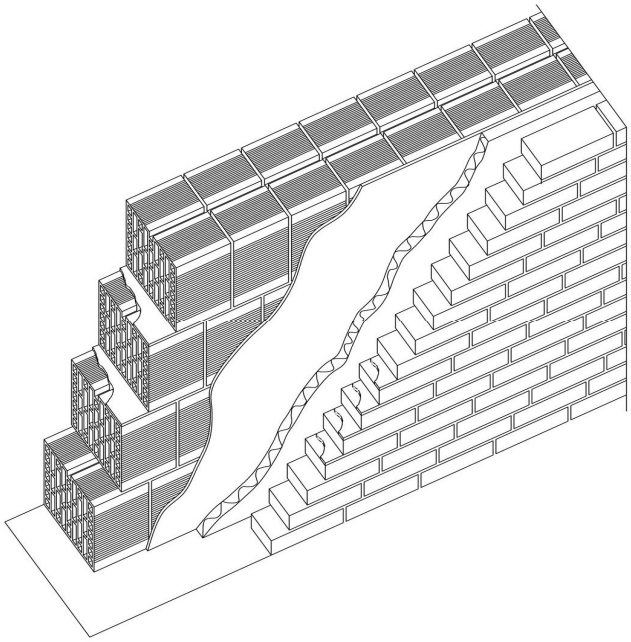
Bricks



Cross laminated Timber

Vertical load bearing elements

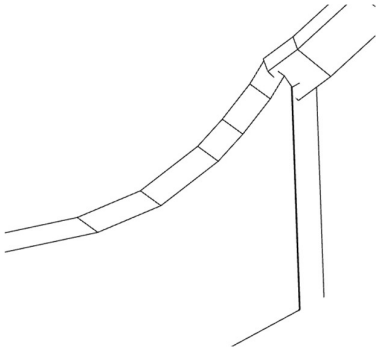
As I said the walls are made of bricks and are going to take vertical loads, from the roof for the little spaces and from the level above.



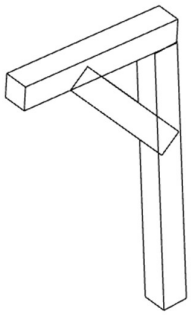
Brick wall

We also have columns aligned to the wall to support the beams that connects to the walls from the bigger spaces.

Some other types of columns are needed to support the roof when it overhang next to the classrooms.

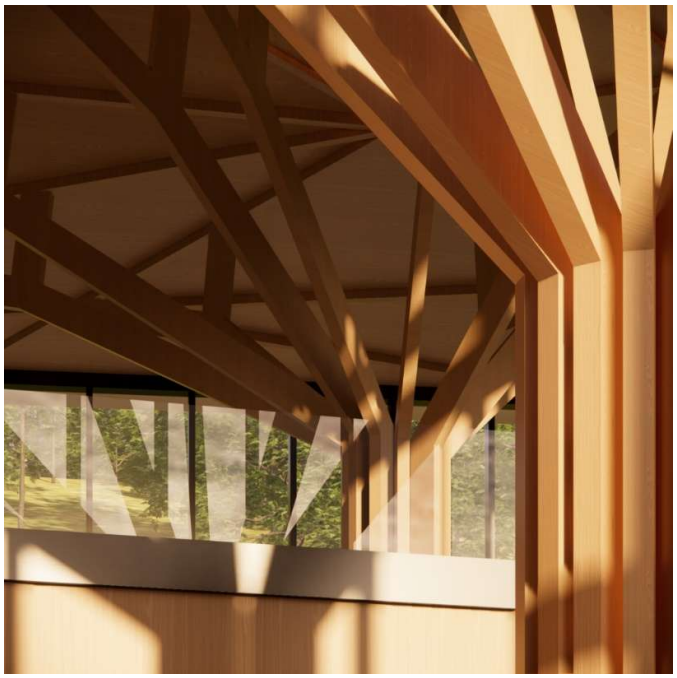


Column in the end of the wall

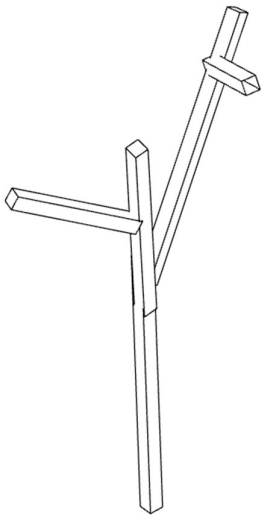


Overhang column

Lastly when the span of the beams from the roof are too big I used tree like column to add a little bit of support. This type of column is great because it doesn't take a lot of space on the ground and is still a valuable support. Furthermore it has quite an esthetic aspect that I find especially appealing for a school.



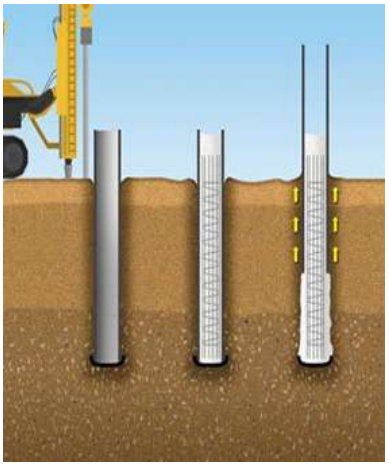
Tree-Shaped Timber Structural System – IAAC BLOG



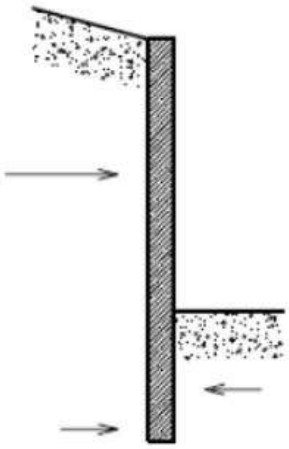
Tree-shaped column

Foundations

For the foundations I will use piles. Both for the column and walls. Indeed it is the best solution for columns and I have a lot of them but for the walls and the part against the ground this will work perfectly too.



How to build



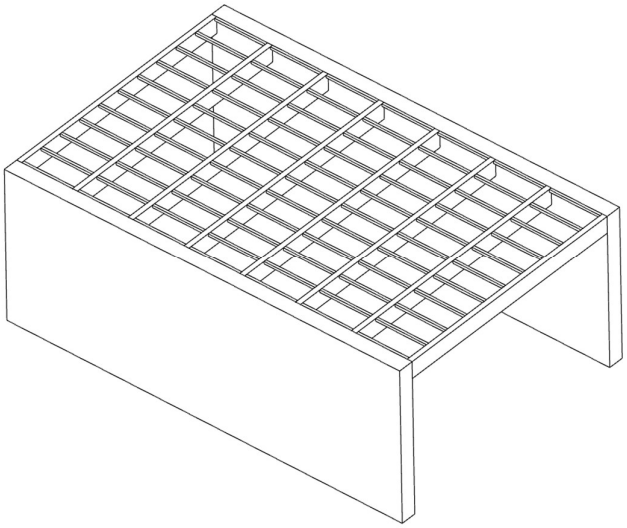
Against ground



For walls

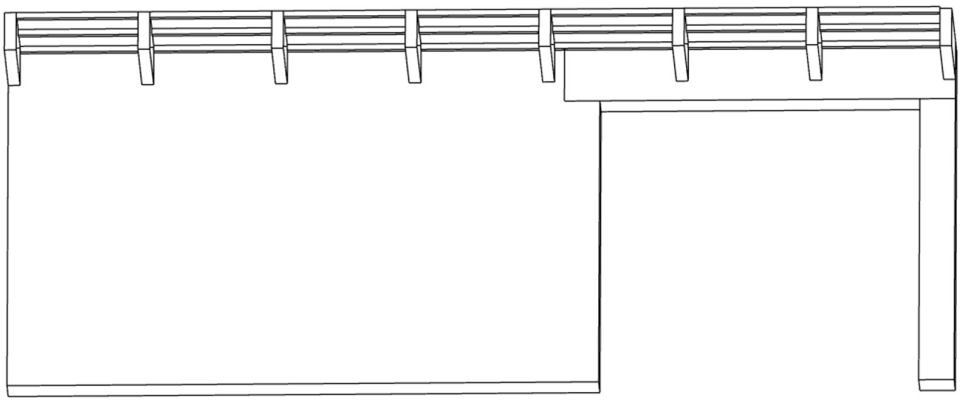
Horizontal Load Bearing element

Beams are used to take all the horizontal loads. First for the levels. Beams connects two walls together. Above the beams are the joists that add structural strength and then the floor can go on top. Those beams are smaller than the other ones because their span is smaller too. They all have the same section as the span is always the same.



Brick walls connected by beams to support floor

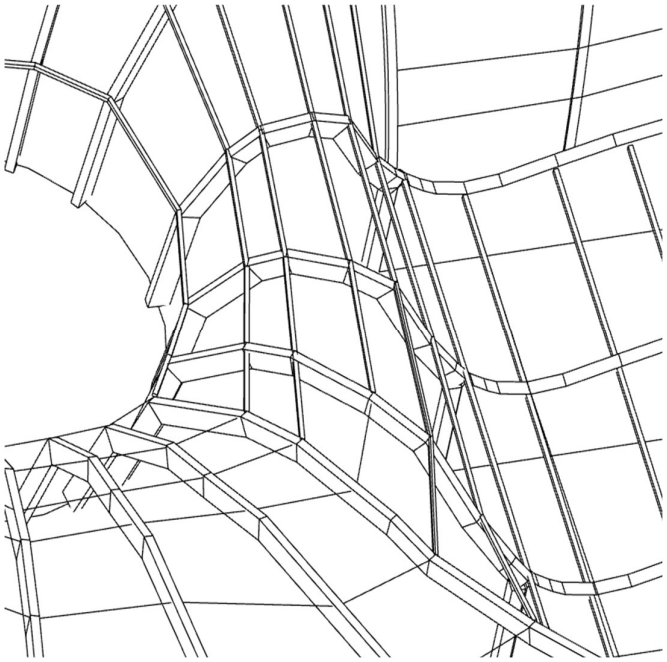
Bigger beams are also used when a walls needs to be open for architectural needs to replace the structural strengths of it.



Open structural wall

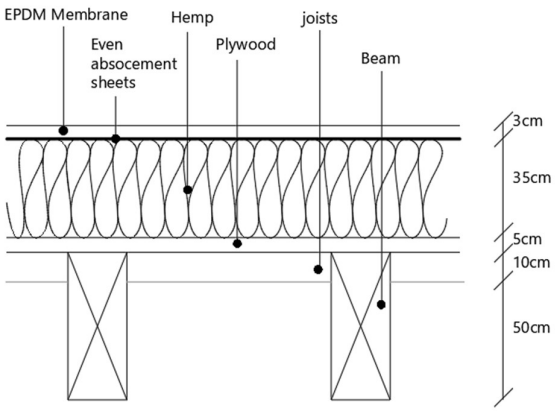
For the roof the shape is way more complicated but it works the same way. Beams connects column for one side and the ground to the other like arches. Then joists come to make it stronger. The isolation and roof covering comes above it.

Reference



Axonometry of structural roof





Section of roof

Bracing

The structural elements we have seen all works in parallel ways. Thus bracing is needed to avoid the building to collapse. For this, some walls are added to connect and close the little spaces. For the roof, the shape is 3 dimensional so it can work as bracing. But a connection of beams and joists might be too weak so it needs structural cross of saint andré (Some cables to connect beams in cross shape). With this covered, the structural integrity should be enough. (We need 5 faces braced on 6 and we have now: 1 the ground, 2 and 3 the structural parallel walls, 4 the added wall or the 3D roof and 5 the roof)



Reference where we can see the saint andré Cross

In appendix you will find the foundation plan, the structural plans, one section and the axonometry of the structure in scale.

Energy efficiency

General requirements

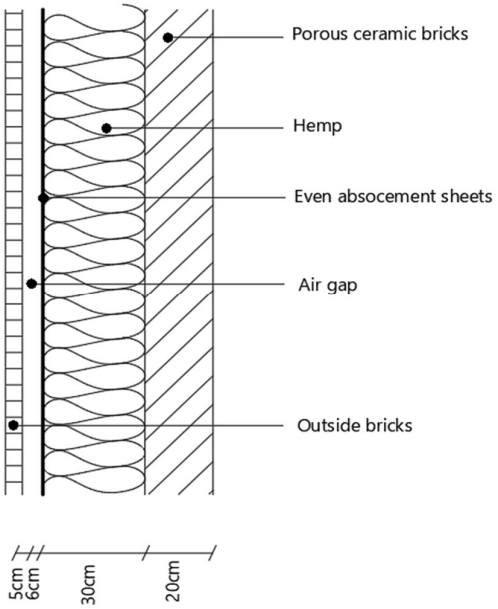
A public building should meet some general requirements to achieve a certain energy efficiency class. This class is A++. Meaning it it's compacity should be small and heat transfer coefficient must be 0.11 for roof and 0.12 for walls.

In addition to this, the insulation must be continuous and the air tightness too. HVAC ventilation system is also needed with a minimum efficiency of 0.8.

Heat transfer coefficient

We will focus on the outside wall and the roof. We can also say that the windows are triple glazed to ensure a maximum of insulation.

External wall:

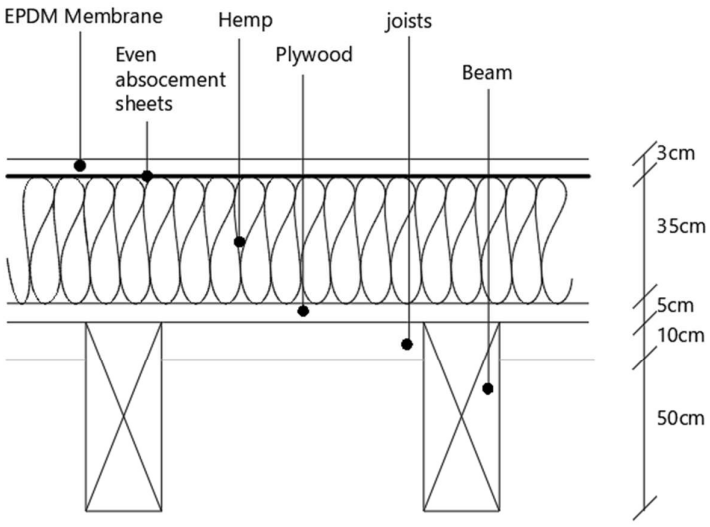


	d (m)	conducti	R (m^2*K/W
Rsi	/	/	0,13
Porous ceramic bricks	0,2	0,8	0,25
Hemp	0,3	0,04	7,5
Even absocement sheet	0,01	0,83	0,012048
Rsi	/	/	0,13
R total			8,022048

U (W/m^2*K) = 1/R = 1,12

1,12 is the wanted heat transfer coefficient

Roof:



	d (m)	conducti	R
Rsi	/	/	0,1
Plywood	0,05	0,17	0,294118
Hemp	0,35	0,04	8,75
Even absocement sheet	0,01	0,83	0,012048
EPDM membrane	0,03	0,29	0,103448
Rse	/	/	0,04
R total			9,299614

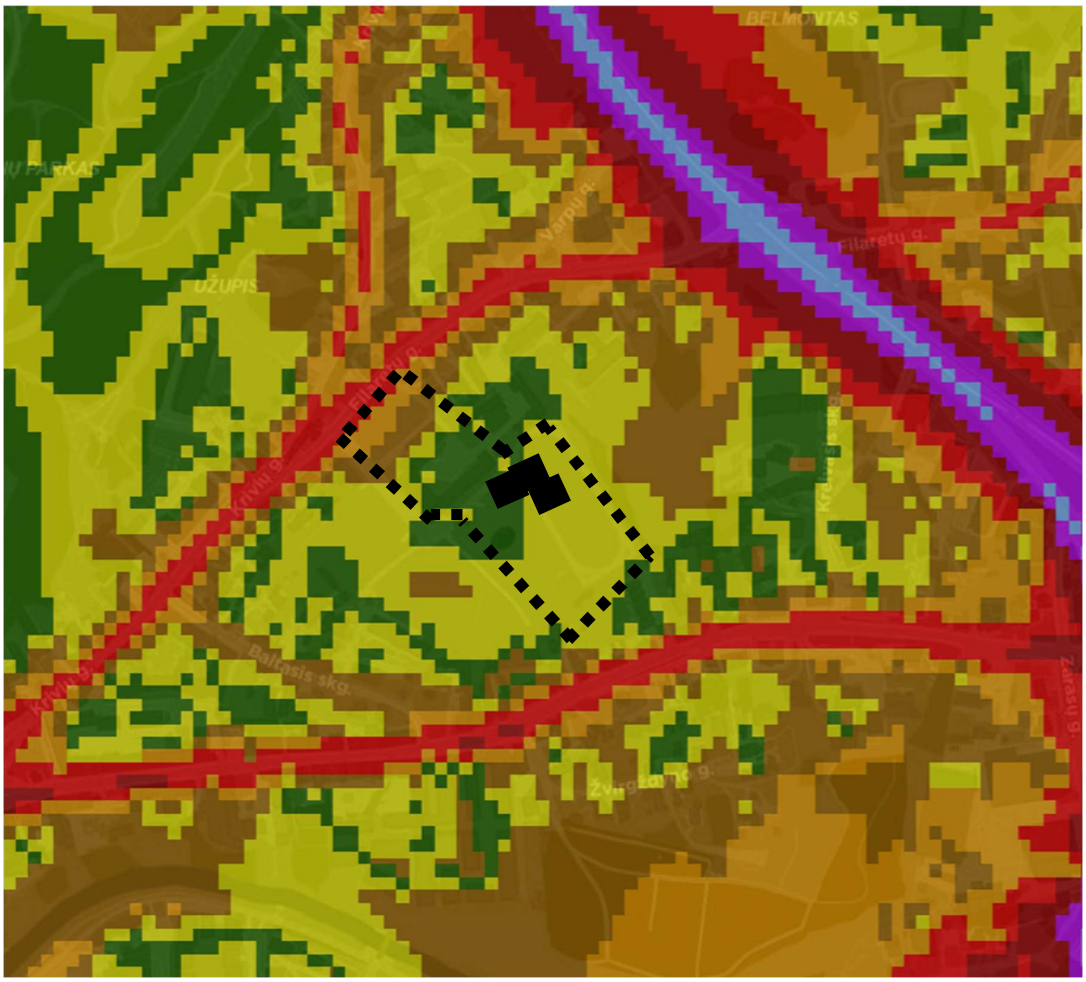
U (W/m^2*K) = 1/R = 1,11

1,11 is the wanted heat transfer coefficient

Acoustics

Outside

Sound class of the external environment of the building



Noise is an important thing to take into account when positioning a building. As we can see on the map, the main part of the site is between 45 and 49dB meaning it is B-class. Next to the road the dB are rising, that's why the building is placed further away.

Unfortunately it is not the perfect place to put the building for the noise as a lot of outside areas are in the yellow zone. But B-class is acceptable and the other elements of the site makes it the perfect place anyway. And the L-shape building can also work like a shield from the sound coming from the main road that is very noisy.

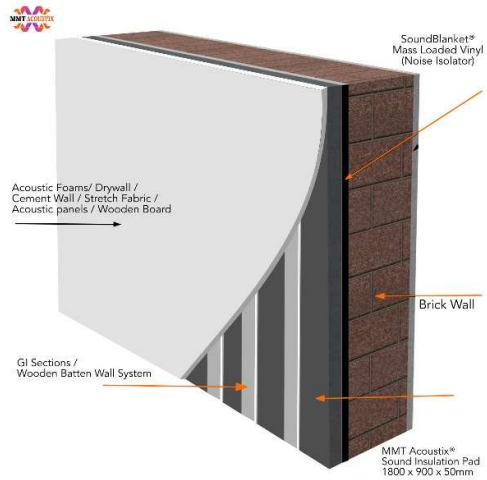
Inside

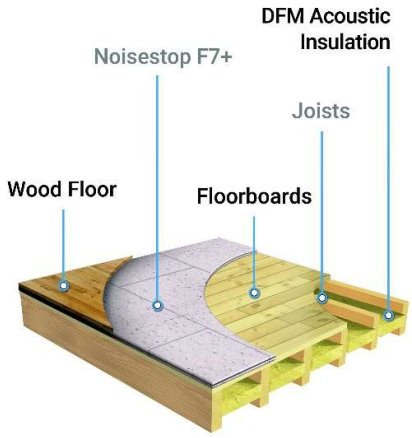
Insulation

It is important to insulate the noise to avoid any disturbance between areas. Especially in a school where recreational space can be very noisy. Thus the classroom are separated from the rest of the school with full walls specifically designed for sound insulation. Especially airborne sound.

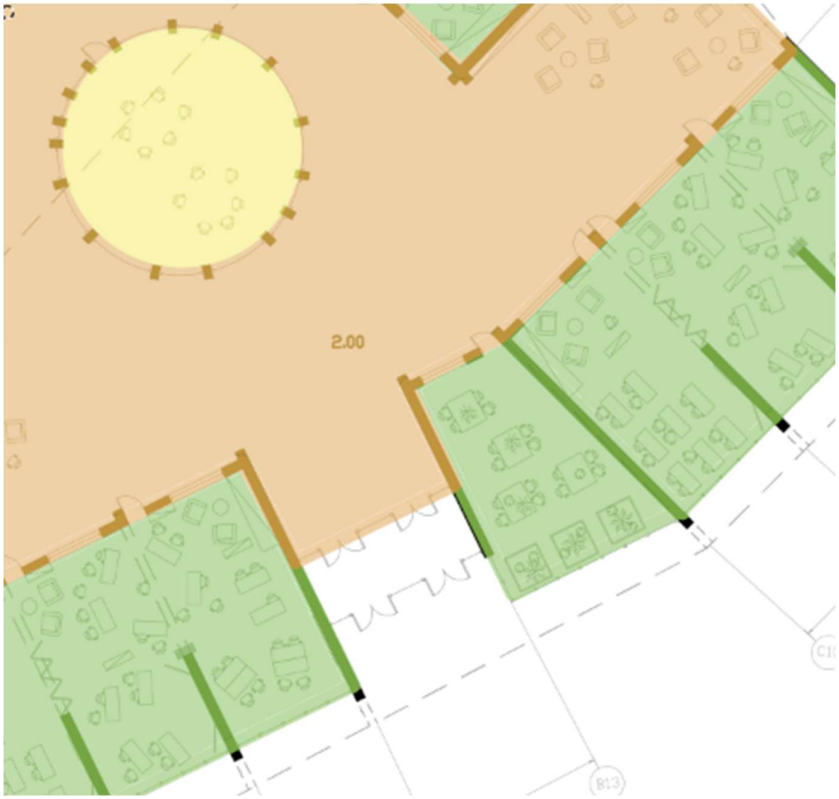
The floors also need to be insulated to the noises. Especially impact on the ground.

Examples of solutions from brands

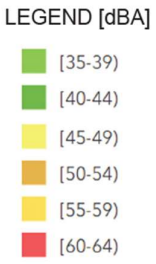




Noises Levels



In this part of the map of noise level we can see different noise level next to each other with walls that needs to be more sound isolated between them.

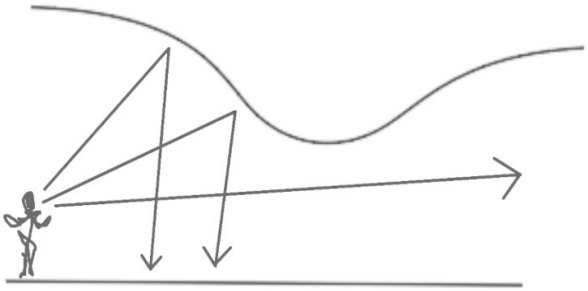


The full drawing is in the appendices

Reverberation

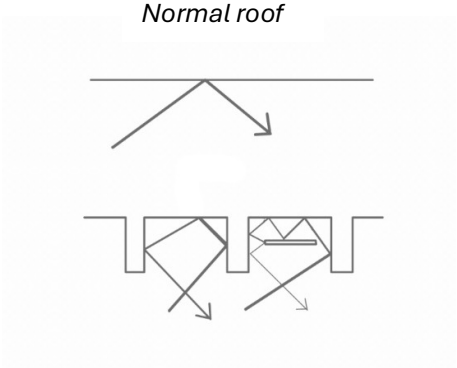
My school is divided into two kind of spaces. Big noisier open spaces (cafetaria, recreation, wardrobe, sport, ...) and small calmer closed spaces (classroom, offices, therapist,...).

The big spaces can have a little longer reverberation time. RT60, 1-1.5 seconds, it helps having a living space without echoing. Those spaces are very big but the shape of the roof help reduce the propagation of the sound. The showing beam help absorbing the noise. In addition, acoustic panels can be placed between the beams.



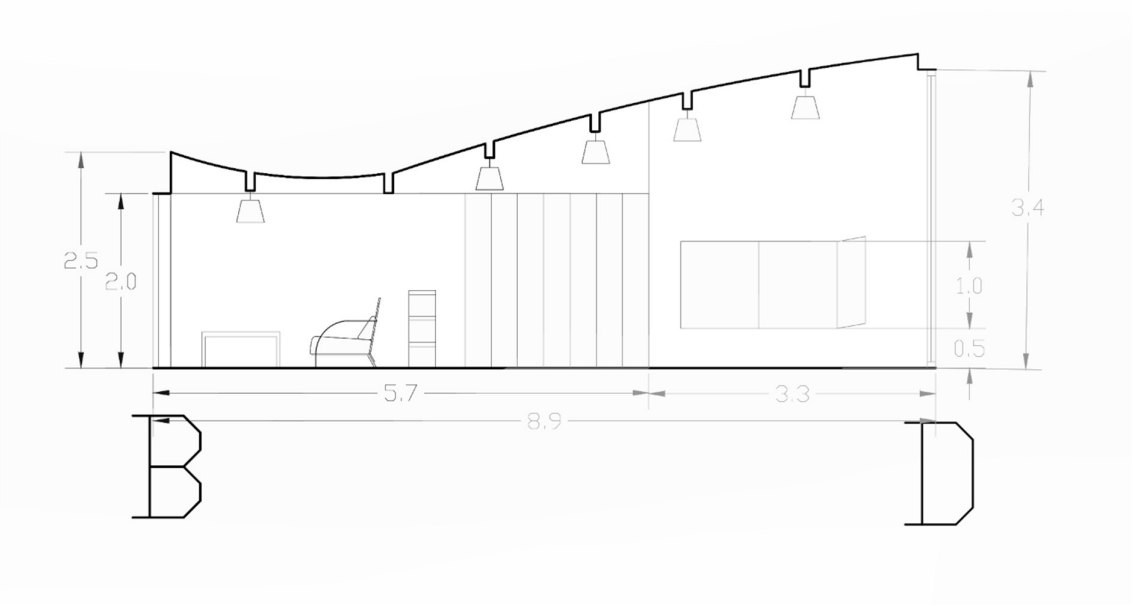
Roof Shape

Normal roof



Beams and absorption panel

For the classroom, the same solutions are applied (visible beams and acoustic panels). This time the reverberation must be shorter : short RT60, 0.3-1 second, to enhance comfort and focus on learning in the classroom.



Section of classrooms

Classroom absorption

Volume of empty enclosed space (V) = 124m^2

Reverberation time = 0.16*V/A

Element	Surface area or quantity	125Hz		250Hz		500Hz		1000Hz		2000Hz		4000Hz	
		as	AsxS	as	AsxS	as	AsxS	as	AsxS	as	AsxS	as	AsxS
Windows	16,1	0,12	1,93	0,08	1,29	0,05	0,81	0,04	0,64	0,03	0,48	0,02	0,32
Walls (Plastered Brickwork)	54	0,01	0,54	0,01	0,54	0,01	0,54	0,02	1,08	0,02	1,08	0,03	1,62
Floor (Parquet)	41,4	0,12	4,97	0,1	4,14	0,06	2,48	0,05	2,07	0,05	2,07	0,06	2,48
Roof	50,6	0,15	7,59	0,11	5,57	0,1	5,06	0,07	3,54	0,06	3,04	0,07	3,54
Chairs	20	0,1	2	0,2	4	0,25	5	0,3	6	0,35	7	0,35	7
Acoustic panel	20	0,15	3	0,11	2,2	0,04	0,8	0,04	0,8	0,07	1,4	0,08	1,6
People	20	0,18	3,6	0,23	4,6	0,28	5,6	0,32	6,4	0,35	7	0,35	7
Sound absorption area			23,6		22,3		20,3		20,5		22,1		23,6
Reverberating Time			0,84		0,89		0,98		0,97		0,9		0,84

For every frequences we can see that the reverberation time is shorter than 1 second thus, the absorption of the classroom matches short RT60 as intended.

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