The shape of melting

Nicolas Carlier Master's Thesis
Studio Anne Holtrop FS22

Booklet

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CONTENT

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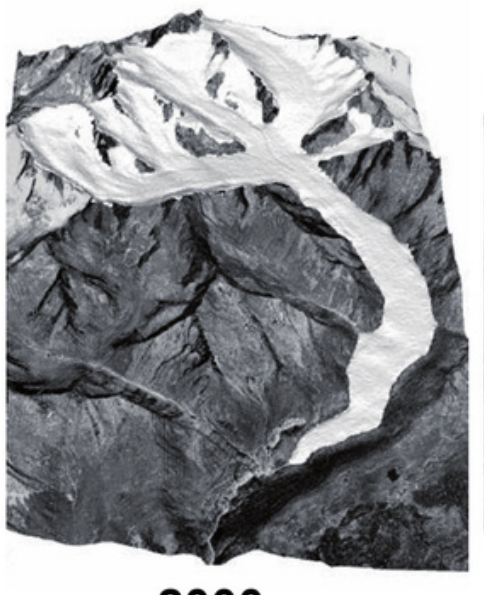
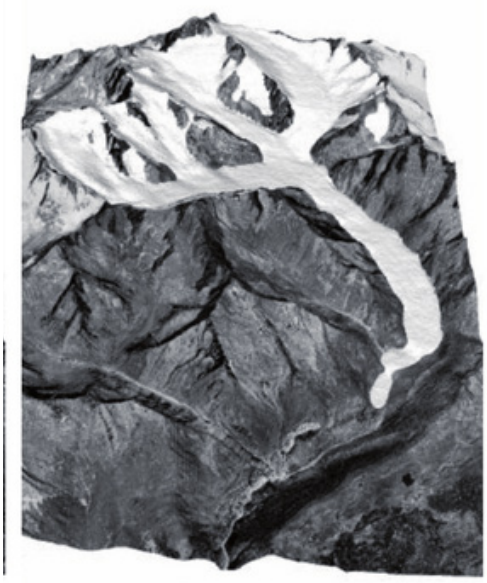
Ice

Aletsch glacier (Robert J Heath)



2000



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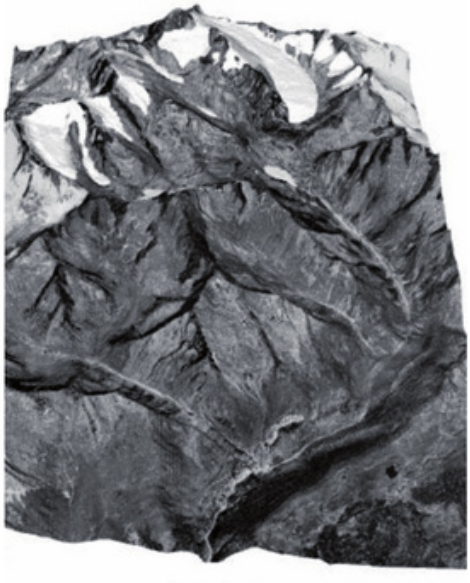


2100

Modelled glacier retreat of Great Aletsch glacier (Jouvet and Huss)

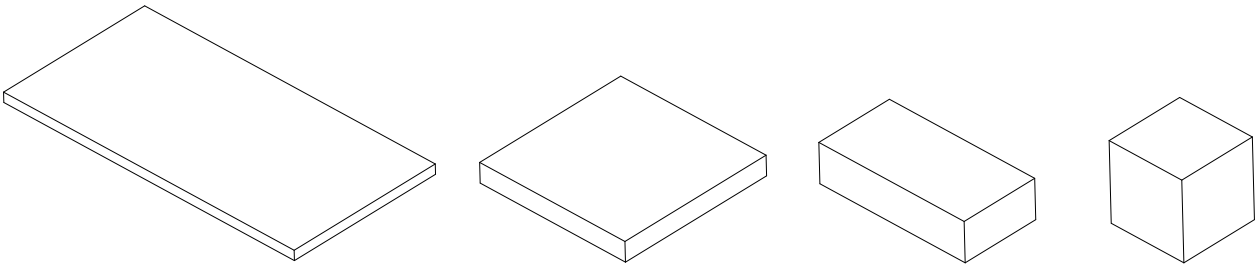
Ice is the solid state of water, liquid substance that freezes to the solid state at temperatures of 0 °C (32 °F). It possesses a regular crystalline structure based on the molecule of water consisting of a single oxygen atom, covalently bonded to two hydrogen atoms (H–O–H).

Zinal glacier, Valais

As ice melts, its shape changes, since it acquires the ability to flow. However, its composition does not change.
Melting is an example of a physical change.

Melting time study using 3x3x3 cm ice cubes

The larger the surface area of the ice cube, the more heat from the air it absorbs, so the faster ice melts. In this way, the melting time of a given volume of ice can be drastically reduced by having a very large area exposed to the air.



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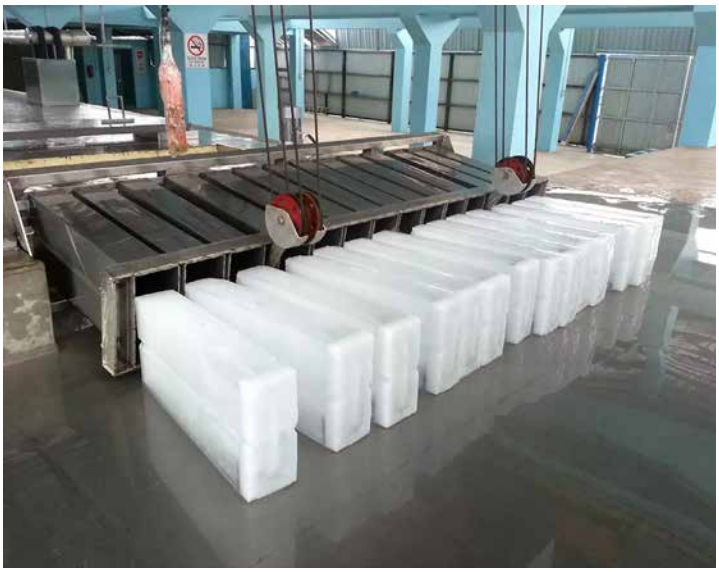
Melting time speed for a same volume of ice

Manufacturing process of ice

Ice blocks manufacturing

Cans filled with fresh water and immersed in a brine bath solution (salt) reaching a temperature below freezing point (-10 °C)



Demoulding

Ice crushing for food preservation / fishing industry

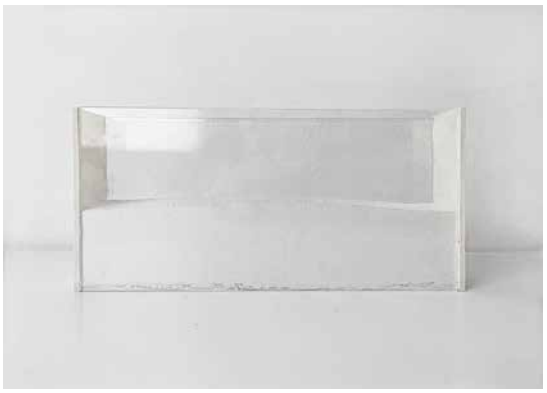
Ice cubes manufacturing

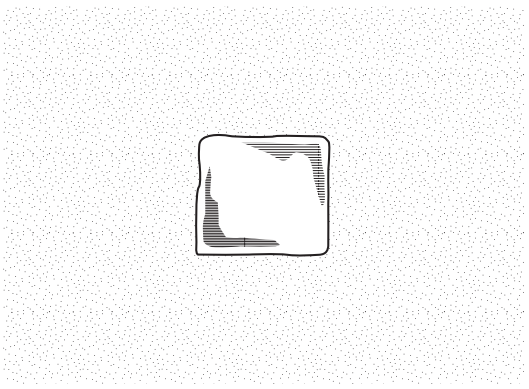
Water flows through a grid frame, filling the cavities and freezes

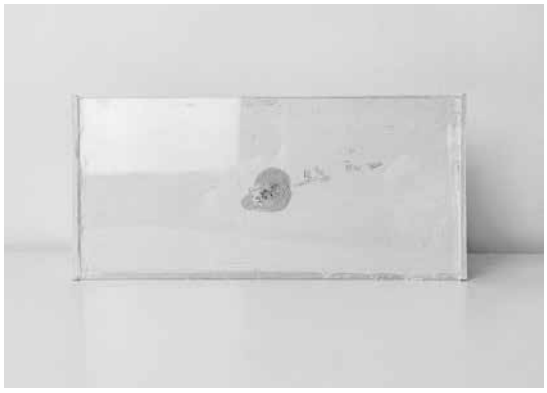
Ice bag, 5 kg

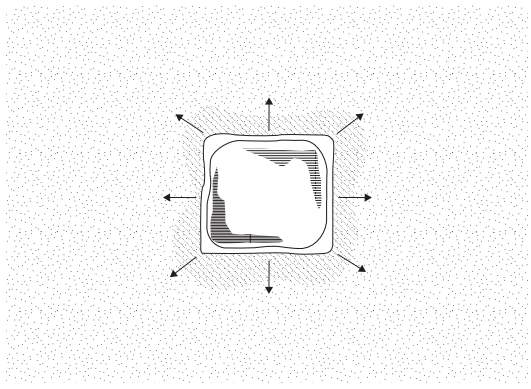
The shape of melting

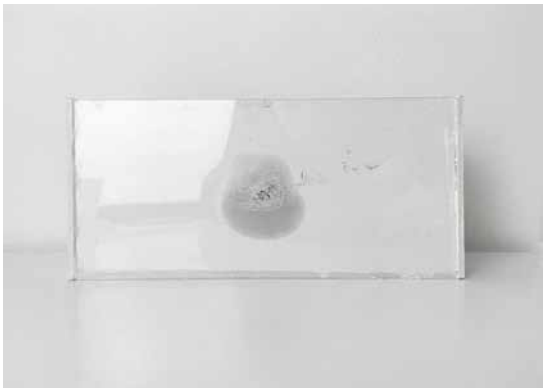
By letting the natural process of ice melting in plaster occur, new spatial possibilities can be explored. The final shape produced by the reaction between water and gypsum is always quite unpredictable. However, based on the resulting shapes, we can observe an accumulation of water flowing down during the melting process of ice due to gravity.

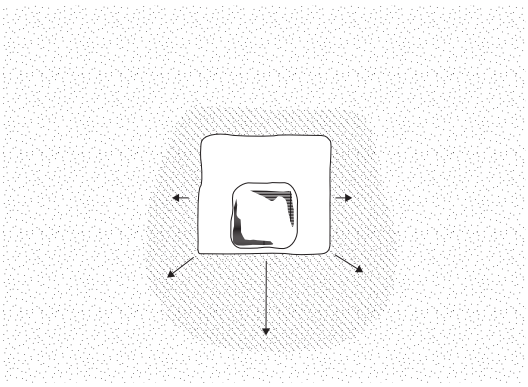


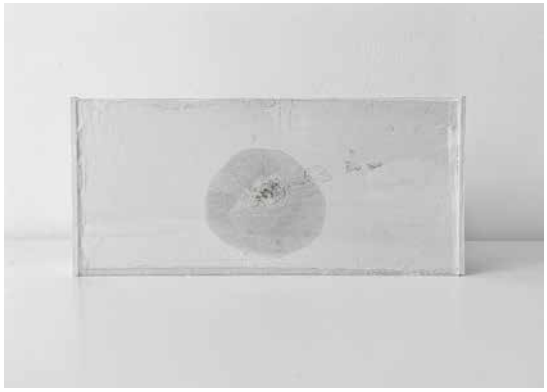


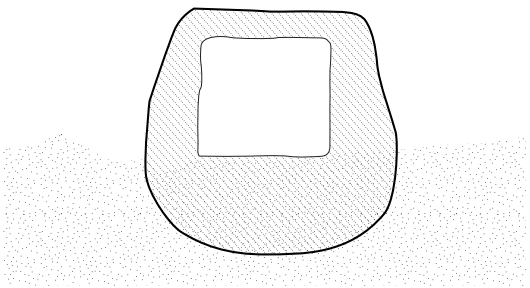




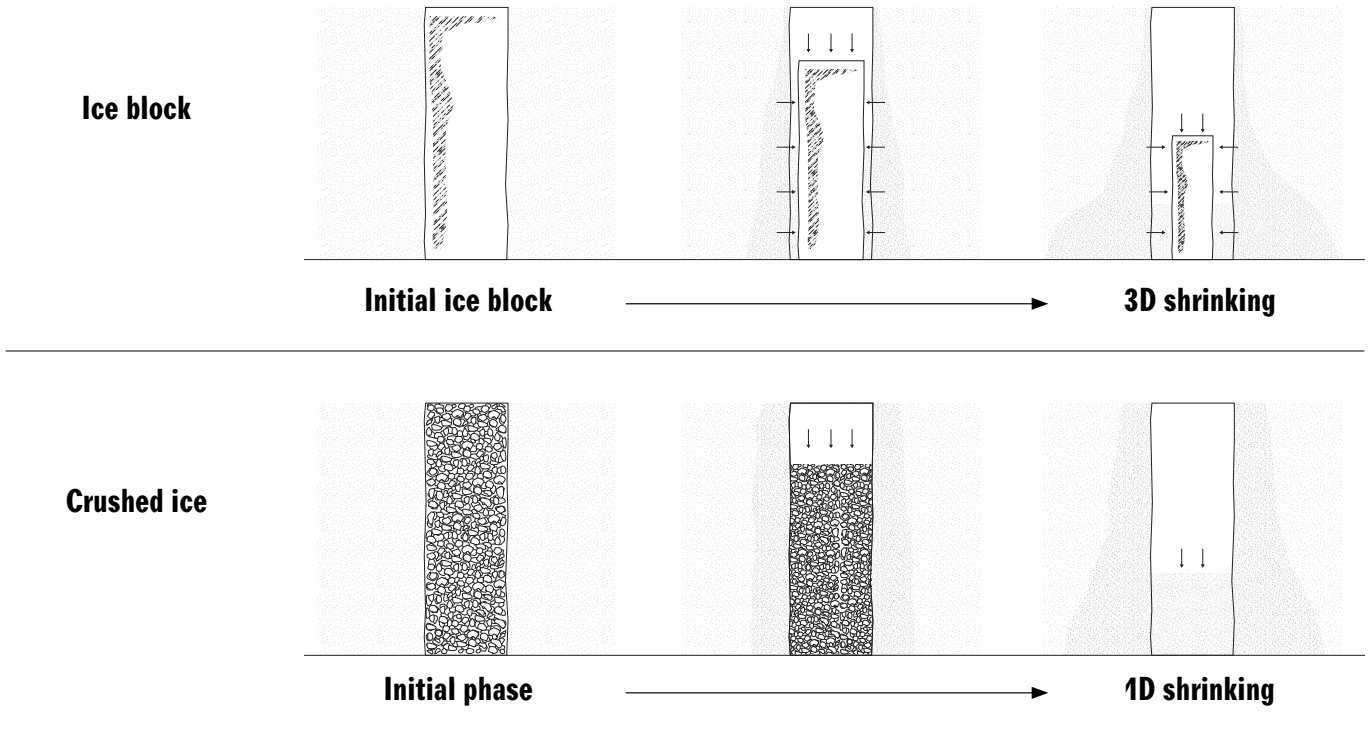








Melting an ice block will shrink towards its gravity center. This leeds to a very thin layer of solid gypsum on the side, whereas with crushed ice we get a much more homogeneous melting.


Ice block
Initial ice block
3D shrinking
Crushed ice
Initial phase
1D shrinking

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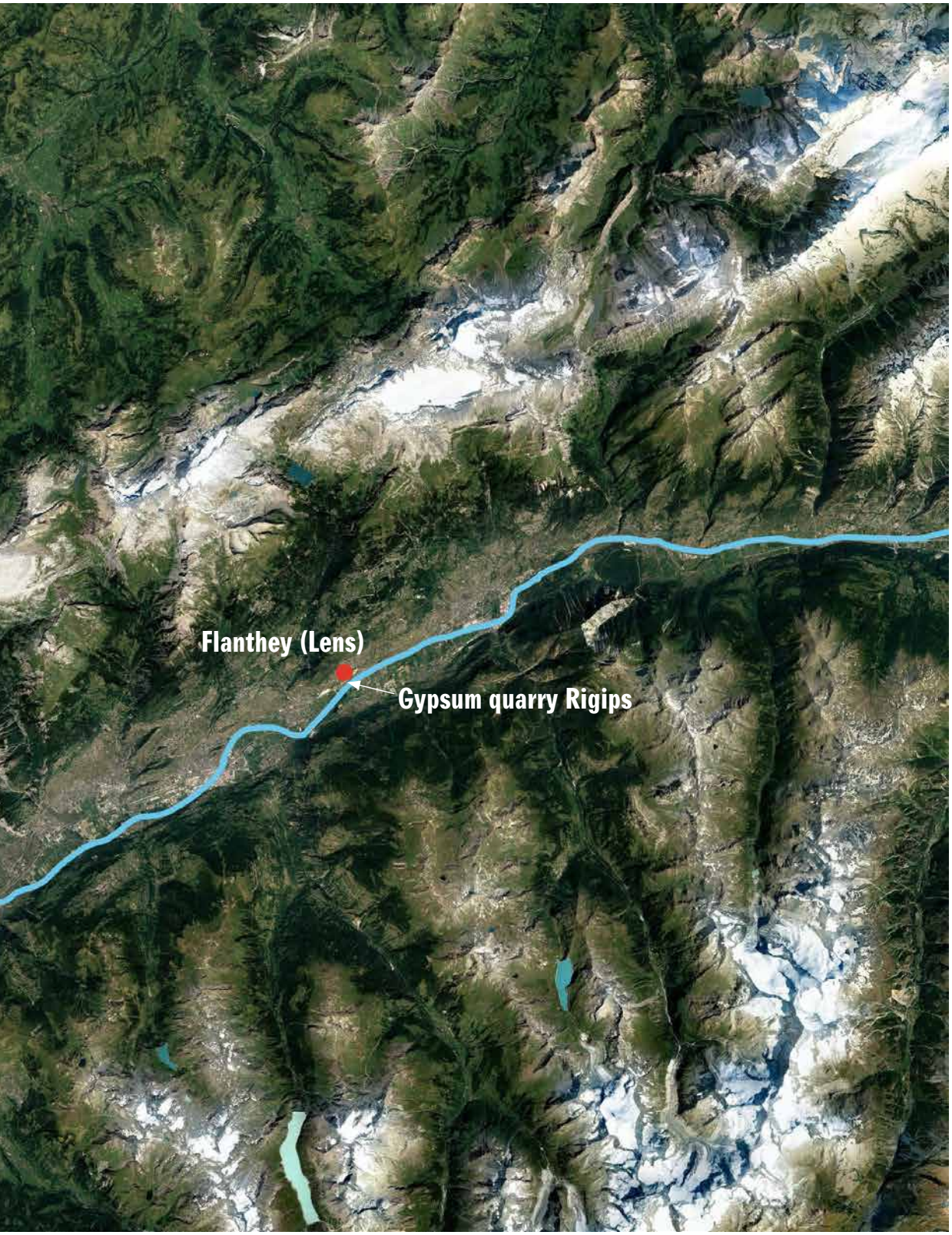
Gypsum

Gypsum is a soft sulfate mineral composed of calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$). Gypsum is used in a wide variety of applications, mainly in the construction sector, since it shows many benefits: fire resistance, great sound absorption property due to the porosity of the material, moisture preservation (controlling and absorbing the humidity in the air). Gypsum has also a long tradition in decoration and ornaments in interior architecture. Even if gypsum shows many benefits, it is nowadays mainly reduced as a covering material in the construction sector (plaster boards). Thus, the project wants to investigate gypsum in its full potential as a building material, strongly linked to the site as a locally available material.

Natural gypsum deposit in Bex

Natural gypsum deposits along the Rhone river


Flanthey (Lens)
Gypsum quarry Rigips

In the region along the Rhone river, we can find two open-pit quarries still in activity today, extracting and manufacturing gypsum.

Gypsum quarry Fixit, Bex

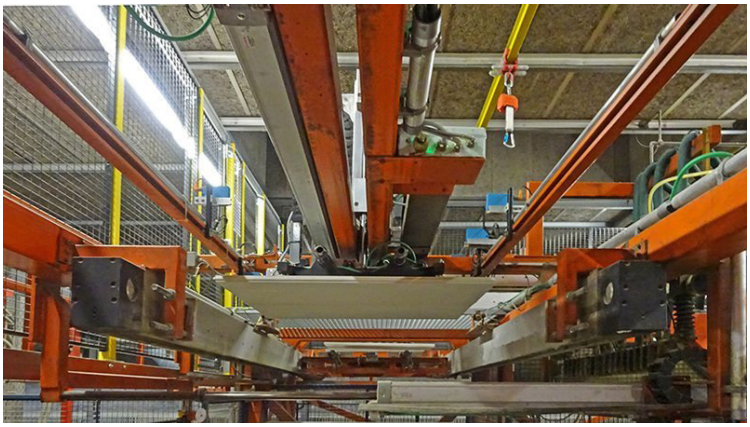
Gypsum quarry Rigips, Lens

Manufacturing process of Gypsum

Gypsum quarry, extraction

Crushing gypsum rocks

Gypsum calcination (120-180 °C), to remove the crystalline bound water

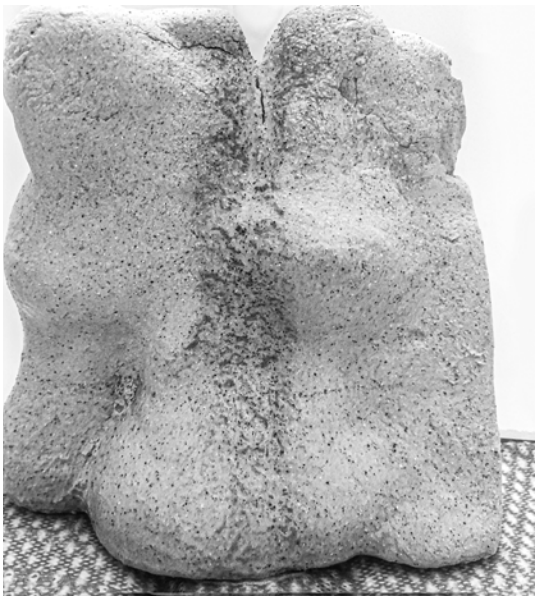


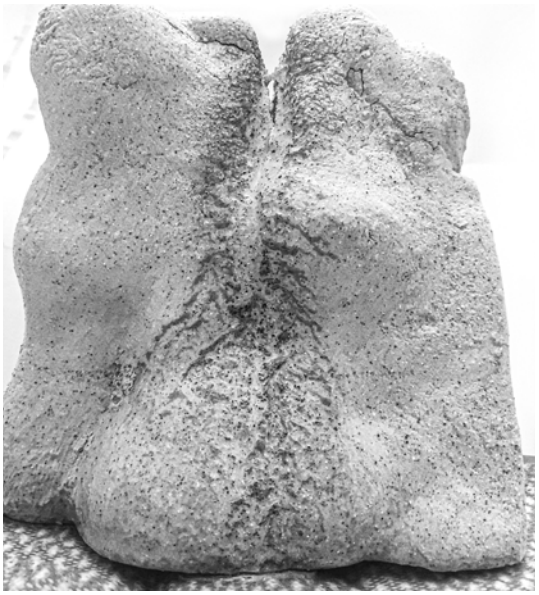
Plaster boards production

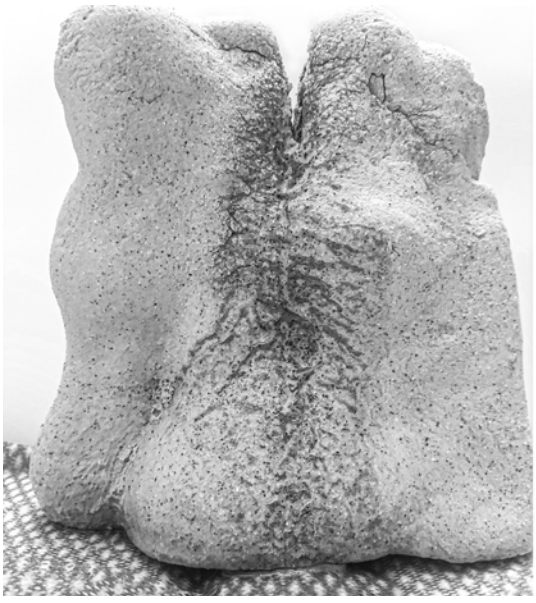
Gypsum is a brittle and porous material which gets easily eroded over time through water from the rain, humidity, temperature change, etc. Deposits of gypsum usually occur in strata from the evaporation of see water.

Natural gypsum stones, collected in Bex

Surface erosion traces on a gypsum rock, Bex







Traces of erosion on gypsum by spilling water droplets

Over time, water and wind have eroded these sedimentary geological structures, letting traces on the surface.

Weathering of gypsum, «Pyramides de gypse», Les Diablerets

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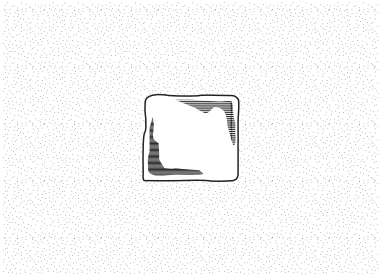
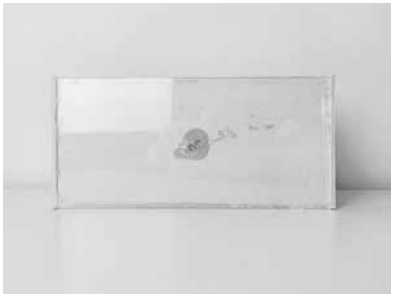
Material gesture

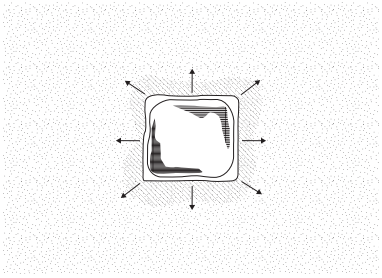
By letting the natural process of ice melting in plaster occur, new spatial possibilities can be explored. The final shape produced by the reaction between water and gypsum is always quite unpredictable.

t0
Initial form of ice

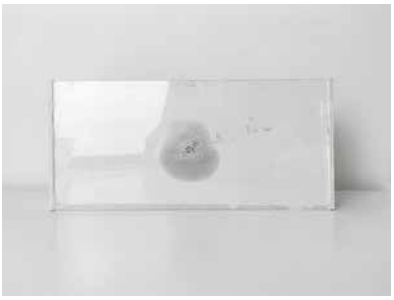


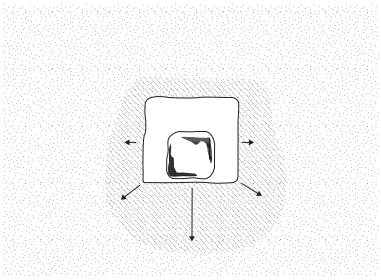
t1
Surface absorption



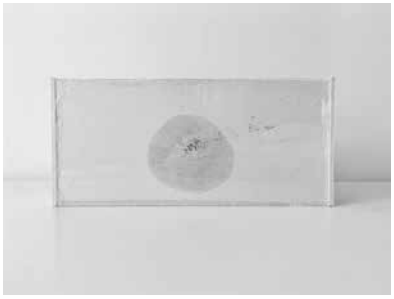


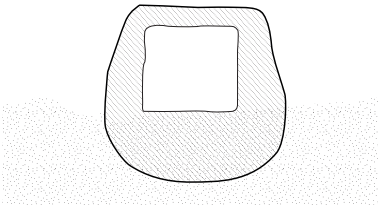
t2
Accumulation of water flowing down





t3
Final solid shape





By this combination, a new constructive technique is being explored in which complex forms can be achieved using standard constructive methods and equipments (standard formwork, simple building process) and using only locally available materials. The melting process of ice enables the slow setting and cooling of gypsum, preventing it from drying too quickly and cracking. During the curing process of gypsum, the water only takes the volume of plaster needed.

Building process

1

2

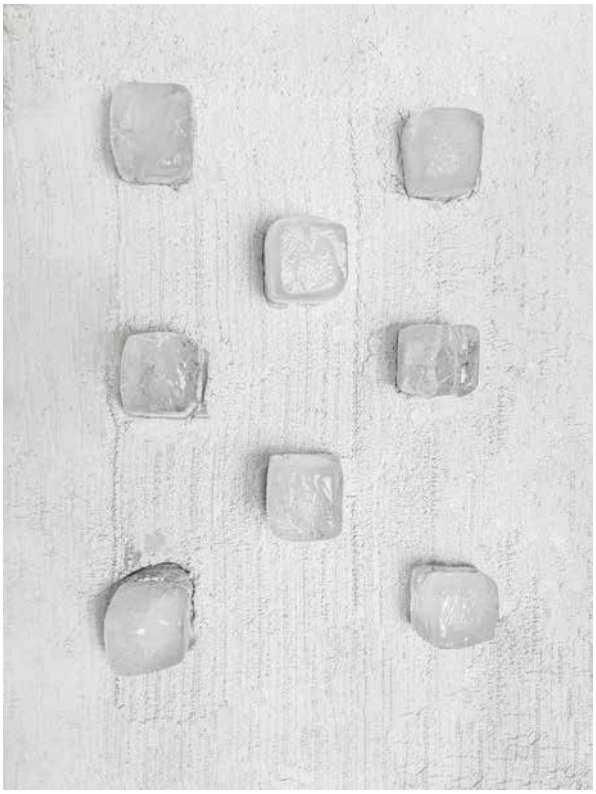
3

4

5

6

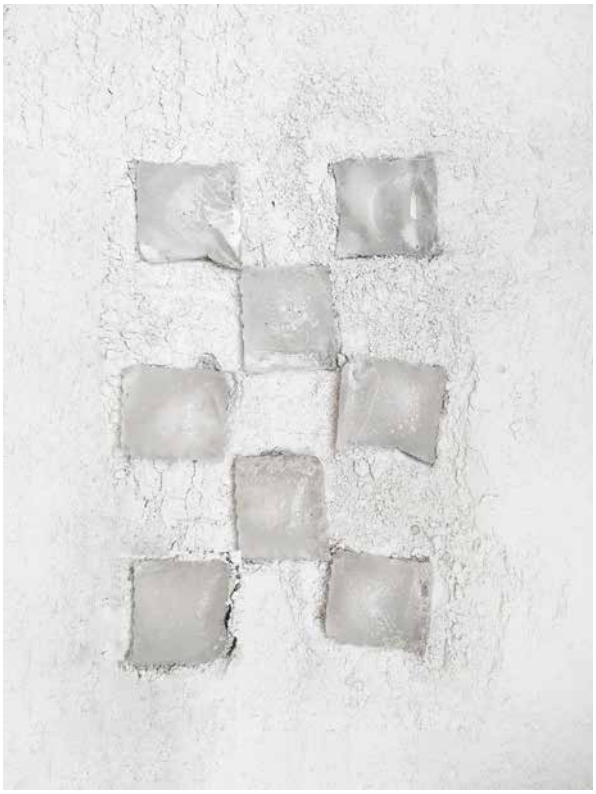
Pattern study



large spacing + shifted

small spacing + shifted

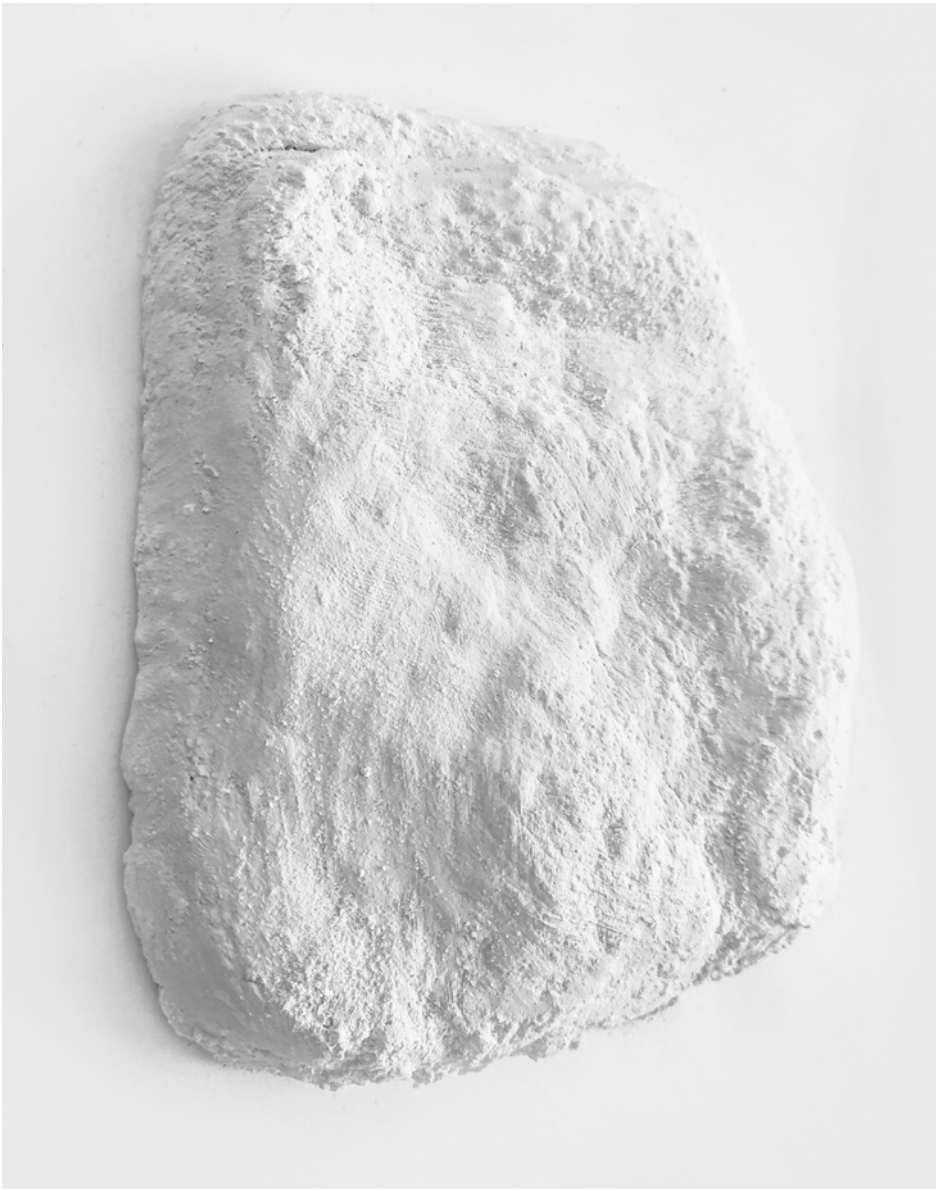
large spacing + regular



no spacing + half ice cubes

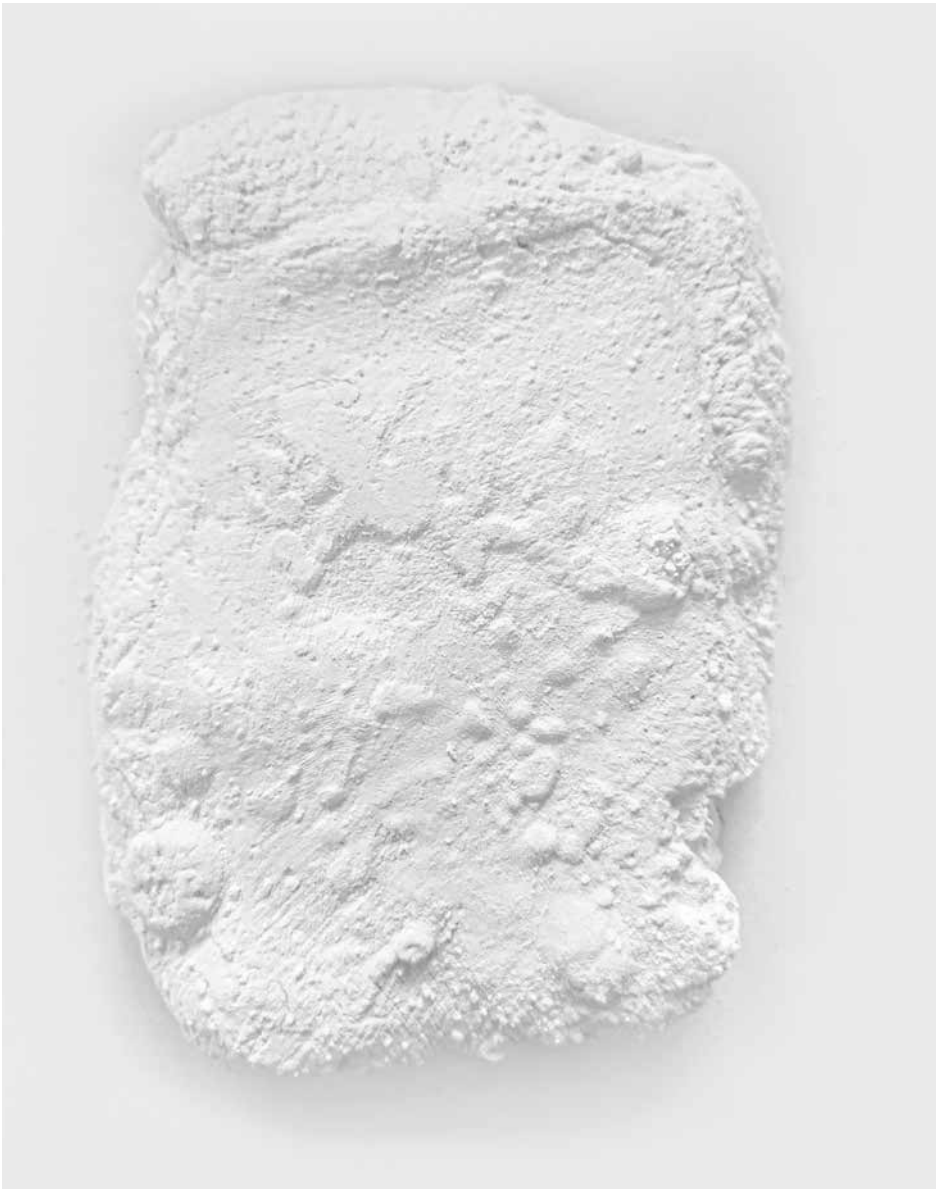
Form exploration

Material tests



Crushed ice

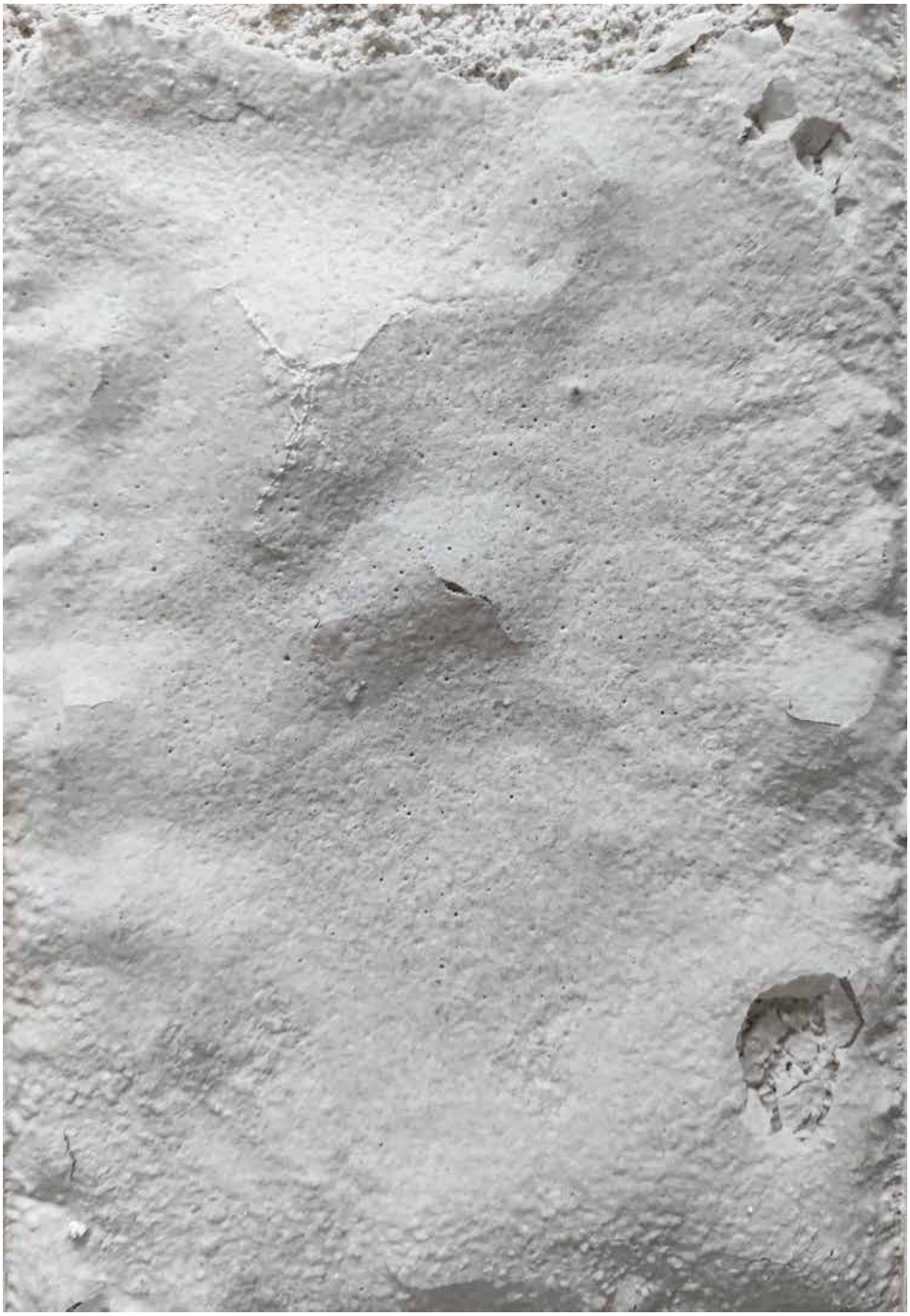
Ice block



Ice slab

Column

Puzzle



Gypsum + salt (heated)

Finding patterns

Regular

Shifted (large)

Shifted (small)

Irregular

Mixed

Constrained

Merged shapes

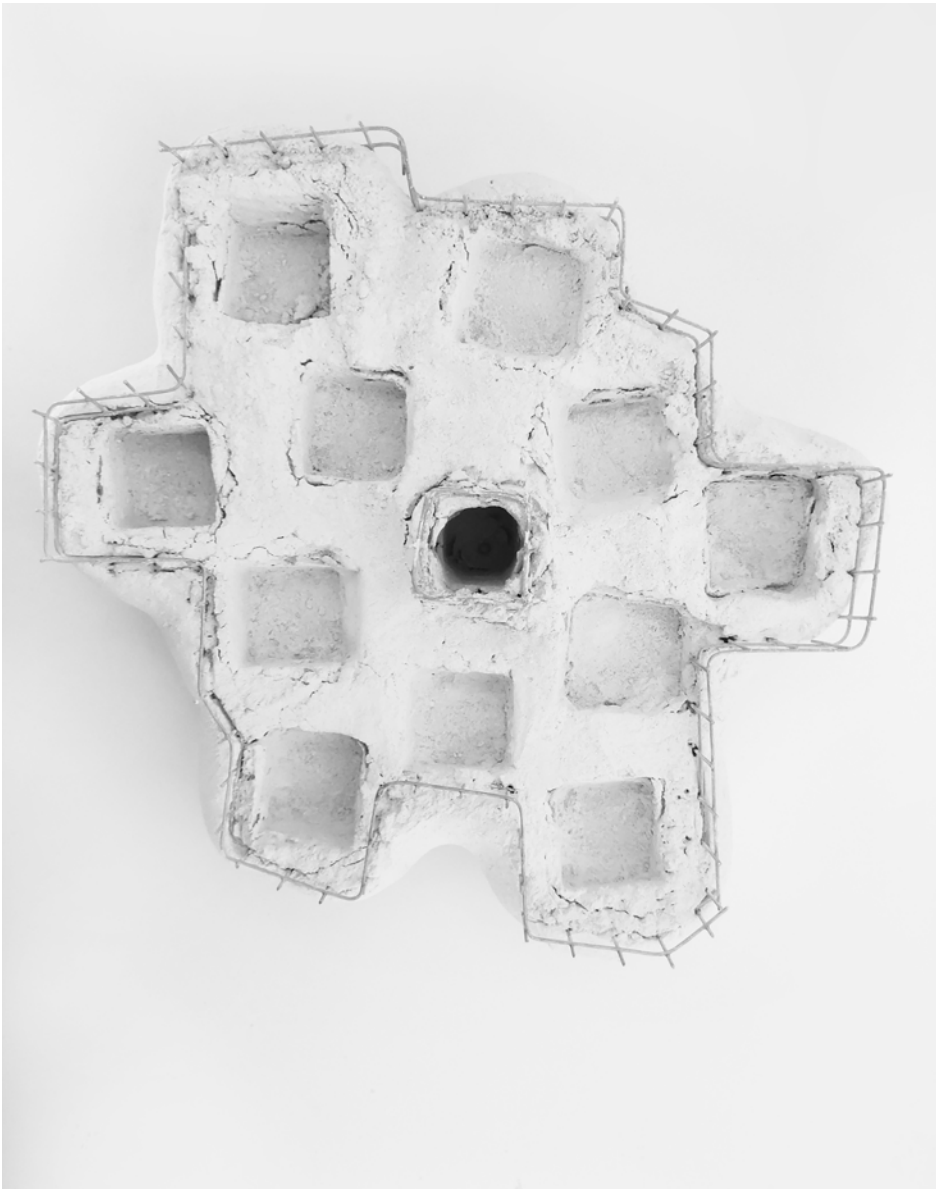
Divided

Negative spaces

Negative space 1

Full

Traces



Negative space 2

Negative space 3

Negative space 4

Closed space

Stacked column

Architectural elements

Steelmesh column

Niche

Crushed ice column 1

Crushed ice column 2

Window

Door

2 pieces corner

1 piece corner

Opening

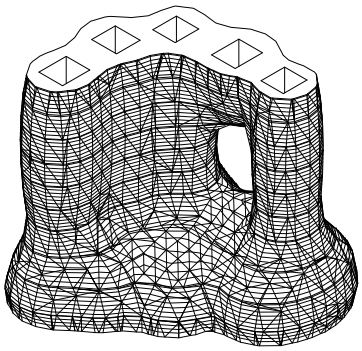
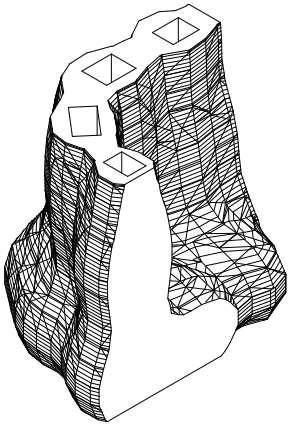
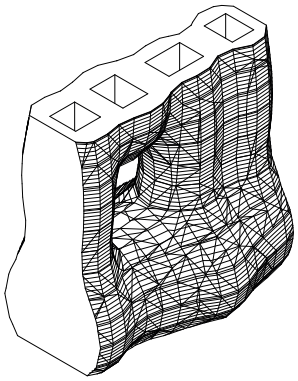
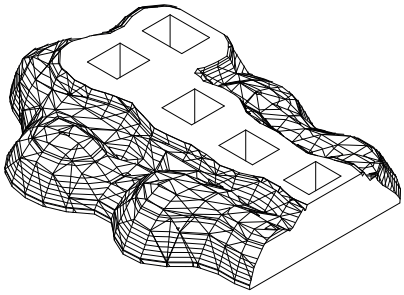
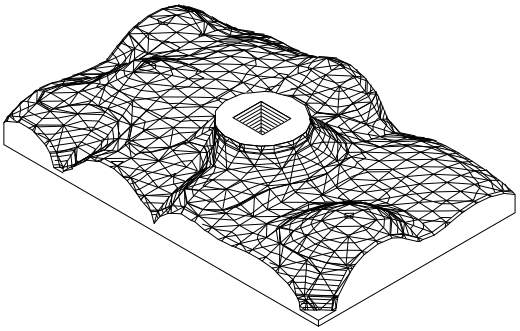
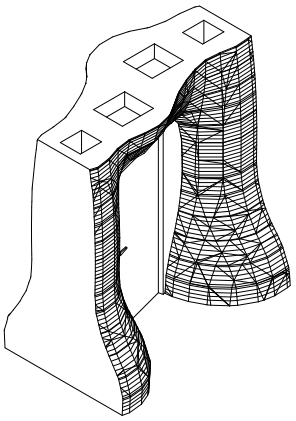
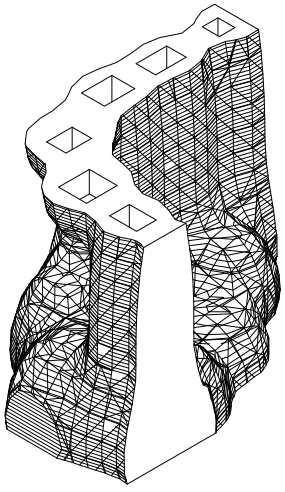
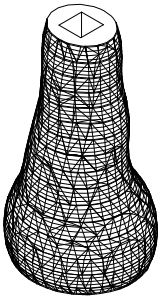
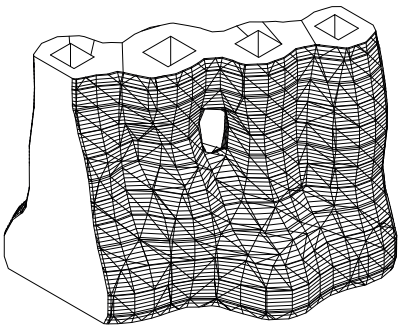
Ceiling

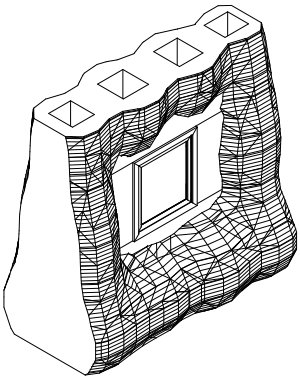
Mushroom structure

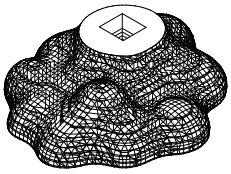
Wall

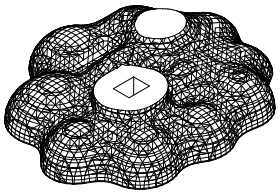
Constellation

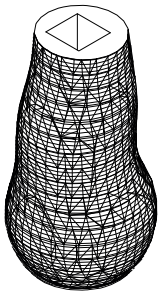
Glossary

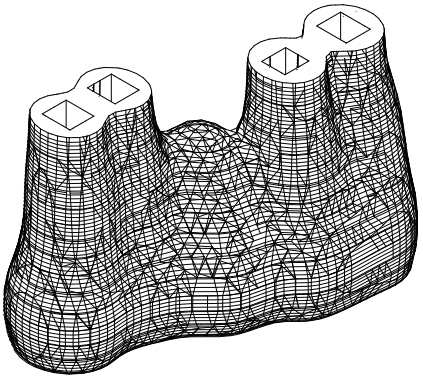










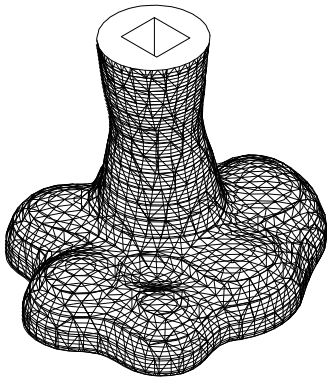


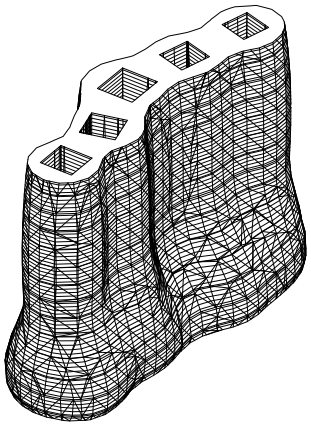


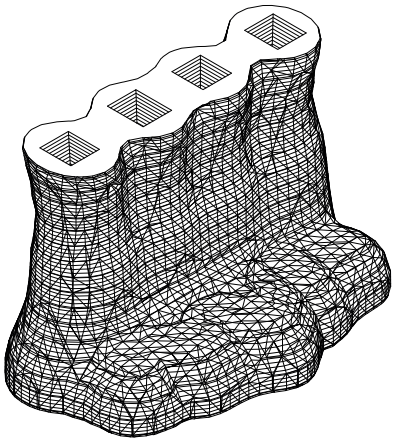


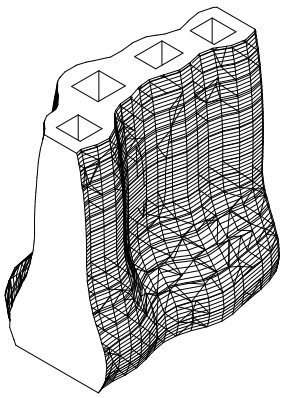












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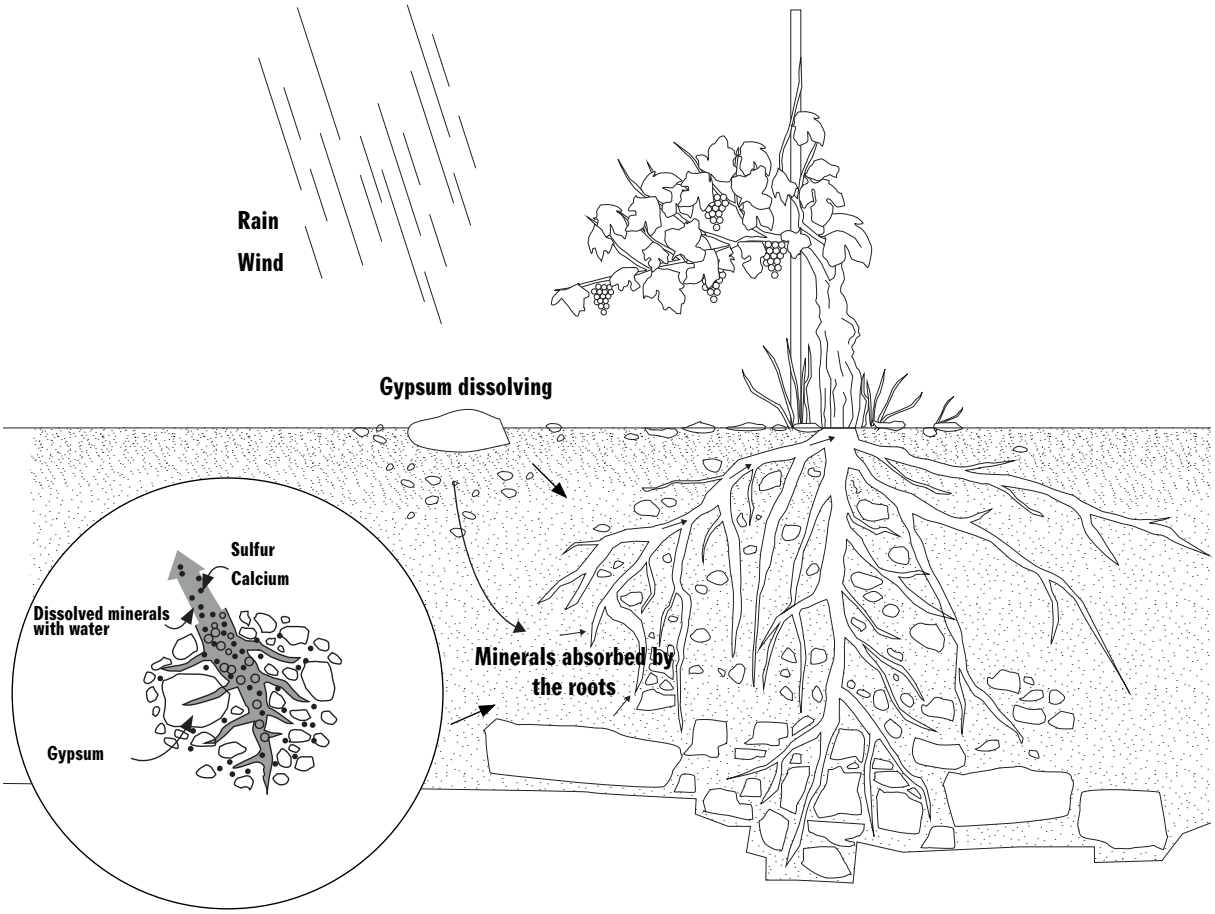
Site

Benefit of gypsum in viticulture

Besides its multiple uses in the construction sector as a building material, gypsum shows also great benefits in viticulture. Indeed, gypsum ($CaSO4•2H2O$) is an essential component during the establishment of a new vineyard, and for an ongoing vine nutrition, as it offers calcium to the vine. Gypsum acts as a soil fertilizer, as it encourages the formation of a better soil structure and facilitates the infiltration of water. Additionally, gypsum also helps to reduce wind and water erosion, especially in the early years of a vineyard establishment.



Bringing gypsum to the soil

Depositis of gypsum in the vine row to prevent surface crusting

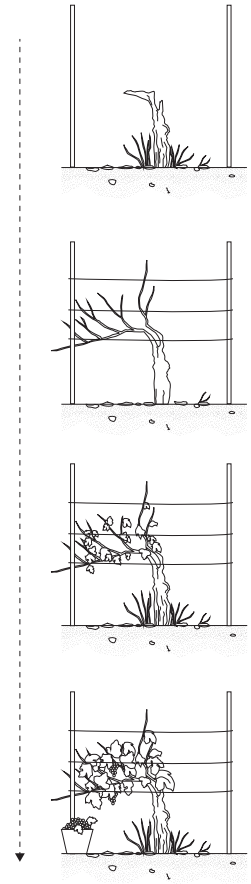
Cation	Common range
Calcium	60% - 80%
Magnesium	10% - 20%
Potassium	3% - 10%
Sodium	<6%
Hydrogen	<5%

Desirable ranges of cations in viticultural soils (Progressive Viticulture©)

Vernacular architecture

All the year along, according to the seasons, specific duties are executed by the viticulturist in the vineyard. The «guérite», small shelter usually placed in the middle of a vineyard, offers a variety of functions to the viticulturist and directly responds to the task done in the vineyard : a storage room for tools and materials, a shelter in case of bad weather, a resting place or a gathering space. These shelters, as well as the terraces are usually built with the local material available, mainly gypsum (region of Bex and Flanthey). An interesting observation is that the walls are usually built without mortar; however, through the years, due to rain, humidity, wind and heat, the stones melt together into a very solid and compact wall.

Guérite in Bex, built out of gypsum (rapazfreres©)



Season		Activity	Need
Winter	December Januar February	pruning : cutting shoots, branches and herbaceous parts trellising: providing a structure/support to the vine	Covered and warm shelter Storage space for tools/material
Spring	March April May	repairing winter damages (walls and terraces) disbudding : maintenance of the vines, removing non-fruiting branches	Storage space for tools/material
Summer	June July August	flowering leaf thinning: selective removal of shoots adding treatments: against fungus (powdery mildew) installation of safety net (against birds)	Shaded area
Autumn	September October November	checking maturity vendanges: harvesting vinification (transforming grapes into wine)	Resting/sitting area

Seasons activities

Although the work in the vineyard becomes more and more mechanized, the harvest of the grapes remains a manual and very exhaustive labor, especially when it's done on a steep landscape.

«Vendange», harvest season

Harvesting the grapes

Filling in crates

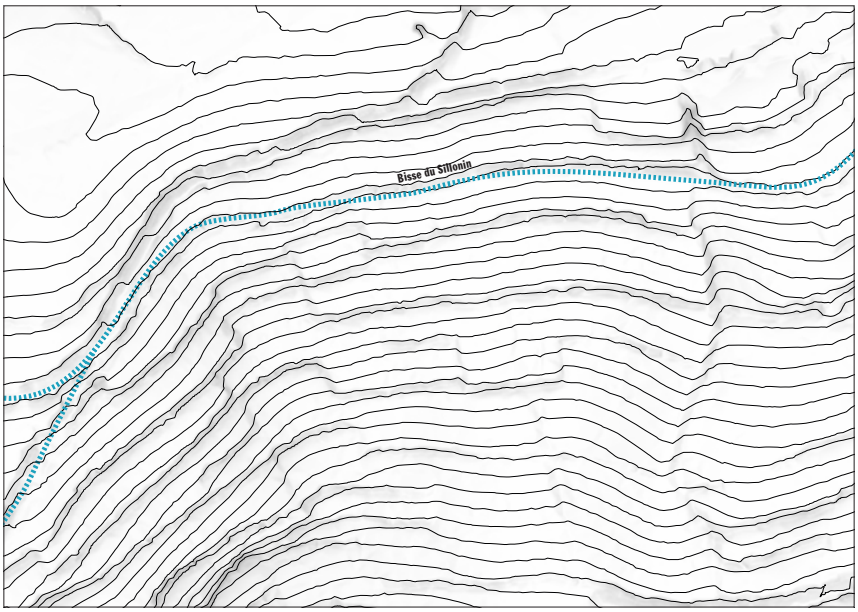
Carrying

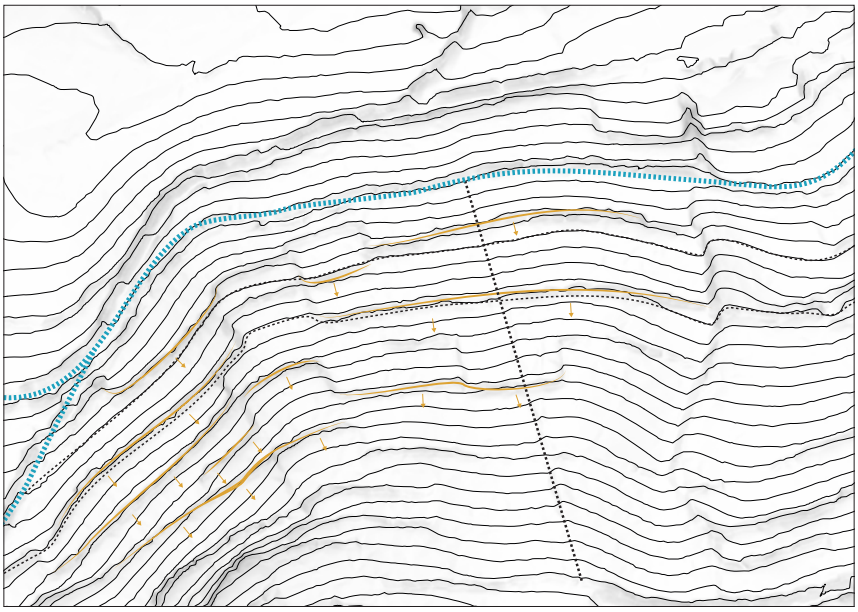
«L'égrappage» (éraflage): removing the grape stem

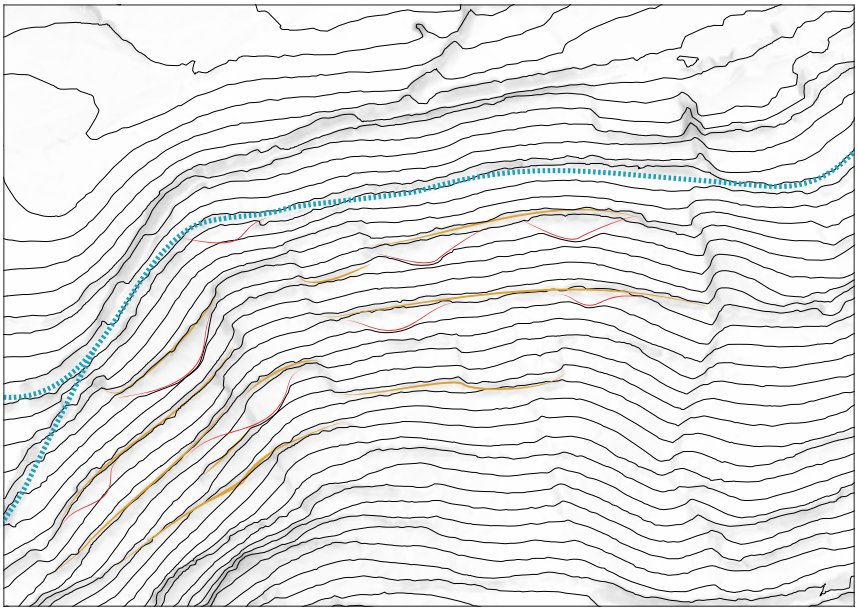
«Le foulage»: pressing the berries to extract the juice

The specific site is built on a very steep slope with terraces underneath the village of Flanthey. The project wants to rethink the site by giving to the locals of Flanthey a facilitated access to the vines, and serving the viticulturist at the same time. By following the existing terraces, a succession of spaces along the walls are created, defining closed and open spaces which could serve many purposes to the winemaker all the year along.

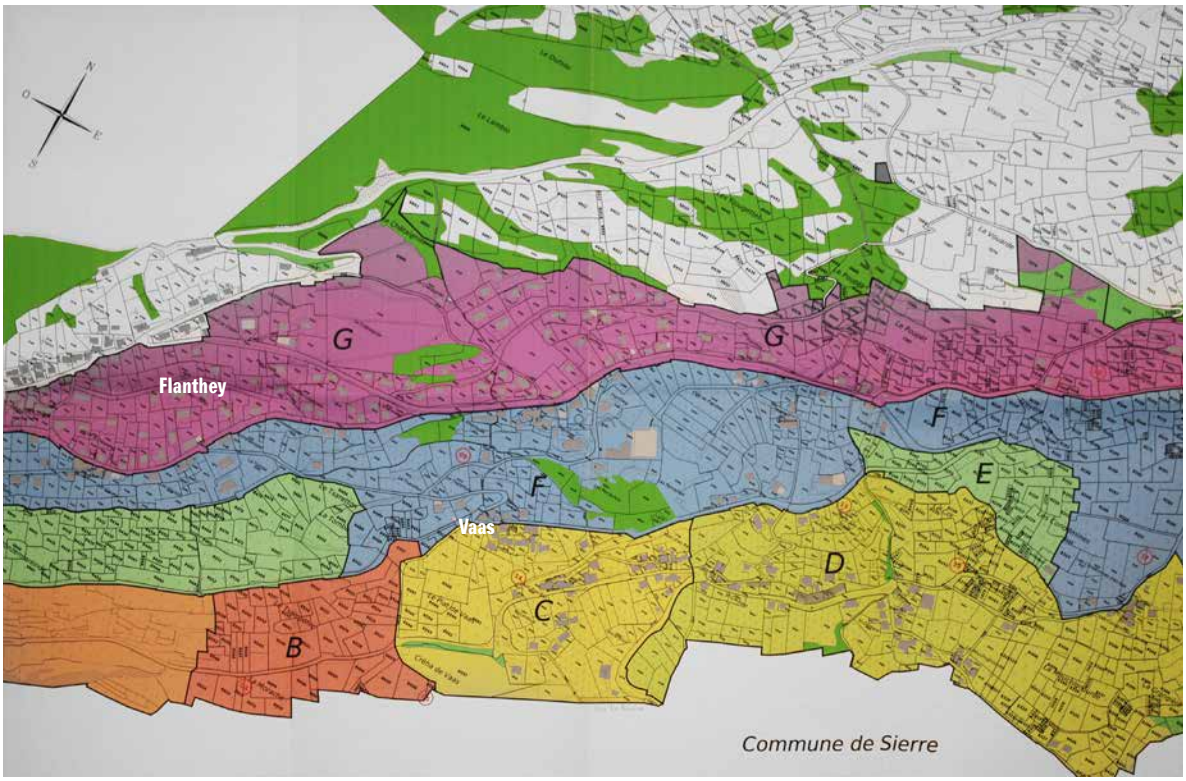

Flanthey
Site
Bisse du Sillonin
Gypsum quarry Rigips
Le Rhône


Bisse du Sillonin





By following the topography, successive spaces along the terraces are created, which could serve multiple functions : wine tasting room, storage space, resting area and gathering place. These spaces are not built as one compact building, but rather as several fragmented spaces, which are distributed along the slope to maximize the impact of the gypsum erosion into the soil.



Cadastral plan, region of Lens

TABLEAU SYNOPTIQUE DES PRIORITES D'ENCEPAGEMENT DE CHAQUE SECTEUR COMMUNAL - COMMUNE DE LENS

Pour de plus amples détails, se référer au descriptif de chaque secteur

CEPAGES BLANCS	SECTEURS D'ENCEPAGEMENT AVEC LES PRINCIPAUX NOMS LOCAUX OU CADASTRAUX							
	Orgival, Champ du mur, Ormy, Hombes	Morache, Champ du mur	Crête de Vaas, Vaas, Boccardoux	Vaas d'en Bas, St-Clément, Pischiou etc...	Hombes, Ionzemarenda Tsaméhro etc...	Creux de Flanthey Vaas d'en Haut Ormy, etc...	Chelin, Le Châtaignier, Gottres etc...	
	A	B	C	D	E	F	G	
Surface en ha	12.00	0.98	0.85	11.60	7.12	10.94	5.29	
Cépages précoces à très précoces	(Epoque de maturité 10 jours avant le Chasselas)							
Müller-thurgau							V V	
Cépages de 1ère époque à 1 à 2	(Epoque de maturité plus ou moins 5 jours par rapport au Chasselas)							
Chardonnay		V V			V V	V V	V V	
Charmont						V V		
Chasselas	V V	V V	V V	V V	V V	V V	V	
Savagnin blanc (1 à 2)	V V		V	V V	V	V		
Pinot gris	V	V V	V V	V V	V V	V V	V V	
Muscat (1 à 2)	V V	V	X	V V	V	V	X	
Pinot blanc	V	V V	V V	V V		V V	V V	
Sylvaner (1 à 2)	V V			V V		V	V	
Sauvignon blanc (1 à 2)					V	V	V	
Cépages de 2ème époque et 2 à 3	(Epoque de maturité 5 à 15 jours après le Chasselas)							
Amigne (2 à 3)	V V			V V	V V			
Chenin blanc (2 à 3)	V V							
Humagne blanc				V V		V		
Riesling						V		
Viognier					V	V		
Cépages de 3ème époque	(Epoque de maturité 15 à 30 jours après le Chasselas)							
Arvine	V V GC	X	X	V V GC	V	X	X	
Marsanne blanche	V V GC			V V GC				

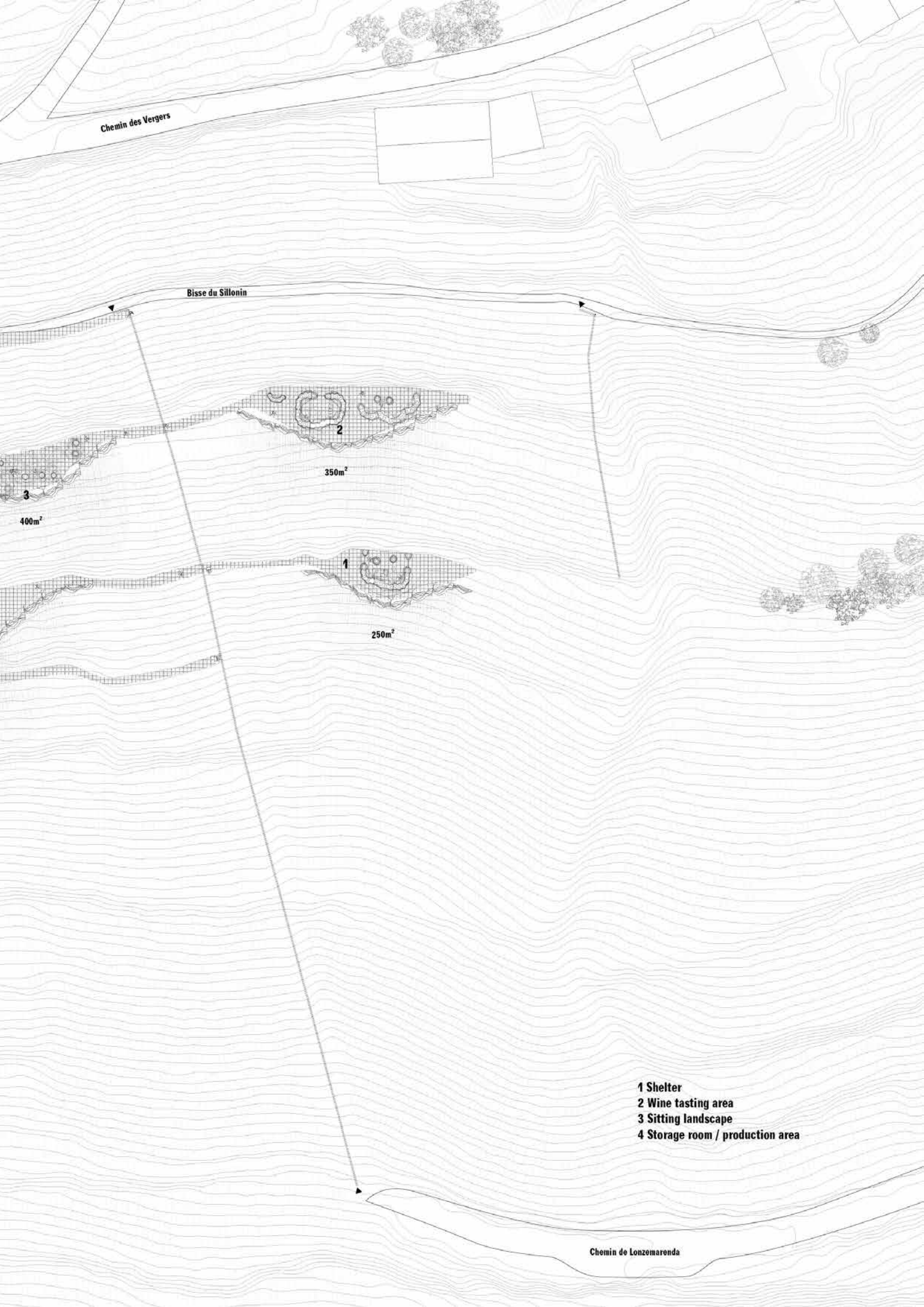
Classes de qualité des cépages selon l'Ordonnance sur la vigne et le vin du 17 mars 2004 avec les modifications du 20 juin 2007:

Cépage Grand Cru	V V GC	Cépage particulièrement bien adapté dans ce secteur ou partie de secteur et qui est réputé produire des vins de grande qualité (typicité des terroirs)
Cépage adapté	V V	Cépage dont on est sûr qu'il est garant d'un très bon vin dans ce secteur
Cépage autorisé	V	Cépage qui permet d'élaborer un bon vin dans ce secteur, mais pour lequel l'étude doit être approfondie
Cépage mal adapté	X	Cépage dont la qualité du vin dans est moyenne dans ce secteur et qu'il convient de changer à la prochaine reconstitution
Cépage interdit	X X	Cépage dont la qualité du vin est insuffisante dans ce secteur. Toute nouvelle plantation avec ce cépage n'a pas droit à l'AOC dès l'affinement et l'homologation des secteurs d'encépagement.

Grape variety, according to the area

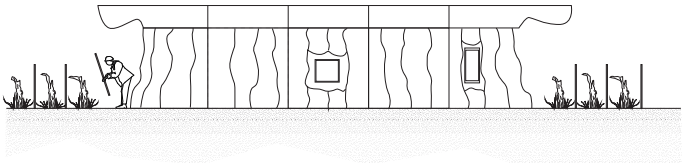
Depending on the soil composition in this region, a large variety of grapes can be cultivated.

Plan 1/200

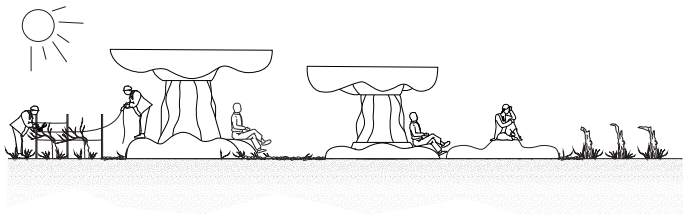

Chemin des Vergers
Bisse du Sillonin
2
350m²
3
400m²
1
250m²
1 Shelter
2 Wine tasting area
3 Sitting landscape
4 Storage room / production area
Chemin de Lonzemarenda

According to the season, the architecture can be used to serve the viticulturist or locals from Flanthey in their activities.

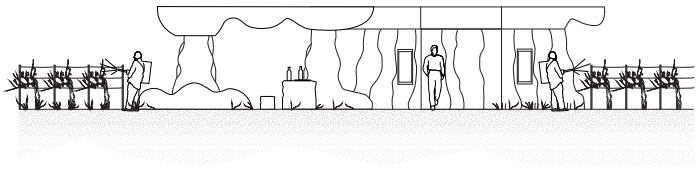
Winter



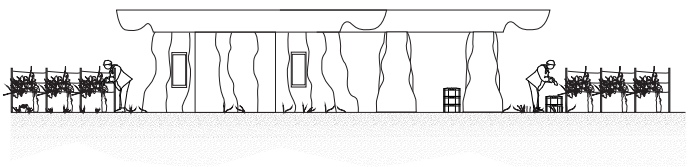
Spring



Summer

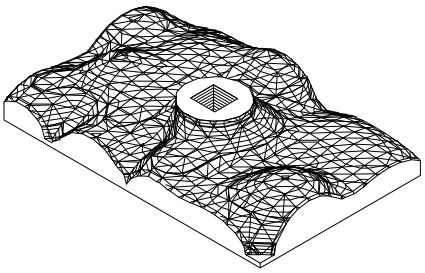


Autumn

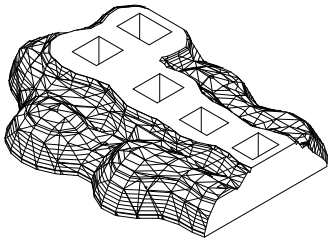


Shelter

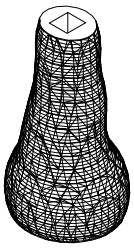
In winter, the shelter can protect the winemaker from the cold. The architecture of the shelter is completely closed to the outside, accessible from the side along the wall, and should remain as small as possible, minimizing heat losses. The reinforced wall terraces are used as a side support for the ceiling elements.



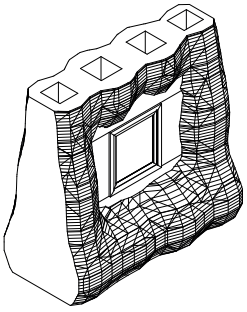
Function: Ceiling on column
Volume : 3.2 m^3
Weight : 9.4 T
Height : 0.5 m
Size : 2.5x4 m



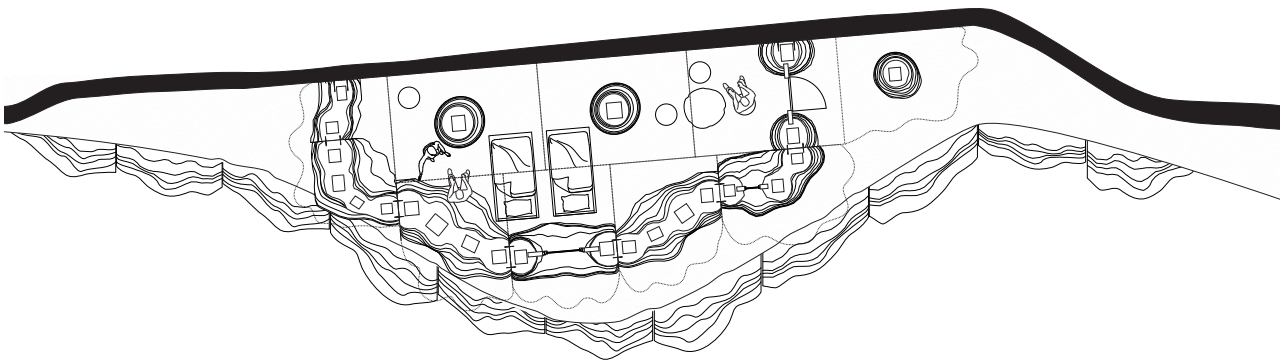
Function: Ceiling on corner
Volume : 2.7 m^3
Weight : 8 T
Height : 0.5 m
Size : 2.5x3.5 m



Function: Column
Volume : 1.8 m^3
Weight : 5.3 T
Height : 2.5 m
Size : 1.3x1.3 m

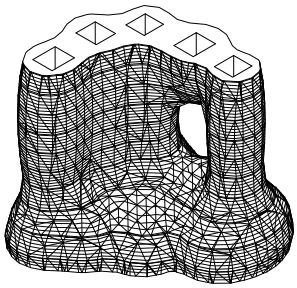


Function: Window
Volume : 3.8 m^3
Weight : 11.25 T
Height : 0.6 m
Size : 2.5x1.3 m

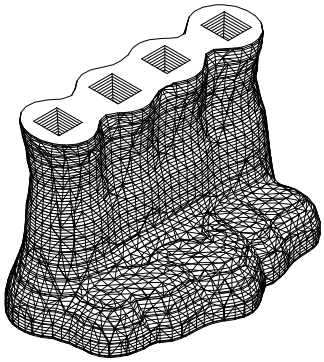


Wine tasting space

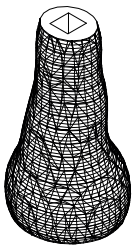
The wine tasting area is used as a gathering place for the locals of Flanthey. The architecture consists in a semi-closed space in which people can gather inside, protected from the wind, but always remaining in close contact to the vines, surrounding the space.



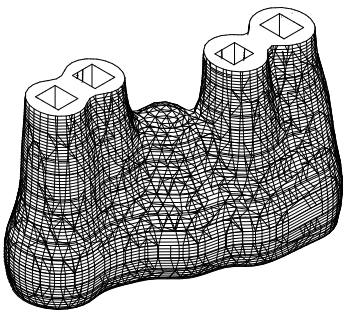
Function: Corner space + sitting element
Volume : 5.1 m^3
Weight : 15 T
Height : 2.5 m
Size : 4x2.5 m



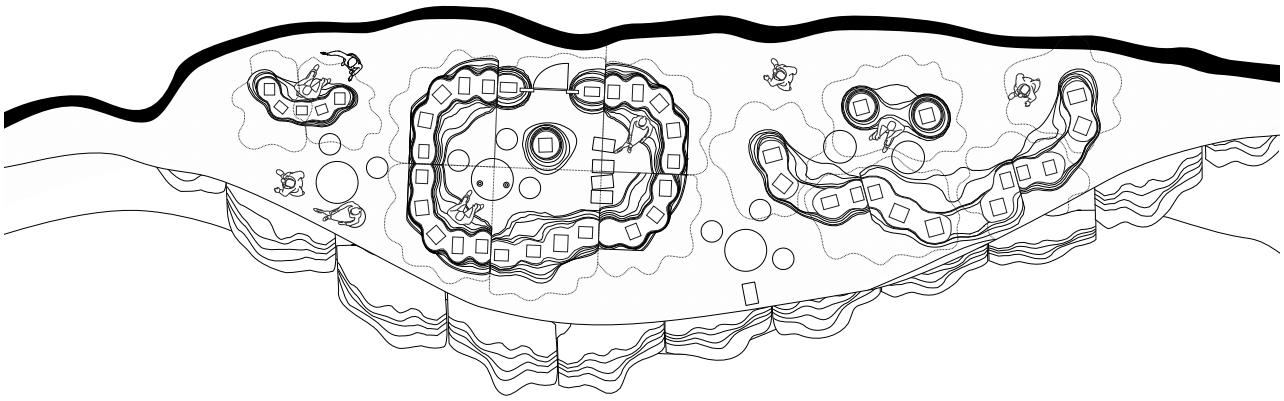
Function: Wall + sitting element
Volume : 7 m^3
Weight : 20 T
Height : 2.5 m
Size : 4x3 m



Function: Column
Volume : 1.8 m^3
Weight : 5.3 T
Height : 2.5 m
Size : 1.3x1.3 m

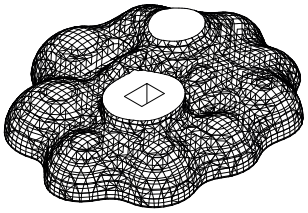


Function: Wall column
Volume : 6.6 m^3
Weight : 19.5 T
Height : 2.5 m
Size : 4x2.5 m

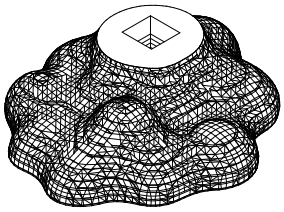


Sitting space

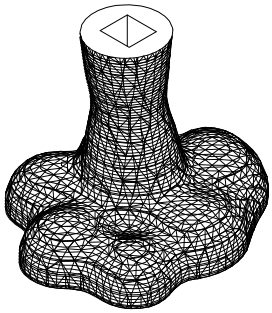
In summer and especially during hot days, the shaded areas offer to the viticulturist a resting space close to the vineyard. The architecture consists in an open space, composed of a constellation of pieces assembled together. The reverted ceiling elements are used to build a sitting landscape on which people can lay down. The ceiling elements are supported by columns connecting the ground elements.



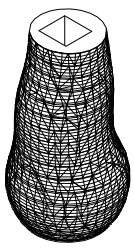
Function: Ceiling on column
Volume : 3.4 m^3
Weight : 10 T
Height : 0.5 m
Size : 4x4 m



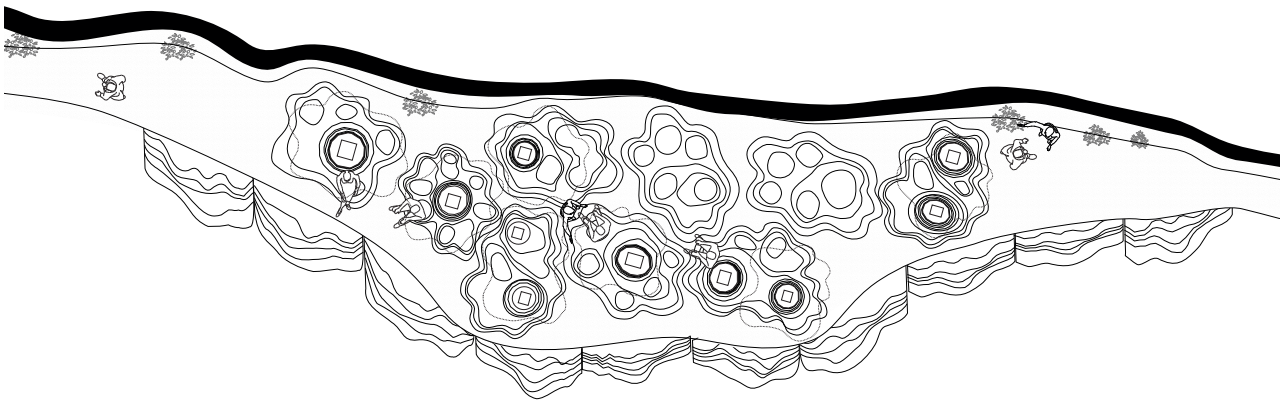
Function: Floor
Volume : 2.5 m^3
Weight : 7.4 T
Height : 1 m
Size : 3x3 m



Function: Sitting column
Volume : 3.5 m^3
Weight : 10.3 T
Height : 2.5 m
Size : 4x3 m

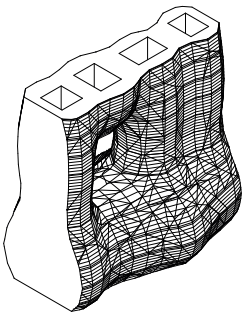


Function: Column
Volume : 2 m^3
Weight : 5.9 T
Height : 2.5 m
Size : 1.3x1.3 m

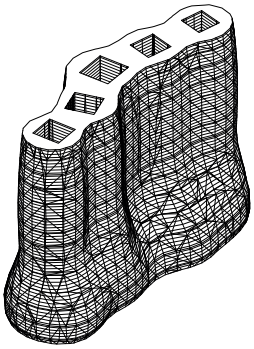


Production space

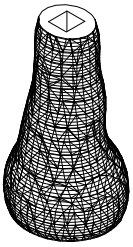
During the harvest season usually taking place in September, the storage / working area can be used as a temporary space for storing the harvested grapes. The architecture consists of a closed storage room on one side and an open working area on the other side.
Indeed, before transporting the grapes to the wine cave for the vinification, the stem has to be removed from the berries. This task is usually done manually or with the help of a sorter processing line, and therefore needs a large space.



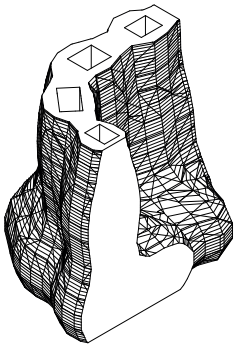
Function: Wall + opening
Volume : 4.1m³
Weight : 12.1 T
Height : 2.5m
Size : 2.5x2m



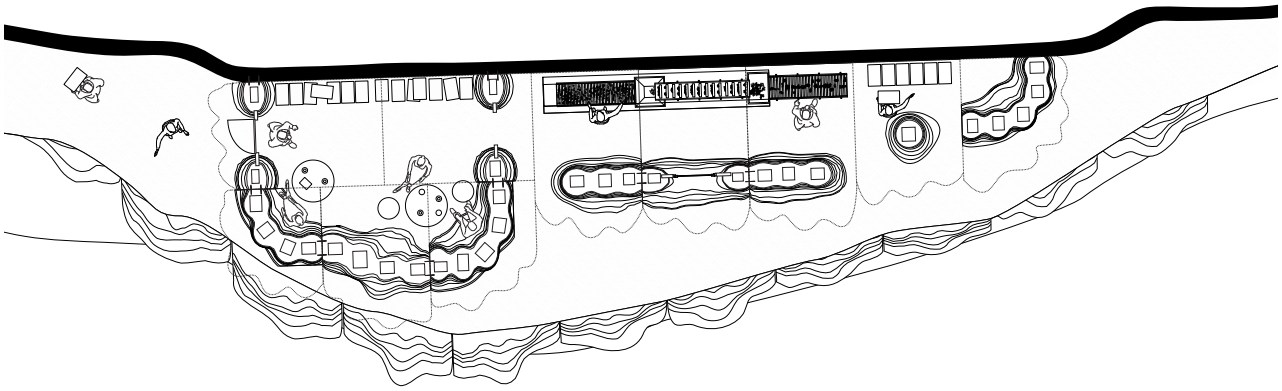
Function: wall
Volume : 6m³
Weight : 17.7 T
Height : 2.5m
Size : 4x2m



Function: Column
Volume : 1.8m³
Weight : 5.3 T
Height : 2.5m
Size : 1.3x1.3m

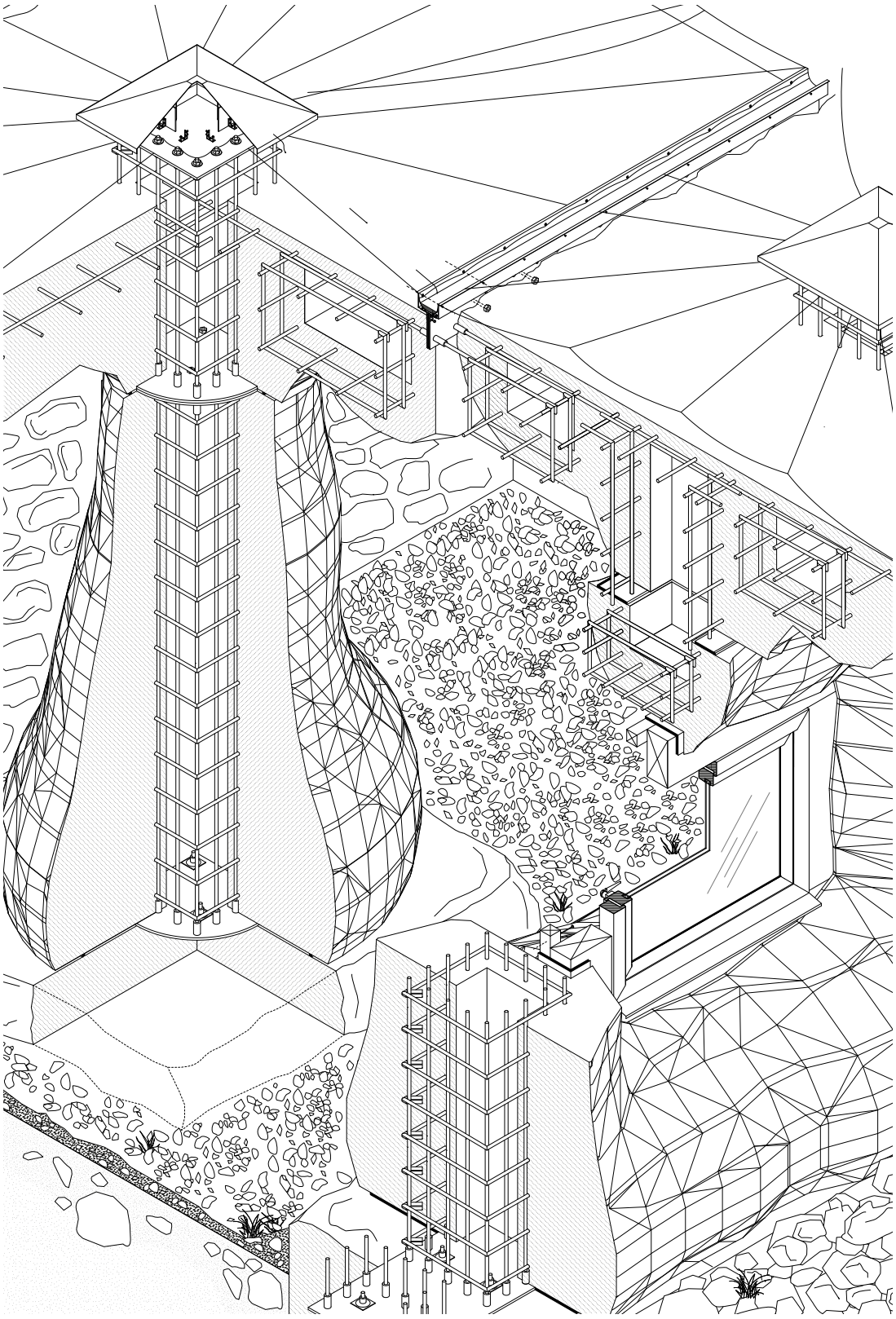


Function: Corner
Volume : 5.5m³
Weight : 16 T
Height : 2.5m
Size : 2.5x2.5m



The shape of melting

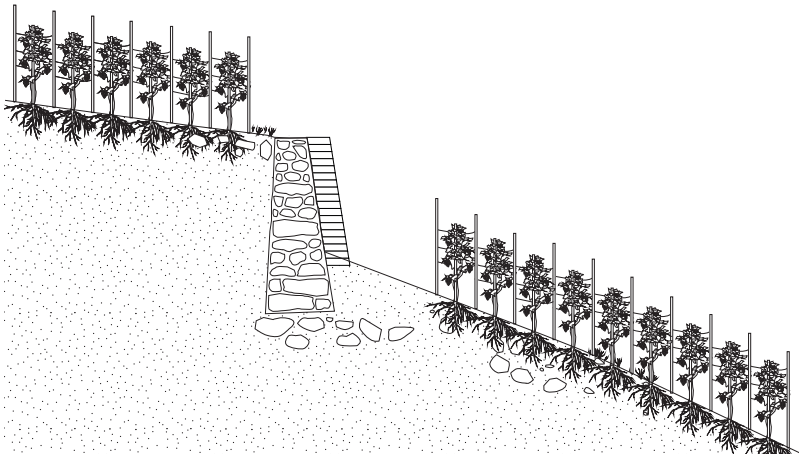
Nicolas Carlier Master's Thesis
Studio Anne Holtrop FS22



Construction

1. Building process: in between terrace

1



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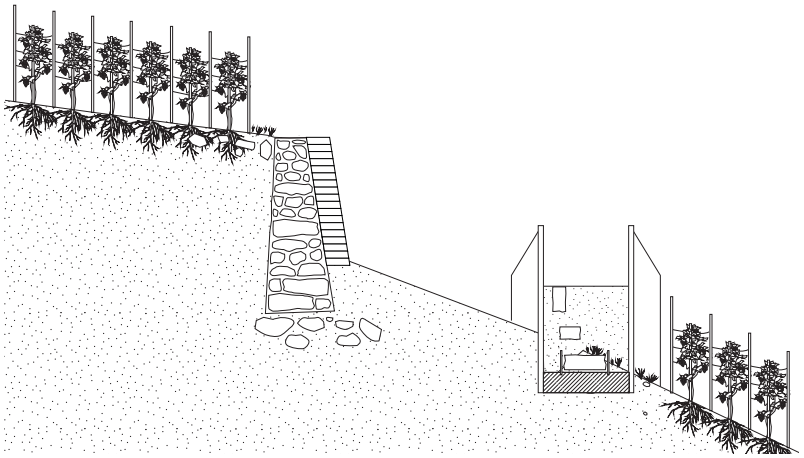
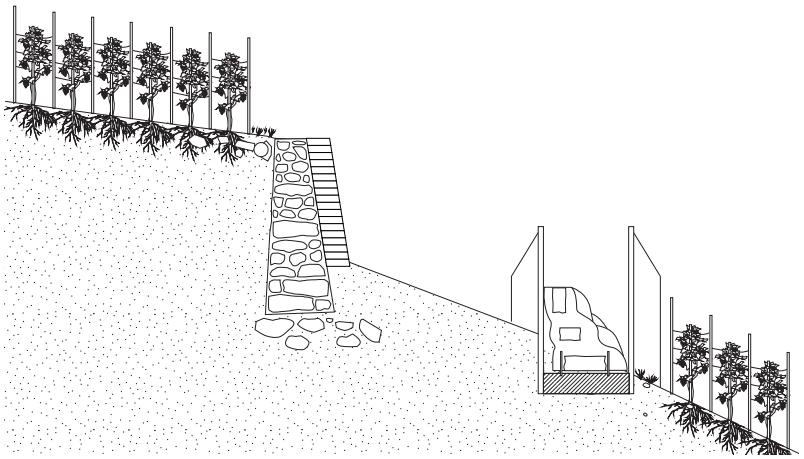


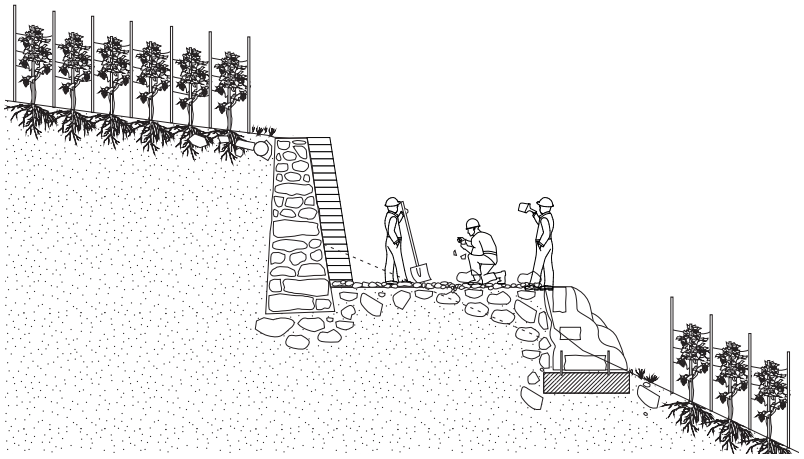
3



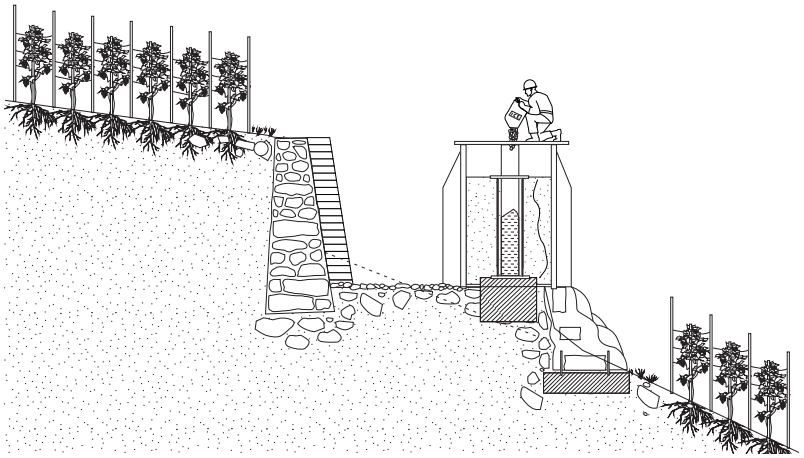
To face the issue of the steep slope [1], an intermediate wall in between the two existing terraces has to be built. A temporary formwork is built and filled with plaster powder from the gypsum quarry of Granges (Rigips), close to the site [2]. While filling the box, ice blocks made from crushed ice are inserted into the formwork. By letting the natural process of ice occur, the final shape of the wall is progressively produced [3]. The terrace wall sits on the ground since this element is meant to erode over time, bringing the minerals to the vines.

Building process: vertical elements

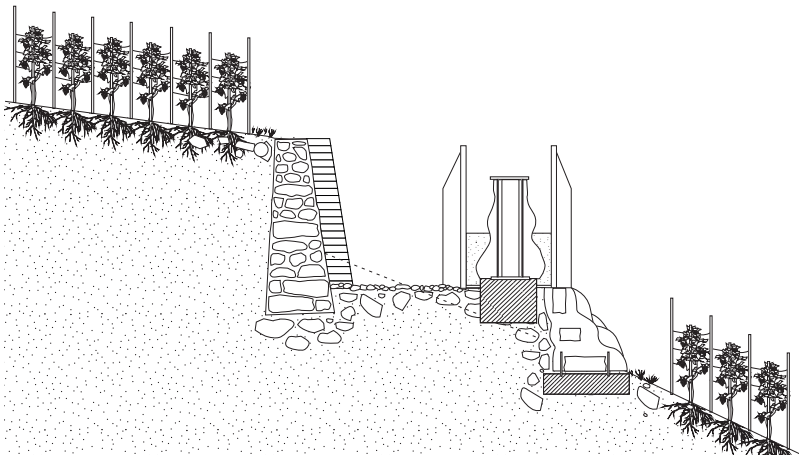
4



5

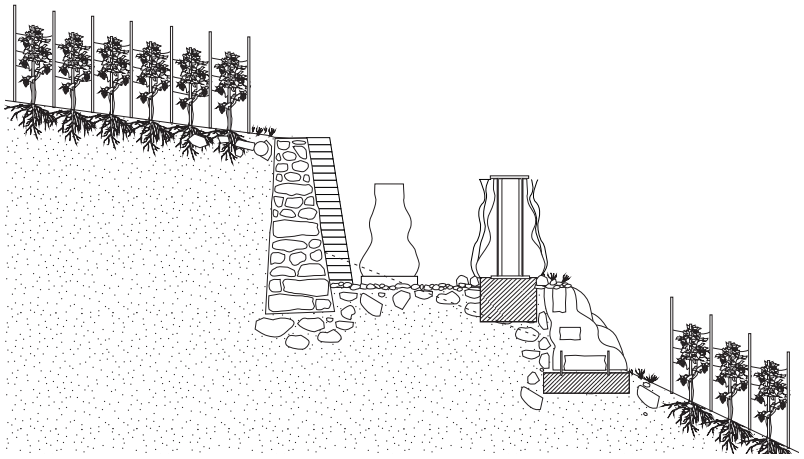


6



After building the intermediate wall, the terrace is filled using natural gypsum rocks found in the area, as well as the excavated earth [4]. Before casting the vertical elements, a stone foundation out of natural gypsum is placed. The vertical elements are then casted on top of the stone foundation, re-using the same formwork built before. To reinforce these elements, steel bars are added around the ice blocks [5]. When the ice melts, the steel reinforcement gets embedded inside the gypsum.

Building process: horizontal elements



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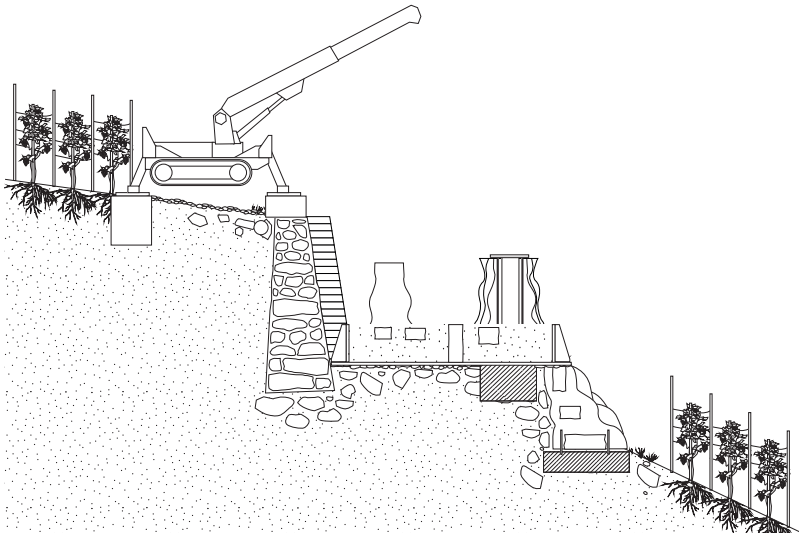

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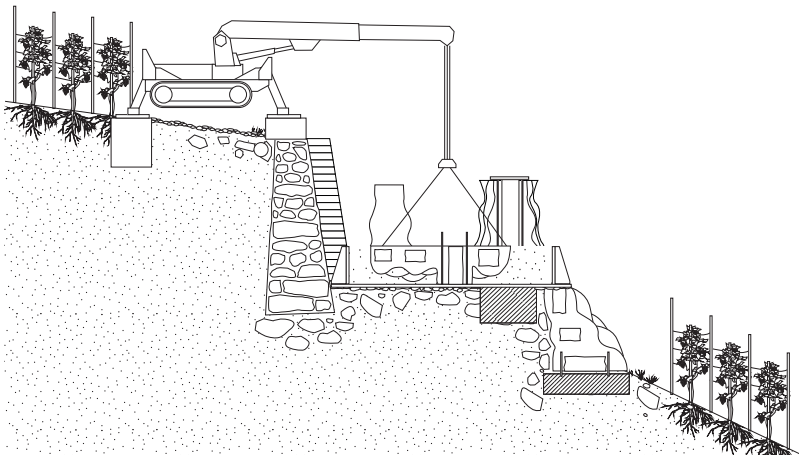
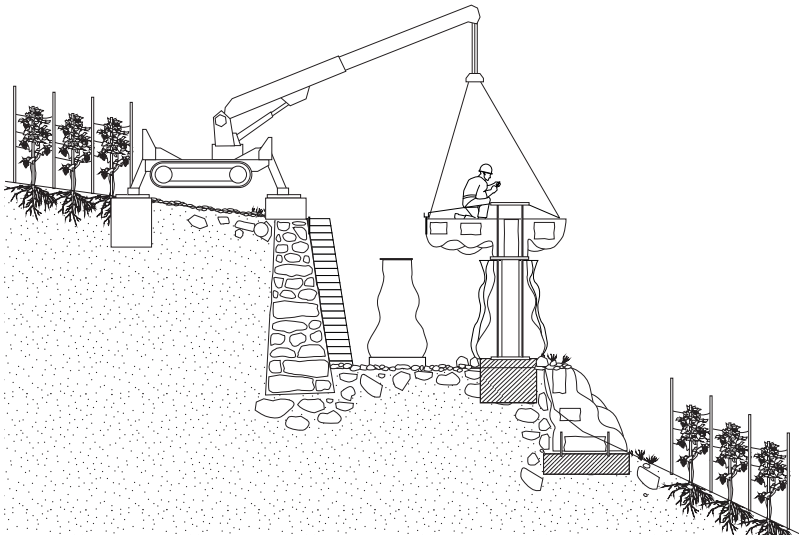


9

The horizontal elements are casted on the ground. To produce these elements, a rectangular formwork is set up right next to the vertical elements [8]. Once the ice melting process occurred, the element is lifted up from the ground using a mobile spider crane with 10 tonnes capacity [9], and assembled on top of the vertical structure using a bolted connection.

Building process: erosion

10



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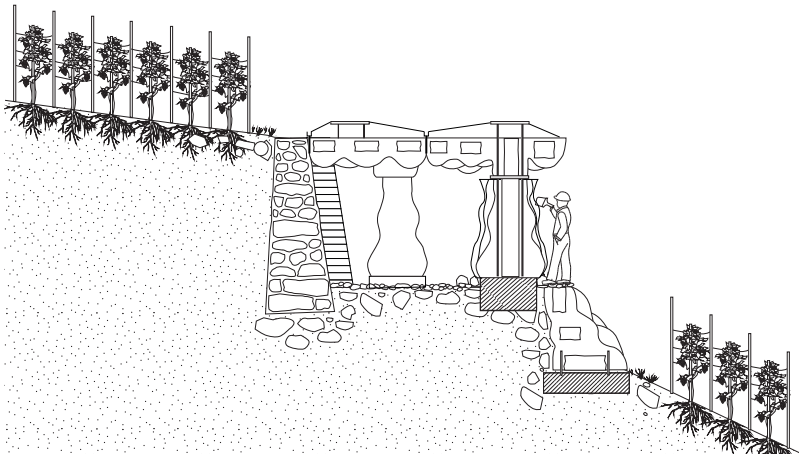

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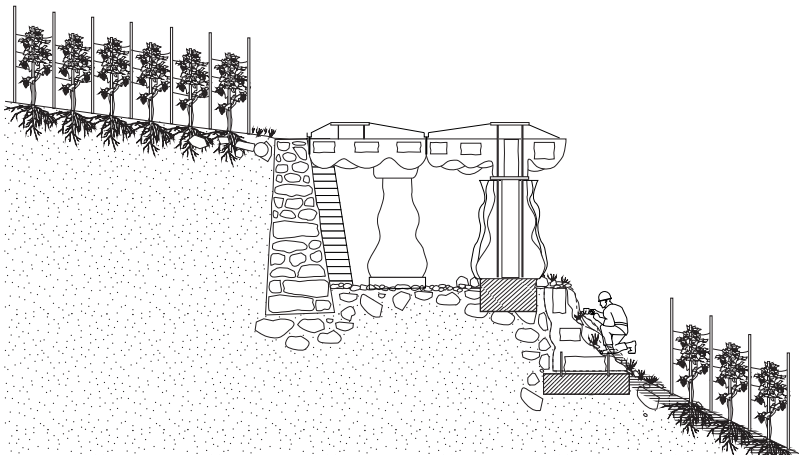
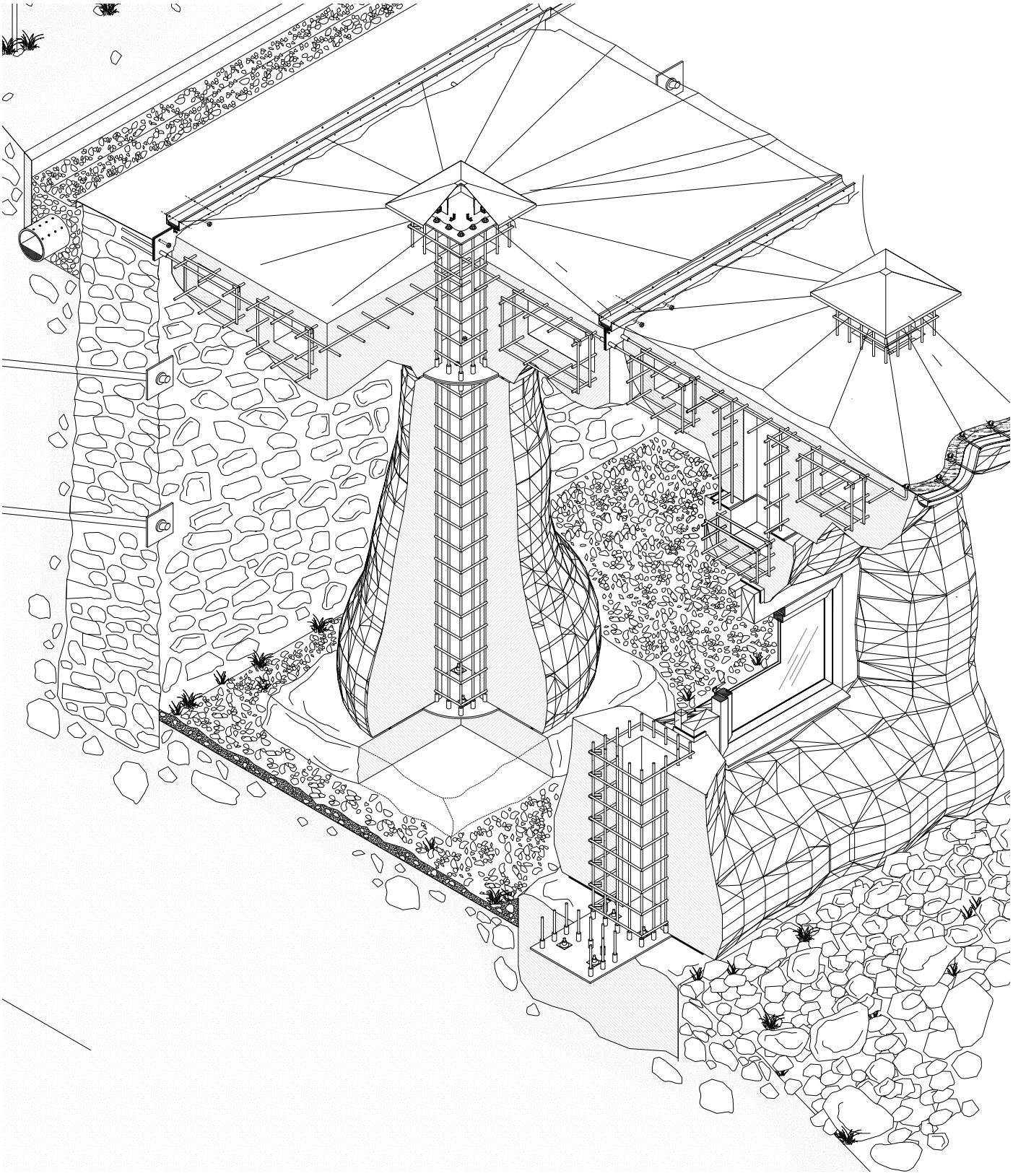


On the roof, steel cables can be added in case of a large span to bring the load down to the main column. Additionally, textile is added as a covering material to bring the water out of the building. The outside surface is covered with a water-resistant varnish to slow down the process of gypsum erosion. Indeed, over time, the gypsum is meant to erode bringing the needed nutrients to the vines (as detailed in booklet 4 about the site).

Assembling details



Natural gypsum blocks found on site from the gypsum quarry are used as a foundation element.

The different elements like the ceiling, wall and column are bolted together when assembled. Two steelplates welded to the reinforcement bars are brought together and bolted from above the ceiling. A waterproof sealant is added in between a wall and a ceiling element to protect the steel reinforcement from corroding and to avoid the water to infiltrate through this joint. A similar joint is used to connect two ceilings together by applying a waterproof sealant in between the steel plates.

The existing wall terrace are reinforced using soil anchors, since the wall serve as a support for the ceiling elements. To avoid the rain water from the top of the hill to flow down onto the roof, a drainage system is installed right behind the existing walll.

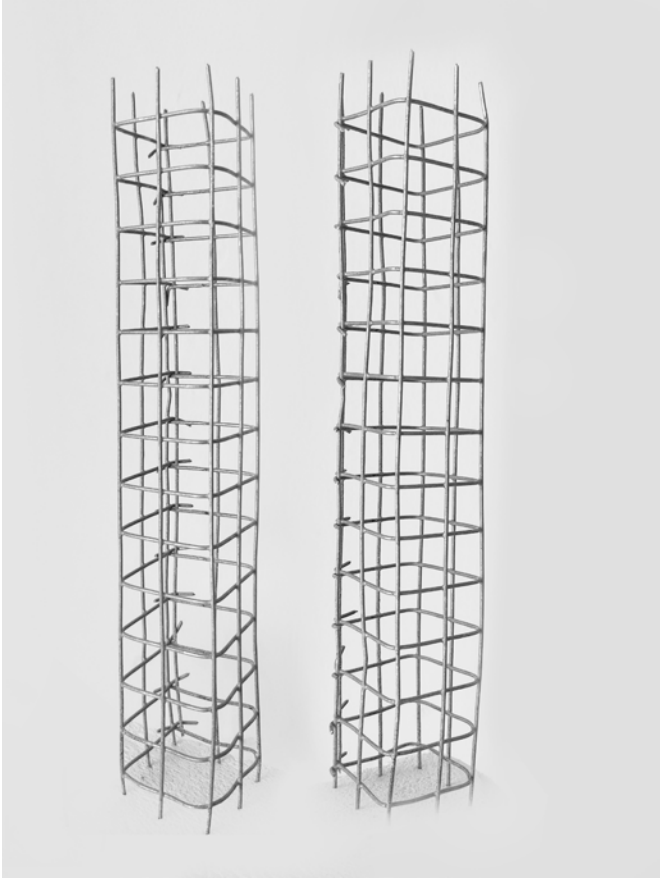
The roof elements are covered with a waterproof textile in order to bring the rainwater out of the building. Thus, in-between two ceilings, a gutter is attached to the steel plate joint connection, which, at the same time, serves as an anchor for the textile. The wall and ceiling exposed to the rain and humidity are treated with a waterproof coating.

3. Reinforcement

Window

Door

Corner



When adding the ice, steel bars are inserted into the formwork around the ice blocks, as a reinforcement. When the ice melts, the reinforcement gets embedded inside the gypsum.

Joint column / foundation stone

Assemblage Column / foundation stone

Column on foundation block