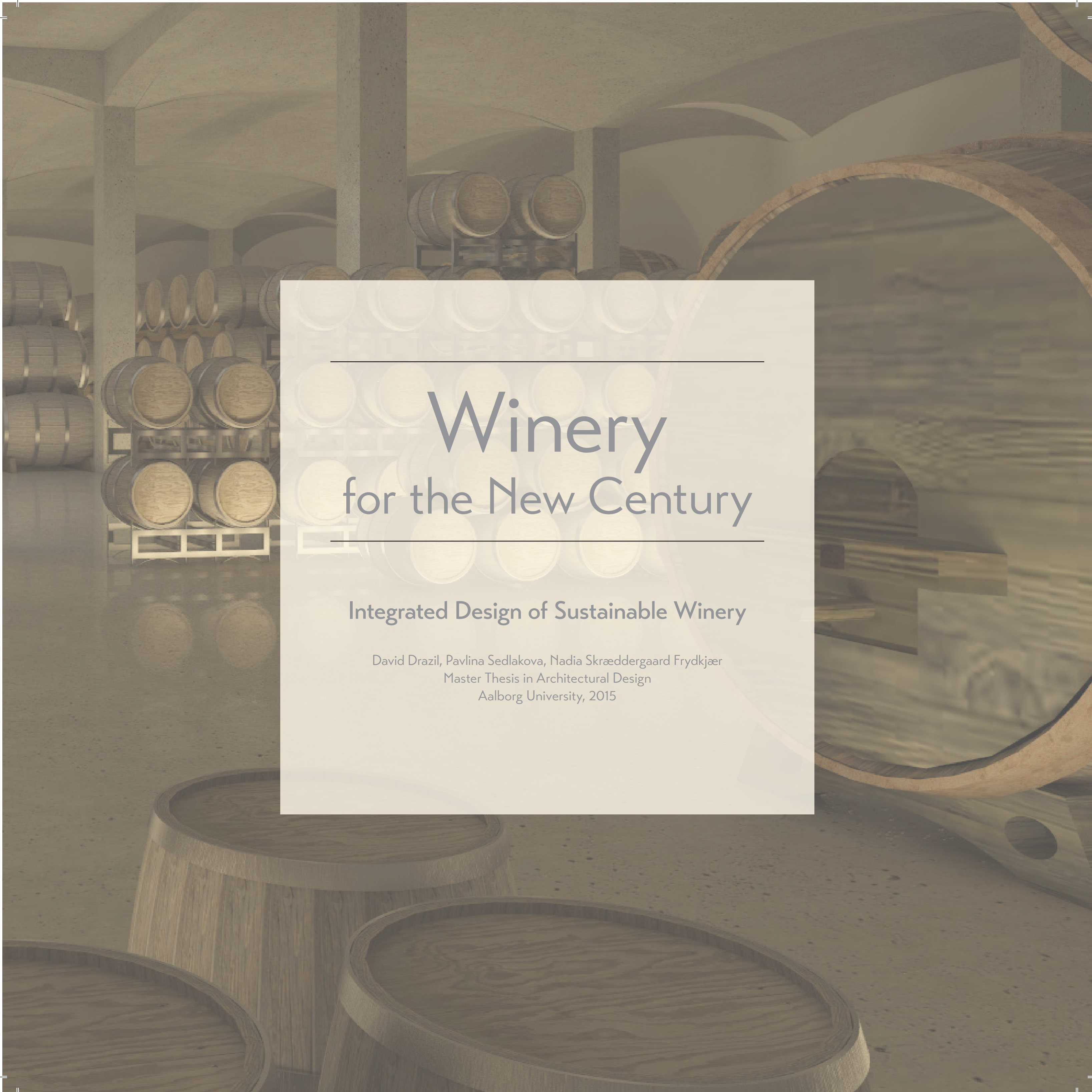

Winery
for the New Century

Integrated Design of Sustainable Winery

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Master Thesis in Architectural Design
Aalborg University, 2015

Colophon

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Abstract

This Master Thesis proposes a new design of a well-established winery in Negrar near Verona, Italy. The aim is to strengthen the social character of the company while integrating cultural functions as well as attracting tourists to this peculiar wine hub.

Wine is the core of the design, so the production has to be clearly organized and uncompromised. In the same sense, different sets of experiences for visitors have to be continuously and thoughtfully built up. The contrasts between the Industrial and Residential together with well-considered Flows have formed a driving force for the design. Furthermore, the technical knowledge has been constantly informing the architectural decisions so a truly integrated design has been achieved.

Acknowledgement

We would like to express our special thanks and gratitude to these people and institutions. This Master Thesis could not have been successfully conducted without their unfailing support, helpful guidance, and valuable inputs. Thank you.

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Our Families and Friends

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Preface

The Master Thesis is carried out by David Drazil, Nadia Skræddergaard Frydkjær, and Pavlina Sedlakova, who are students on the 4th semester in 2016 of the Master programme in Architecture and Design at Aalborg University in Aalborg, Denmark.

The theme of the Master Thesis is Winery for the New Century, focusing on integrated design of a sustainable winery located near Verona, Italy.

Reading Guide

After the brief introduction to the topic, where the motivation and problem has been pre-stated, the six main parts are following; each covering different aspect of the project.

The **Analyses** part concludes on the most relevant information gained during the research phase and the Design principles have been defined in info-graphical boxes. As a final part of the Analyses section, a more elaborated and informed Problem is stated, followed by a Vision for the solution.

The **Ideation** section is narrowly focused on explaning the conceptual ideas and solutions.

The **Presentation** offers a large scale overview of the project, where the design highlights and the engineering results are described from a perspective of the building's users.

The **Design Process** coveres and summarizes the iterations which have been analysed through the project and the results have served as a basis for decision making on the way to the final design solution.

The Conclusion and Reflection is located in the **Epilogue** chapter. The **Appendix** contains what is relevant for understanding the design decisions, but not the essential.

Motivation

Since Wine is a product deeply and historicaly rooted to European society, it represents a symbol of tradition, connection, craft, and high spirits.

The strong contrast between Wine as a trigger of emotions and Wine as an industrial product resonated with our wish for trying something we haven't dealt with yet. This very specific initial topic can be understood and challenged in a number of ways, from an almost scientific approach oriented to maximal efficiency to a merely tactile and poetic attitude. The openness of the theme allows for imagination, for telling stories about past, and for creating new narratives by designing sophisticated spaces. On the other hand, professional winery is nowadays an industrial facility with a lot of demands regarding both technological process and indoor environment. These two poles do not exclude each other, but they can mutually complement and create integrated solution where the technical and engineering demands inform the architecture during the design process.

Industry in general is a great source of pollution and large consumer of energy and resources. This specific field is actually very clean in terms of direct pollution and waste, but the inconsiderate layout of production parts in many wineries allows for large energy savings simply by passive means. Therefore, it is interesting to investigate how the architectural intentions can be integrated with the technical goals in order to reach a responsible design. The climatic conditions in Italy is very different from those in Northern Europe In Italy there is a big potential for exploitation of solar radiation for energy production, but at the same time the climate implies a threat in the form of unwanted heat.

“ The winery design covers everything from a scientific approach to a merely tactile and poetic attitude.

Since architecture has the power to affect the way people perceive, not only spaces around them, but also how they experience food and beverages in such spaces, the integral part of the winery design is the investigation on how the spaces should be organized and designed in order to provide the foremost impression to the customer. This brings for us the opportunity to explore the potential of new technologies for visual presentation, such as Virtual Reality (VR). We believe that there is a great potential for such a tool during the design process were we aim to investigate its advantages and limitations from the perspective of architects.

Methodology

At Aalborg University, the Problem-based Learning (PBL) methodology is the core of its educational model. An authentic problem has to be defined as a point of departure. A solution to that problem should be proposed in a form of a project of high academic standard which is carried out by a group of students. The group work is based on self-government and mutual collaboration, supplemented by a supervisors' guidance during the process. [AAU, 2015]

The solution of a defined problem can be reached by following a number of different paths where there always can be more solutions to the specific problem. This project is dealing particularly with sustainability in the field of Architecture and Engineering and aims to result in a holistic and complex design piece combining, among others, aesthetics, functionality and technical solutions. In order to ensure that all relevant parameters have been taken into consideration, the methodology of Integrated Design Process (IDP) has been followed.

The five phases of IDP presents a structured approach to successfully handle the complexity of the design process with a truly integrated result. During the loops among different phases (of neither fixed, nor equal time-duration), various tools contribute to the development of a final design [Knudstrup, 2004]. The project has followed this methodology throughout the whole design period using the design phases described on the diagram on Fig. 1.

OTHER METHODS USED DURING THE DESIGN PROCESS

The time scheduling has been used as a project management method for planning and time-management.
The radar chart has been used as it allows to compare more values and more design options in one diagram.
Virtual Reality has been tested as a new design tool with possible usage already in early phases, enabling designers to experience the space with correct scale, depth and lighting conditions.

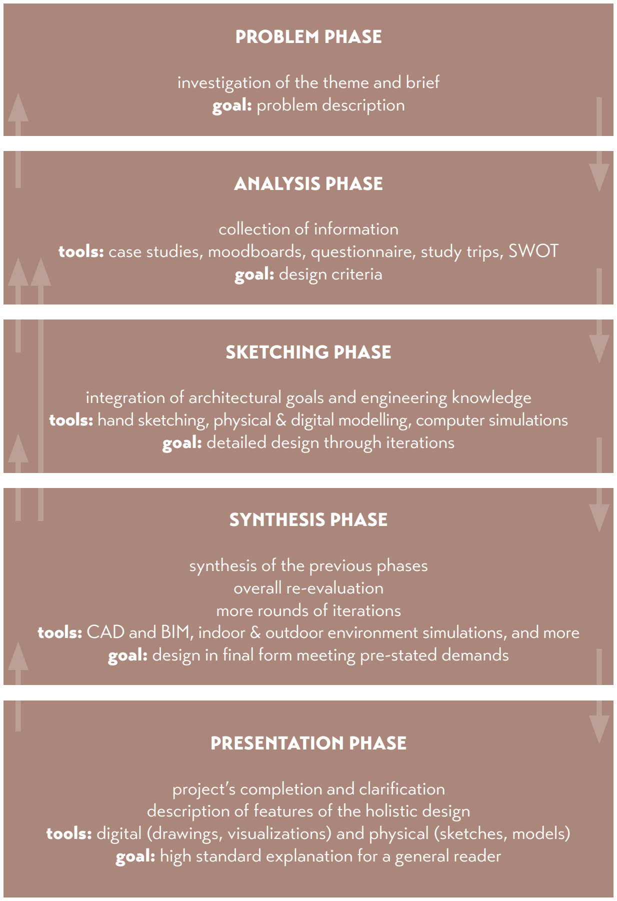


Fig. 1. Application of the Integrated Design Process methodology

Introduction

The cooperative company of Cantina Valpolicella Negrar is deeply rooted in local history and society and continually contributes to a number of working opportunities in the region. However, the ambition of the owners is to promote the prestige of a well-recognized brand and transform the current industrial facility into a catalyst for culture, tourism and research. The building which hosts the production nowadays can be described as a "patchy and controversial multilayered maze" [YAC, 2014, p. 5] without efficient internal connections and with no spaces suitable for interaction with the public. Therefore, the complete re-design of the winery and its outdoor areas have been suggested in order to reach the settled goals.

" The ambition is a transformation of an industrial facilitiy into a catalyst for culture, tourism, and research.

According to the regional Chamber of Commerce, the Veneto region is characterized by the highest number of tourist per year in Italy [VR Camcom, 2016]. The tourism is mostly based on natural attractions and historical heritage [Romano and Natili, 2010]. However, majority of tourists also come to experience local food and wine. The wine tourism is growing and is considered to be a driver for rural economy and social development. What is more, the wine tourism has low environmental impact and high respect for both the territory and identity. [Presenza, 2010] This high potential brings challenges for the architects, who should solve how the winery's position in the wine-network could be strengthened by architectural design in order to attract more tourists to the area and at the same time provide benefits for the local community. Moreover, the design needs to respond to the high energy demands of an industrial facility, especially by integrating smart passive and active energy strategies within the design.

The resulting architecture aims to be clear and honest in its expression, providing both carefully designed experiences for the visitors and employees while the production itself is efficient and functionally organized. The local and wine-making tradition must be respected, but refined with innovative approach to design and technology.

01

Analyses

In this section, the academic and practical knowledge is collected while relevant design principles are extracted. The refined and elaborated Problem statement emerges as a conclusion of the section and the Vision for the problem's solution is outlined subsequently.

Framework

Since the wine-making process is based on traditional principles and experiences, the architect's deep understanding of this complex procedure is essential for a well-designed outcome. In this chapter, the results from comprehensive analyses regarding the problematics of wine-making will be described.

The point of departure has been taken in traditional principles, knowledge, and experience which has been personally studied from professional wine-makers in Italy, Denmark, and the Czech Republic (for more information about methods and conclusions, please see Appendix). From this basis, the aim of this project is to investigate how these principles are influencing architecture and how they can be translated into contemporary language using modern technologies.

> *“Wine is not just an object of pleasure, but an object of knowledge; and the pleasure depends on the knowledge.*
>
> - Roger Scruton

The Wine Cycle

The wine-making process is in its pure scheme clearly linear, however, the architecture is influenced by a number of other inputs; the most important parameters are further showcased on the Case studies (see p. 18). On this spread, the journey of the wine will be explained as it represents the design criteria for the functional layout of the wine production.

The diagram on Fig. 2 describes the simplified wine-cycle with the specifics of the Cantina Negrar's procedures from a harvest to a final bottled product. The harvest is split into two parts: first (October) is highly selective and only the best grapes are transported in boxes to the winery and then dried for three months. The second harvest is full-range (November) and the grapes are analysed and weighted while entering the winery and than directly unloaded to a crusher. From the crusher, the juice, together with the skins, is immediatelly running through a hose to a fermentation tank. Once the dried grapes reach the optimal chemical composition (February), they are loaded to the grape crusher as well and fermented afterwards. The duration of the upcoming phases is depending on the particular end product and is a matter of business secret of the wine-makers. The following procedure is simplified as for a general product by Cantina Valpolicella Negrar (CVN).

The November fermentation is faster and lasts for 6-10 days and it is ended by a significant temperature drop, pressing, and skin removal. Afterwards, the wine matures in steel tanks and the duration, again, depends on the product - however, it can take up to 1 year. Part of the wine is refined, filtered and bottled, part is mixed with juice which has undergone different procedure, and is maturing for another 15-20 days. After this period, the wine is released to the bottling line system. The bottles are corked, labeled, packed in cardboard boxes and stacked on palettes. However, they are not ready to be dispatched, but the bottles have to age in a dark storage with controlled temperature for 4 to 6 months. Once the ageing period is over, the palettes are loaded on trucks distributed.

The Amarone wine, the company's best known product, is made of the dried grapes and the procedure is slightly different from the one described above. After fermentation, the wine is maturing in oak barriques and barrels (of volume up to 50 hectoliters) for up to 5 years. After this period, the wine is pumped over to the stabilization tanks, refined, and prepared for bottling.

This description outlines the complexity of the processes leading to a quality wine products created by CVN. The sequence of spaces required for the production is described on Fig. 3. **The Analysis zone, Grape Drying Hall, and Grape Crusher** has to be easily accessible for small trucks which are delivering the grapes. Furthermore, the Crusher has to be connected by hoses (possibly through the ceiling) with the **Fermentation tanks**, which has to be adjacent both to the **Maturation barrels** and the **Bottling line. Storages for bottle ageing** are required before the final product can be loaded on trucks and dispatched [information has been provided by Cantina Valpolicella Negrar and for purposes of this text has been simplified].

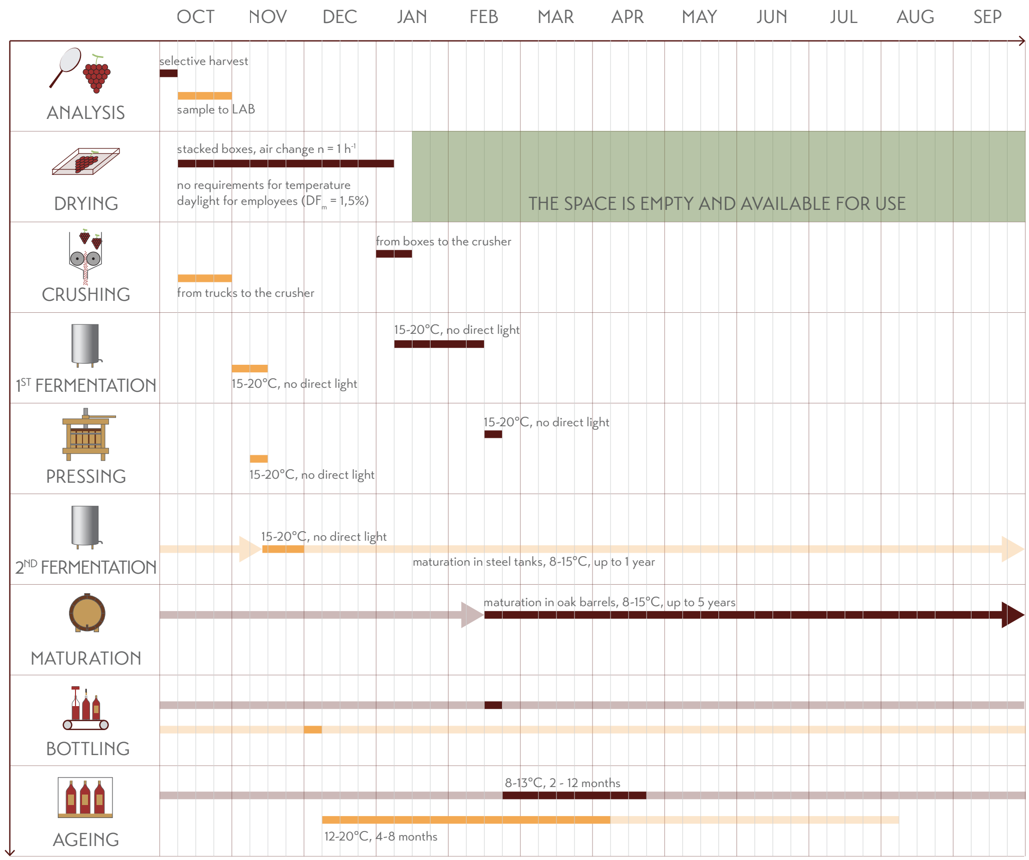


Fig. 2. The simplified Wine Cycle presented on a Gantt Chart along with the requirements for the production spaces. In theory, the sequence of processes on Y-axis would represent an ideal Gravity Flow principle (for the case study on Gravity flow see p. 22), which is in reality hard to achieve.

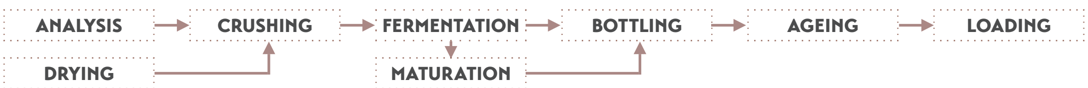


Fig. 3. Sequence of required spaces for wine production at Cantina Valpolicella Negrar

Fig. 4. Antinori Winery in Italy is one of the finest examples of contemporary wine-architecture dealing with interaction of visitors and production [Tstyleme.com, 2016]

Case Studies - Wine and Architecture

In order to get a relevant insight into the design of contemporary wineries, several cases have been studied. Since the proposed design has a focus on combination of smart technical solutions with architectural spaces providing extraordinary experiences, a number of excellent examples focusing on desired parameters have emerged. On the following pages, case studies with these features will be analysed:

- Interaction between the production and visitors
- Overall sustainable approach of winery design
- Solutions related to optimization of energy consumption
- Spatial organization utilizing gravity flow principle

The characteristics of important parameters from each of the case studies has been described and the learning outcomes has been concluded.

EXPERIENCES AND WINE PRODUCTION

The project of Antinori Winery by Archea represents an example of architecture designed for Wine and Visitors. Visual connection and sensory perception are amplified as the experiences are clearly defined and assigned to the specific spaces. In this way, the architecture is assisting in building up the complex picture of wine-making.

The landscape is ultimately merged with the building by burying the volume to the hill and planting vineyards on the roof. This solution provides for thermal stability and optimal level configuration for the wine production while respecting the aesthetics of the natural panorama. The designed flows of wine and visitors are arranged contrapositively so the visitors follow the path from "bottle to grape" (Fig. 6). The efficient functional planning is supported by the structural clarity as illustrated on Fig. 5 and Fig. 6.

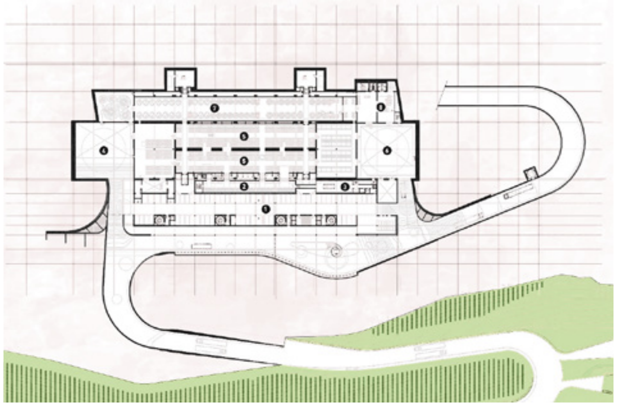


Fig. 5. Regular structural grid with the dimensions 10 by 10 meters ensures efficient spaces in the production [Antinori.com, 2016]

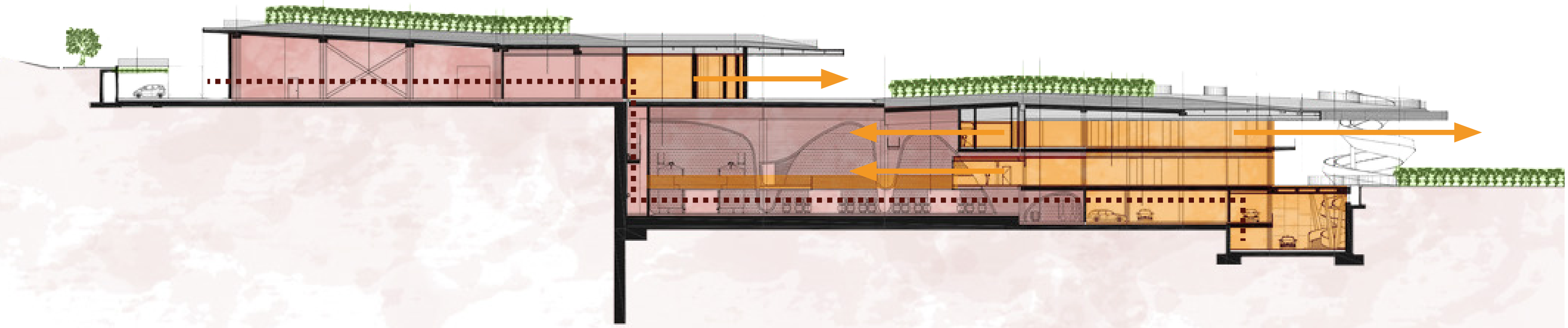


Fig. 6. The cross-section describes how the production (■) and visitors (■) are interacting within the building's volume [Antinori.com, 2016]

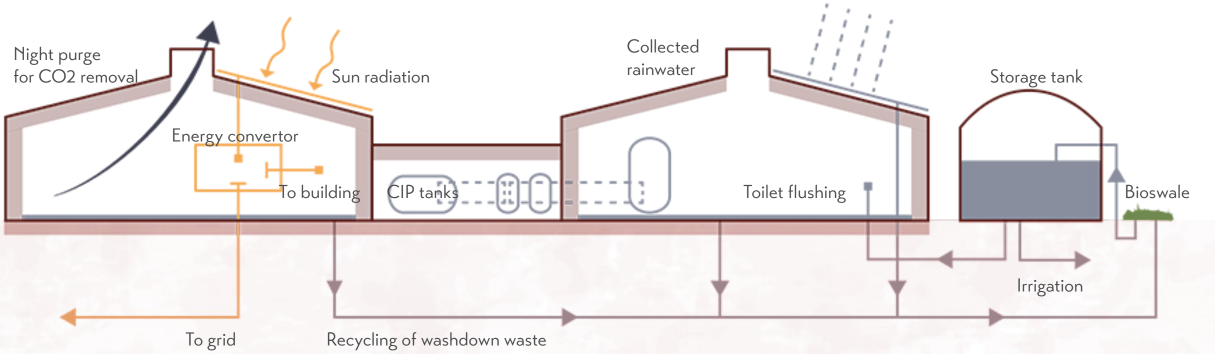


Fig. 7. Descriptive diagram of sustainable highlights of the UC Davis Research Center - an example of Zero Energy Wine-making Facility [Inhabitat.com, 2016]

SUSTAINABILITY IN CONTEMPORARY INDUSTRIAL WINE PRODUCTION

UC Davis Research Center is a good example of application of sustainable principles to a design of an industrial wine-making facility. It showcases the following principles (some of them captured on a diagram on Fig. 7 which will be a source of inspiration for the project proposal):

- High performance insulation
- Night air purge
- Electricity generation from solar radiation (PV's)
- Rainwater management
- Clean-in-place (CIP) equipment management
- Visual connection to outdoor spaces

Moreover, the principles of passive sustainable winery design defined by Chauncey (2006) are listed below and will be followed during the design process:

- Reduce heat gain/loss by placing production underground
- Increase shading coefficient
- Increase daylighting levels
- Increase views to the outdoors
- Increase natural ventialtion
- Reduce potable water usage
- Adapt spaces to a flexible use
- Create building with mass

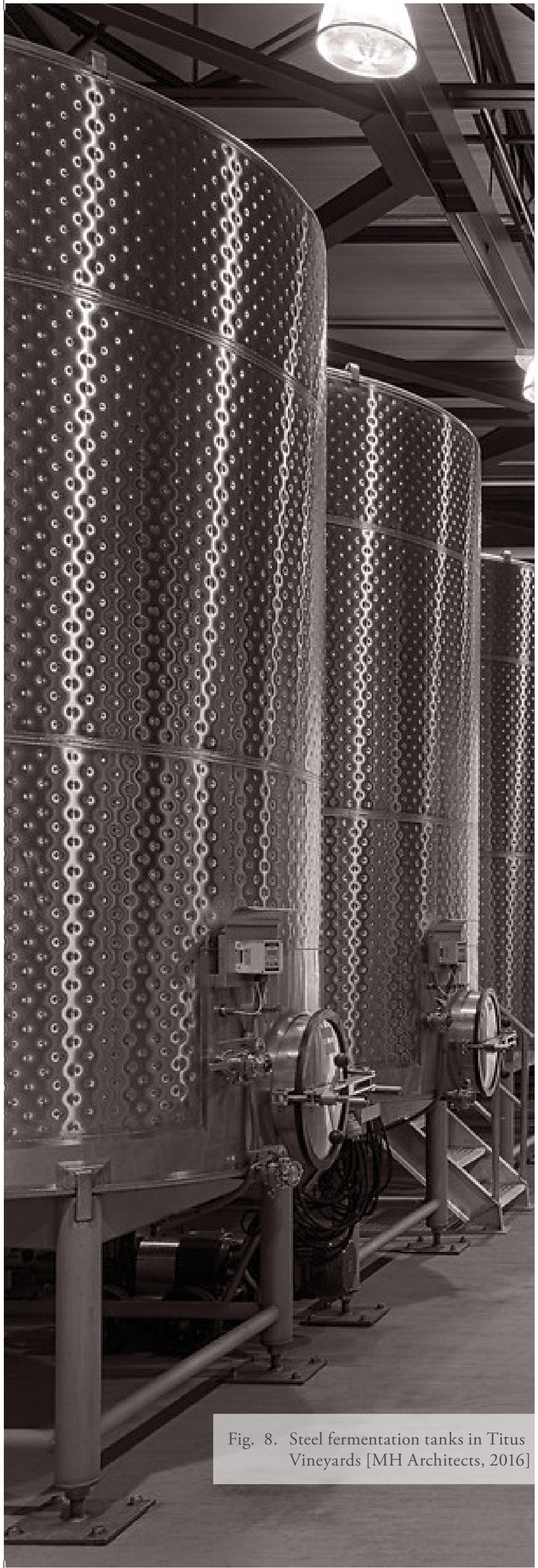


Fig. 8. Steel fermentation tanks in Titus Vineyards [MH Architects, 2016]

MODELLING OF HEAT TRANSFER IN TANKS DURING FERMENTATION

According to the research on „*Modelling of Heat transfer in tanks during wine-making fermentation*“ conducted by Colombié, Malherbe and Sablayrolles (2007) the following has been concluded:

- Best simulation results have been obtained for the tanks being placed indoors (in comparison to an outdoor placement).
- Results from the study are applicable to industrial scale.
- *„The model can now be integrated into new control systems for wine making, for example to optimize the use of tanks and the energy required to cool the entire winery.“*
- The parameters of the tanks cannot be changed significantly, therefore it is necessary to focus on variables which have high impact on energy consumption and can be controlled.
- Indoor air temperature and controlled air speed can be used to significantly decrease the power required to cool the tanks inside a cellar.

Therefore, the design will consider indoor tank placement as optimal for energy savings. For the simulation of indoor environment, the heat transfer from the tank to surrounding air is negligible if the room’s design temperature is kept in a range from 15°C to 20°C. For more information and calculations, please see the Appendix.

GRAVITY FLOW

This principle is a well regognized solution for sensitive and natural wine-making procedures as it utilizes natural gravity force for gentle wine transport. The cycle starts at a highest point with destemming and pressing the grapes, then fermented on a lower floors, matured in a bottom cellar and finally bottled. While energy is saved as pumping is avoided, what is more, the pumping itself is causing irreversible damage to the wine and thus is kept to a necessary minimum or avoided entirely [based on the interview with J. Thrysøe, 2016]. To make use of these benefits, the proposal aims to incorporate the gravity flow principle to a largest possible extent from the beginning of the design process.

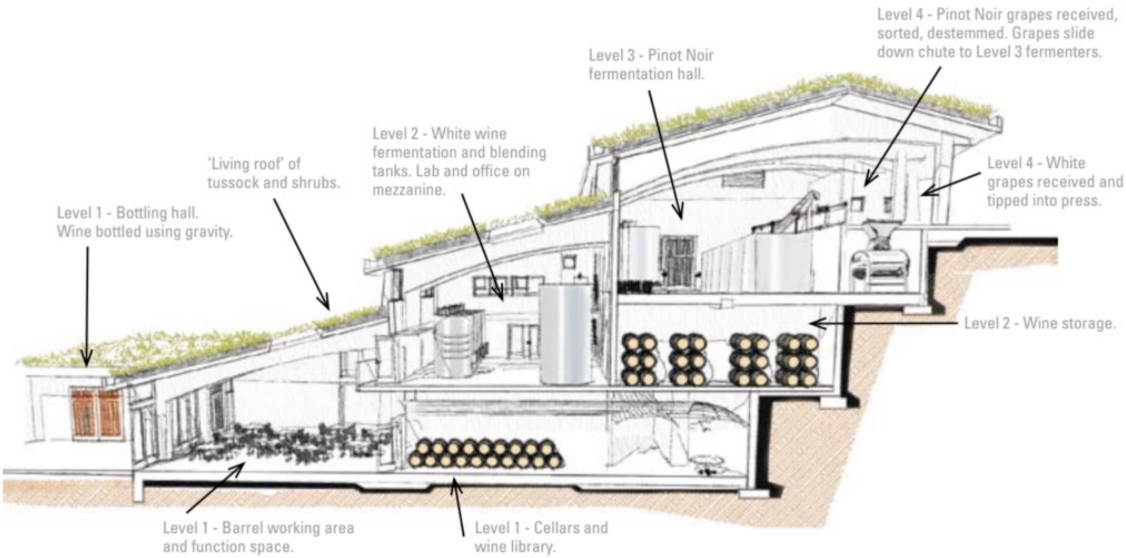


Fig. 9. Section of Woollastone Winery in New Zealand which is utilizing the gravity flow principle in its full potential [Guldbækvingaard.dk, 2016]. However, the scale of the production is significantly smaller and the topography also differs from the conditions existent at the project's site.

THERMAL BEHAVIOUR OF TRADITIONAL UNDERGROUND CELLARS

According to a research carried out by Mazarrón (2009), underground wine cellars are good example of bioclimatic construction providing optimum conditions for maturing wine with no energy consumption. The process of maturation needs low temperatures and no sudden changes in temperatures which are provided by soil properties.

This traditional principle will be applied and evaluated during the design process and furthermore enriched by contemporary technology. The diagram on Fig. 11 describes how the temperature stability increases with the depth under the surface. Based on this knowledge, both the fermentation and maturation hall will be placed underground.

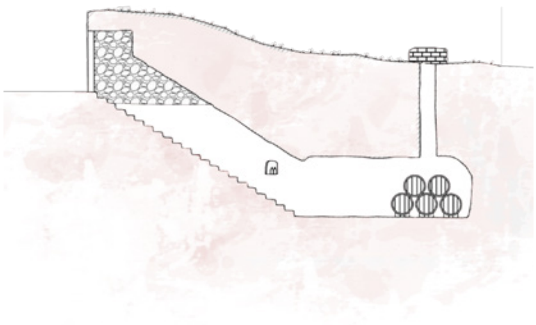


Fig. 10. Traditional cellar in Northern Spain - the temperature range is equal to Northern Italian [Mazarrón, 2009]

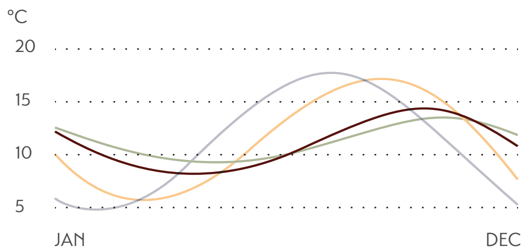


Fig. 11. Ground temperature during a year at a depth of 1 m (■), 3 m (■), 5,5 m (■), and 7 m (■) [Mazarrón, 2009]

Sustainable Principles & Goals

Firstly, the energy consumption has to be reduced to a possible minimum, but the user comfort and production demands cannot be compromised. The principles and demands of the wine-making are further described in "The Wine Cycle" on page 16. This text will focus on the requirements and principles for the other related functions (spaces for visitors and employees).

In order to reduce energy demands, passive strategies will be implemented during the whole design process. The design shall enable naturally driven ventilation (cross-ventilation and stack effect) and exploit the possibitilies of building with thermal mass (heavy concrete structure for greater temperature stability) and ground properties (see p. 23). Overheating shall be prevented by keeping the openings relatively small and shaded, but with respect to daylight factor (where required) and, most importantly, visual connection to the outdoors. Outdoor spaces should be consciously designed and passively cooled by vegetation, water pools, and shaded by buildings' volumes or light timber structures (principles derived from the context analysis). Once the energy consumption is minimized, active on-site energy generation shall contribute to the grid and counterbalance consumed energy.

Fig. 12. Vinícola Cuna de Tierra (CCA):
massive structure,
shading by vegetation and volume itself
[ArchDaily.com, 2016]

Fig. 13. Mame Printing Press Roof (J. Prouvé):
natural light in a factory,
large span concrete structure
[Designboom.com, 2016]

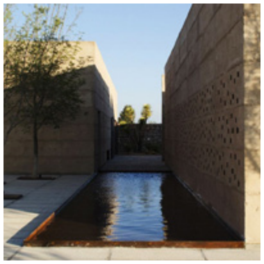


Fig. 14. Vinícola Cuna de Tierra (CCA):
outdoor comfort - water and shadow
[ArchDaily.com, 2016]

ENERGY & COMFORT

COMFORT & ENERGY GOALS

ZERO OR NEARLY-ZERO STANDARD
ON-SITE ENERGY GENERATION
STABILE INDOOR ENVIRONMENT
VISUAL CONNECTION
NATURAL DAYLIGHT

ACCOMMODATION & OFFICES

TEMPERATURES IN RANGE OF 20-27°C
CO_2 IN CLASS II (EN15251)
VISUAL CONNECTION
SOLAR PROTECTION
DAYLIGHT FACTOR 2% AT THE OFFICE

PASSIVE STRATEGIES

NATURAL VENTILATION

CROSS-VENTILATION
STACK EFFECT
NIGHT CO2 PURGE & FREE COOLING
OPTIMALIZATION: FAN ASSISTED VENTILATION

THERMAL STABILITY

STRUCTURAL THERMAL MASS
SOIL THERMAL MASS
RELATIVELY SMALL OPENINGS
SHADING SYSTEMS

GREEN ROOFS

WATER RETAINMENT
THERMAL STABILITY
UV PROTECTION FOR STRUCTURAL LAYERS
AESTHETICS

PASSIVE COOLING FOR EXTERIOR

VEGETATION
LIGHT SHADING STRUCTURES
WATER POOL
ENABLED AIR MOVEMENT

❝ Wine is a real value that gives us a sense of the unreal. But, above all, I have faith in good wine and I think that all those who believe in it will be saved.
- Luigi Veronelli

DESIGN PRINCIPLES

LEARNING OUTCOME
FROM CASE STUDIES

GRID	SENSORY EXPERIENCE	UNDER-GROUND CELLARS	VISUAL CONNECTION	WINE CYCLE
GRAVITY FLOW	TANKS PLACED INDOORS	THERMAL MASS	FLEXIBLE SPACES	NIGHT PURGE & FREE-COOLING

As a result of the analyses phase, a number of design principles have been defined. These principles have generated a driving force for the design and have been acting as a strong foundation for the iterations during the design process.

Claudio Oliboni

Viticulturist | Cantina Valpolicella Negrar

WINE PRODUCTION
[BOTTLES PER YEAR]

7

million

The Program

Cantina Valpolicella Negrar has expressed their ideas and whishes regarding the winery re-design through a competition brief in the year 2014. For the purpos of this thesis, this brief has been specified after personal visit in the winery to clearly state the meaning of the building. Furthermore, the target groups have been defined at this stage.

The current business strategy of Cantina Valpolicella Negrar (CVN) is to process quality wine from grapes delivered from more than 230 local vine-growers. The locality and the brand is well-recognized both internationally and domesticaly. Therefore, an uncompromised **wine production** forms an utmost priority for the company.

In order to strengthen the prestige of the brand, with the new representative building CVN aims to provide spaces for **gathering and interaction**, which is consistent with their social-oriented business strategy. The goal is to transform the winery into contemporary **culture, education, and knowledge exchange centre**, tightly connected to the industrial production. In this sense, the proposal converts an unappealing and predominantly industrial facility to an attractive spot.

The various situations one can **experience** during a stay in the winery should be **well-designed, comfortable, and holistic**. The functions should include services for tourists (such as accommodation and visitor centre) as well as functions for local society (social hub, restaurant, or shop). The designed spaces should be **flexible** to accommodate various events, especially in the part of the production which is only in use for 3 months per year and in the rest of the time is empty. The room program on page 30 contain more specific description of the individual spaces which will together form the new Winery.

Room Program

The room program has been defined as a direct response to the CVN's brief. Each function can be categorized in one the three main groups - the Wine Production (■), Visitor Facilities (■), whereas the rest of the spaces forms a transition zone between the two mentioned (■). The diagram on Fig. 15 displays the proportion of the whole occupied by each zone.

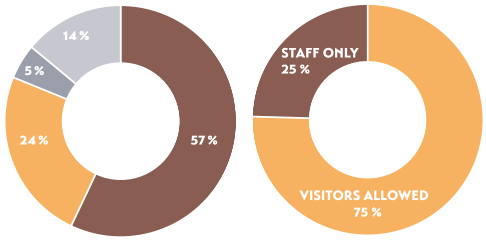


Fig. 15. The Wine Production represents almost two thirds of total area. Guests are allowed to visit 75% of the building

WINE PRODUCTION	AREA [m²]	HEIGHT [m]	NATURAL LIGHT	VISUAL CONNECTION	DESCRIPTION COMMENTS
Delivery Office	35	4	■	■	Directly connected to the supply and loading area. Visual connection to the outdoors.
Laboratory	150	4	■	■	Adjacent to the supply zone (analysis of incoming grapes) and Drying Hall. North and indirect light.
Grape-Drying Hall	900	8	■	□	Ensured ventilation, temperatures not defined, daylight preferred to minimize demands for electricity. Empty for 9 months - flexibility! Grape press on the highest level of the plot (as part of Drying Hall).
Manipulation Space	250	8	■	■	Well-connected for fork-lifts, also inside-outside and to the elevator. Unobstructed space.
Fermentation Hall	1500	8	■ | □	■	Must accommodate tanks of max ø 4m and h=5m. No direct light, no sudden temperature changes, required temperatures 8-20°C (depending on season and activity). Located in the level between the Drying Hall and Maturation Hall to utilize the gravity flow. Functional design - "real business".
Bottling Line	300	8	■ | □	■ | □	Connected to the fermentation & maturation halls. Stabilization tanks, filtration zone.
Bottle Ageing Storages	300	8	□	□	Two storages with adjustable temperatures for settling and ageing the final bottled product.
Manipulation Space	150	8	□	□	Connected to storages and bottling line, enough space for palettes, cardboard boxes, and bottles.
Maturation Hall	2500	8	□	■ | □	No direct light, stable temperatures 8-15°C. Appealing atmosphere, presentable spaces.
Loading Area	250	8	■	■	Directly connected to the industrial elevator. Serves also as kitchen-supply zone. Weather protection, especially from rain.
Cardboard & Bottle Storage	250 & 250	8	■	□	Unheated space - possibly open-air shelter (empty bottles) and closed room (cardboards)
Storages and Technical Rooms	500	4	□	□	Usually connected to the staircase core, providing enough space for machinery and ducts.
	6735				

FUNCTIONS RELATED TO WINE & VISITORS	AREA [m²]	HEIGHT [m]	NATURAL LIGHT	VISUAL CONNECTION	DESCRIPTION COMMENTS
Entrance Hall	100	6	■	■	Readable and representative. 10-15 adjacent parking places. Connected to underground parking through elevator and staircase. Possible to by-pass out of opening hours to access accommodation.
Shop	200	4	■	■	Accessible from the street facade as well as from inside. Includes tasting area.
Front Desk & Shop Staff Room	50	4	■	■	Small facilities for desk staff - kitchenette for coffee breaks and toilets.
Lobby & Courtyard	290 & 650	4 | ∞	■	■	Junction of flows, a place for informal interaction and gathering, as well as for organized events. Important visual and physical connection to the landscape. Zones both exposed to the sun and protected from overheating to ensure comfort during most of the year. Lobby and Courtyard from inseparable and permeable unity, expressed also through materiality. Lobby shall provide shelter from possible extreme climatic condition (sun, rain, snow, etd) and ensure inner connectivity.
Presentation Core	1200	4 | 8	■ | □	■	Accessible individually as well as on a guided tour. Wide range of possible experiences, various ways of how to experience the wine production, also depending on visitor's interests. The Vertical Hall connects the main floors and guides the circulation.
Restaurant	290	4	■	■	Important connection to the Courtyard, accessible through Lobby. Visual connection directed to the landscape, framed vineyards. Possible physical connection to the ground level (vine plants) and roof evening terrace (wine tasting and outlook). Protected from the noise generated by the road and the wine production and supply.
Kitchen	140	4	■	■	Located between the restaurant and supply zone. Visual connection to the landscape.
Staff Room & Facilities	200	4	■	■	Chill-out zone, gathering lounge with sofas, kitchen and dining table. Visual connection to the landscape and production. Staff facilities: changing rooms, showers, toilets for up to 40 employees.
Tasting Room	180	4	■	■	Oriented to the best views (south-west), providing sheltered interior and exposed sun-terrace.
Offices	200	4	■	■	Accessible through the main representative staircase in Vertical Hall and through a Production staircase (also fire escape), efficiently connecting all levels. Daylight factor 2% at working spaces, window geometry shall prevent glare and overheating. 1 separated office for the director, meeting room, kitchen and dining area, toilets.
Storages and Technical Rooms	690	4	□	□	Front desk archive, shop storage, cleaning rooms, technical rooms for machinery and equipment.
	2850				

VISITOR FACILITIES PARKING	AREA [m²]	HEIGHT [m]	NATURAL LIGHT	VISUAL CONNECTION	DESCRIPTION COMMENTS
Accommodation 2 pers.	3x55	4	■	■	Generous room for two, including own bathroom and small kitchen zone. Adjacent semi-private terrace and common outdoor space for accommodated guests. Accommodation shall be accessible also out of front-desk's opening hours.
Accommodation 4 pers.	3x75	4	■	■	Larger apartment for family of 4, two bedrooms, kitchen and living zone, bathroom, direct access to designated outdoor zones. All apartments shall be protected from visual and acoustic disturbance.
"WorkAway" Lodge 8 pers.	130	4	■	■	Basic lodgement for voluntary workers. Common room with kitchen and dining space.
Technical Room, Cleaning, Gardening Storage	55	4	■	□	Storage for equipment and machinery, connection to the entrance area and the courtyard. Technical room for heat pumps and other building services.
	575				
Parking	**1650**	3	■	□	50 parking spaces protected from the weather, direct access to the entrance hall.

Target Groups

Since the primary ambition of this Winery is to change the perception from being simply a factory to form an attractive place to be at, it is important to define its potential users. Subsequently, the design will be targeted according to their preferences.

Thanks to the location in the heart of the Valpolicella region, the site has a perfect position in relation to the wine-maker's network. This is beneficial not only for the cooperation among the vine-growers, but it is also attractive for tourists spending their time in the area. According to Romano and Natilli [2010], the number of people interested in connecting their italian holiday not only to seaside, mountains, or culture, but also to experiencing the region through local wine and food, is expected to grow in the upcoming years. Therefore, there is a great potential in the development of attractive facilities for tourists.

“ The Wine Tourism forms an essential part of social and economic sustainable development of the region.

What is more, the wine tourism has low environmental impact and is respectful of both the terrirorial impact and identity [Presenza, 2010]. As it cherishes traditions and habits experienced in-situ, the wine tourism phenomenon encourages local people to continue their craftmanship and preserve it for future generations, also because of its economical benefits. Therefore, it forms an essential part of social and economic sustainable development of wine-producing regions.

CVN's ambition to build a prestigeous and high-branded facility is less compatible with the attractivity for the local population which is not expected to have high income level. Nonetheless, the Winery can serve as a generator of regional economic profit and thus secure a number of interesting jobs in services. The regional profit may attract new inhabitants, or at least minimize the current depopulation. Moreover, the building's architecture and carefully designed experiences shall passively and nonviolently encourage the users to be happy to spend money for the products and services. Last, but not least, the design should be flexible enough to accommodate various social events attractive for the local inhabitants, such as theatre performance, art exhibitions, business conferences, or family gatherings for special occasions.

WINE TOURISTS

CLASSIC & ROMANTIQUE

Travelling with his family by a private car
on a pilgrimage journey among the local wineries.
Interested in general knowledge about wine-making,
wine tasting in nice settings, and local products.
Higher income level implies high expectations
for quality of all services and experiences.

EXPERIMENTALIST & GEEK

Average age of 35, independent, flexible and mobile,
travelling with his friends or a partner.
Seeking for uncommon experiences, excited to touch
all the buttons and screws he can spot.
Not interested in pre-designed tours, but wants to see
the "real business" and perhaps even make his own wine.

AGROCULTURIST & WORKER

Any age group, any educational/income profile.
Usually travels alone of with a friend/partner
and stays at the area for several weeks.
Enjoys to be a part of a local community,
prefers the manual field work.
In his spare time experiences the region.

LOCALS

WINERY EMPLOYEE

All employees (management, production employees,
and visitor-facilities staff) enjoy visual contact both to the
outdoors and to their colleagues. Their workplaces
are efficiently organized, but during the breaks they like
to have different opportunities on where to gather,
chat and drink their coffee.

SHOP/RESTAURANT CUSTOMER

Usually very busy in his daily schedule so he just stops by
the shop's entrance and buys products from the store.
Time to time, there is a good occasion to go to the local
restaurant and have a nice dinner or drink a glass of wine:
outside or inside depending on the season, weather
and time period of the day.

SOCIAL EVENT GUEST

Brings the community life to a production facility while
playing his role of spectator/actor in a theatre performance,
local art exhibition, organization
of a trade fair or conference...
or perhaps in an unique wedding ceremony?

Fig. 16. The target group definition has been based on data from Verona's Chamber of Commerce [VR CamCom, 2016] and on personal interviews with Jan Thrysøe, Tenna Doktor Olsen Tvedebrink, Marina Valenti, and Mr. Salgari.

Site Analysis

Northern Italy belongs to the traditional wine-making regions. This activity has been performed here since the 8th century [Commune Negrar, 2016]. Therefore, wine culture is deeply rooted in local society as one of the most characteristic values. Some of the traditions have been preserved, but the present-day demands of speed, quantity, and profitability present a serious threat both for wine and the community. Thorough analyses of the context have helped to reveal the potential of building a successful design which aims to combine the social values with traditional industry.

Fig. 17. Hills of Valpolicella

NuKeglus

The Context

Fig. 18. Geopolitical structure of the region

The municipality of Negrar is located in Valpolicella Area which is well-know region for its wine of superior quality. The whole Veneto region is the most visited region in the whole Italy, both when analysing visitor rate and the absolute number of arrivals in 2012 [VR Camcom, 2016]. Therefore, there is a high potential for facilities oriented towards touristic business.

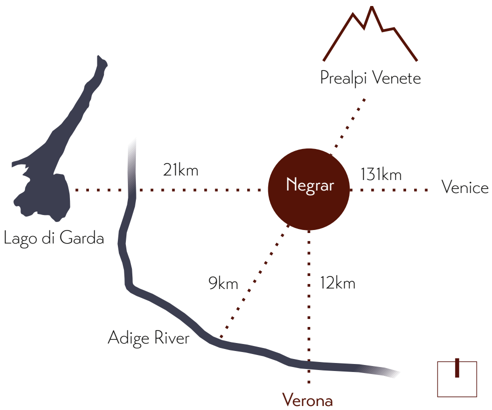


Fig. 19. Distances to the important touristic sites in the area

Thanks to the proximity to a number of other well-recognized touristic sites, Negrar has a very convinient position. Moreover, one of the largest hospitals in the region is located here. Although the tourists are present in the region [VR Camcom, 2016], Negrar is not drawing enough attention to attract them and thus generate profit on tourism. By enhancing the position of the current factory to a regionally and perhaps nationally important Wine Center, the attractivity and profitability of the area should be increased.

The Site

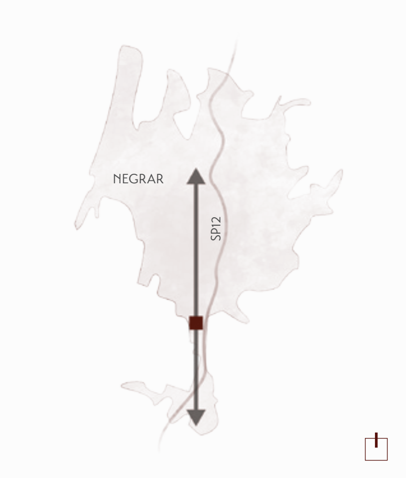


Fig. 20. Relation Axis: the site to Negrar

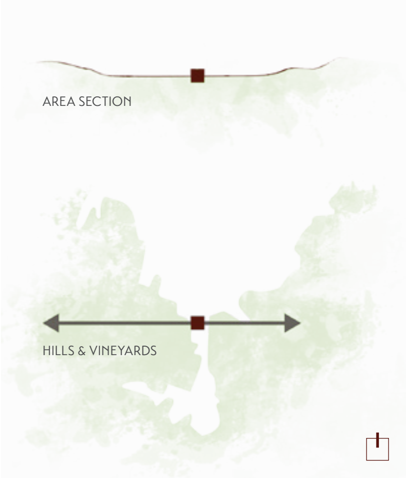


Fig. 21. Relation Axis: the site to the Landscape

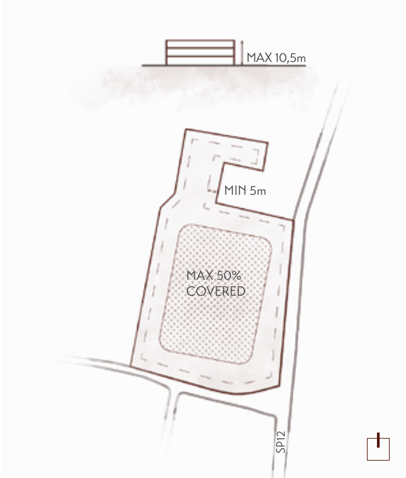


Fig. 22. Site restrictions given by the local plan

URBAN RELATION

The Site is located on the edge of Negrar, right next to the state road connecting the town to Verona. The relation to the urbanized area and various means of transport (car and bus) is very clear. Therefore, high human activity and occupancy can be expected.

LANDSCAPE RELATION

The relation to the landscape is one of the most inspiring and characteristic features at the site. Even though the eastern side is bounded by a busy road, the visual connection to the nearby hills and vineyards is still interesting - especially from elevated areas as the road is overlooked and noise diminished. The western side allows for direct connection to the landscape, both visual and physical.

SITE RESTRICTIONS

The local plan sets the construction line offset from the plot boundary by 5 meters. It is also not allowed to build higher structures than 10,5 meters. Maximum covered surface area by the building is 50 % of the site (the site's area is 15423 m^2). As the required area is large (12500 m^2) and more levels for the production are required, underground structures will be considered.

Fig. 23. The Site's analysis - topography, noise, views, access, surrounding buildings

Fig. 24. The site's surroundings, scan QR for 360° photos

Climate

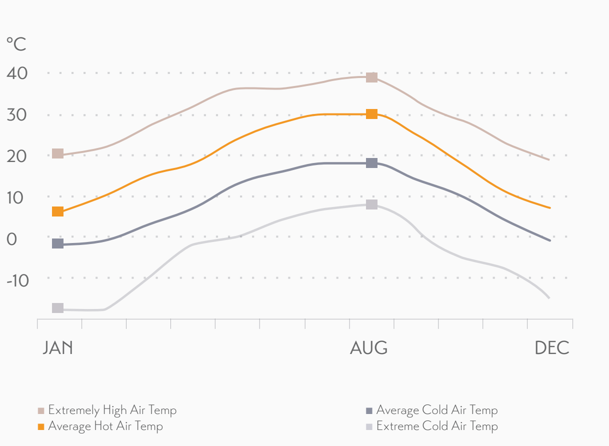


Fig. 25. Temperature profile [worldweatheronline.com, 2016]

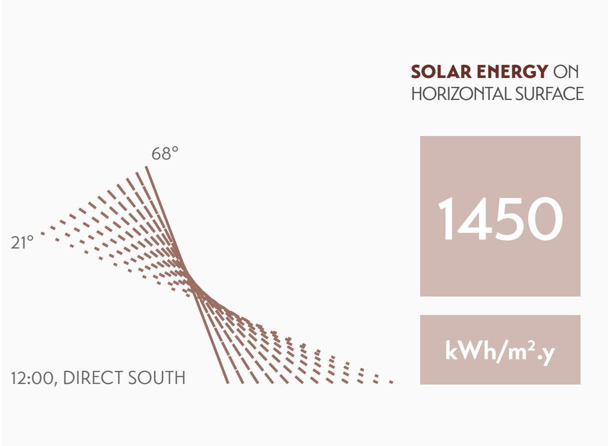


Fig. 26. Insolation and sun angles at 12:00 during the year [sunearthtools.com, 2016]

TEMPERATURE AND HUMIDITY

According to Köppen Climate Classification System, the region of Negrar is classified as Cfa, meaning humid subtropical climate [Köppen, 2016] characteristic with hot and wet summers and cold, humid winters. Average temperatures in winter are slightly above 0 °C and summer months are typically hot with temperatures between 25 °C to 30 °C. The high temperatures correlate with the highest expected occupancy during the main touristic season (April to October). Therefore, the outdoor spaces have to be designed carefully with regards to the percieved comfort. Furthermore, the facade design has to respond to the risk of overheating and be informed by local solutions for solar protection.

INSOLATION

Strong solar activity is very typical for this region with high number of sunhours during the whole year, peaking between May and September with 200-300 sunhours per month [weather-and-climate.com, 2016]. Such a large portion of sunhours allows for well occupied exposed outdoor spaces during the year, but it presents a threat during the high summer. Therefore, outdoor area have to be zoned into shaded and unshaded and designed with regards to the expected operation hours.

Solar energy recieved on a horizontal surface is high during the year [weather-and-climate.com, 2016], thus integration of PV panels to the architecture should be considered.

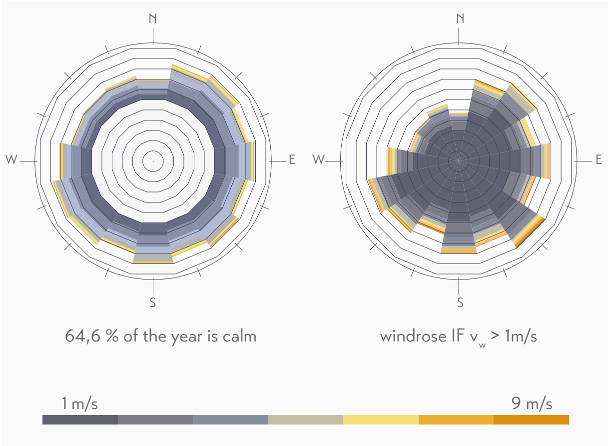


Fig. 27. Windrose [Energy.gov, 2016]

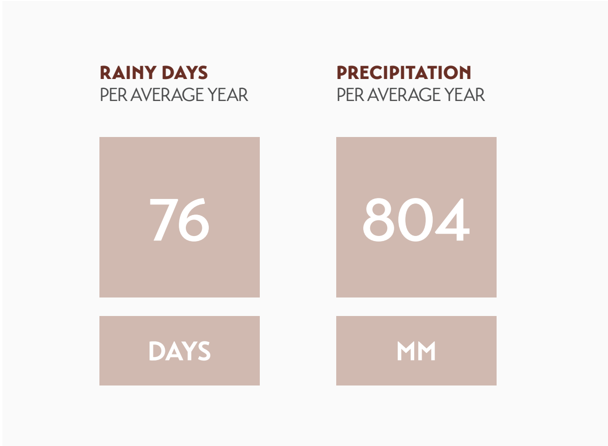


Fig. 28. Average precipitation [yr.no, 2016]

WIND

According to the weather data for Verona (the nearest recording location) from Energy.gov [2016], there is no wind for most of the time. The diagrams above displays the count of hours with wind of a certain direction. The blank central part of the left diagram represents calm days (almost 65 % of the time). The right diagram shows distribution of the wind direction if the wind velocity exceeds 1 m/s. Therefore, it has been assumed, together with the knowledge about solar radiation and temperatures, that wind does not present a threat for the outdoor spaces. Moreover, the design shall support the movement of air in the outdoor spaces by creating a few narrow spaces which can emphasize the convection.

RAINFALL

The climate is quite humid [Köppen, 2016] and, in Italian context, with significant precipitation during the year. 76 rainy days [yr.no, 2016] represent 20 % of the year. Therefore, the outdoor spaces should have an alternative formed by sheltered semi-outdoor spaces and the design of such sheltered spaces should be considered along with solar protection. Furthermore, water management, especially retainment, should be considered.

Atmosphere and Materiality in the Surroundings

Fig. 29. Negrar's town centre - warm atmosphere and colours, precise steel details, massive building materials. The local architecture, both traditional and contemporary, is characteristic by significant orthogonality, relatively flat roof angles and building heights not exceeding 10 m (except for the church tower).

Fig. 30. Pavement details made of local limestone

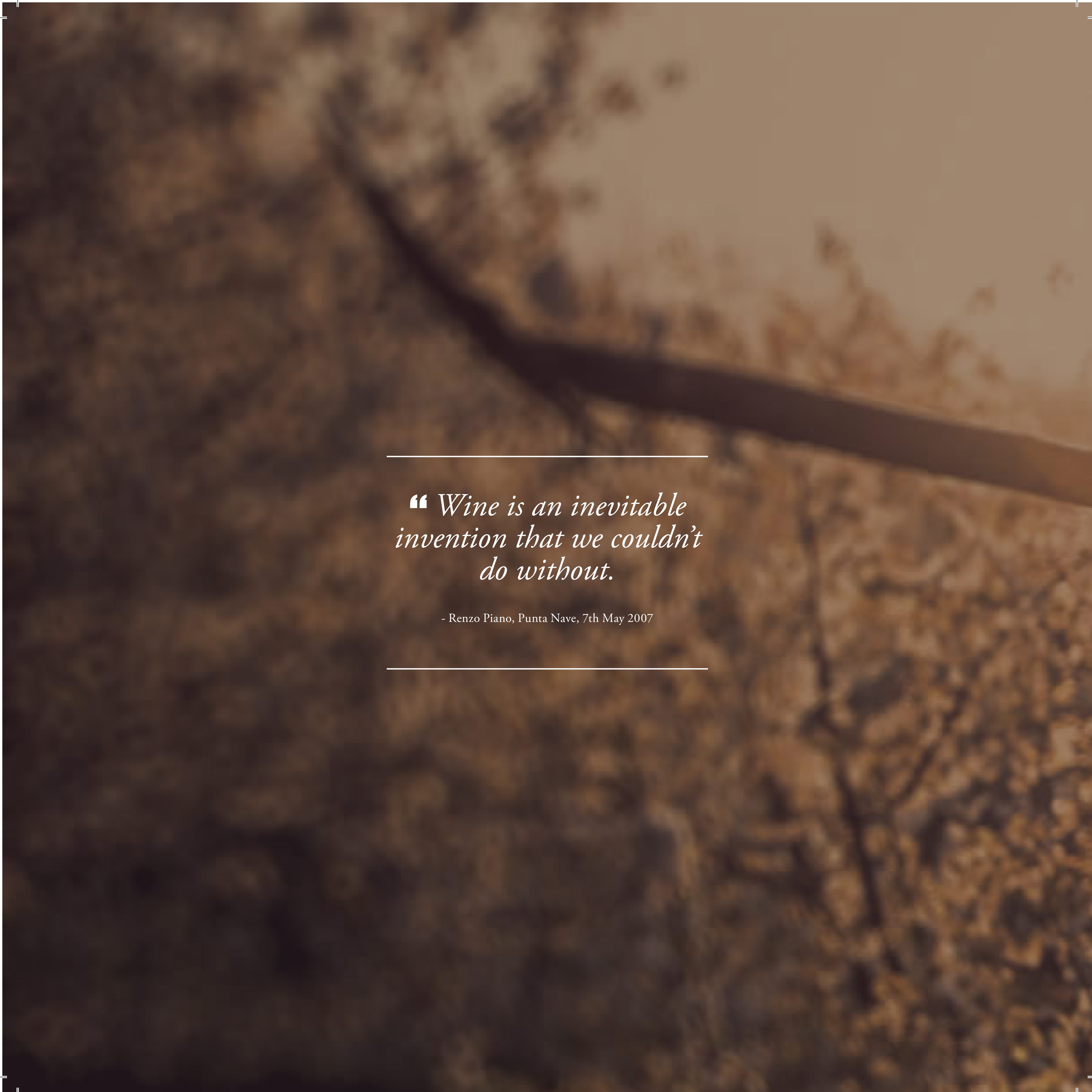
Fig. 31. Colours and textures collected at the site's surroundings. Predominant colours appear on a scale from warm red to dark grey, complemented with natural green elements. Coarse textures are often combined with smooth plastered surfaces and precisely crafted steel elements, both with dark finish or corroded. Typical construction materials are stone and concrete providing enough mass for thermal stability, additional structures are contrastingly light - made of timber or steel.

DESIGN PRINCIPLES

LEARNING OUTCOME
FROM SITE ANALYSES

NOISE PROTECTION	READABLE ACCESS	ZONING	LIMITED HEIGHT	FRAMED VIEWS
WARM COLOUR PALETTE	MASSIVE MATERIALS	SOLAR & RAIN PROTECTION	ORTHO-GONALITY	POTENTIAL FOR OUTDOOR SPACES

These design principles form a conclusion from the analysis of the site and its surroundings. What is more, these simplified headwords, together with the principles extracted from the analyses of wine-making industry, form a point of departure for the design process.

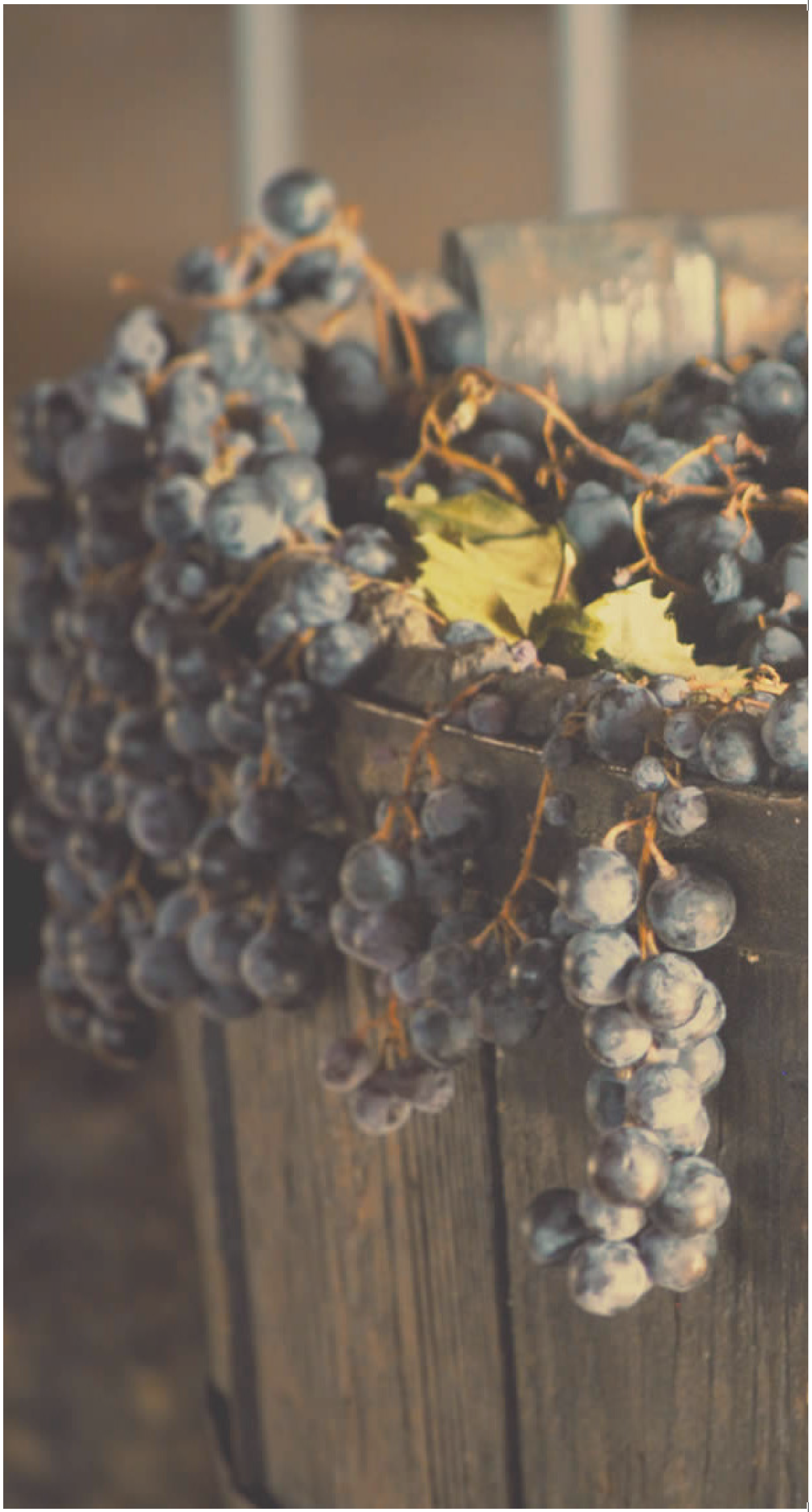


“ Wine is an inevitable invention that we couldn’t do without.

- Renzo Piano, Punta Nave, 7th May 2007

Summary

In order to follow the PBL and IDP methodology (see p. 8), it is essential to define the problem and outline a vision for the solution. In this case, the elaborated problem statement presents a conclusion of the analyses phase. The analyses phase has significantly deepthened the understadning of the project, especially regarding the climatic conditions, technological procedures of wine-making, and the optimal flows of the building's users.



Problem Statement

The deep analyses have revealed a strong, but **unused potential** of Cantina Valpolicella Negrar. The **layout is inefficient and unsatisfactory** for a contemporary wine making. Therefore, the character of the production is unsustainable and **energy consumption is irresponsible**. Although the business is prosperously based on cooperation of the local community, the **architecture is not supporting the social character**. The facility is **closed, unappealing, and unadaptable**, unprepared to successfully host social events. Despite the position in middle of the most touristically dense area in Italy, CVN does not provide attractive activities and services for tourists, thus **squanders on earnings and employment potential**.

Vision

Through the proposed transformation, the **relation of the architecture and the context** shall be strenghtened by respecting **local materiality** and conscious design of **outdoor spaces**. The ambition is to define a **balance between traditional and contemporary** in regards both to the architecture and engineering aspects. Responsibility and sustainability shall be secured predominantly by **passive strategies integrated** to the architecture. The energy consumption shall be reduced to a possible minimum and compensated by an active on-site **electricity generation**.

By exploiting the potential of creating a “beautiful factory”, the Winery shall become an **open and inviting facility** where the rooms have strong **character** and **flexible** organization. The architecture shall generate various and occasionally unexpected **experiences** along the journey through the building. The **flows** of visitors, employees, and wine shall not interfere, but trigger **interaction and exchange of knowledge**. As a result of the proposed conversion, the Winery shall become an **attractive spot** in the wine-makers’ network.

Design Parameters

The most important design criterias have been summarized to the chart on page 47. There are four main categories, covering the aspects of the design of a sustainable winery project. Although they have been separated with regard to higher clarity of the criteria, all of them are mutually dependent and influencing each other. During the design process, these aspect should be tested and continuously integrated to the design with the aim of creation a funtional unity. Fullfilling these criteria during the process should secure that the goals defined in the program and in the vision will be acomplished.

INTEGRATED DESIGN OF SUSTAINABLE WINERY

ARCHITECTURAL ASPECTS

contextuality, local materiality, outdoor spaces,
shaded areas, relation to nature

exposure of wine production, sensory experiences,
visual connections, enhancing brand's prestige

readable navigation, human scale, spatial flexibility

coarse and smooth textures, honest construction,
conscious light and spatial settings

integrated technical aspect to the architecture

TECHNICAL ASPECTS

massive structure with high thermal capacity,
shaded openings, enabled cross ventilation,
natural daylight

passive strategies for thermal stability
(see p. 17 and p. 30 for requirements for the wine production)
and low energy consumption

aim to minimize energy consumption
and, if possible, reach zero energy standard

indoor comfort for accommodation & offices:
temperatures in range 20-27°C, CO_2 class II (EN15251)
(offices: Daylight Factor > 2%)

FUNCTIONAL ASPECTS

compactness and efficiency despite the large scale

clear spatial design with regards to the flows
(production, employees, visitors, traffic)

the wine production shall not be interfered by visiting guests
direct visit to the production spaces only under supervision,
therefore a number of alternatives have to be designed

ideal layout shall both separate the visitors and production
(noise, focus on work tasks)
and create interaction and knowledge exchange

SOCIAL AND CULTURAL ASPECTS

respect for local traditions, products, and architecture

inviting, relaxed and warm atmosphere
accessible for everyone

utilize the potential for:
organization of large scale events
(theatre, conference, exhibitions, trade fairs),
wine festivals (VinItala - winemakers and merchants),
and important private celebrations
(weddings, family gatherings)

02

Ideation

This section explains how the Vision has been transformed into conceptual principles which depict the selected design solution.

Concept

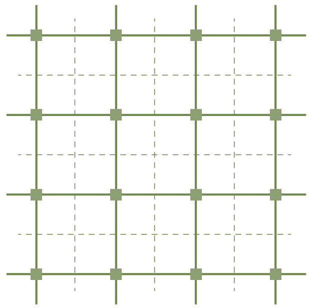
The Concept of this project can be described with these main values - Flow, Contrast & Transition, and Grid. These values were based on the gained knowledge from thorough analyses part, taking into considerations possible solutions for the defined Problem. Through out the whole process these values will be used as essential guidelines, which drive the design decisions. All of them together concern design aspects such as functionality, contextuality, experiences or form and aesthetics. On the next pages they are described in detail and with direct application on the project design.

FLOW

The Flow covers importance of wine flow during the wine-making process, gravity flow as a traditional principle, and different flows of tourists, locals, and employees in the winery.

CONTRAST & TRANSITION

The Contrast represents the relation between the strict industrial wine production and human scaled visitor-oriented part. The Transition is created between those two to smoothly connect them in one whole.



GRID

The Grid includes both inspiration from rows of vineyards and the functionality of a structural grid necessary for efficient manipulation in the wine production area.

FLOW ON THE SITE

The traffic of cars and trucks is strictly divided. Trucks are positioned in the north, close to another industrial facility and where the terrain is highest. Therefore, the position creates the best possible use of the gravity flow. On the other hand, visitors coming by cars, bus, or by feet enter the site from the south.

CONTRAST & TRANSITION ON THE SITE

The transition part creates a functional and volumetric gradient between the two contrasting zones. This central zone is essential for mutual interaction and knowledge exchange. Through the transition principle, experiences for users are continuously built up.

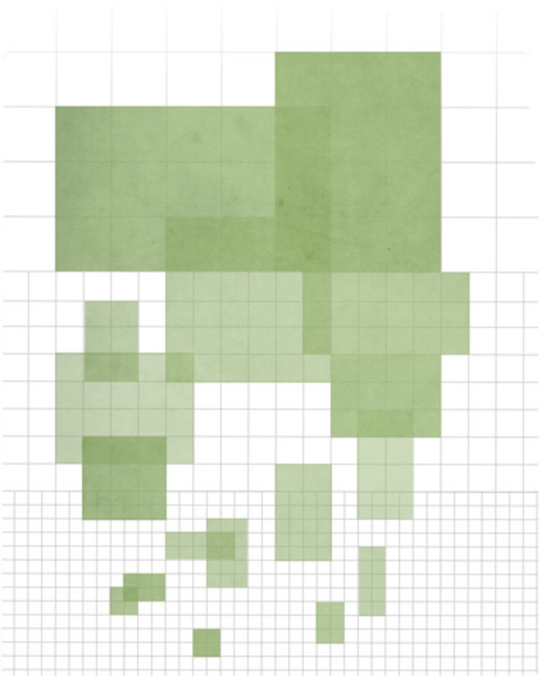
GRID ON THE SITE

The Grid has adopted the directions from the vineyards around the site. Furthermore, according to the zoning of the site, the Grid is adjusted to follow the Transition and to respect the design criteria of the spaces. The production zones are based on a larger, functional grid than the visitor zones, which are related to the human scale.

Distribution of Functions

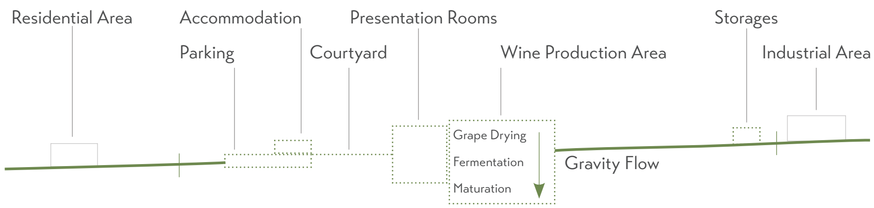
Functional distribution on the site is one of the elements which have played a key role in the concept development. The main values described on the previous page have been further objectified and their application on the design have been detailed. The required functions have been distributed on site with regards to target user group, accessibility, spatial needs, considered level of flexibility, and orientation to cardinal points. Last, but not least, results from the site analyses (climate, noise, views, surrounding functions, etc.) have been taken into account.

Abstract Principle



Grid Density	**Description**	**Main Functions**
10 x 10 m	Wine Production Big Scale Compact Volume Functionality Clear Layout Efficiency	Grape Analysis Grape Crushing Drying Hall (flexible) Fermentation Hall Maturation Hall Bottling Line Storages & Loading
5 x 5 m	Transition Part Central Core Hub of Flows Functions related to both Wine and Visitors	Entrance Hall Courtyard & Lobby Shop Offices Presentation Rooms Restaurant Kitchen
2,5 x 2,5 m	Visitors-oriented Part Human Scale Scattered Volume	Accommodation Workaway Lodge Parking

The production area is oriented towards North with an easy access for the trucks. On the contrary, the visitor facilities are located on the southern side, close to the calm residential area, with the best orientation to remote views and south-west orientation. The orientation of functions in the transition zone is defined either by orientation to the street and incoming visitors (Office, Shop, Entrance), or by connection to the landscape (Restaurant, Framed View). The Core of the project is formed by the Courtyard and the Presentation Area.



Design Principles

The primary goal of the project is the integration of engineering solutions with architectural principles. Following this method, the design should not only be aesthetically appealing, but also fullfilling demanding requirements for comfort and energy performance.

The design decisions shall be informed by on-going calculations and simulations. The obtained results are meaningful only when further analysed and put in context with other relevant design criteria. At last, but not least, the documentation for the resulting values has to be provided.

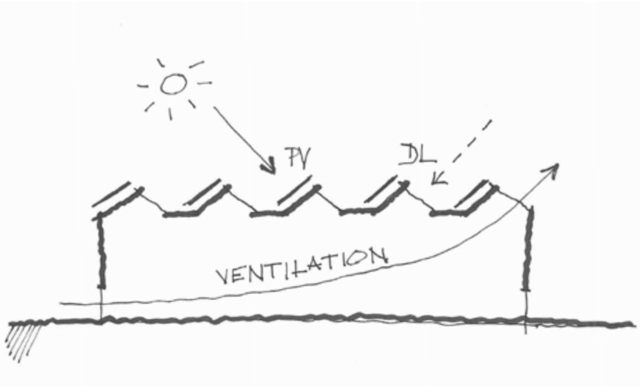
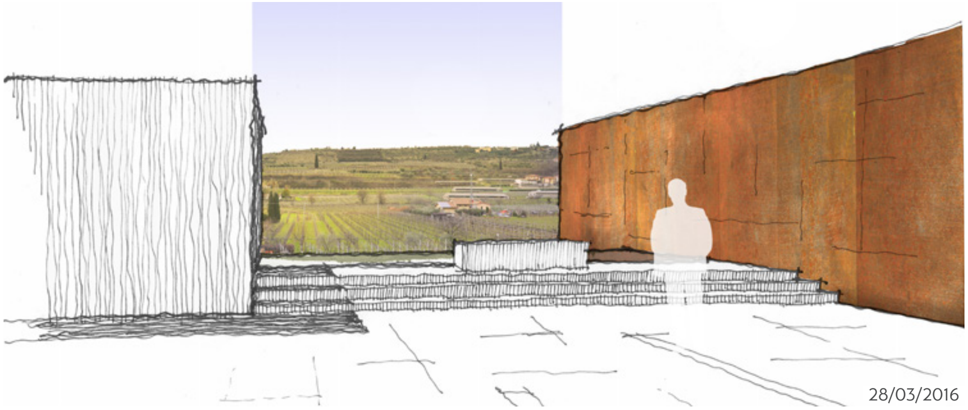


Fig. 32. Integrated design of the Production volume



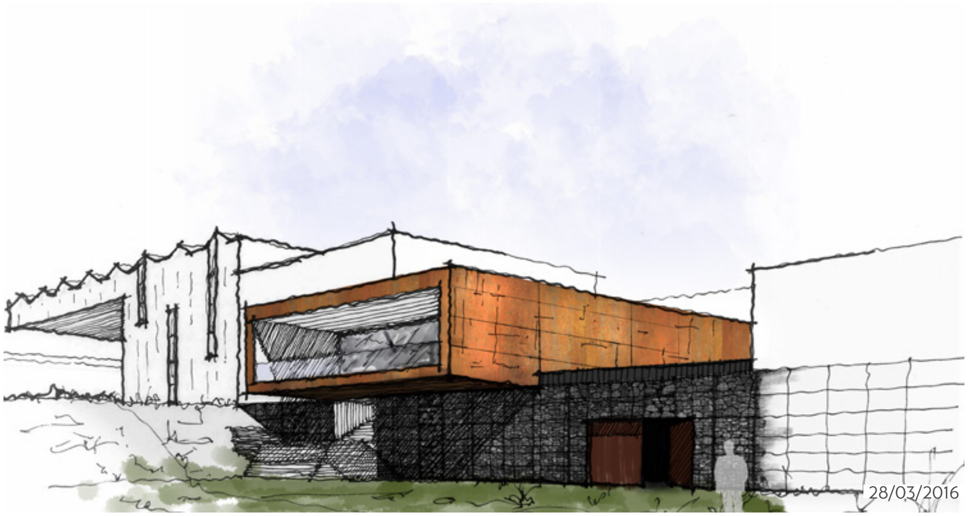
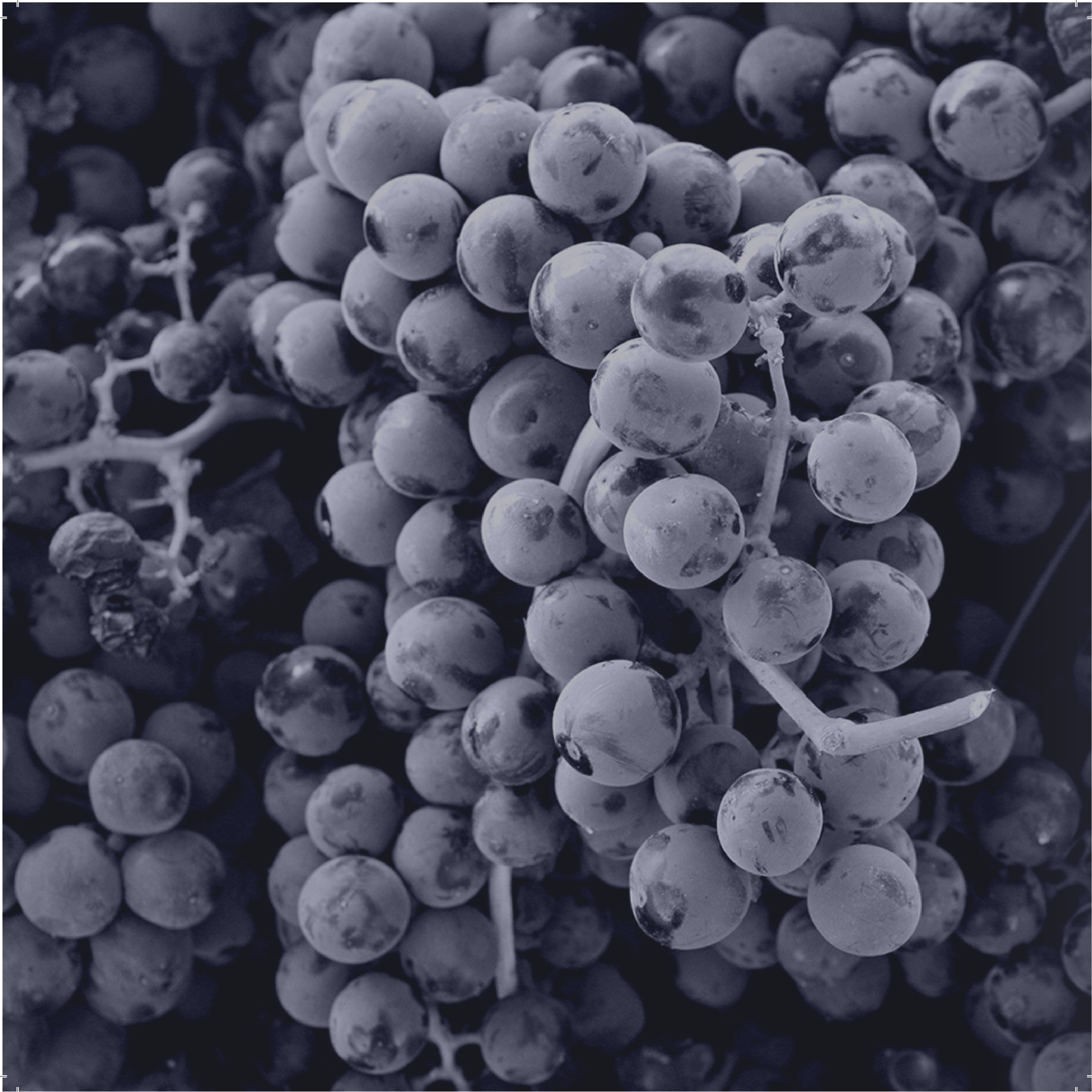
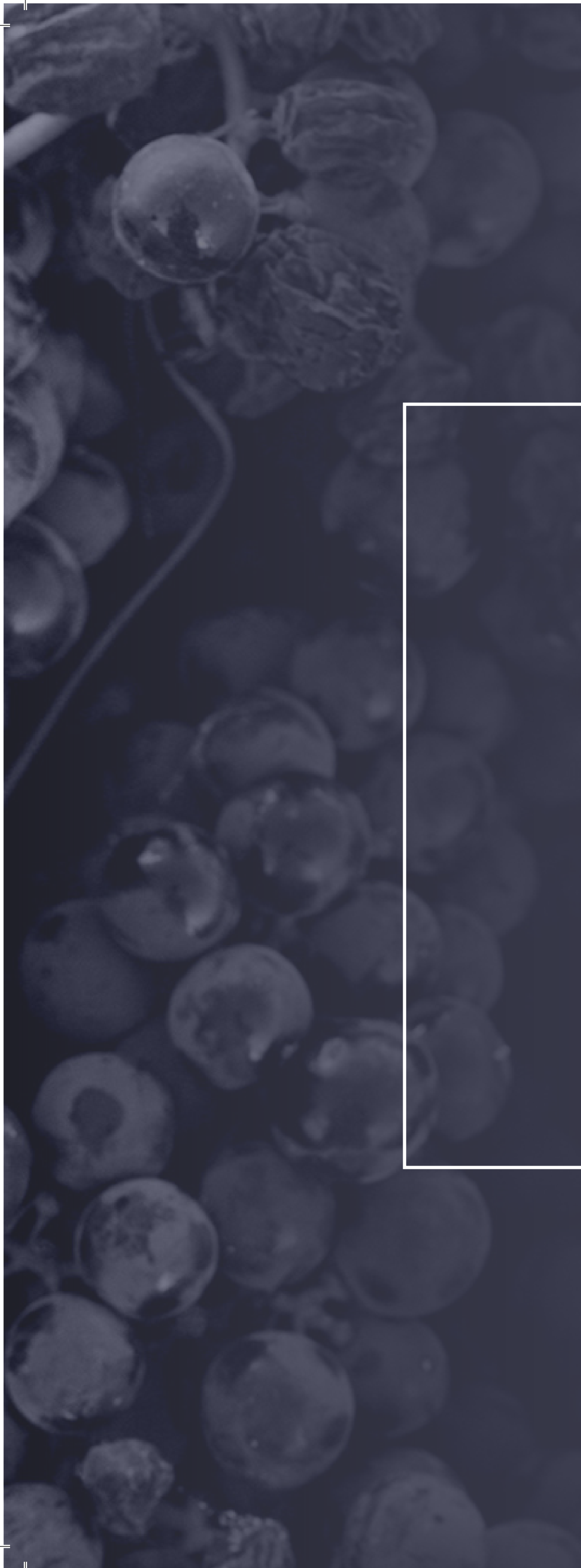


Fig. 33. Principles for building up unique spaces connected to the context and strong experiences for users





03

Presentation

On the following pages, the project outcome is presented. The architectural and engineering part have formed an inseparable unity, thus the calculation results are presented along with the design.

Winery for the New Century

Winery for the new century is blurring the border between industry, culture, and education. Its design merges functions of the factory with an attractive visitor facility, therefore secures both profitability and knowledge exchange.

The proposal preserves the wine production as the essence of the building and extends the orientation towards the visitors. This interconnection presents the gist of the architectural design which stresses upon the different possible experiences and allows for flexible use of the spaces, both for tourists and local inhabitants.

Passive strategies, namely thermal mass, shading, or free cooling have significantly decreased the energy demands. In order to reach the nearly-zero energy standard, electricity is actively generated on the site by photovoltaic panels integrated in the roof. The engineering solutions for reducing the energy consumption have been integrated to the design and thus form an inseparable part of the architecture.

Fig. 34. Masterplan

Masterplan 1:1000

The masterplan layout has been consciously developed to strengthen the intentions of the design (see the design process of the "Courtyard" on page 108). The two conceptual axes have been inscribed to the architecture; the connection from the main street through the courtyard to the landscape builds up the atmosphere of the place and prepares for the experiences to come (x-axis). The second axis (y-axis) symbolizes the transition between the human scale (accommodation zone) to the industrial scale. Located on the cross-over of these axes, the courtyard serves as a hub, naturally setting up informal meetings.

As concluded from the analyses ("Climate" on page 38), the wind is not percieved as a problem but rather a benefit for comfort, especially in the summer. Therefore, the penetration of the accommodation zone helps the movement of the air and what is more, allows for more light in the courtyard in winter (see p. 108). The scattered volumes forms passages which, together with conscious placement of openings, secure privacy for the guests from the courtyard side. The plinth with underground parking prevents from unwanted spectators from the street but enhances the views to the nature for guests.

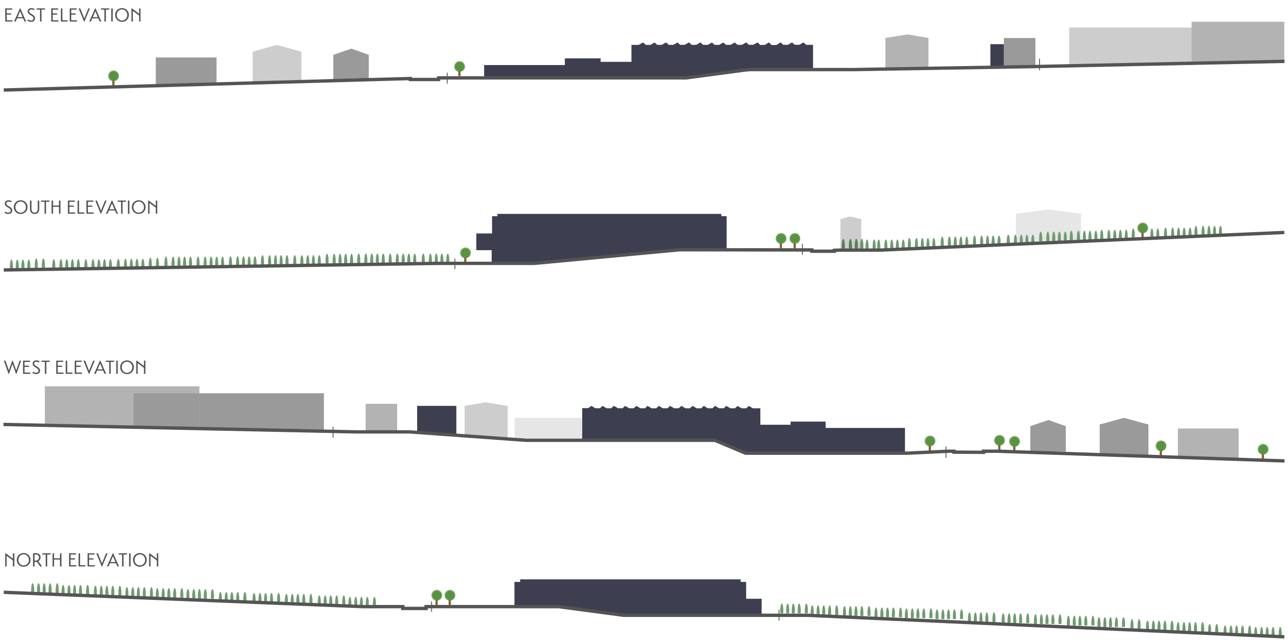


Fig. 35. The scale proportion of the context and the designed building is illustrated on the diagrams above

Sections

The principles of the building's design can be showcased on the sections illustrated on Fig. 36 (longitudinal) and Fig. 37 (cross-section). The longitudinal section represents the gradient between the visitor oriented zone on the left (south) and the wine production on the right (north). The Courtyard, Lobby, and Presentation Core form a transition from human to industrial scale not only in plan, but also in section. In that sense, the conceptual axis of human activities is strenghtened.

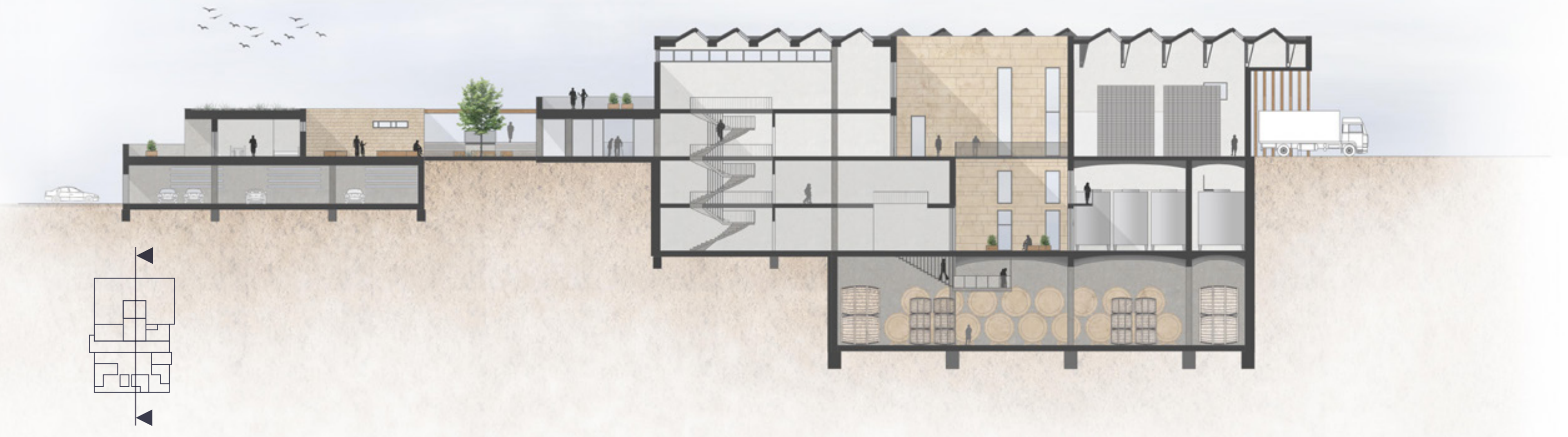


Fig. 36. Longitudinal section describes how the visitors can approach the wine production without disrupting the process

The cross-section displays the second conceptual axis; from the busy road on the right (East) to the landscape (West) which showcases the true essence of the region - the vineyards. The spatial sequence of the architectural spaces continuously affects the perception and builts up the experiences for the users.

More detailed description of the spaces illustrated on these sections will be provided through suggested scenarios for visitors (tourists & locals) and employees from page 70.

Fig. 37. Cross-section: spatial sequence from the front space to the entrance hall, open courtyard, exhibition tunnel down to the landscape

Overview of the Levels and Functions

The schematic exploded axonometry on Fig. 38 describes the spatial organization of the building, as well as basic functional orientation. The three main zones - Accommodation for Visitors (■), Functions related to Wine & Visitors (■), and Wine production (■) are displayed together with their mutual adjacencies. All floorplans are schematically presented on Fig. 39 - Fig. 44. For full scale furnished plans, please see the Drawing Folder attached to this presentation booklet.

On the following pages, the project will be described through scenarios designed for representants of the target groups. For better orientation, the path will be marked on an equivalent diagram to the axonometry on Fig. 38.

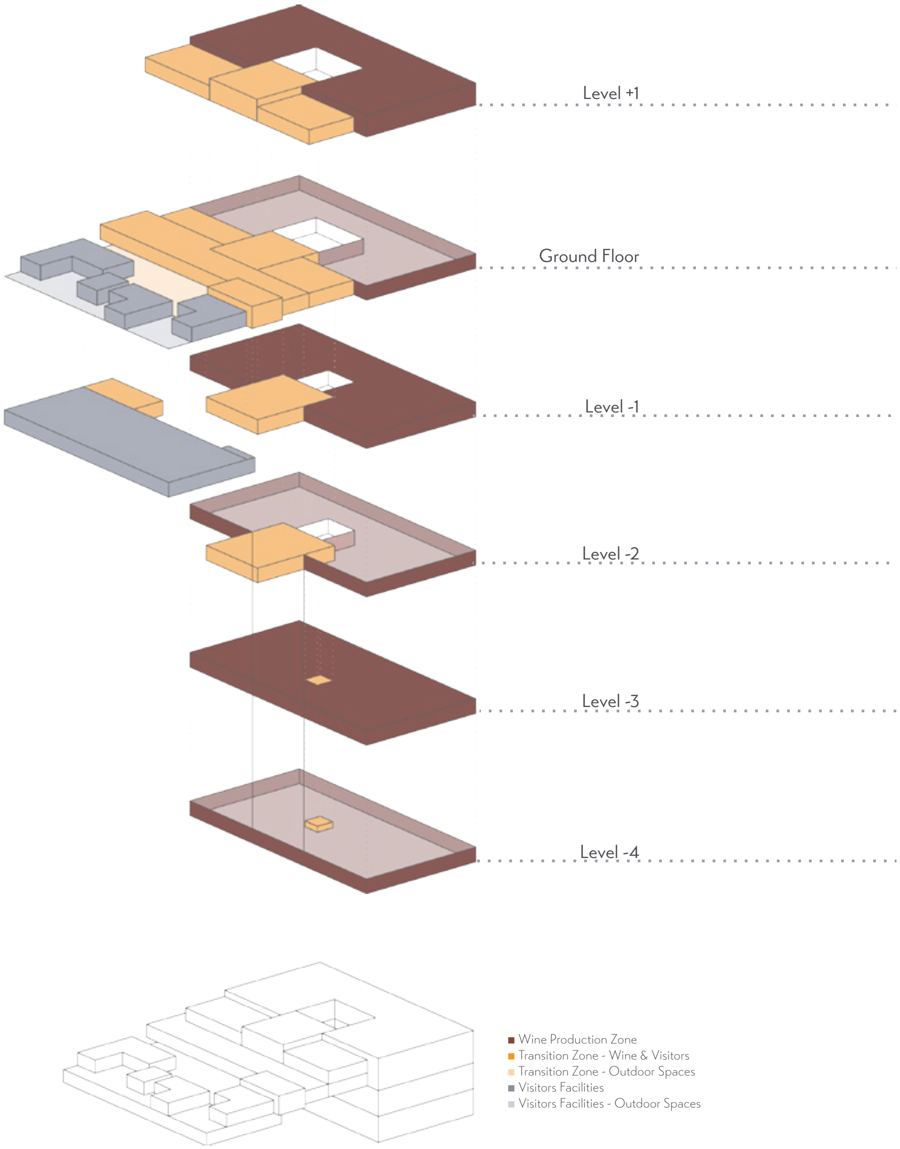


Fig. 38. Exploded axonometry of the building's volume

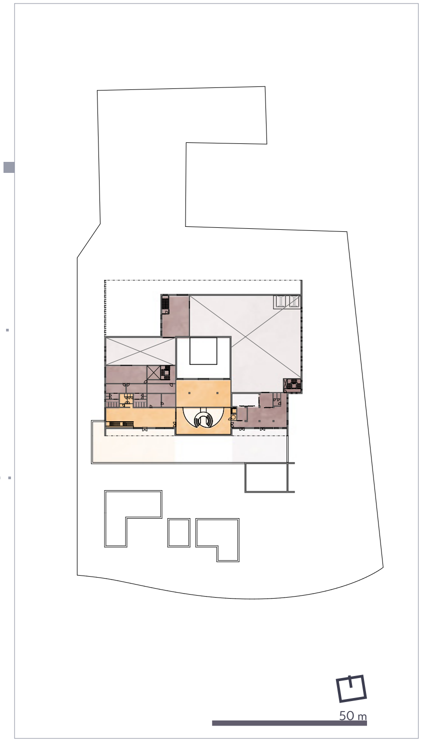


Fig. 39. Level +1 [+4,000]

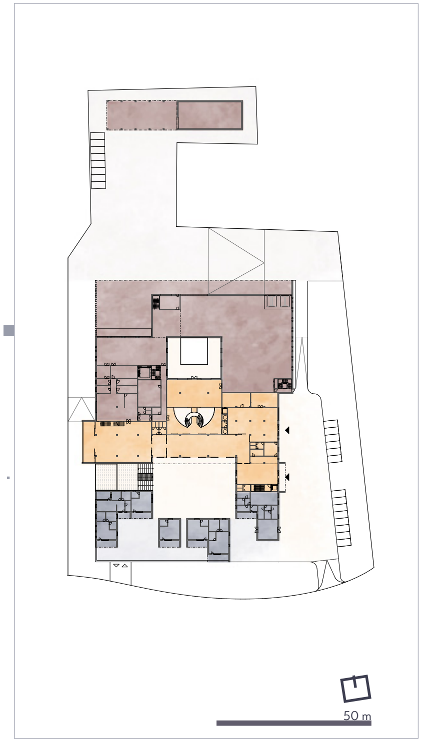


Fig. 40. Ground Floor [±0,000]

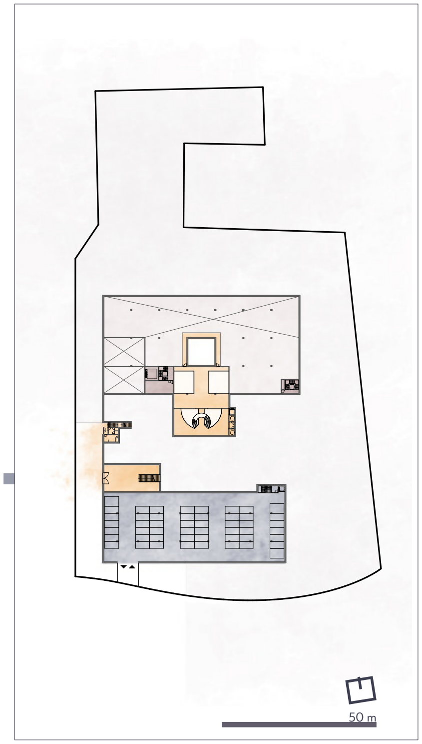


Fig. 41. Level -1 [-4,000]

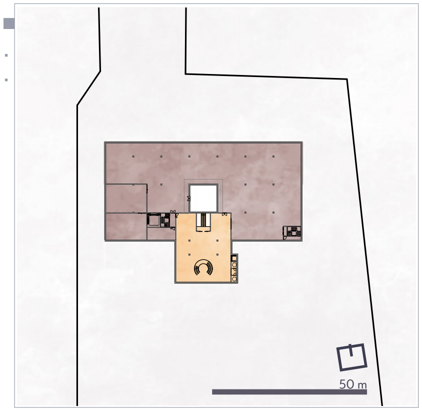


Fig. 42. Level -2 [-8,000]

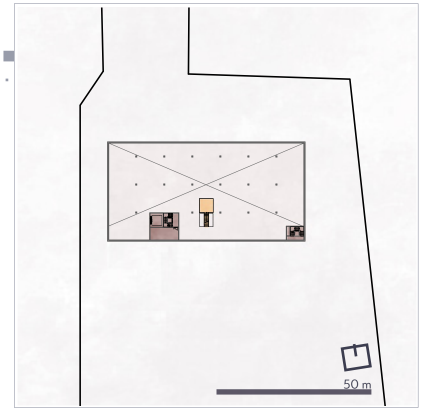


Fig. 43. Level -3 [-12,000]

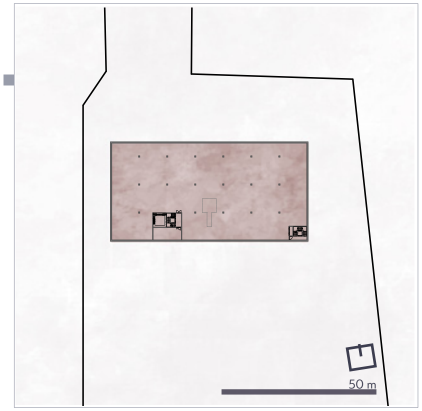


Fig. 44. Level -4 [-16,000]

Materiality

The material choice has been inspired by the local warm colour palette (for illustrative photos from Negrar, please see p. 40). Therefore, the context and tradition have been respected, but the detailing and application of the materials reflect the present-day approach.

The scale of facade stone cladding correspond to the scale of facade and located functions thus inscribe the conceptual transition. Moreover, the expected velocity of motion around the building has been considered. From a distant and moving vehicle, the details are not distinguishable, but when slowing down and getting closer, the plasticity is revealed; the perception has changed for the first time and the sequence of experiences has started.

The most important functional elements are accentuated by the application of weathering steel cladding which is characteristic by its warm and outstanding colour. Therefore, the Entrance hall is outstandingly and clearly marked, framing of the restaurant volume is emphasized, and the importance of the Presentation Core is underscored.

Smooth exposed concrete indicates the structural material and adds clarity and calmness, especially on the axis "Entrance - Landscape" and on the inner side of all overhangs and massive railings.

All the previously described materials have rather heavy and massive character, therefore they are complemented with dark oak timber (durable and local material) for lightweight structures and outdoor furniture. The expression is further softened by the use of vegetation, namely oak trees, vine plans and extensive greenery on the roofs.

LIMESTONE PAVEMENT
outdoor and semi-outdoor areas

Courtyard, Lobby, Shop & Front Space

SMOOTH CONCRETE
inner facades (overhangs)
general pavement and flooring

distinguishes axis Entrance-Landscape

LIMESTONE CLADDING
all generic outer facades

smaller: visitors & transition
larger: production

WEATHERING STEEL "CORTEN"
framing, emphasizing, guiding

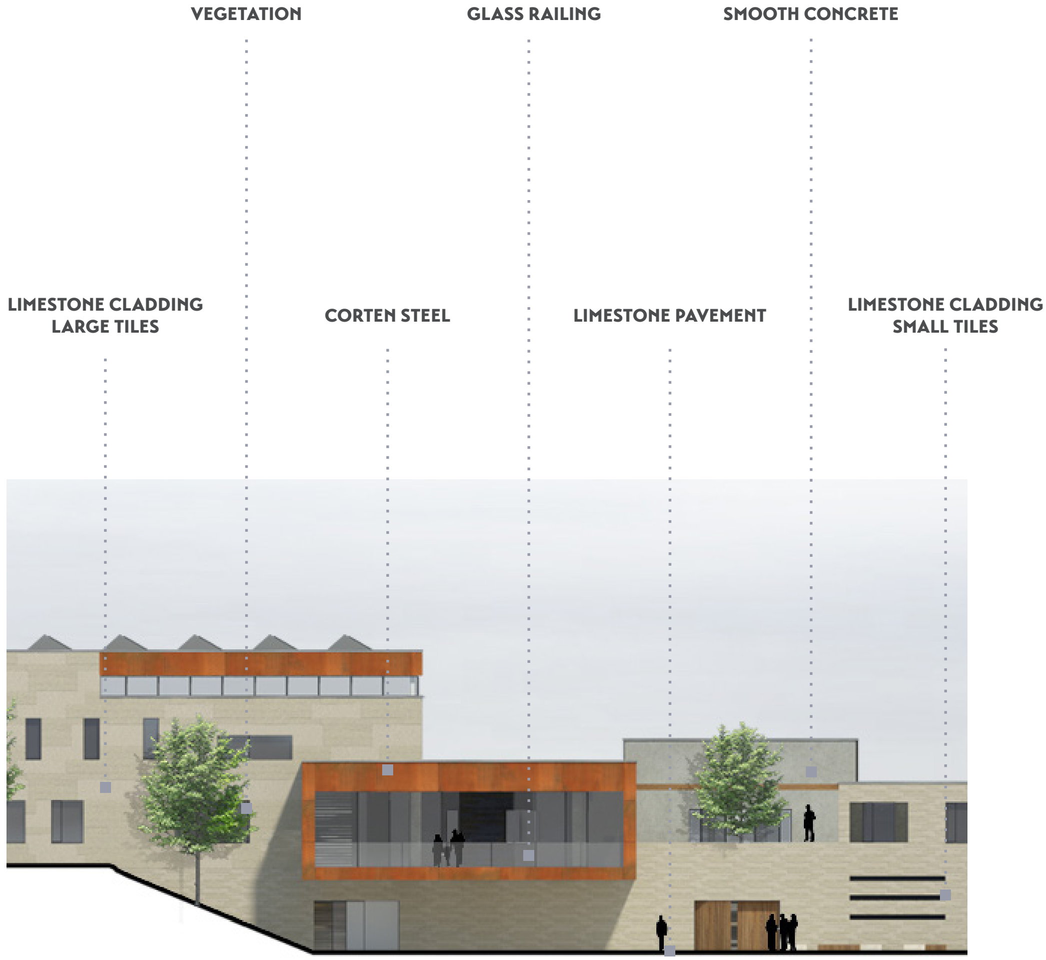
Entrance, Restaurant, Presentation

DARK OAK TIMBER
shading, outdoor furnishing
representative flooring

Offices, Presentation, Restaurant

VEGETATION
softening natural elements, shading

Courtyard, Accommodation, Restaurant


VEGETATION
GLASS RAILING
SMOOTH CONCRETE
LIMESTONE CLADDING LARGE TILES
CORTEN STEEL
LIMESTONE PAVEMENT
LIMESTONE CLADDING SMALL TILES

Facades & Landscape

The relationship to the landscape has played an inportant role during the design process. The natural sloping of the landscape has been fully utilized to apply the gravity flow principle (the Grape Inlet is located at the highest part of the site). Furthermore, the whole Drying hall has been located above ground level to exploit the opportunity to use the space for various event (out of the Drying period, which takes place from November to February). Moreover, sufficient air change rate has formed the most important criterion for this space and the above ground placement allowed for installation of openings to enable cross ventilation. The distinctive height of the production spaces has been inscribed to the predominant verticality of these openings.

The height of the volumes in the production zone has reached the maximum level allowed by the local regulatory plan, which is 10,5 m. In the visitor oriented zone the height reaches only 4 meters from the Eastern side.

The openings have been designed with regards to the risk of overheating, to the visual connection, and (namely in the Offices) to the daylight factor.

Fig. 45. Southern facades - limestone cladding is complemented with a line of smooth concrete emphasizing the Entrance-Landscape axis. The Presentation Area is accentuated both in volume and material.

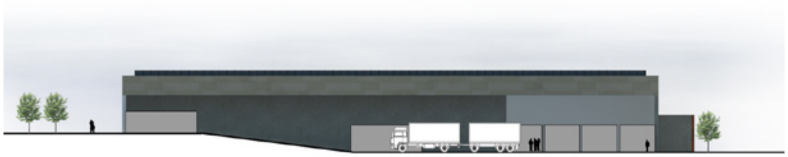


Fig. 46. Northern facade has a clearly functional characted represented by concrete facade in the inner side, but the outer envelope is clad with large tiles. The grape inlet is located in the North-East corner.

Fig. 47. The Entrance is located on the Eastern facade and it is emphasized by a larger volume and outstanding materiality. The North-East corner of the Production zone is utilizing the natural sloping of the terrain and thus is partially buried. This level difference of 2,5 m has allowed for placement of the grape crushers with direct unloading.

Fig. 48. The Restaurant presents a dominant on the Western facade. The openings are relatively small in general - on the production zone they are typically of vertical character, thus inscribing the inner dimensions and purpose of the space while providing natural ventilation. On the contrary, the human-oriented zones have been designed with regards to the views, risk of overheating, and daylight conditions.

Scenario 1 - Visitors

EXPERIENCES & KNOWLEDGE

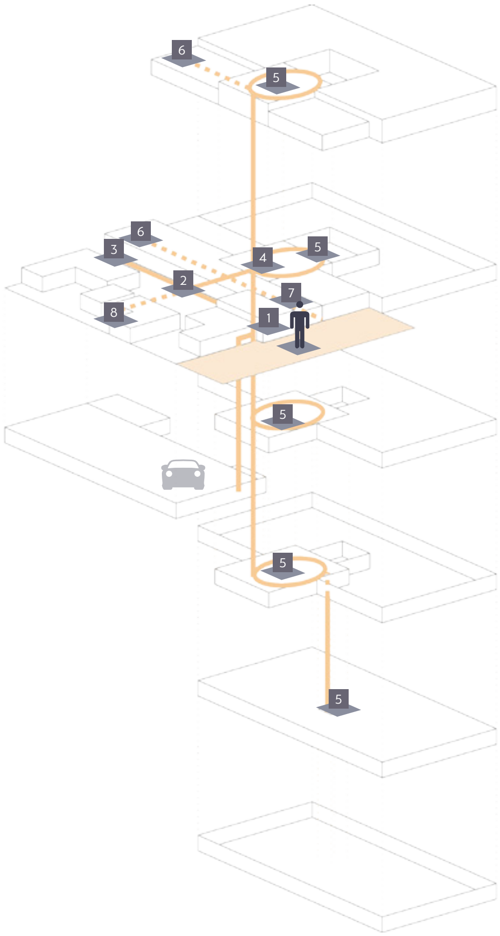
Wine tasting is a ritual which requires specific mind-set to be able to fully enjoy all its aspects. To achieve that, the architecture has to act as a background that complements and enhances the intended activities. Therefore, the highest priority has been set to the pacifying qualities of designed spaces tested from a human perspective using Virtual Reality tools. One of the possible spatial sequences experienced from a perspective of a "wine-tourist" will be described in this chapter.

The visitor begins his journey at the frontspace, where the designed greenery creates the first gentle division between the outer world and the world of wine. The velocity of his motion has been slowed down and the details in materials, indefinable from a distance, have appeared. The landscaping and furnishing of the space suggest what may come next and thus present a metaphorical appetizer stimulating desire for more [dictionary.com, 2016]. Through a clearly marked Entrance Hall, the visitor follows first axis of transition, from a noisy urban environment to the landscape and roots of the wine.

As a closed room with a single-directed visual connection, the **Entrance Hall** ■1 symbolizes a gate (a typical motif for italian architecture) to the following space - which opens up to the sky again. In the **Courtyard** ■2, the movement and life is naturally generated by its central position. Its design contains a number of parallels to a traditional urban plaza - the **view is directed and framed** ■3 to a dominant (in this case the hills & vineyards), the clear border is penetrated by a number of small lanes providing distributed flows of people. The **Lobby** ■2 forms a metaphore to an archway - protecting from climatic distress (overheating, precipitation) and providing both a pathway and a multifunctional, semi-outdoor space.

The Lobby, designed with a lower ceiling, allows for the adjacent **Vertical Hall** ■4 to be contrastingly tall and change the visitors perception again. The movement and light conditions designed for the **Presentation Core** ■5 carry away the connection to the surroundings and enhance the inner focus - to the poetics of wine and yourself. Following the **Gravity Flow** of the wine, the visitor experiences all the production stages of the wine (further described on page 76).

After leaving the Presentation, the position of **Restaurant** ■6 and **Shop** ■7 secures, that the visitor will have the opportunity to buy the company's and local products. Last, but not least, the **Accommodation** ■8 provides a comfortable retreat after the wine tasting and invites to spend more time close to the origins of Wine.



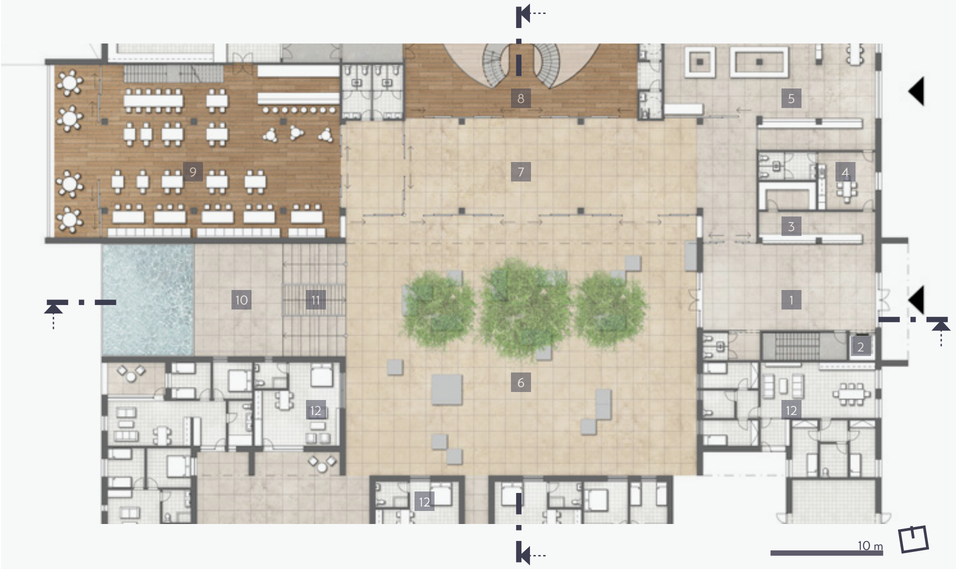
READING GUIDE - USER PATH
This axonometry showcases a possible path of the visitor in the building along with the most important spaces. The space described on each spread is always highlighted.

THE COURTYARD & LOBBY

Thanks to its position, the courtyard represents the essence of the users' flows interlacing. The space has been designed to serve as a hub for different activities and zoned to support movement as well as provide seating places. Natural elements have been brought into the Courtyard to soften the expression and support the connection to the landscape. The Entrance-Landscape axis is strenghtened by the planted trees and vines creep on the timber frames.

The Lobby is an inseparable part of the Courtyard, which has been designed as a semi-outdoor space. Its character varies depending on the season; during summer, the glazed sliding wall is opened and the Lobby is a fully shaded extension of the Courtyard, additionally shaded by the trees. In winter, the Lobby is not heated, only by solar gains, and serves as a hallway, protected from climatic distress. More information on thermal comfort in the outdoor spaces is provided on page 74.

The Courtyard directly connects the Accommodation Zone and Entrance Hall with the Restaurant, Shop, and Vertical Hall (further continuing to the Presentation Core). Moreover, the connection to the landscape is secured on a visual level through a contemplation zone with framed view and an exhibition tunnel leading directly to the neighbouring vineyards.



1	Entrance Hall	5	Shop	9	Restaurant & Bar
2	Access from the Parking	6	Courtyard	10	Contemplation Zone
3	Front Desk	7	Lobby	11	Tunnel Entrance
4	Facilities for Desk Staff	8	Vertical Hall	12	Accommodation Zone

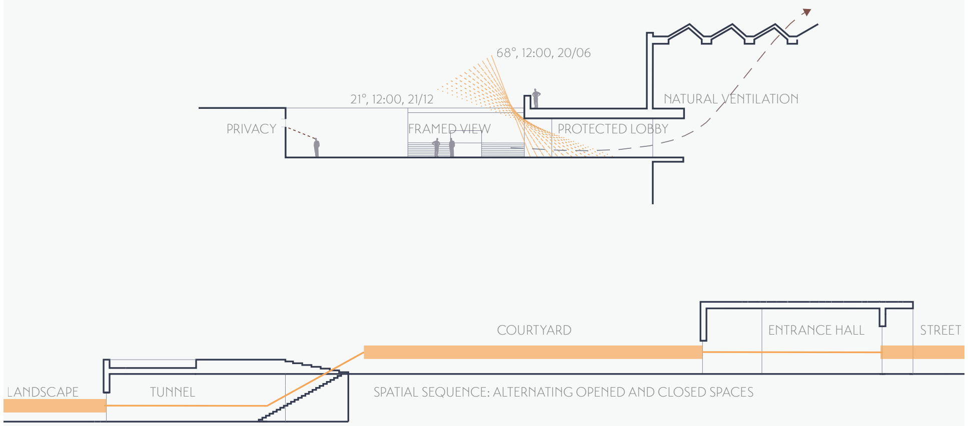


Fig. 49. Floor plan of the Courtyard area and principal sections describing the spatial organization and design principles

THERMAL COMFORT IN THE COURTYARD

The climatic analyses have revealed a potential problem regarding excessive heat stress in outdoor spaces, therefore the microclimatic conditions in the courtyard have been analysed in terms of percieved comfort. If the conditions are good for most of the operation period, the design is more likely to be successful and users will naturally tend to occupy the space.

Universal Thermal Climate Index (UTCI) have been used as a design guideline as it takes into consideration solar radiation, wind velocity, dynamic clothing model (to a certain extent, people respond to uncomfortable condition by changing their clothing level), and motion speed. For more information, please see the Design Process on page 108.

The Courtyard has been divided into 4 zones:

- The Lobby (1)
  - permanently shaded, closeable in winter
  - overhang prevents overheating
- Tree Area (2)
  - deciduous trees shading particularly in summer, both the Lobby and the area under the trees
  - strenghtening the axis, guiding natural element
- Grid Shaded/Framed Area (3)
  - permanently shaded space as it is designed for people to stop, sit and look out
- Exposed Area (4)
  - designed for periods with acceptable temperatures (9 months of 12) when it is possible to enjoy sun
  - designed for movement, but also partially furnished

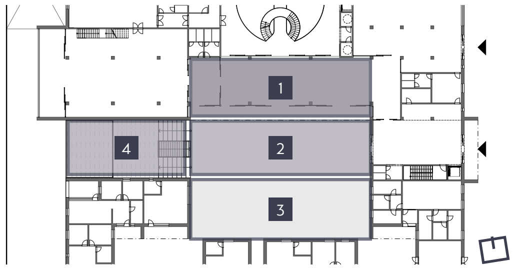


Fig. 50. Scheme of the Thermal Zoning

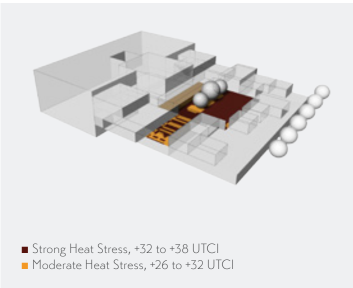


Fig. 51. Extremly Hot Day: t_{air} = 35 °C

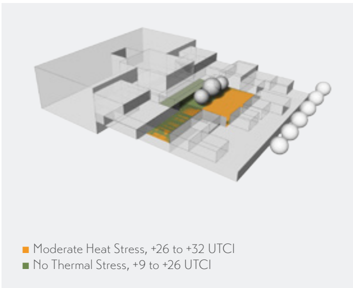


Fig. 52. Typical Hot Day: t_{air} = 27 °C

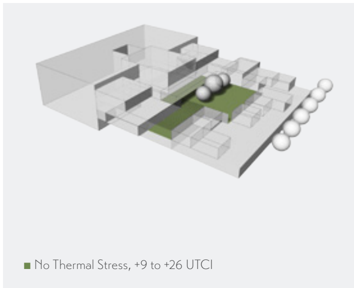
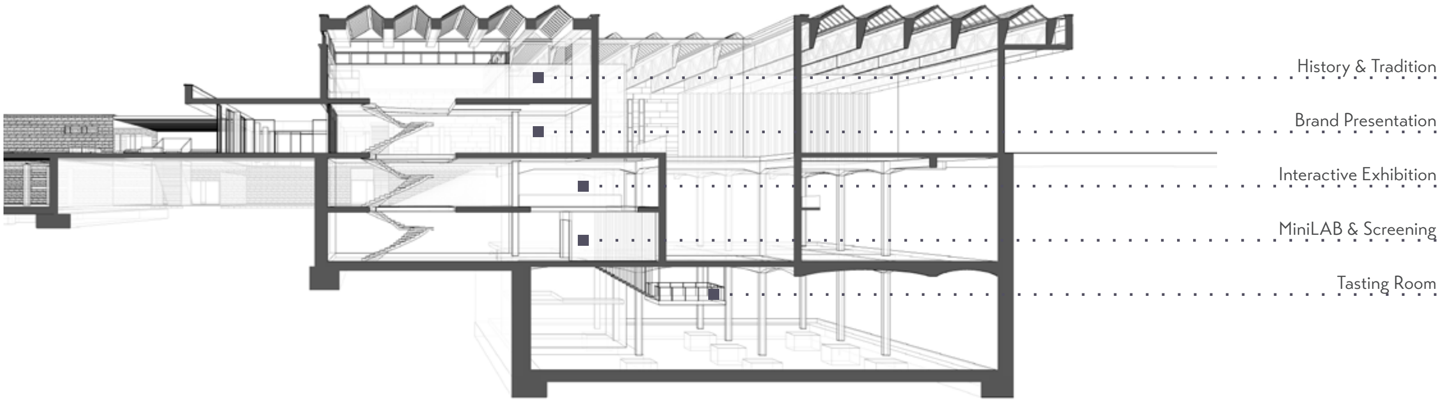


Fig. 53. Typical Day: t_{air} = 15 °C

FRAMED VIEW

This zone provides the connection to the local area, in particular to the vineyards and the surrounding hills. The space can be generally used as a calm, contemplation zone which is passively cooled down by shading timber grid and a water pool. The pool also reflects the scenery and thus builts up a stronger visual experience.

Thanks to the spatial organization, this zone is flexible enough to be used, for instance, as a ceremony area for a wedding. More information about the flexibility of the Courtyard and Lobby is provided on page 92.



PRESENTATION CORE

The Presentation Core truly embodies the concept of transition between the two poles; humans and industry. Through the spiral movement along the exhibition, the visitor experiences the essence of wine production in various ways while following the path of wine. The exhibition space has been designed both for organized and self-guided tours.

For guests interested in traditional techniques and history of the area is prepared the exhibition on the first floor. On the ground floor, the Brand's Presentation is located and it has been assumed that the space can be flexibly re-organized and updated; also in relation to a possible art exhibition opening which can take place particularly in the ground floor (stretching from Lobby through the Vertical Hall). Moreover, on this floor, the visitor joins the wine on its journey from "grape to bottle" as the space is adjacent to the Grape Drying Hall. The process can be observed both from indoors and from the gallery in the Light Well through openings which serve also for cross-ventilation.

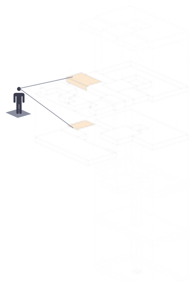
In the first basement, the exhibition is targeted on modern technologies, interactive presentation and "real business". The visitors are allowed to visit the Fermentation Hall from a catwalk surrounding the volume of the Light Well and thus not interfering with the ongoing production. The second basement utilizes the darkness and temperature stability for an experimental workshop with MiniLAB and offers space for Screenings on the wall.

The previously mentioned spaces represent the gist of the Wine Presentation and could be compared to a "main course", implying that the dessert is yet to come. This "dessert" has been embodied in a suspended platform designed for wine tasting surrounded by thousands of litres of wine in oak barrels. Here the visitor adjusts his mind-set for the last time and his visual, olfactory, and auditory sensation can be fully focused on the Wine.

The Maturation Hall is fully functional for the production, however, the aesthetic potential of the space has been utilized. The suspended Tasting Room along with different barrel sizes creates a spatial variation; while the generous central manipulation space next to the platform can be used for special occasions such as large group tasting or short term social events.

RESTAURANT

Due to the large extend of the presentation and the alcohol consumed during the wine tasting, the visitor is likely to tend to seek a place to eat. Therefore, in a direct connection to the Presentation, the restaurant is located. It is divided into several zones and the customer can select the preferred position to be seated.



The volume of the main dining room is extended towards the landscape and provides great and undisturbed outlook to the nature. Some customers would prefer to dine as close as possible to the vineyard instead of overlooking the area, therefore the lower terrace has been designed. It is partially sheltered by the restaurants volume, partially exposed to the sun and connected to vines in order to mimic the ultimate presence “in medias res”.

On the restaurant’s, an evening terrace is located. It is accessible both from the restaurant as well as from the top floor tasting room, which is designed especially for “after-siesta” tasting: exposed to the evening sun and overlooking the landscape.

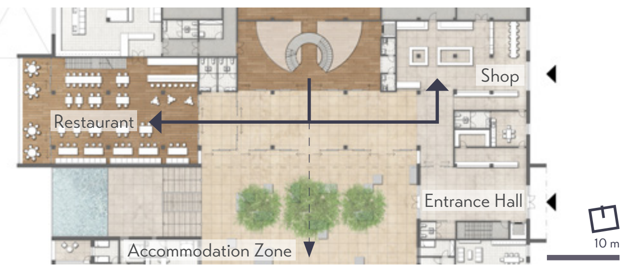
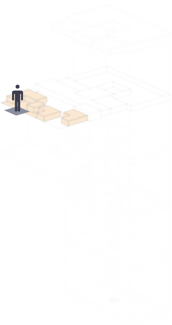
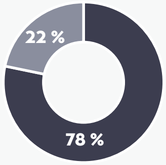


Fig. 54. After the exhibition, the visitor is offered to visit a shop or the restaurant and prolong his stay in the Wine Centre

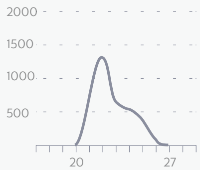
ACCOMMODATION

For those visitors who would like to sleep over in the Wine center or just use is as a base point for their Wine tours around the region, the accommodation zone has been designed. The best views are to the south west and it is also the most calm part of the site, so the apartments have been designed carfully with regards to the indoor comfort. Furthermore, the daylight conditions, issues of privacy and safety, and structural detailing have formed an inseparable part of the integrated design.





EN15251 CLASSES CO_2
■ CLASS I, ■ CLASS II

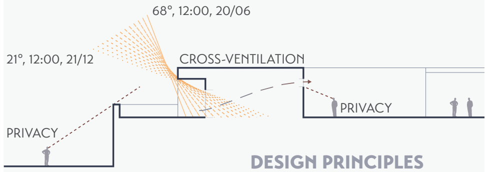


TEMPERATURE PROFILE
DURING A MODEL YEAR

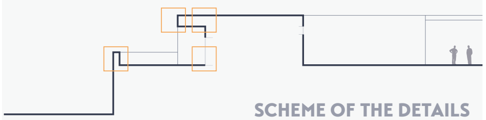
97%

HOURS DURING A YEAR
WITHIN RANGE OF 20-27°C

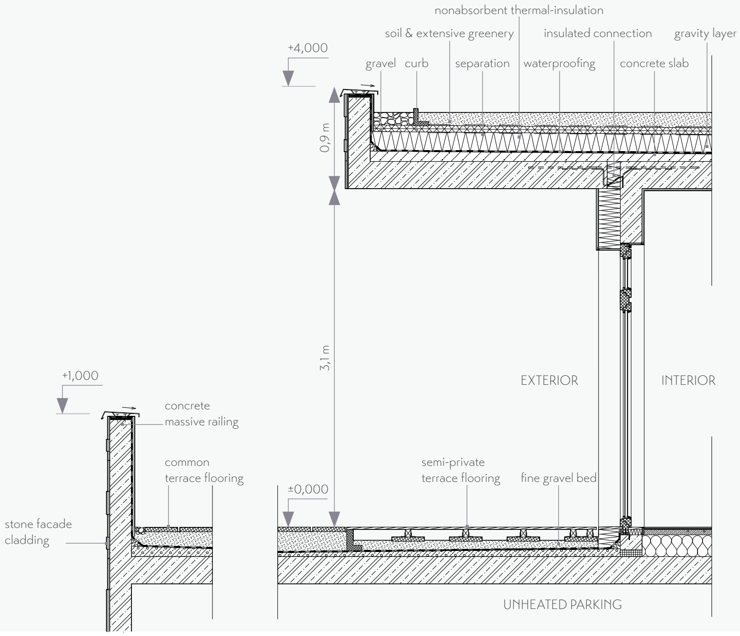
TECHNICAL PRINCIPLES



DESIGN PRINCIPLES



SCHEME OF THE DETAILS



1 Apartment 55 m², 2 beds
2 Apartment 75 m², 4 beds
3 Common Terrace for Guests
4 "WorkAway" Lodge
5 Storage/Technical Room
6 Entrance Hall
7 Courtyard
8 Framed View

Fig. 55. Floor plan showing the Accommodation zone and the adjacent areas

The accommodation zone has been divided into two zones - the larger portion oriented to the south west is primarily designed for general guests whereas the eastern building has been dedicated to the travelling working forces, associated on web platforms like "WorkAway.net" and similar. Those guests are not expected to pay for they stay as they actively contribute to the owner by working on his vineyards.

The stucture is made of concrete insulated in the exterior facade and clad with local limestone. As a general rule (applied through the whole project), the flat roofs which are visible from higher levels are covered with extensive greenery. The reasons are aesthetics, water retainment, and better indoor temperature stability when combined with thermal mass of concrete and proper thermal insulation. For more details on the technical considerations during the design process, please see "Accommodation" on page 118.

Scenario 2 - Employees

EFFICIENCY & PRODUCTIVITY

Until now, the building has been described from a perspective of an incoming visitor. Nonetheless, the employees' perception has been considered as equally important. Thus this scenario represents a possible path of an office employee who will visit the whole production part and the design will be described.

The spaces have been designed with regards to the wine-making criteria (see p. 18) and to overall efficiency, especially in terms of accessibility and compactness. Sensory testing on site have revealed, that by raising the floor level by only 4 meters, the noise distress from the main road is significantly lower and quality of remote visual contact increases. Therefore, the offices have been located on the first floor.

Fig. 56. Access to the offices is possible through the main representative staircase as well as by the back staircase core which leads to the production zone

The offices are located on the first floor, accessible both from the representative vertical hall as well as from the back staircase which serves also as a fire escape thus physical and visual contact to both the visitor zone and production is secured. The southern terrace and northern patio provide for sufficient cross-ventilation and distributed daylight.

JOURNEY OF THE WINE

The Wine cycle and its requirement presented on page 16 and in the Room progam on page 30 have informed the layout and volumetry of the whole production zone. The journey of the wine is displayed on Fig. 57 and will be described from a perspective of an office employee who will inspect the production.

The wine-making process starts at the Ground Level where the **Drying Hall** ■1, **Analysis Station** (Delivery Office & LAB) ■2a, and **Grape Crusher** ■2 are situated. Once the grapes are processed, thanks to the Gravity Flow principle the juice is naturally running down to the **Fermentation Hall** ■3. After the processes of fermentation are finished, the wine is either released to the **Maturation Hall** ■4a and than to the **Stabilization tanks** ■4b, or directly moved there (■4b). The stabilization have to take place at the same level as the bottling line is located. Once the last refinements of the wine are finished, the wine is bottled, corked, labeled, and packed at the **Bottling line** ■5. The finished products are than stored in controlled conditions in **Ageing Storages** ■6. After the ageing period, the palettes with packed wine are transported via **Industrial elevator** ■7 to the **Loading area** ■8 and dispatched to the dealers.

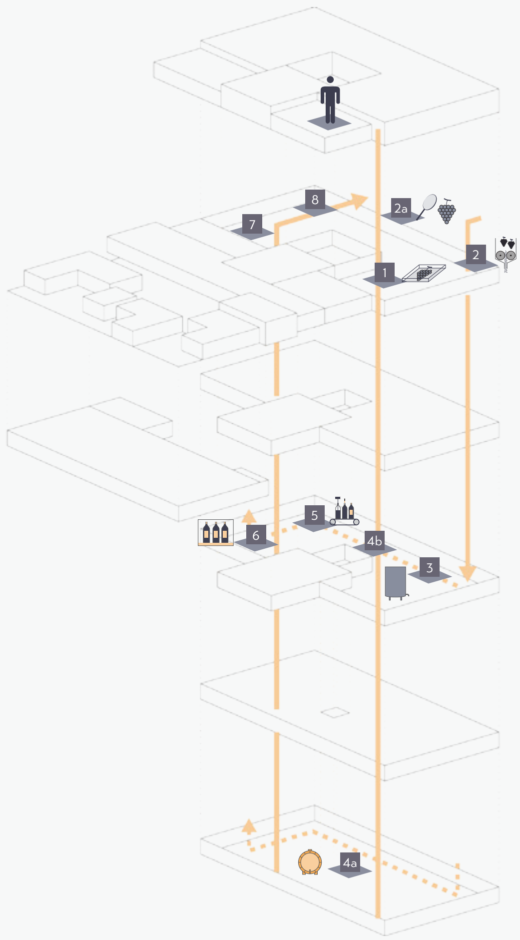


Fig. 57. The path on which harvested grapes slowly transform to a wine

GRAPE DRYING HALL

This space has been designed with special regards to accessibility and flexibility required by the room program. The different activities and supply flows related to the production take place in different time periods as described on the diagrams with timelines on Fig. 59.

Majority of the space belongs to the initial phases of wine-making, the grape analysis, grape drying, and grape crushing. As activities take place only during/after the harvest, the space would be unused for the rest of the year. Therefore, the orientation towards the road supports accessibility to various social events (described on page 95). The overhanged volume protects from rainfall during loading and unloading while using the same architectural typology as the visitor oriented zone. Visual and physical connection to and from the production is provided through a number of designed openings.

LIGHTWELL

In order to bring daylight and natural air to the production, the Lightwell has been introduced to the design. As the design have developed, the Lightwell have become an integral part of the Presentation area, as well as of the Production (both the Drying and Fermentation Halls). The space may be used both by employees and visitors. Thanks to the Lightwell, unique and unexpected spatial experience can be provided for guests of the special events located in the Drying Hall.

Fig. 58. The Ground Floor Plan depicts the visual and physical connections among the spaces

INTEGRATED ROOF DESIGN

The final iteration of the roof have met the required parameters while integrating the photovoltaic panels and distributed skylight within the design. Large span beam truss structure (max 25 m) have been selected as ideal solution for daylight, PV instalation, and flexibility of the space. The total installed PV area has reached 1095 m^2 (south orientation, declination of 8° to the west) and the on-site generated energy has significantly improved the final energy balance (for more information, please see p. 91).

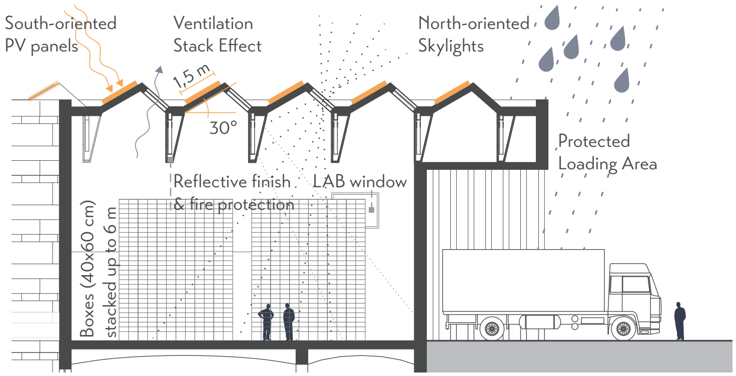


Fig. 60. Highlights of the roof design for the Ground Floor of the Production zone

TIMELINE OF ACTIVITIES

The wine production is characteristic for its seasonality, therefore various activities may be designed to take place in the same area because they occur in different time periods. The diagram on Fig. 59 describes three main flows related to the production and supply. Moreover, the icons illustrate that the spatial demands for all trucks have been fulfilled.

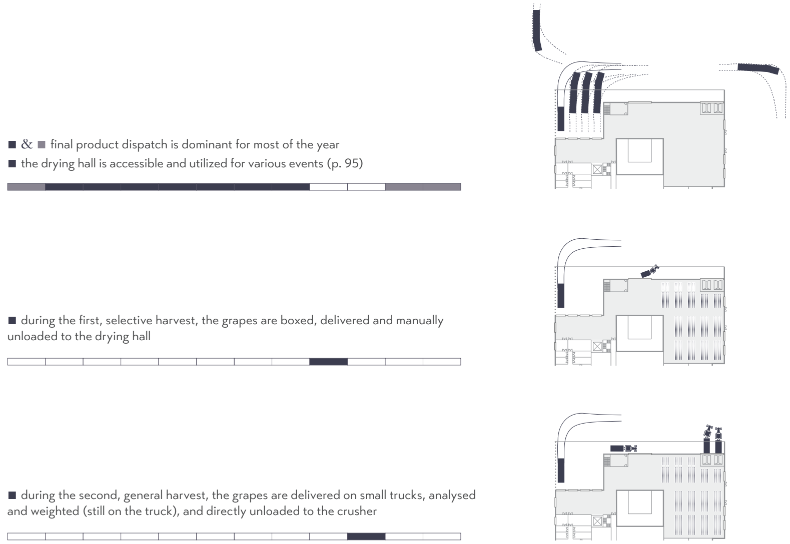


Fig. 59. Illustration of various supply & dispatch flows taking place in different time periods

FERMENTATION & MATURATION HALLS

The two largest spaces of the production zones have been designed with regards to the thermal stability of the space (see the next page), efficiency of the spaces, and opportunity to present the real and full scale picture of the production to the visitors. During their tour, the production is not interfered as the visitor flow is bounded by designed openings, elevated catwalks, and platforms. What is more, this organization of space allows for great spatial and sensory experiences as the room can be overlooked in short time and all the characteristic sounds, smells and light settings can be percieved. The material expression has respected the structural solution and demands for durability and easy cleaning.

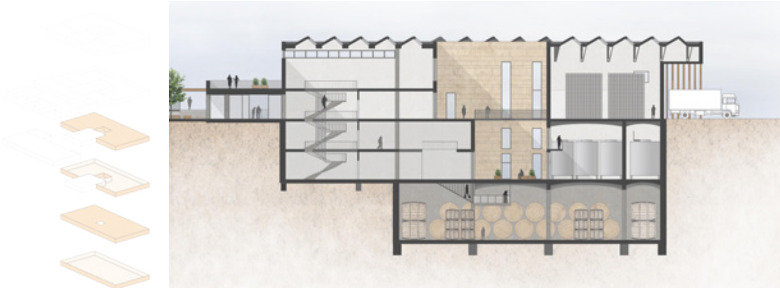


Fig. 61. Section through the production zone - Drying Hall is on the Ground floor

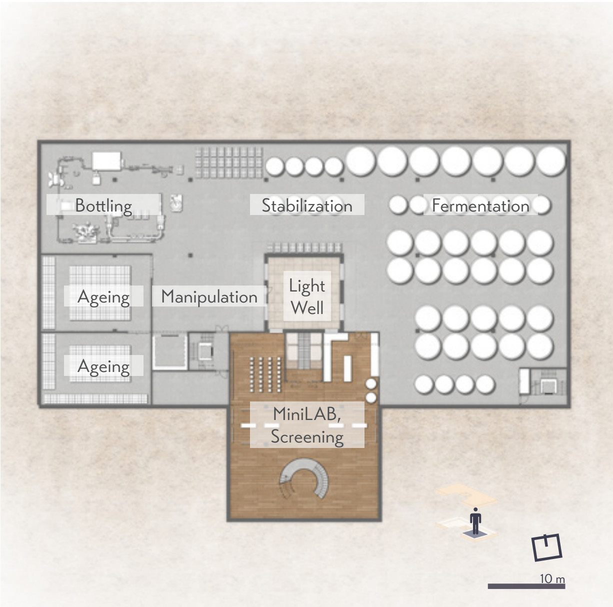


Fig. 62. Floorplan of the Fermentation Hall, located at the Level -2 [-8,000]

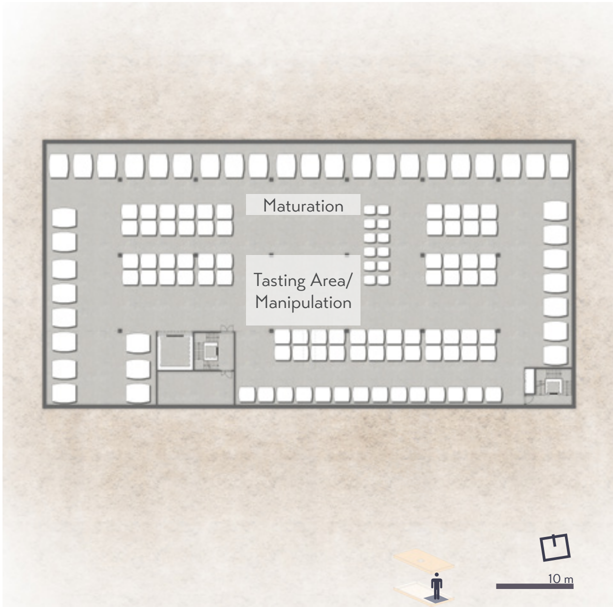


Fig. 63. Floorplan of the Maturation Hall, located at the Level -4 [-16,000]

THERMAL STABILITY

Since the thermal stability is essential for production of high quality products, the temperature profiles of the underground rooms has to be studied. The wine production comprises of various activities which take place in various seasons. Most of the production spaces have cooling-dominated character (due to the climatic conditions and process demands). Therefore the thermal properties of soil has been exploited (p. 23) and the thermal mass of concrete has allowed for greater stability. Considering the expected heat loads, the resulting temperature profiles satisfy the requirements without any special energy contribution for cooling or heating (Fig. 64, Fig. 65,)

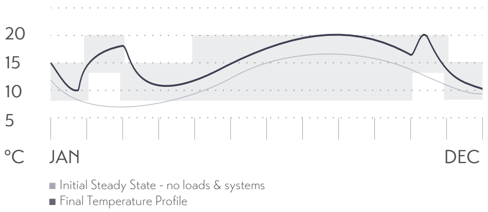


Fig. 64. Annual temperature profile of Fermentation Hall [BSim]

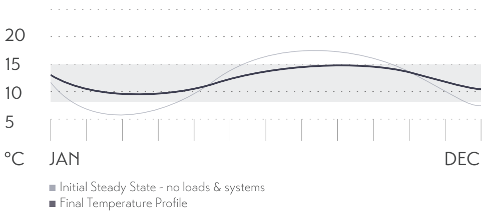


Fig. 65. Annual temperature profile of Maturation Hall [BSim]

The large trees and overhang are shading the large glazing of the Lobby.

ENERGY CONSUMPTION

Since the software typically used in Danish conditions for documentation of energy demands (Be15) is unsuitable for this project (mainly due to a lack of weather files), the calculation has been performed according to the pattern described on Fig. 66.

The entire building has been divided into zones with similar heat load contribution and energy demands. Due to the large total area of the project, the sizes of the zones have been compared in order to be able to determine potential for improvement of energy performance. The larger the zone is, the more sense it makes to apply changes to the design as the final energy consumption is normalized (per m^2 of floor area). The zone consumption has been a) researched in literature as a typical value, b) simplified and hand calculated, c) obtained as a result from a simulation software (BSim).

As the annual energy consumption is highly dependent on the actual weather and significantly influenced by the users, it is impossible to determine a precise result. Therefore, the calculation outcome has been multiplied by uncertainty factors to obtain results for the "best case", "best guess", and "worst case". All values have been multiplied by Primary Energy Factors according to the Danish Building Institute [sbi.dk, 2016].

	SPACES	AREA [m^2]	% OF TOTAL	LITERATURE [CIBSE.org]	HAND CALCULATION	BSIM
Unheated Spaces	Lobby & Corridors Technical Rooms Parking & Other Rooms	4097	33 %	-	■	-
Low-impact Spaces (non-production)	Accommodation	492	15 %	-	■	■
	Staff Rooms	387		-	■	-
	Presentation	963		-	■	-
High-impact Spaces (non-production)	Offices	369	3 %	■	-	-
High-impact Spaces (commercial)	Shop & Storages	653	9 %	■	-	-
	Restaurant	290		■	-	-
	Kitchen	140		■	-	-
Wine Production	Drying Hall	852	41 %	-	■	-
	Fermentation Hall	1704		-	■	■
	Maturation Hall	2545		-	■	■
		12500	100%	ANNUAL PRIMARY ENERGY CONSUMED: 52 kWh/m^2		

ON-SITE ANNUAL PRIMARY ENERGY GENERATION

31

kWh/m^2.year

BEST GUESS ANNUAL PRIMARY ENERGY CONSUMPTION

21

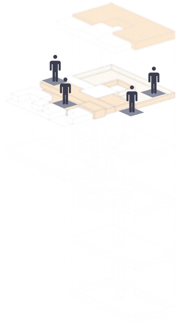
kWh/m^2.year

Fig. 66. Scheme of Energy consumption calculation and the results for "best guess" calculation. For more information, please see Appendix.

Scenario 3 - Locals

FLEXIBILITY & EASY ACCESS

The project's ambition is to propose an industrial facility, which is not only a factory producing wine, but also a place to gather and interact. In this chapter, the spaces which could be attractive for the local inhabitants, are described. Moreover, the design stresses upon flexibility of the Courtyard and the Drying Hall, therefore a number of possible scenarios with participating local people have been suggested.



RESTAURANT

The restaurant can host wide range of events, from private celebrations to provide catering for larger amount of people. The connection to their native landscape combined with quality local food ensures popularity.

SHOP

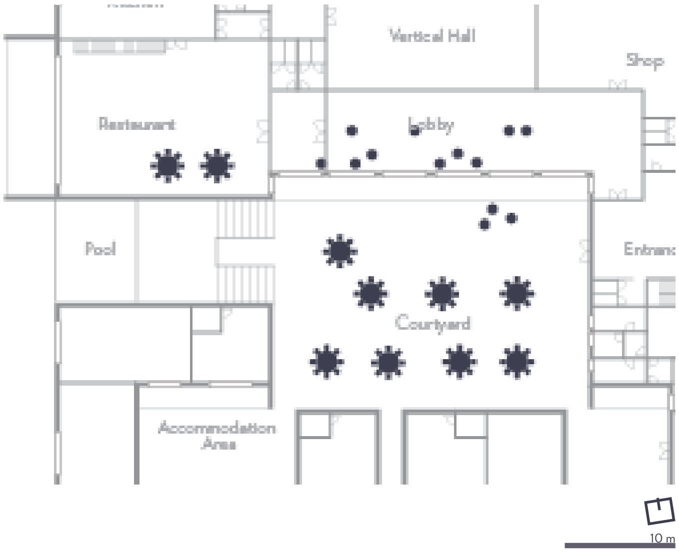
Directly distributed local wine and products with affordable prices are attractive for the customers from the area.

TASTING ROOM

Local companies like to present the region to their customers through wine tasting therefore and build and strenghten business and personal relationships. One of the three designed tasting rooms is perfect for such occasion.

EXHIBITION OPENING

Thanks to the conscious zoning, the design of the Courtyard allows for various events with expected larger amount of people at one time. The company often supports local artists and some of the art pieces have been donated as an expression of gratitude. The spaces adjacent to the Courtyard, especially the Lobby and partially the Vertical Hall, offer spaces suitable for exhibition of sculptured or manufactured art. Moreover, interesting expression can be achieved when the framed views are combined with an art piece. The opening event of such exhibition will populate the whole Courtyard area. Refreshment can be easily served from the Restaurant/Bar or directly in the Lobby.

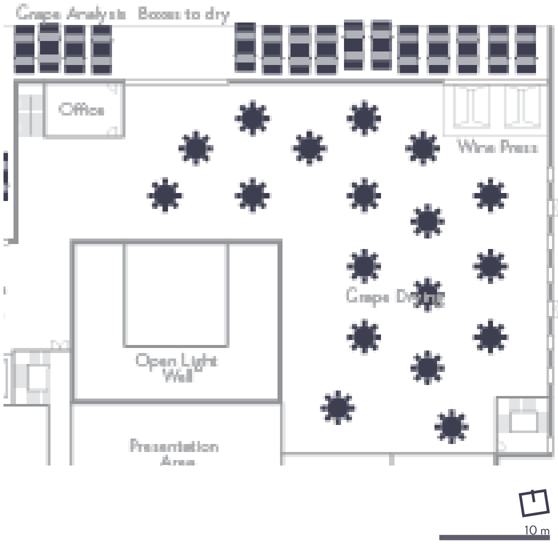


WEDDING

A wedding can be helt in the unique scenario of a relatively small and focused place framing the surrounding nature, typical with the vast vineyards. The view is clear and unobstructed as the build in-pool takes the place of a railing. Moreover, the water surface reflects the landscape and cools down the air. The guests would percieve the whole picture of a married couple with the background of vineyards and hills while the couple can experience their special moment on the elevated and detached platform. As for the exhibition opening, the refreshment can be also easily served from the shaded and protected Lobby and the ceremony guests can freely occupy the space.

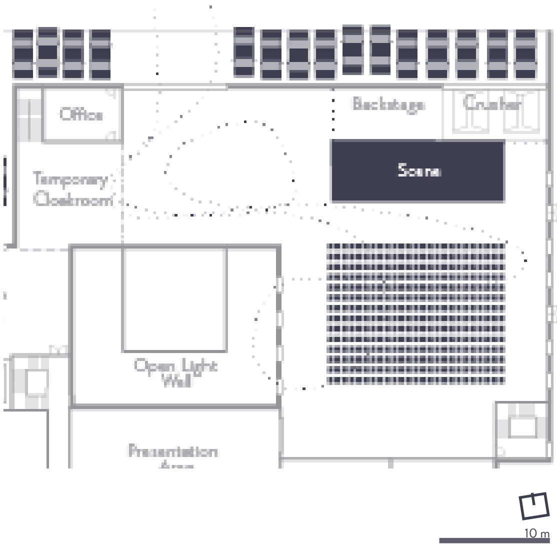
CONFERENCE/TRADE FAIR

The Drying Hall represents a room easily transformable from a production space to an event hall. The guests are approaching the building from the northern side, experiencing unfamiliar feelings of being in a real and operating factory. The large space, coarse materiality, good ventilation possibilities and unexpected amount of daylight coming from the northern skylights and slender facade openings - all together it is building up a special character of a place to be remembered. Once the harvest period comes on schedule again, the place is promptly transformed back again.



THEATRE/CINEMA/CONCERT

To a certain extent, the spatial experience of visiting a “factory-in-use” may be similar as for the conference/fair scenario. However, theatre performance usualy takes place in the evening when the light settings of the rooms are adjusted artificially and the atmosphere is changed. The space with lowered ceiling next to the delivery office will serve as a temporary cloakroom, the space around grape crusher provides for a back scene. During the breaks of the performance, the Lightwell stands in for a standard lobby, providing fresh air in an space unforseen in an industrial facility.



04

Design Process

The design have been continuously informed during the process as the various options have been tested by using different tools. A relevant extract from the rich process which has led to the final solution is presented in this section.

Design Process

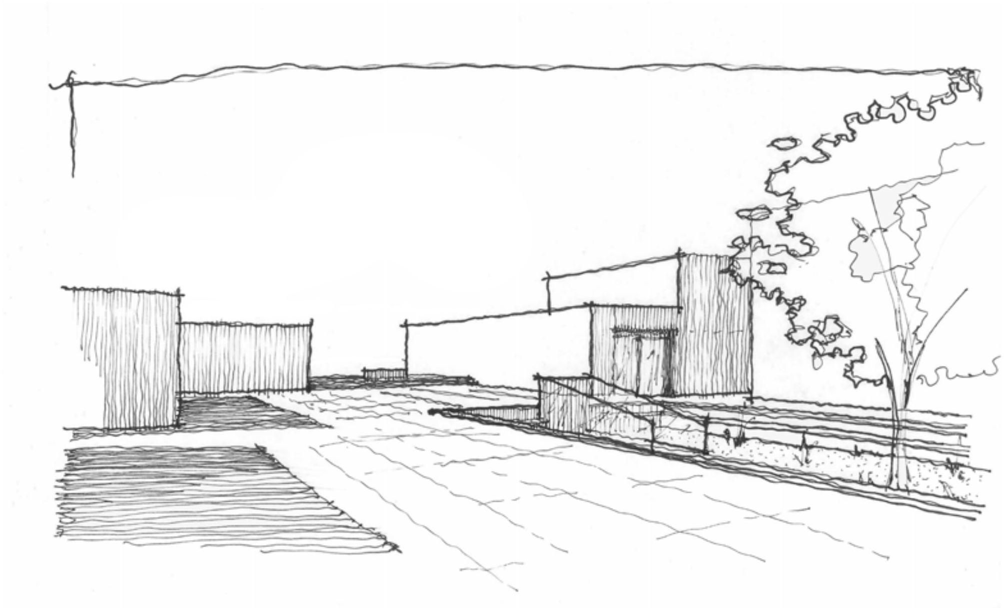
The design of the Winery project has been documented and a relevant extract from the process will be presented on the following pages. The various studies, sketching, modelling, and simulations have informed each other, so a truly holistic solution could be achieved.

> *❝ Design is not how it feels like or looks like.*
>
> *Design is how it works.*
>
> \- Steve Jobs

“ Design is not how it feels like or looks like.

Design is how it works.

- Steve Jobs



Highlights of the Design Process

VOLUME DEVELOPMENT

On the following diagrams, the highlights of the design are described. The design process have not been linear as it may seems so from the sequencing diagrams, but once the design have been finalized, the most important elements have been simplified into explanatory illustrations.

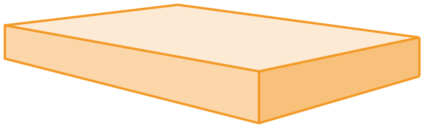


Fig. 67. Maximum possible overground volume

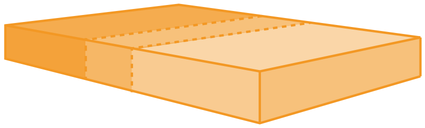


Fig. 68. Three zones: Production, Transition, Visitors

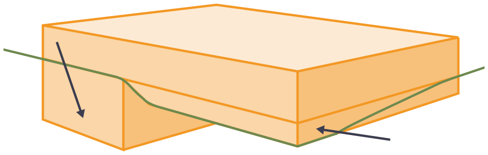


Fig. 69. Utilization of natural terrain slope (gravity flow, parking)

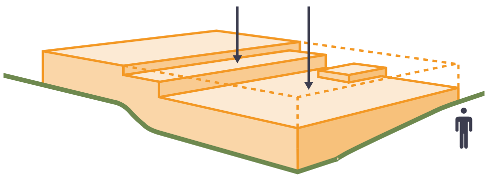


Fig. 70. Relation to the human scale

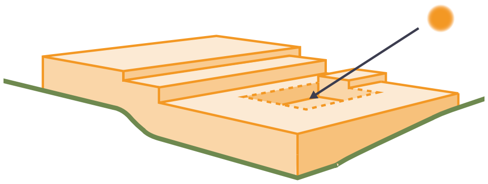


Fig. 71. Courtyard for natural light and ventilation for people

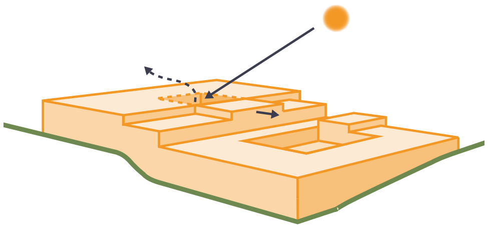


Fig. 72. Lightwell for natural light and ventilation to the production

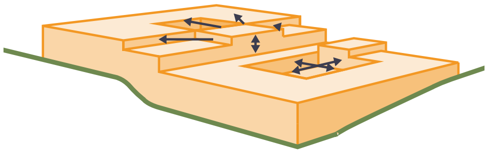


Fig. 73. Courtyard and presentation core as central junctions

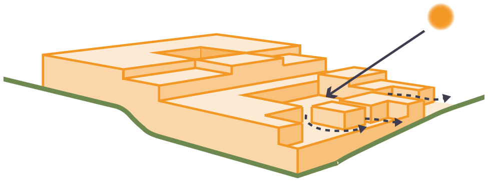


Fig. 74. Volume penetration for light access and air movement

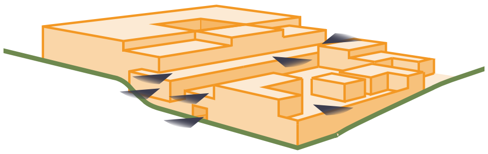


Fig. 75. Framed views and relationship to the landscape

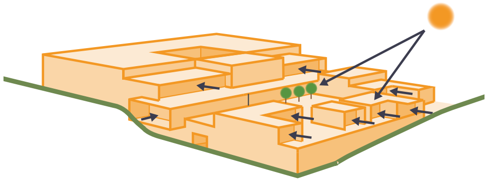


Fig. 76. Passive strategies: shading (overhangs, vegetation), thermal mass

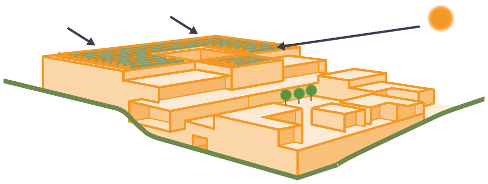


Fig. 77. Active strategy: PV panels installed on the top roofs

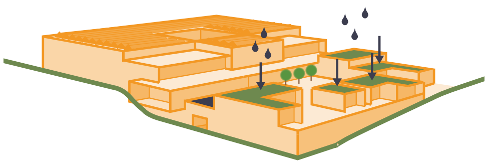


Fig. 78. Water: pool for cooling, green roofs to retain precipitation

Flow and Functions

FLOW

In order to ensure fluent organization of spaces, iterations on possible access flows have been performed.

FUNCTIONS ACCORDING TO FLOW

The five best options of the flow organization have been selected for further development (decision-making have been based on context analyses). These flows have formed the point of departure for distribution of the functions.

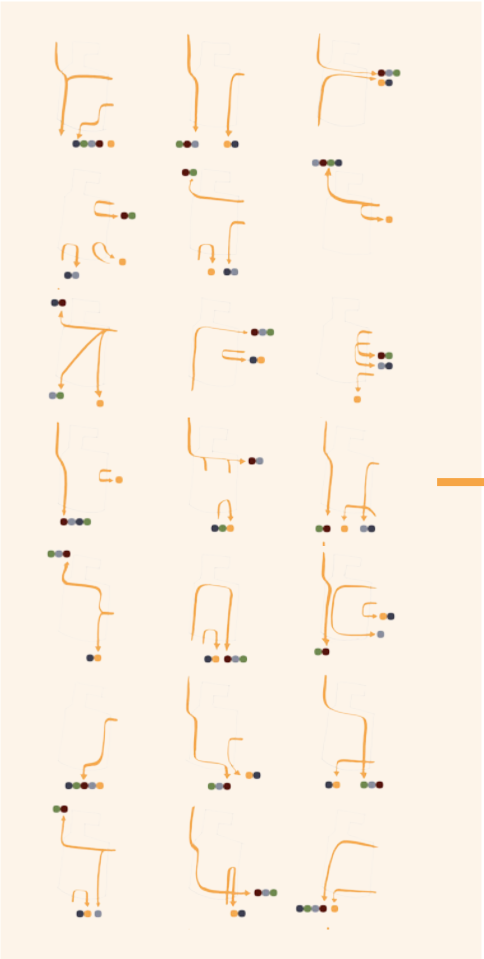


Fig. 79. Flows on the site: Grape Inlet (■), Bottled Wine (■), Visitor Access (■),Restaurant Supply (■), Employee Access (■)

Fig. 80. Sketch models in scale 1:250 have revealed the possibilities of functional and spatial organization of the building.

EVALUATION OF MODELS

The criteria have been defined and models have been evaluated. The evaluation process have generated a fruitful discussion and clarification of the goals, which have led to a successful project development.

Trafic flow 1
Potential for strong form 2
Outdoor shaded areas/ventilation 3
Visual connection 4
Quality of outdoor areas 5
Orientation of functions 6
Inviting, clear navigation 7
Visitor experience 8

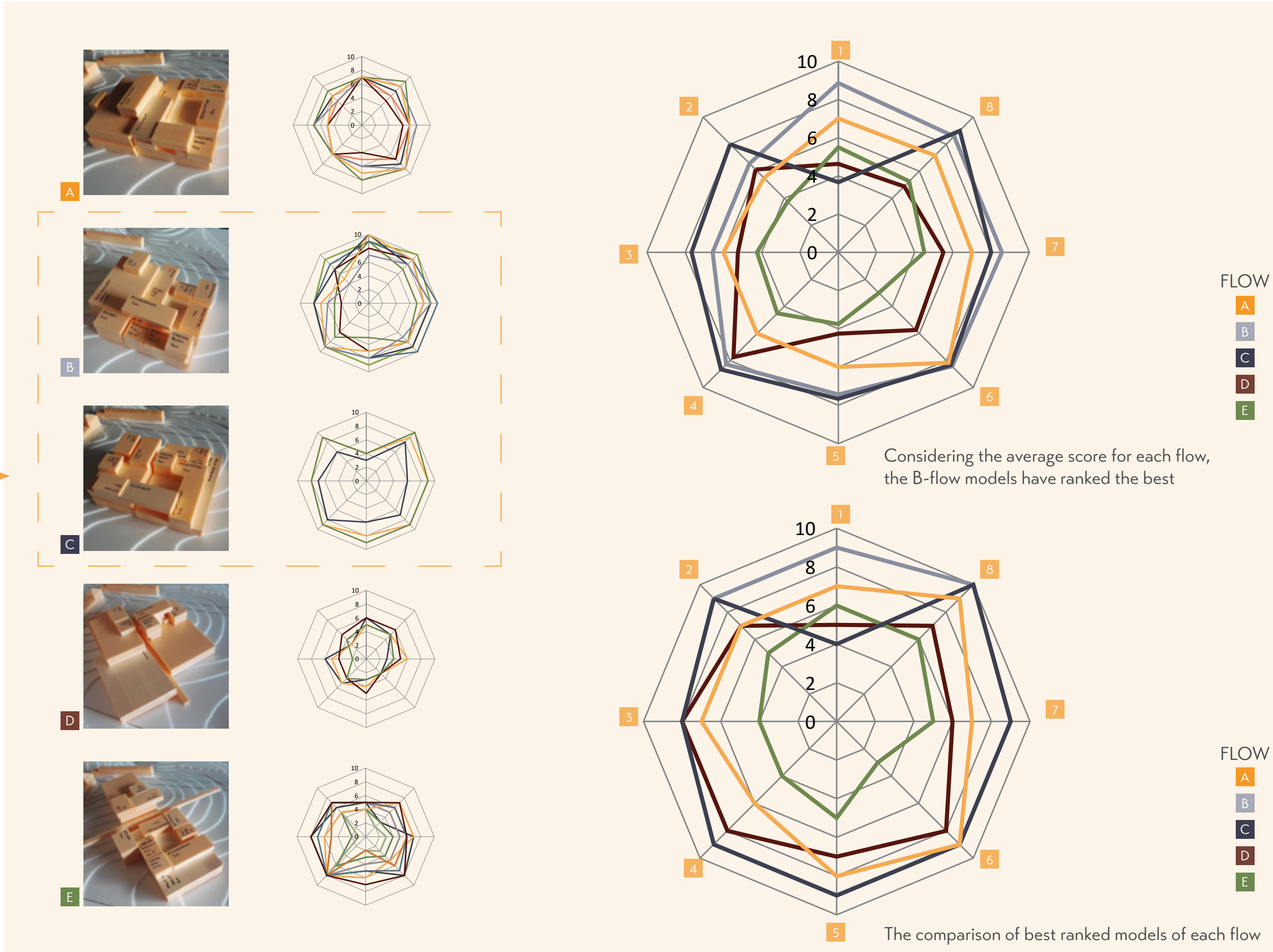
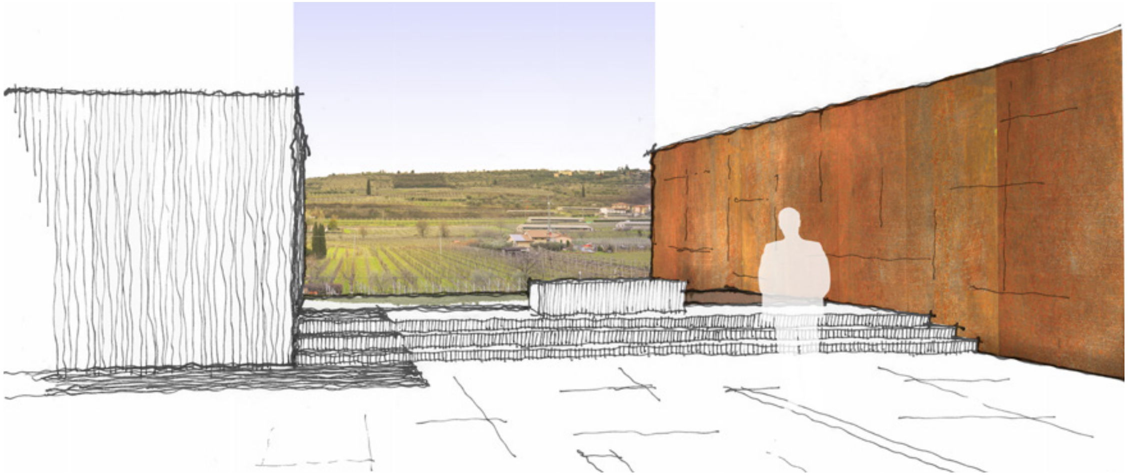


Fig. 81. The best ranked functional distribution and flow (B) have formed a strong foundation for the project

Experiences & Nature



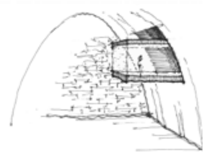


Fig. 82. Elevated box overlooking barrels

Fig. 83. Mirrors to see what is beyond

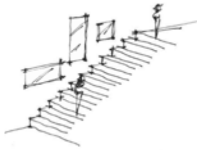


Fig. 84. Production exposed from different heights

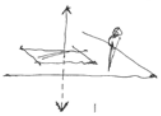


Fig. 85. Glass floor

Fig. 86. Open level

Fig. 87. Tunnel

Fig. 88. Glass wall

Fig. 89. Media & technology in presentation room

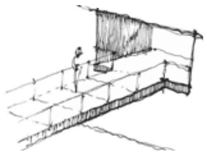


Fig. 90. Bridge/Catwalk

THE CATALOGUES

The transformation from a factory to a touristically attractive cultural centre combined with ongoing wine production is the essence of the project. Therefore, a catalogue of possible presentation means of the production have been developed and used when defining the character of presentation spaces. Different options represent different sensory perception of the visited spaces. (Fig. 82 to Fig. 90)

Diagrams on Fig. 91 to Fig. 98 represent a catalogue of possibilities when it comes to the connection to local nature and landscape. Most of these principles have been applied, tested, and iterated during the design process. In general, this method has been very helpful as these important principles have been developed into a collection of design criteria, eventually applied on the design.

Fig. 91. Next to the vineyards

Fig. 93. Vineyards from above

Fig. 92. Sounds and smells

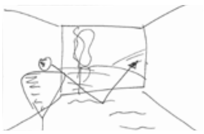


Fig. 94. Reflected surroundings

Fig. 96. Green roofs

Fig. 95. Plants in pots

Fig. 97. Grapes hanging from the roof

Fig. 99. Windows in different positions

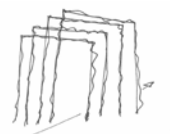


Fig. 98. Framed view

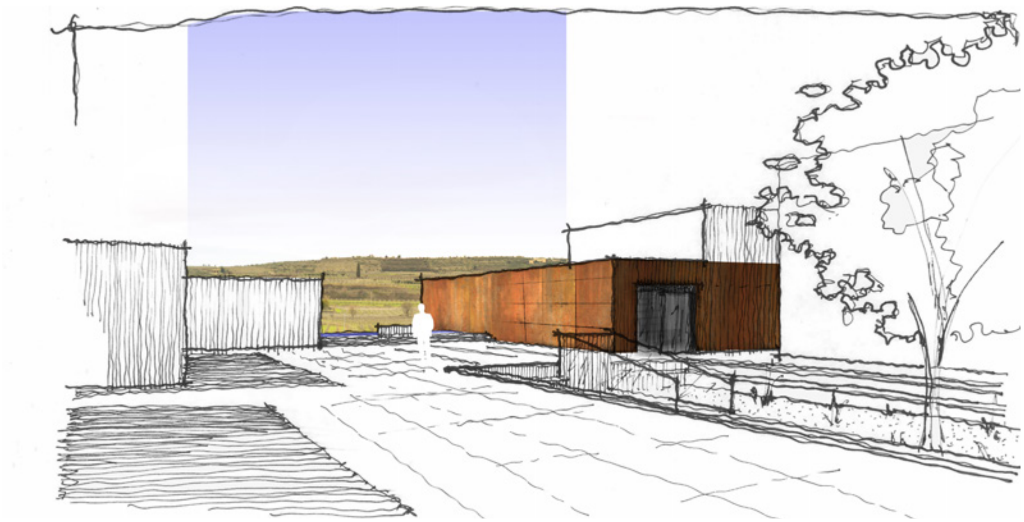
Courtyard

INTEGRATED DESIGN

The courtyard have been designed with regards to a number of relevant inputs so the required qualities of the space could be achieved. The following criteria have been considered:

- aesthetics
- functionality
- respect to conceptual values
- shadow range during the year
- percieved outdoor comfort
- indoor environment
  - daylight
  - temperature
- materiality

In order to simulate, analyse, and optimise the design, Grasshopper plugins LadyBug and HoneyBee have been used. These plugins serve as an user interface for energy simulation software Energy+. The process and results of the calculation will be described on the next page.



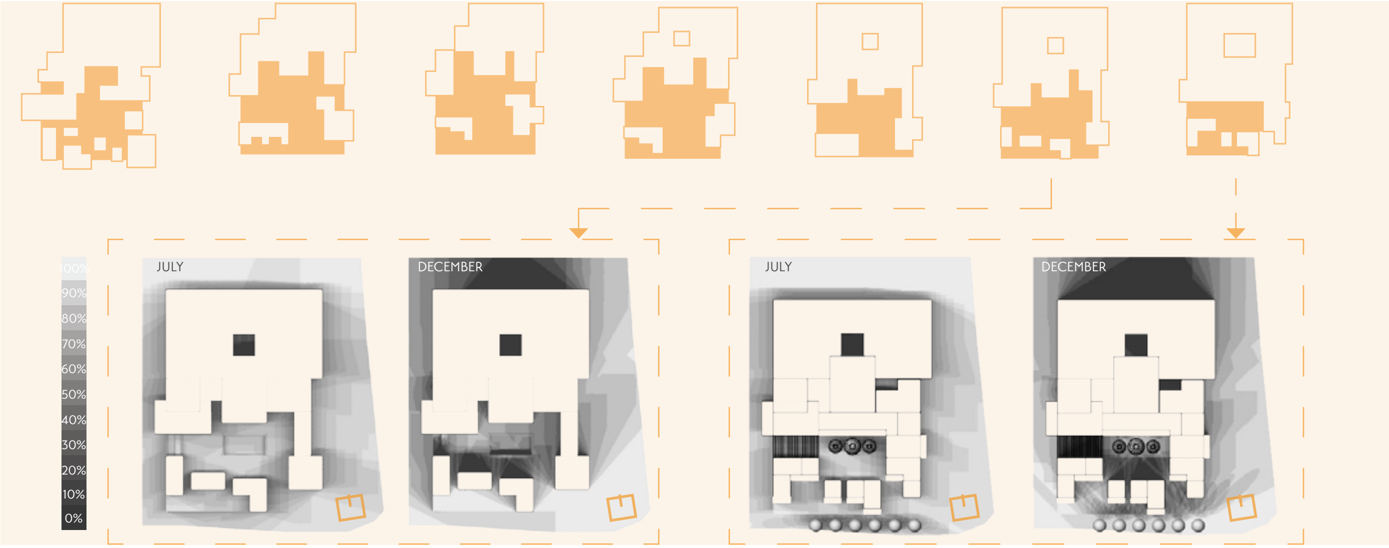


Fig. 100. The considered options for the general layout have been analysed in terms of shadow range during the whole year. Examples from the process are showcased above

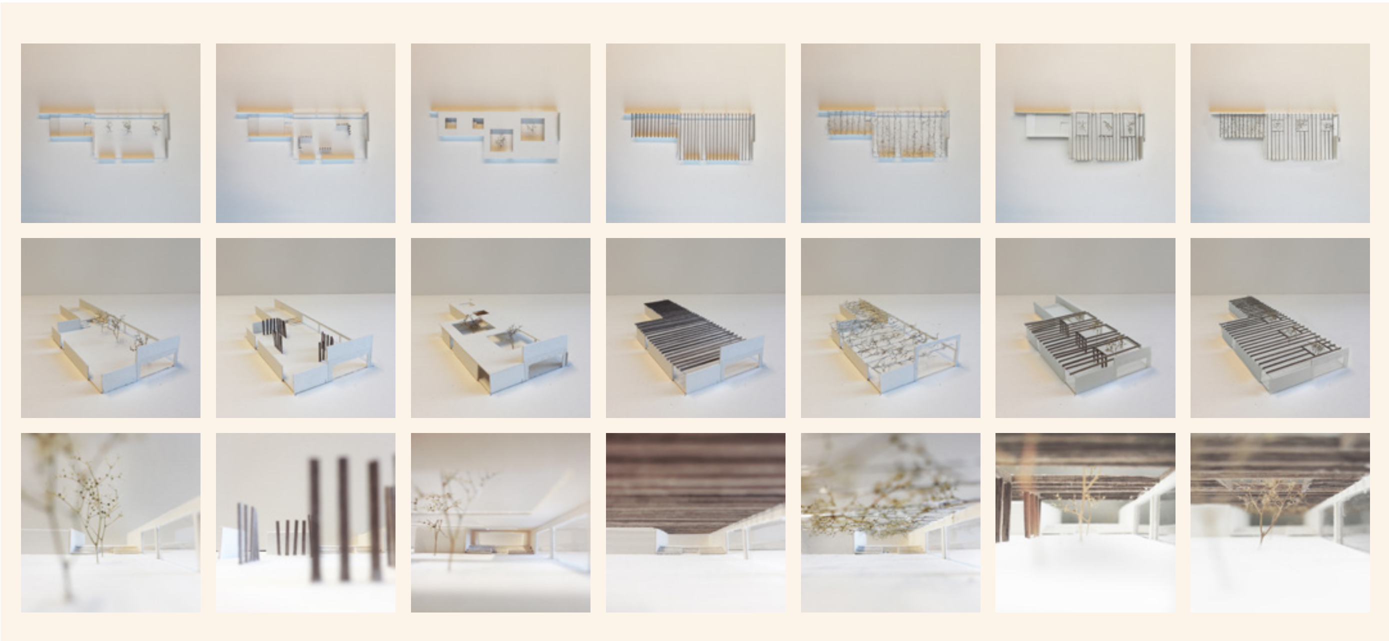


Fig. 101. Once the general layout of the masterplan have been clarified, the aesthetics and spatial character of various shading structures have been studied on physical models

THERMAL COMFORT IN THE COURTYARD

Outdoor areas like the courtyard presented on these pages have to be investigated in terms of perceived comfort in any climatic zone. If the conditions are good for most of the operation period, the design is more likely to be successful and users will naturally tend to occupy the space.

UNIVERSAL THERMAL CLIMATE INDEX (UTCI)

The air temperature of the outdoor space is not a value ready to be used to evaluate a quality of such space. The perceived comfort is affected by other important climatic factors, such as wind velocity, solar radiation, and humidity (Fig. 102). Those factors would still not be enough to evaluate comfort from a human perspective, so the advanced multi-node "Fiala" thermoregulation model has been selected to simulate behaviour of people, dynamically responding to the situation by changing their clothing level. All these factors form a system of Universal Thermal Climate Index (UTCI) equivalent temperatures which can describe the conditions in analysed outdoor space. (UTCI.org, 2016)

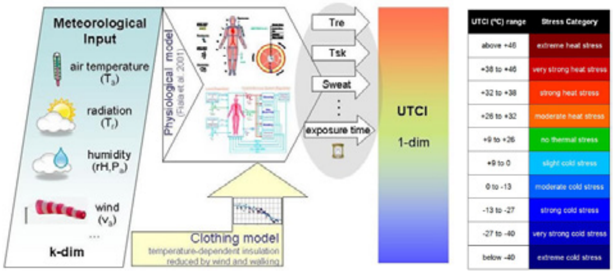


Fig. 102. UTCI components and assessment scale [UTCI.org, 2016]

DANISH AND ITALIAN CLIMATE CONDITIONS

For better understanding of the UTCI system, the same space was evaluated in different climate zones but with the same air temperature of 24,6 °C (Fig. 103). It is clearly visible that in the shaded areas behind the buildings the comfort index has significantly lower values in Danish climate than in Northern Italian environment. In other words, the volume of the building itself (h=4m) could sufficiently shade (and provide comfort) the adjacent area in Denmark, but not in Italy. Therefore, other means of solar protection have to be evaluated.

STRATEGIES FOR PREVENTION OF OVERHEATING

The following strategies for protection from solar radiation have not only been assessed as a solution for the initial problem, overheated outdoor space, but their impact on adjacent spaces has been investigated, too.

- trees
- timber grid 1: 0,05 x 0,3 m; dist. 0,55 m
- timber grid 2: 0,02 x 0,1 m; dist. 0,35 m
- comparison between N-S and E-W orientation
- grid combined with vegetation

(results from the analyses are presented on Fig. 104)

Results from more detailed studies of the comfort in the courtyard revealed that the problem of having seriously overheated space (Strong Heat Stress category) never appears and the Moderate Heat stress is occurring only for approximately 14 days between 10th July and 10th August. Therefore, placement of a full span fixed solar protection will not be 100% beneficial and the investigation focus has moved more to investigate the indoor temperatures in the Lobby. The initial studies have served as a source of information for the design and, together with the architectural decisions, the courtyard has been divided into three areas described on page 74.

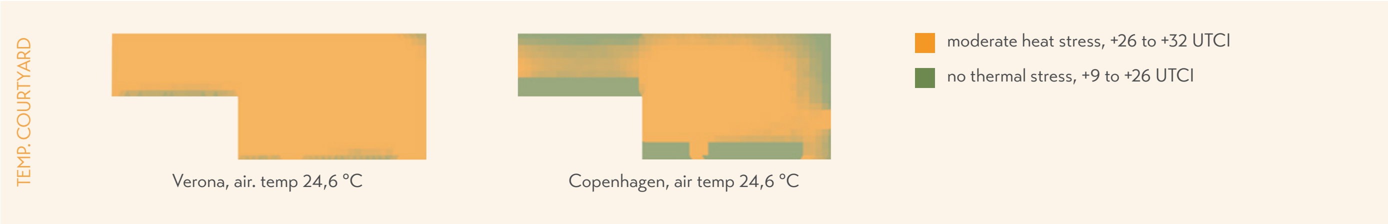


Fig. 103. Comparison between the percieved temperature (UTCI) in Verona and Copenhagen while the air temperature is the same

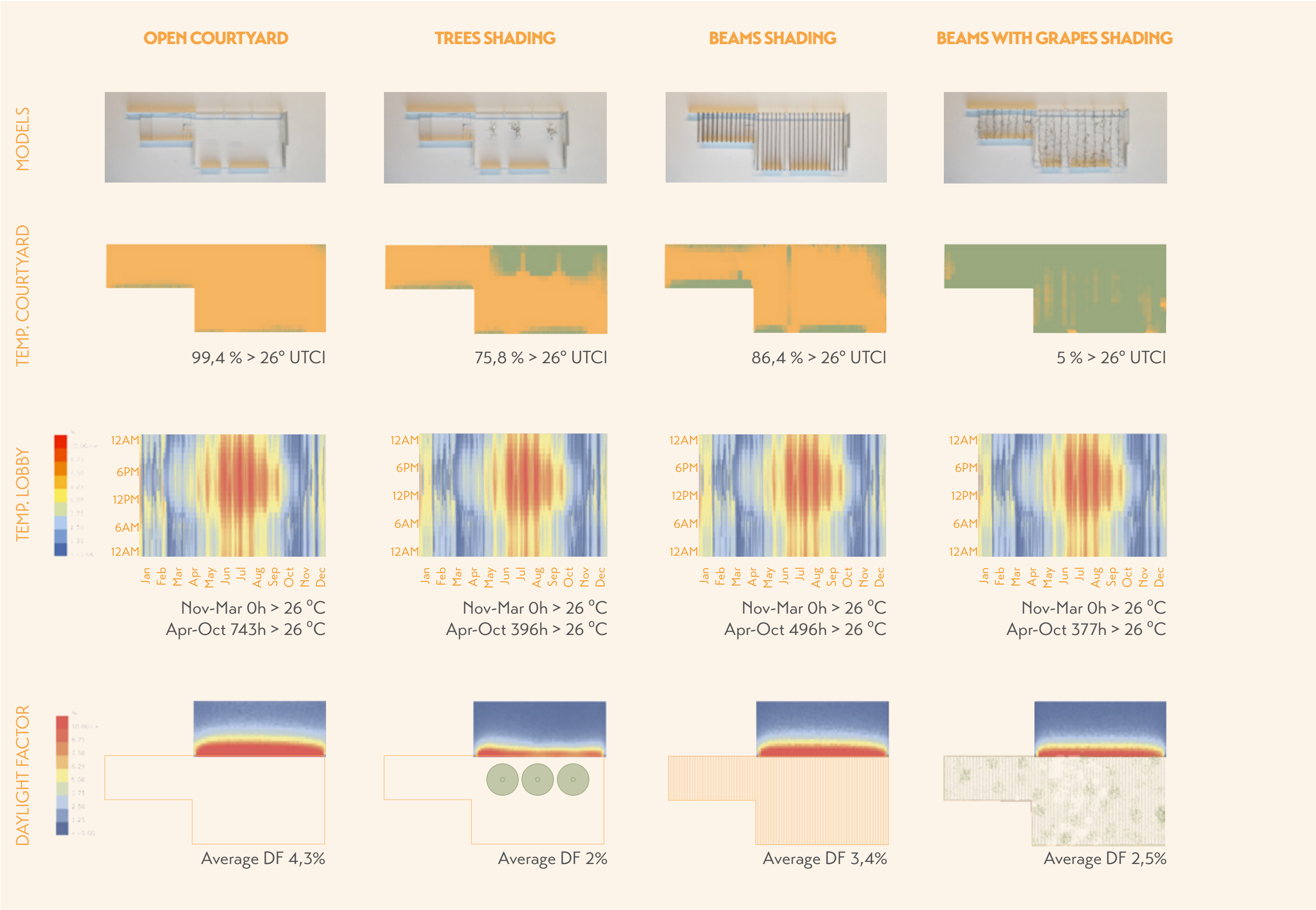


Fig. 104. Various parameters have been considered and integrated during the design process of the courtyard and lobby. The presented results for UTCI are for a typical hot day

Virtual Reality

ENTRANCE HALL

During the study trip, the 360° spherical photos have been taken at the site from specific positions. Therefore, the design iterations could be contextualized and evaluated with correct scale perception. This tool have been namely used for the design of the entrance hall as the visitor's pereption of the space is hard to estimate from traditional rendering methods. The QR code contains a weblink where the different tested methods of use of virtual reality are showcased (original site photo, overlayed sketch, matching rendered model)

Fig. 105. Virtual reality as a design tool - scan the QR code for 360° images

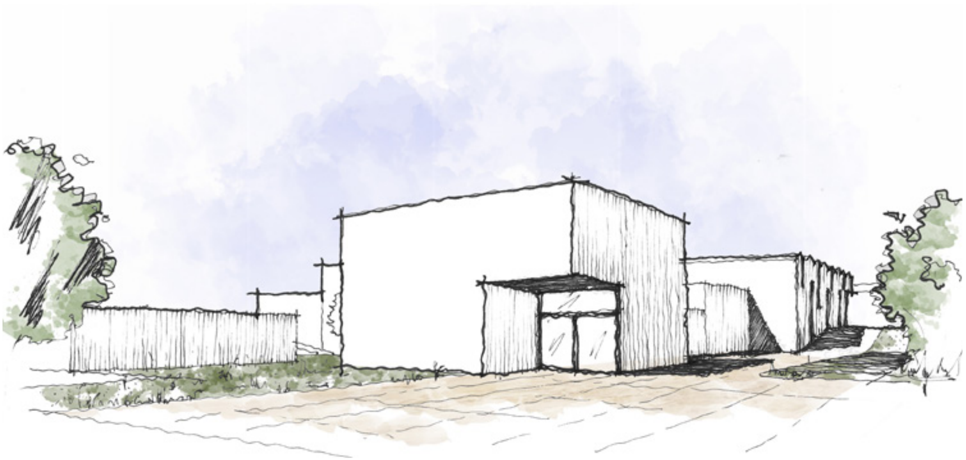


Fig. 106. Iteration of the Entrance Hall volume - access from the cornes

VERTICAL HALL

The spherical renders have been also used during the design process of the Vertical Hall when the different geometries and layouts for the staircases have been considered. Firstly, the relevant options from the sketching phase have been modeled in cardboard and evaluated as scaled models. Than the model have been processed digitally and rendered as 360° perspective in order to evaluate the spatial qualities. Scan this QR code to see the images.

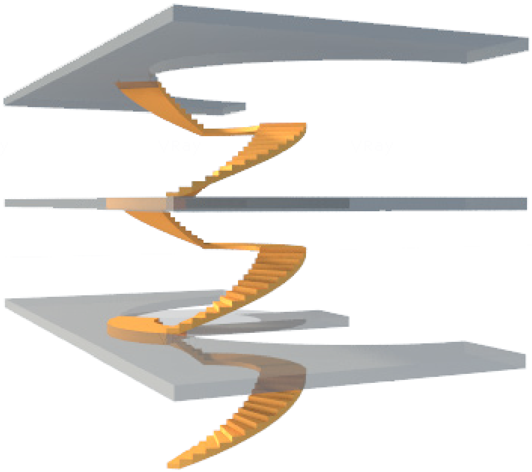


Fig. 107. Final spatial solution for the vertical hall encourages the desired movement around the volume

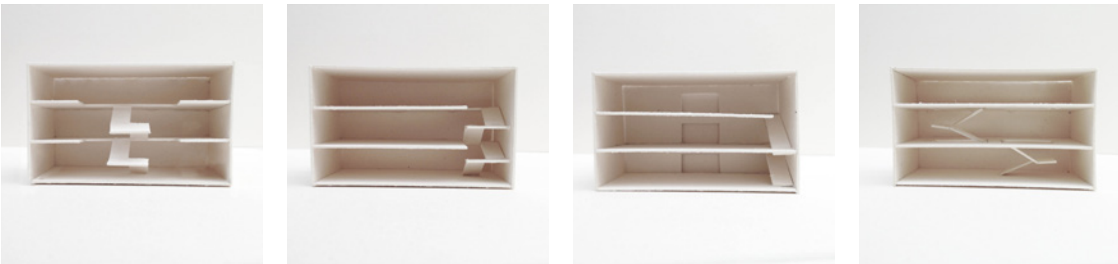


Fig. 108. Cardboard sketchmodels have been used as a initial study for evaluation of spatial qualities. Afterwards, the 360° rendering have been made.

Factory Roof

ENERGY PRODUCTION & DAYLIGHT

From the beginning of the design process, the possibilities on integration of photovoltaic panels have been analysed and tested. A number of small initial calculations have been performed in order to be able to assess advantages and disadvantages of the design iterations. As a result from these analyses, it has been concluded that the best results would be obtained for roof angle of approximately 30°. An overview of the partial results is available on Fig. 109.

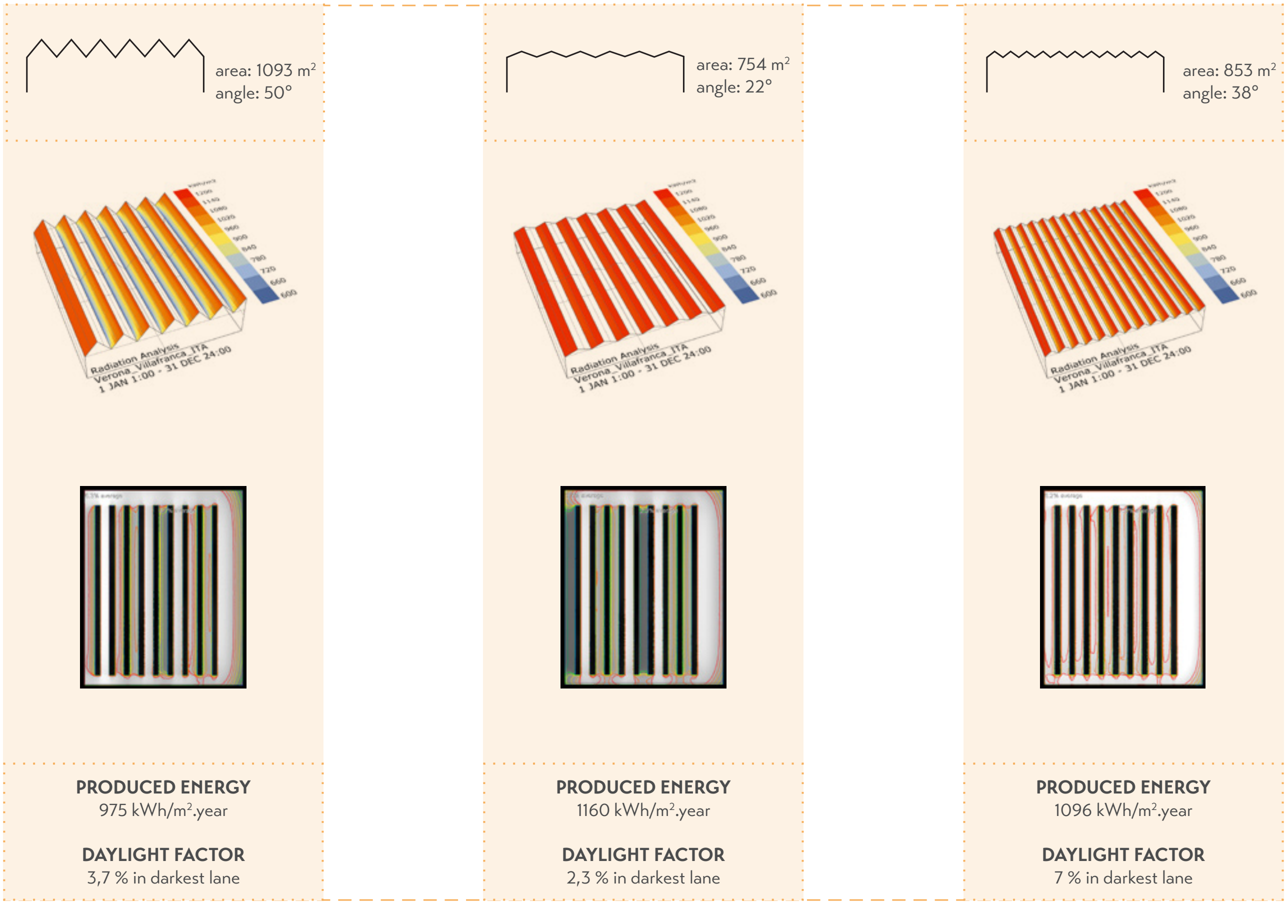


Fig. 109. Overview of the initial calculations performed for the factory roof

PERCEPTION OF THE ROOF SHAPE

Since the volumetric expression of the architecture is strictly orthogonal, the impact of the triangular roofing elements on the perception from the human perspective has been evaluated and illustrated on The design option ■ A (sharp facade edges) has been considered as too expresive, whereas options ■ B (offset) and ■ C (raised attique) has proven that the geometry is suitable. Therefore, the final design combines these two principles.

On the next page, the structural considerations will be described.

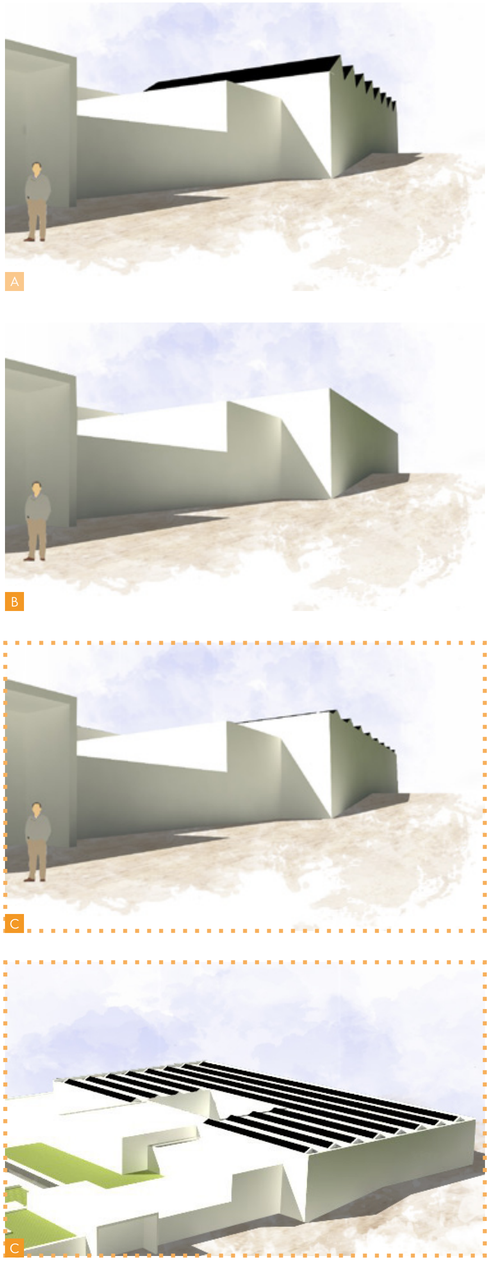


Fig. 110. Roof design iterations

Structural Principles of the Production Volume

FACTORY ROOF

There were several design criteria for the roof of the Production Volume. Firstly, a need for a flexible space of grape drying area predestinated very free floor plan with a minimum of load-bearing elements. Secondly, big span structures were considered as covering of the loading area for trucks. Finally, the integration of photovoltaic panels facing south and windows facing north (natural ventilation, daylight) was the last main criterion.

The need for flexible space, big spans, and the advantage of a regular and symmetric shape of the volume led to hall structures. Furthermore, several options of such structures were considered. Keeping in mind the architectural form, functionality, and the design criteria, a system of trusses burdened mainly with bending moment was chosen.

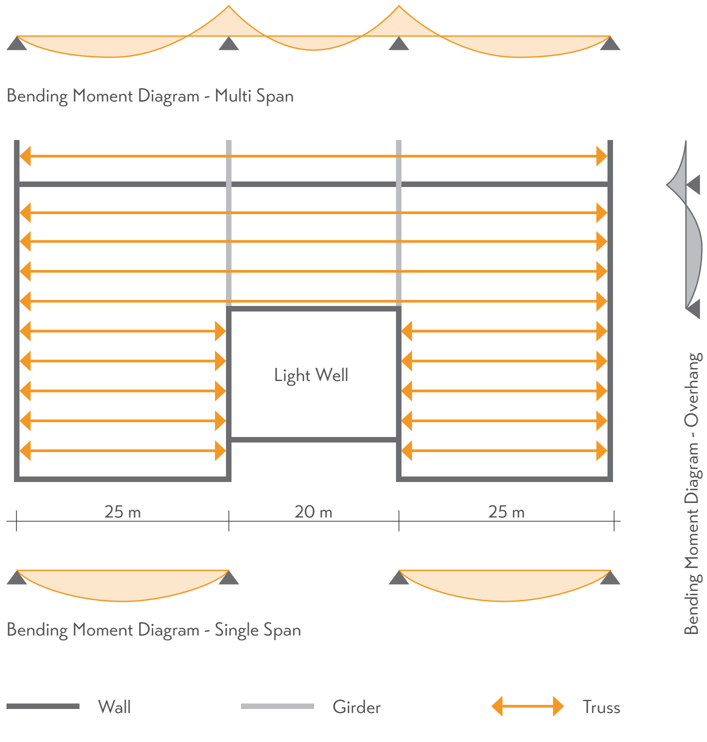


Fig. 111. Static Scheme of the Factory Roof

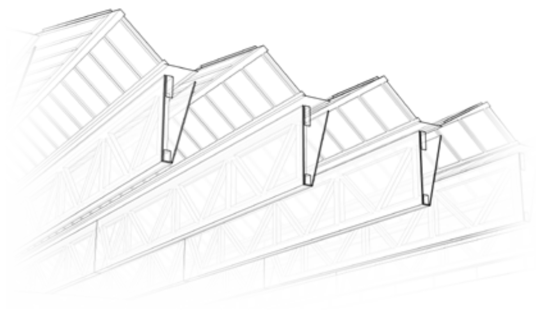


Fig. 112. Integrated Roof Structure

Specifically, system of Pratt trusses made of steel and oriented in one direction was chosen to create a roof structure for the whole production volume. It is relatively light structure ideal for big spans, which at the same time creates a flexible space in the grape drying area without any inner vertical load-bearing elements. On top of that, this one-direction system works great together with integration of PV´s and windows in the roof, providing both structural support and enough space for incoming light.

UNDERGROUND STRUCTURE

The structural system in underground spaces is slab-girder-column system based on the grid 10 x 10 meters. There have been optimizing iterations of this system concerning structural efficiency and spatial atmosphere. Beginning with simple and constant profiles of the girders, strengthening the head of columns and preventing from piercing the slab, to curved girders and finally to shallow spherical vault. Eventually, as a legacy to traditional wine cellar, curved girders and vaults have been used in the fermentation hall and maturation hall, respectively.

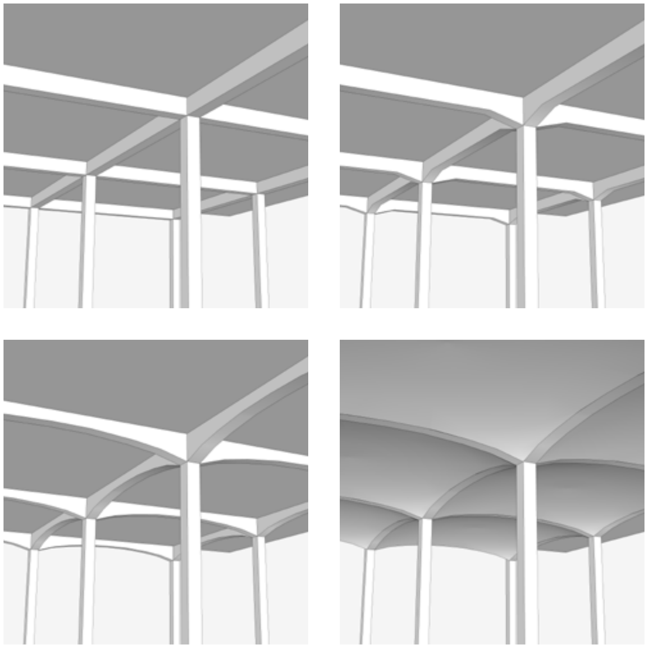
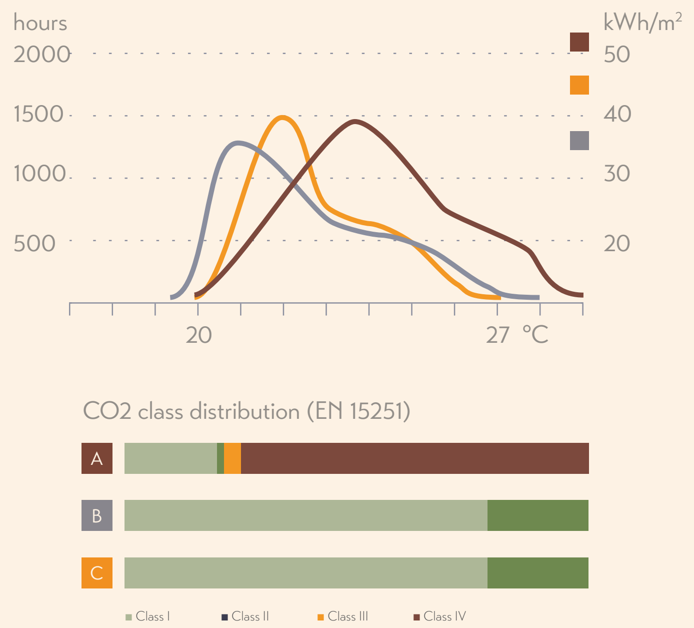


Fig. 113. Slab-Girder-Column Iterations

Accommodation

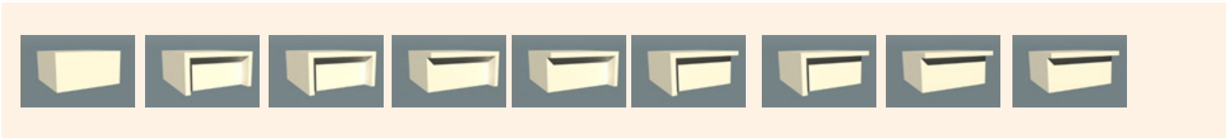
INDOOR COMFORT

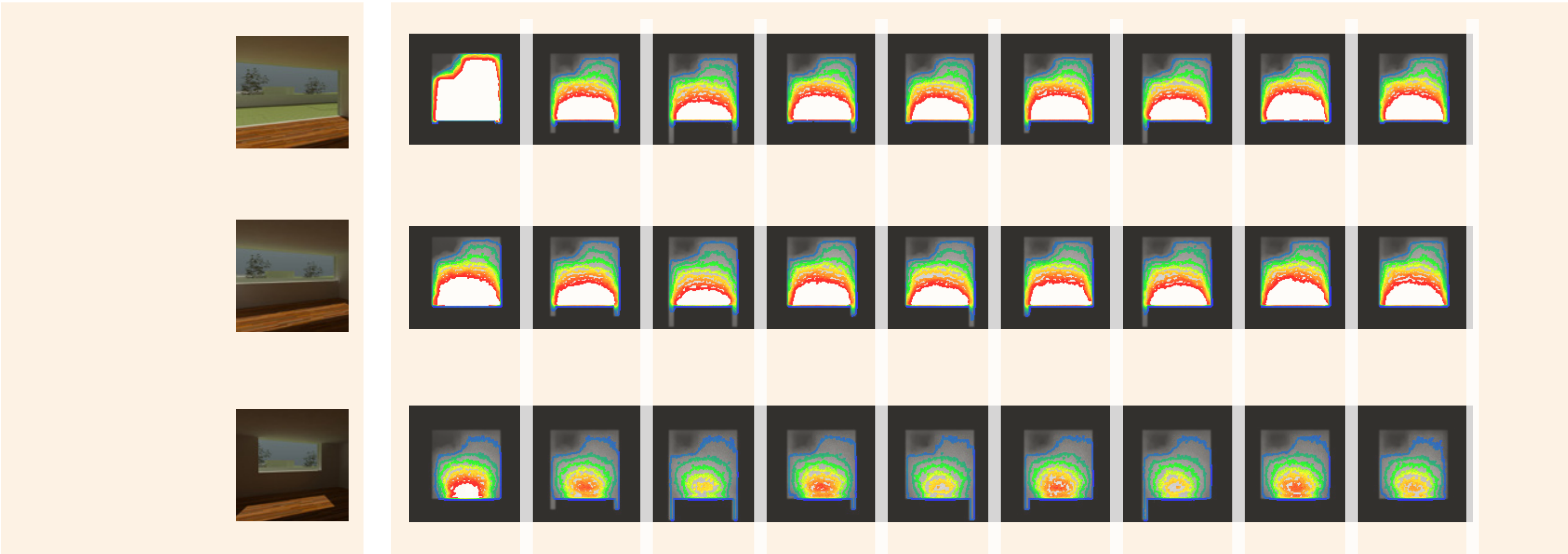
The indoor comfort presents the most important criterion for the design of the accommodation unit. The conditions in the most exposed solitary apartment have been simulated in BSim software in order to obtain relevant information for design of the facades, openings and glazing percentage, and structural layers. Overall Energy consumption has been compared for the design options, however, the accommodation units form only 4 % of the total area. Thus the energy optimization regarding solar gains in winter/heating need zone would have lower priority in comparison to the larger zones.



DAYLIGHT AND VIEW STUDIES

A number of studies with regards to the light conditions inside the apartments and visual connection to the outdoors have been performed. Due to the climatic conditions characterised by large amount of sunhours during a typical month (see "Climate" on page 38), the daylight factor value has a lower importance than for the same space analysed in Northern Europe. Nonetheless, the facades have to provide satisfactory visual contact with the area visited by the guest. In general, the facades are provided with two types of openings - standard height for visual contact and high-sill windows for ventilation, daylight, and privacy.





Heat Transfer in Wine Production

In order to be able to estimate the energy consumption of the Fermentation Hall, investigation on the biochemical processes have been conducted. The total expected release of heat and production of CO2 have been determinated. However, due to oversimplification and inaccuracy of obtained outcomes, more accurate and verified results will be taken into consideration for upcoming calculations (for more information about reference study, please see p. 21).

Firstly several tests on radiation on tanks placed in the exterior have been performed as that correlates with the present-day situation at the Winery. Secondly, the hypothesis has been formulated: by placing the tanks into a controlled environment, the heat transfers would be reduced, therefore the energy required for heating/cooling would be minimized. This hypothesis could not be verified within the scope of this Master thesis, nonetheless, the results from a research studies by Colombié, Malherbe and Sablayrolles (2007) and by Mazarrón (2009) have confirmed, that the underground placement of wine-production is the most sustainable and energy efficient solution.

Even though the following results did not lead to the final numbers used for calculations of the energy consumption, the process of the targeted research have informed the design with a large amount of valuable inputs. Thanks to this phase, the technological part of the wine-making have been understood.

VENTILATION RATE

Production of CO2 during fermentation
Calculation of the mass and volume of CO2 per every 1000 litres of wine.
The calculation is based on the:
- chemical reaction of fermentation
- molecular mass of Ethanol and Carbon Dioxide

Afterwards, the **Ideal Air equation** has been used to determine the volume of CO2 produced for the whole fermentation period (4 weeks = 672 h). To simplify, it has been assumed that the production is constant during the period. It is also assumed that only 5% of the whole CO2 produced by the process is leaking from the stainless steel tanks to the indoor environment. This number than forms the base for further calculation of the ventilation rate.

Maximal allowed concentration of equivalent pollutant (CO2) in the indoor air has been set to 850 ppm (to fulfill Class II of EN 15251:2007) which is equal to maximum of 500 ppm above outdoor concentration (350 ppm). The expected concentration of the actual CO2 is expected to be higher during the fermentation period.

Surface and Volume of the tanks has been determined. S(tanks), V(tanks)

Surface of the room has been determined. S(tanks), V(tanks)

The volume of the room has been determined as:
V(room) = V(room, net) - V(tanks)

Air flow rate has been calculated as:
Q = mCO2 [l/h]/ (qi - qo)*10-3

Air change rate (related to V(room)):
n = Q / V(room)

Result of the calculation based on the necessary air flow for people in the space (7 l/s per person, max 8 people in the area):

ACR: n = 0,02 h-1

ENERGY CALCULATION

Generation of Heat from the fermentation process
Fermentation is an exothermic reaction. The generated heat can be calculated from Enthalpy of combustion as

$$E = \Delta cH * n(C_6H_{12}O_6)$$

This result had been intended to be used as an input to a heat balance calculation (as a heat load). However, it has turned out that **the calculation is far more complicated** due to the mass accumulation. The heat transfer is also depending on the conditions that vary a lot during the period (depending on the position of the tank (indoor x outdoor)). The changing conditions are convection coefficient on the outer surface (due to various air speeds) and temperature differences.

Therefore, the calculation cannot be simplified without having a proper thermodynamic and physico-chemical model of such behaviour. Such a model has been developed in the study by Colombié, Malherbe and Sablayrolles (2007).

The radiation recieved on the tanks' surface has been determined using the weather file for Verona [Energy.gov, 2016] with following results (Fig. 114).

A calculation has been performed for a specific outdoor temperature to test how the heat balance for such a situation would look like. However, precise calculation would require sophisticated model of thermodynamic behaviour for the situation with a) tanks outdoor, b) tanks indoor for the whole year.

The problem occured when it comes to different design temperatures of the room during the different parts of the winemaking process as further described on the next page.

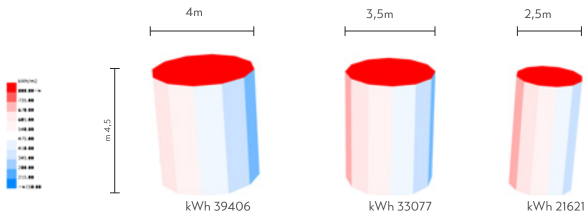


Fig. 114. Received solar radiation on surface of the fermentation

HEAT BALANCE

Transmission heat loss coefficient (simplified, no cold bridges) according to EN 12831:2003:

$$H_T = \Sigma A \cdot U \cdot e_k$$

Design heat loss (simplified, no cold bridges) according to EN 12831:2003:

$$\Phi = H_T \cdot (T_i - T_o)$$

An attempt to make calculations on a general level has been performed. In this method, the surfaces and U-values of the room and the tanks would be compared.

$$U_{room} \cdot A_{room} < \text{or} = \text{or} > U_{tank} \cdot A_{tank}$$

However, **the heat transfer differs according to the period of the year and expected activity in the space:**
16% of the year (2 fermentation periods) the transfer occures on the area of 4871 m2
84% of the year (maturation in steel tanks) the transfer occures on the area of 2166 m2 (the rest of the area has no transfer due to no difference in design temperatures).

Moreover, ΣU_{room} is considered to be much smaller than U_{tank} = 1,74 W/m2K.

Therefore, **H_T is smaller for cooling down the whole room compared to cooling down the tanks.**

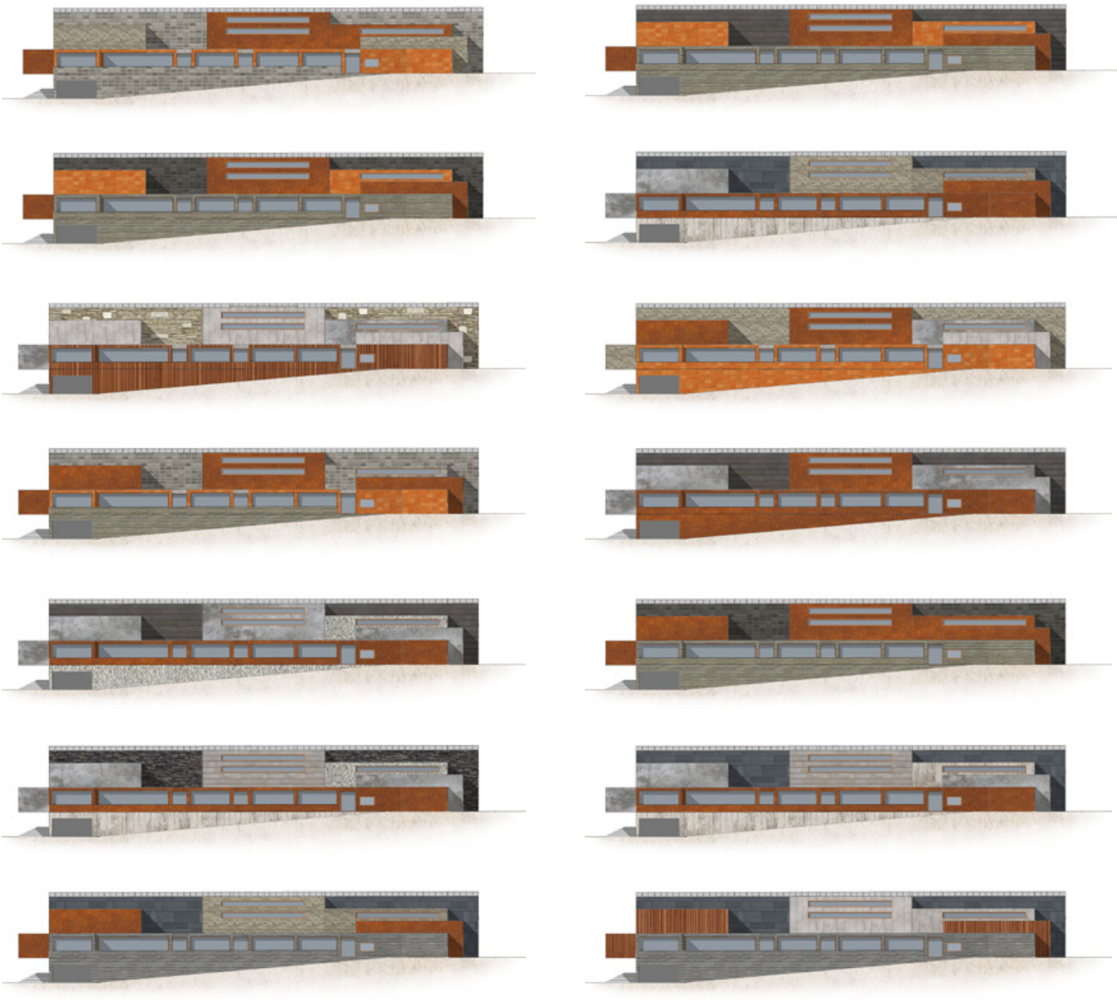
The strategy for cooling the room is mainly passive utilizing the thermal inertia of the soil (ca. 12°C in the depth of 4 meters) (Mazarrón, 2009).

As a result from this calculation it can be concluded that a **more detailed calculation of indoor environment has to be performed**. The next step is to model the situation (with different conditions for different processes) in BSim. The results of the calculation are presented on p. 89.

Facades

MATERIALITY

From the beginning of the design process, contextual character of the material expression have been intended (for further description of the locally used materials, please see “Atmosphere and Materiality in the Surroundings” on page 40). The design iterations on the facades have been therefore predominantly oriented on finding the correct scale and texturing of the facades so the project’s intentions are supported. The design of openings have considered the cardinal orientation, glazing percentage, views to the surroundings, privacy, safety, and inscription of the inner functions to the surface.



05

Epilogue

This section concludes the project and reflects on the entire process. Moreover, it contains the lists of referenced materials.

Conclusion

The proposed solution for the Winery for the New Century presents an answer to a defined problem, stated at the beginning of the design process. Despite the large scope of the project, the functional layout have been designed into desired level of detail. The two layers of the functional program, the visitors and the wine production, have been merged with the focus on social aspects, defined and unique experiences, sustainable solutions, and with respect to the context and local architecture.

The facility has been designed as an inviting, but safe space, where the technology meets aesthetics and culture. Therefore, the place would become an attractive place for visitors, both the tourists and the locals. Thanks to the great variety and attractivity of the spaces, and activities and events which can be organized at the Wine Centre, the place can become regionally important.

The project have fulfilled the design criteria stated at the beginning of the design project. Wide range of methods and tools have been applied during the process, including academic research on relevant design problems, architectural design considerations. The architectural expression have been developed together with well integrated sustainable strategies both passive (thermal mass, natural ventilation, building's orientation, vegetation as well as active (photovoltaic panels integrated to the roof design). Structural solution for the have been developed as well, however only in principles as the main focus of the thesis have been sustainable design.

Reflections

While developing the project of the Winery for the New Century, many challenges have been tackled. Some of them were anticipated from the beginning, the other were rather surprising.

One of the biggest challenges was diving into an unknown area of winemaking in such a big scale, combining very rich and diverse room program and different flows of people using it. In this sense, the study trip to Cantina Valpolicella Negrar was indisputably a huge benefit for the correct insight into the problematics in order to get on the right track.

On the way, the complexity of winemaking was discovered, supported by academical and scientific articles regarding this topic, especially very complicated process of fermentation and its thermal model simulation, which has a direct impact on the indoor environment conditions of the fermentation hall. More detailed solutions for this part of the project would require some extra time and another round of iterations, even though the level of detail may be considered as beyond the architect´s profession.

Overall energy demands of the building, with the goal reaching nearly zero-energy building, were optimized during several loops of the integrated design process. Both passive and active strategies were used and from the process it is clear, that further development would lead to even better results. However, due to scale of the project and a large number of aspects taken into considerations, especially the technical ones, a couple of the points leading to better sustainable result could be developed into bigger detail. Namely, water management on site reducing the water consumption and light conditions in the area of the bottling line improving the users´ comfort.

Furthermore, regarding the calculation of the overall energy consumption, only the most relevant part of the project has been evaluated in a simulation software. The rest is based on hand calculations and information from literature, which leads to higher uncertainty of the results.

All in all, due to thorough research and analysis part and very rich integrated process of the project, all the important aspects of the wine production, wine tourism, local culture, and contextuality were incorporated into the final design resulting in holistic architecture, which is definitely a possible answer to the defined problem and the brief.

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List of Illustrations

We would like to thank Cantina Valpolicella Negrar for their graphic material.

06

Appendix

In this section, the relevant process material is attached. The containing information is not essential for understanding the project, but rather supplements the documentation for some of the design decisions.

ANNUAL ENERGY CONSUMPTION CALCULATION

	Energy Group	Components	Spaces	Total Area [m2]	% of total		El. Consumption [kWh/m2] Literature	Hand Calculation	Bsim	Best Case	Best Guess	Worst Case	Energy Best [kWh]	Energy Best Guess [kWh]	Energy Worst [kWh]	% with PEF 0,6	% with PEF 1,8	Primary Energy Best Case [kWh]	Primary Energy Best Guess [kWh]	Primary Energy Worst Case [kWh]
VISITOR & OPERATION RELATED FUNCTIONS	Unheated Spaces	Lighting	Lobby & Corridors	4097	33%		0	18	0	0,9	1	1,1	66371	73746	81121	0	100	119469	132743	146017
			Technical Rooms																	
			Parking and Other																	
	Low Impact Spaces (non-production)	Lighting	Accommodation	492	4%	15%	0	5	49	0,9	1	1,1	23911	26568	29225	80	20	65264	72516	79767
		Heating	Staff Rooms	387	3%		0	30	0	0,9	1	1,1	10449	11610	12771					
		Fanpower	Presentation	963	8%		0	50	0	0,9	1	1,1	43335	48150	52965					
	High Impact Spaces (non-production)	Lighting	Offices	369	3%		100	0	0	0,7	1	1,3	25830	36900	47970	20	80	40295	57564	74833
		Equipment																		
		Heating																		
		Fanpower																		
	High Impact Spaces (commercial)	Lighting	Shop & Storages	653	5%	9%	150	0	0	0,5	1	1,1	48975	97950	107745	40	60	114213	228426	251269
		Equipment																		
		Heating	Restaurant	290	2%		90	0	0	0,5	1	1,1	13050	26100	28710					
		Fanpower	Kitchen	140	1%		350	0	0	0,5	1	1,1	24500	49000	53900					
WINE PRODUCTION	Grape Drying	Fanpower	Drying Hall	852	7%	41%	0	15	0	0,8	1	1,2	10224	12780	15336	0	100	18403	23004	27605
	Fermentation	Lighting	Fermentation Hall	1704	14%		0	15	0	0,9	1	1,1	49842	55380	60918	0	100	89716	99684	109652
		Fanpower						0	17.5											
		Heating						0	0											
	Maturation	Lighting	Maturation Hall	2546	20%		0	3,5	3,6	0,9	1	1,1	16269	18077	19884	0	100	29284	32538	35792
		Fanpower						0												
				12493	100%								332757	456261	510545			476643	646474	724935
													26.6	36,5	40,9			38	52	58

PVs	Area [m2]	Efficiency [-]	System Efficiency [-]	Annual Solar Radiance [kWh/m2]	Best Case	Best Guess	Worst Case	Energy Best [kWh]	Energy Best Guess [kWh]	Energy Worst [kWh]	% with PEF 0,6	% with PEF 1,8	Primary Energy Best Case [kWh]	Primary Energy Best Guess [kWh]	Primary Energy Worst Case [kWh]
	1095	0,15	0,85	1535	0,9	1	1,1	192874,7	214305	235736	0	100	347174	385749	424324
													28	31	34
									Annual Primary Energy Consumption [kWh/m2.y]				10	21	24

HEAT TRANSFER FROM THE FERMENTATION TANKS AND CO2 PRODUCTION

Heat Loss Calculation According to EN 12831

Room: Fermentation Hall

Level	Name and description of the construction: WG - wall-ground, WE - wall-exterior, ED - exterior door, EW - exterior window, WP - partition wall, FM - floor maturation, CGD - ceiling grape-drying	Lenght	Width/Height	Area	Number of Openings	Area of Openings	Area without Openings	U-Value	Correction to U-Value	Thermal Reduction Factor	Transmission Heat Loss Coefficient	Indoor Design Temperature	Outdoor Design Temperature	Temperature Difference	Design Transmission Heat Loss	Total Heat Loss (Transmission and Ventilation)
							A	U	Δ U	f_{ij}, b_u	H_T				Φ_T	
	-	m	m	m²		m²	m²	W/(m²K)	W/(m²K)	-	W/K	°C	°C	K	W	W
1st Underground	WG - basement wall	143,00	7,00	1001,00	0	0,00	1001,00	0,13	0,00	1,00	130,13	17	12	5	650,65	
	WE - light well	31,00	7,00	217,00	0	0,00	217,00	0,13	0,00	1,00	28,21	17	6	12	324,42	
	FM - floor maturation	-	-	1704,00	0	0,00	1704,00	2,44	0,00	0,50	2078,88	17	12	5	10394,40	
	CGD - ceiling grape-drying	-	-	1704,00	0	0,00	1704,00	0,50	0,00	1,00	852,00	17	20	-3	-2556,00	
	WP - storages and staircase	35,00	7,00	245,00	0	0,00	245,00	3,30	0,00	1,00	808,50	17	15	2	1617,00	
	-															
	-															
			Σ	4871						Σ	3897,72			Σ	**10430**	
Air Flow Rate in Heated Space			$V_i = V_m \cdot n =$		11059	m³/h										
Required Air Change Rate				n =	1,06	1/h			Specific heat capacity of air				$c_p =$	0,28	W.h/(kg.K)	
Volume of the Space				$V_m =$	10448	m³				Density of Air			ρ =	1,20	kg/m³	
Room Height				v =	7,00	m							$H_v = V_i \cdot c_p \cdot \rho =$	3715,70	W/K	
														$\Phi_v = H_v \cdot (\theta_i - \theta_e) =$	**42 730**	**53 161**

Results	Value	Unit
Mass of CO_2	135938	kg
Total Volume of CO_2	74313912	l
CO_2 Produced per Hour	221172	m3/h
CO_2 Released (5%)	11059	m3/h

Variables	Value	Unit
Temperature	20	°C
Wine Volume	1286262	l
Fermentation Period	672	h
Max CO_2 Conc.	850	ppm
Equipped Room Volume	10448	m3

Values and Constants	Value	Unit
Ideal Air Pressure	101325	Pa
Boltzmann Constant	8,314	J/mol.K
Fermentation Period	293,15	K
Outdoor CO_2 Conc.	350	ppm
Equipped Room Volume	10448	m3
M_C (Carbon)	12	g/mol
M_O (Oxygen)	16	g/mol
M_H (Hydrogen)	1	g/mol

Values and Constants	Value	Unit
ΔcH ($C_6H_{12}O_6$)	-2810	kJ/mol
ΔcH (C_2H_5OH)	-1367	kJ/mol
ΔcH	**76**	**kJ/mol**

Substance / Unit	Volume	Volume (SI)	Density	Density (SI)	Mass Weight (SI)	Mass Weight	Molar Mass	Amount of Substance	Total Indoor Pollutant Generated per Time Unit
	l	m3	g/ml	kg/m3	kg	g	g/mol	mol	l/h
Wine	1286262	1286	1	1000	1286262,3	1286262280	-	-	-
C_2H_5OH 14%	180077	180	0,7892	789,2	142116,55	142116547	46	3089490	-
CO_2	74313912	74314	-	-	135937,57	135937567	44	3089490	110586,2

	Diameter	Radius	Height	Units	Surface	Inner Volume
	m	m	m	-	m2	m3
Tank 1	4	2	4	7	75,40	45,36
Tank 2	3,5	1,75	4	22	63,22	34,21
Tank 3	2,5	1,25	4	13	41,23	16,62
				Σ=	**2454,76**	**1286,26**

INTERVIEWS WITH WINEMAKERS

To gain more knowledge about winemaking directly from the source - the winemaker, two interviews and one questionnaire had been conducted.

The Vranka Winery, Czech Republic

Mr. Vranka, who leads his own winery in Southern Moravia, Czech Republic, kindly agreed to fill in the questionnaire in the electronic form. Although the settings are different, there are still many relevant and inspiring information for the design of a much larger facility which is the topic of this thesis.

- wine production has to have a clear concept - what kind of wine is going to be produced and who is the target group
- problems related to production - humans never can control natural biochemic processes on 100%, wine may be impaired
- problems related to distribution - transport and storage (temperature)
- problems related to sales - right focus; competition and rivality
- average electric energy consumption is 0,5 kWh/m2 per year, energy supply is not provided by other means than from the electric grid
- rainwater and grey water are collected to drain-pipes and absorbed to the soil; production water is neither toxic, nor contamined
- production waste is 100% biodegradable, therefore composted
- 90% of other waste is sorted for recyclation
- grape processing room: processing machinery, tanks for primary fermentation. Daylight natural and sufficient artificial. Anti-slip floor, water drainage.
- pressing room: 15-25°C (according to fermentation type), ability to heat/cool the tanks. Daylight natural and sufficient artificial. Anti-slip floor, water drainage.
- fermentation room: 15-20°C ability to heat/cool the tanks, when fermentation period is over, can serve as barrel storage
- barrel storage: 8-13°C, old vault underground cellars
- satisfied tourists generate rise of sales and attract more tourists
- cooperation with other wineries is related to wine events in the region
- attractive activities: organized wine tasting, family celebration, business event, Christmasv party, events for tourists connected to the region, guided tours in the production all year round with wine tasting, recommended - restaurant, accommodation, e-shop, web page
- organized tours can visit the entire facility, contamination of the production is less likely - the responsible person knows, where to guide. Non-organized tourists should stay in the tasting/presentation area.

INTERVIEWS WITH WINEMAKERS

Guldbæk Vingård, Denmark

The second interviewed winemaker was Mr. Jan Thrysøe who is the owner of Guldbæk Winery in Svenstrup, Denmark. This interview took place directly at the Winery. Although both interviewed wineries has different settings and are exposed to different climatic conditions than the Italian winery, thanks to principal similarities of winemaking process, useful knowledge could be obtained.

- 4 floor levels are ideal for the production.
- It is optimal to use the gravity for the production (from level to level). Using the pumps decreases the quality of wine.
- The production needs are different from white wine and red wine.
- Controlled temperatures in fermenting room. White wine fermenting at 14 °C, red wine fermenting at 15 - 30 °C.
- Stable temperatures in storage are needed.
- Flexibility by closing doors/walls among different functions in the production area, so the temperatures can be controlled separately according to the kind of production.
- The pressing area, which is used to create the juice, is only in use for a few weeks per year and can therefore be used for other activities/events.
- 1 plant gives 2-4 bottles of wine in Italian context which can be used to fit the size of all production rooms.
- Cover the ventilation in its own room/outside because of noise
- Possible to live at the vineyard for workers from workaway.com, where people live for free and work for free a couple of hours per day, so they can be tourists in area.
- Toilets not in direct relation to the production rooms.
- Sinks in all rooms for the production.
- Easy cleaning of production areas due to washable surfaces and drainage.