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department of architecture
and urban design

Odense University Hospice

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Thesis of master of Building Architecture

Achnowledgment

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Thank you.
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Abstract

There is a global public debate going on about care for the elderly and the dying, and what is meant by good quality palliative care. Today there are 8,500 modern hospice projects in 123 countries. The hospice has become an iconic building for this new culture.
The residential hospice care movement is increasingly accepted and supported globally, and yet, unfortunately, the amount of literature on best practices in the planning and design of residential hospice facilities and adjacent outdoor spaces remains relatively small.
Most of the Denmark's population is elderly and vacancy of a hospice in the project of new Odense university hospice was felt.
Therefore, in this Thesis, I choosed to design a hospice in this project site and in relation with University of southern denmark and new Odense university hospice.

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Chapter 1

Introduction

What is Hospic?

Worpel,Ken. (2009). Modern Hospice Design: The architecture of palliative care

The word hospice can be traced back to the Middle Ages, where it referred to a place where travellers and the sick could find hostel and protection. The word hospice derives from the Latin word hospitium, which freely translated means “a resort for travellers”. The hospice of the present day can be defined as “a house offering care and quality of life for the terminally ill and the dying as well as their relatives.” From the early 1800s the hospice was used by Madame Jeanne Garnier as a description for care for dying patients. In 1842 she founded the hospice ‘Dames de Calvaire‘ in the south east of France, which was followed by a hospice for the dying in Lyon the following year. In Ireland the concept was introduced in 1879 at the opening of “Our Lady’s Hospice” in Dublin. Other historical institutions were ‘St. Luke’s Hospital’ in England, which opened in 1893 and ‘St. Joseph’s Hospice’ in Hackney, which opened in 1905 The nurse, socialworker and doctor Dame Cicely Saunders founded the modern hospice movement. She formulated and developed the hospice philosophy, which is now a description of the specialised care of the dying. In 1967 Cicely Saunders founded the first hospice in modern time – ‘St. Christopher’s Hospice’ in Sydenham, a suburb of London.

The Historic Development in Denmark

In Denmark the hospice and palliative care were placed on the agenda in earnest in the 1990s. In 1996 accession was made to the aims of the WHO for palliative care, which were to be offered to all terminally ill and dying patients, regardless of whether they were in their own home, at hospital or at a hospice. The National Health Service recommended a unified organization of palliative care in counties and municipalities, so the care was available on a basic as well as on an expert level. The establishment of specific palliative expert teams was suggested with the purpose of assisting the dying, their relatives and professioals, when terminally ill and dying patients stayed at home or in hospitals. In 1999 the National Health Service worked out professional guidelines for palliative care in Denmark. At a basic level palliative care includes the relief work taking place in the common hospital wards and at home. At this level professionals must know the fundamental principles and attitudes of palliative care as part of their entire work area. Palliative care at expert level is aimed at patients with complex symptoms, which demand specialised and/or interdisciplinary care. This care is rendered at hospices or in palliative units/wards at hospitals, but also in the patients' own homes or in nursing homes via visiting palliative teams.

The expert care is undertaken by an interdisciplinary group of professionals, who must know all aspects of palliative care and who work exclusively within the palliative area. Sankt Lukas Hospice in Hellerup, which opened in 1992, is the oldest in the country and it was also here the first home hospice opened in 1997, consisting of a visiting specialist team with consulting functions within palliation, aimed at the terminally ill and dying patients and their relatives. This was considered a support for care in primary sector and under hospital management.

Hospices in Denmark – an overview

In December 2005 there were seven hospices available in Denmark: Sankt Lukas Hospice in Hellerup (1992), Sct. Maria Hospice Center in Vejle (1995), Diakonissestiftelsens Hospice in Frederiksberg (1997), KamillianerGaardens Hospice in Aalborg (1999), Hospice Soeholm in Aarhus (1999), Hospice Fyn in Odense (2004) and Arresoedal Hospice in Frederiksvaerk (2005). More hospices are underway in the remaining counties. Furthermore, Bispebjerg Hospital has a palliative care unit with 12 beds, and other smaller palliative care units exist at other hospitals.

The actual hospice idea as well as palliative care is relatively new concepts in Denmark. As already mentioned these have only been developed as a professional area within the last 10-15 years. The National Health Service has pointed out that the existing information about the possibilities available within palliative care today is not sufficiently diffused among the healthcare staff, neither is it communicated to potential patients and relatives to the required degree One of the challenges today is therefore to develop services of palliative care for patients, so they become equally available for all patients and relatives, regardless of their physical location in the country.

Hospices in Denmark - a statistic picture (2004)12

- The average duration of admission for the individual patient in a hospice in Denmark was 25.4 days and nights.
- The average age for the admitted patients is 67.7 years, with a var ance in age from 29 to 90 years.
- There were almost equal numbers of men and women, with a slight predominance of women (47.1 % men and 52.9 % women.).
- Approx. 95% of all patients was diagnosed with cancer.

Odense

Odense is the third-largest city in Denmark. It has a population of 179,601 (1 January 2019), and is the main city of the island of Funen. Odense is the birthplace of Hans Christian Andersen and Cobots. By road, Odense is located 45 kilometres (28 mi) north of Svendborg, 144 kilometres (89 mi) to the south of Aarhus and 167 kilometres (104 mi) to the southwest of Copenhagen. The city is the seat of Odense Municipality and was the seat of Odense County until 1970, and Funen County from 1970 until 1 January 2007, when Funen County became part of the Region of Southern Denmark. Odense has close associations with Hans Christian Andersen who is remembered above all for his fairy tales. There has been human settlement in the Odense area for over 4,000 years, although the name was not mentioned in writing until 988, and by 1070, it had already grown into a thriving city. Canute IV of Denmark, generally considered to be the last Viking king, was murdered by unruly peasants in Odense's St Alban's Priory on 10 July 1086. Although the city was burned in 1249 following a royal rivalry, it quickly recovered and flourished as a centre of commerce in the Middle Ages. In 1865, one of the largest railway terminals in Denmark was built, further increasing the population and commerce, and by 1900, Odense had reached a population of 35,000. The University of Southern Denmark was established in 1966.

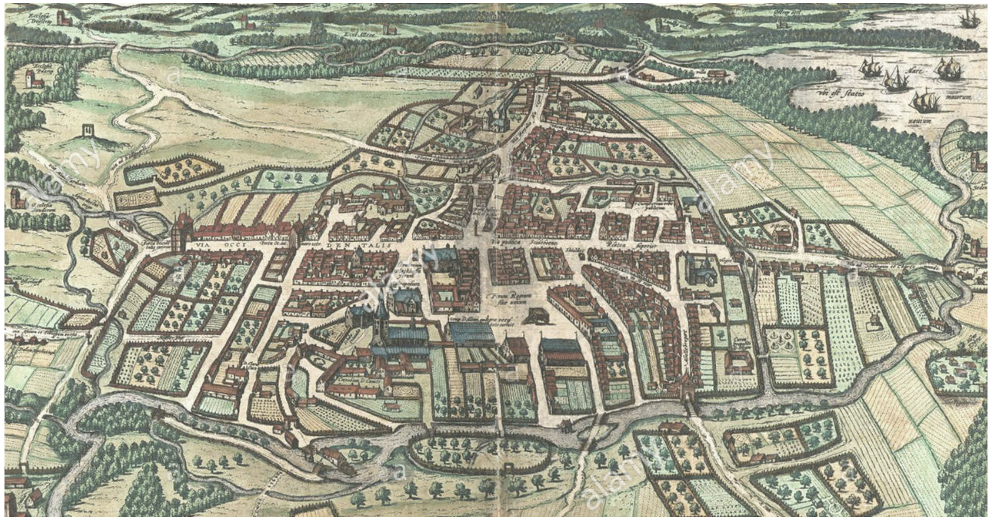
Alastair H.Thomas.(2010).The A to Z of Denmark

ARCHITECTURAL STATUS OF ODENSE

nordivatours.com

History

The name Odense is derived from Odins Vé, meaning "Odin's sanctuary" as the area was known as a sanctuary for worshippers of the Nordic god, Odin. Odense is one of Denmark's oldest cities. Archaeological excavations in the vicinity show proof of settlement for over 4,000 years since at least the Stone Age. The earliest community was centred on the higher ground between the Odense River to the south and Naesbyhoved Lake (now dry) to the north. Nonnebakken, one of Denmark's former Viking ring fortresses, lay to the south of the river. In 1247 Odense was burned by Abel of Denmark during conflicts with his brother King Erik IV. The cathedral had to be completely rebuilt. Nevertheless, the town continued to flourish as a commercial centre, and was charted in 1335. The city thrived economically during the Middle Ages, attracting many merchants and craftsman who traded their goods. After the Danish Reformation, involving the suppression of the Catholic bishopric in 1536, the city enjoyed a sustained period of prosperity from the 1530s to the mid-17th century, becoming northern Funen's commercial centre. One of the main sources of income was the sale of cattle, providing substantial funds for the construction of fine half-timbered houses for the local merchants. The local nobility also participated in the city's development by building residences where they spent the winter months.



Braunius map of Odense from 1593

Knud J.U.Jespersen(2006). A history of Denmark

Dramatic changes began in Odense in the 18th century to modernise the city and a great plan was drawn up for development. In 1720, Frederick IV ordered the rebuilding of Odense Palace, partly on the foundations of the 13th century St. Hans's Monastery, and the construction of St Hans's Church by the Knights Hospitallers. Founded in 1796, Odense Teater is the first provincial theatre in Denmark and the country's second oldest. From the 1840s, the city enjoyed a period of rapid expansion beyond its traditional boundaries, becoming Denmark's second largest city. The city gates were demolished in 1851 and soon afterwards development extended to the area south of the river. Glove production, which had begun in the 18th century, developed into one of the most important industries while the harbour facilities were further expanded. In 1853 Denmark's first modern water and gas works were opened in Odense. All this provided an ideal basis for industrialisation, attracting a wide range of industries including iron and metals, textiles, and food and beverages. Separate areas of the city were devoted to increased industrial and residential expansion, and the population of the city began to grow markedly; by 1900 it had 35,000 inhabitants.

Knud J.U.Jespersen(2006). A history of Denmark

CONTEMPORARY ARCHITECTURAL DISTRICT

thinglink.com

Chapter 2

Analysis & Researches

Danish Architecture in time

History

More than a thousand years ago, in the Viking age, military encampments were built in Denmark, most likely by king Harald Bluetooth. These constructions, which are known through excavations, are remarkable for their circular ramparts. As Christianity came to Denmark, so did churches — first wooden churches and later stone churches. The stone churches, which heralded the Roman period, included both large cathedrals and small village churches. Around 1160, a new building material, brick, was introduced to Denmark. This was used for Roskilde Cathedral, a three-aisled cathedral from the transition period between Roman and Gothic style. Roskilde Cathedral is Denmark's most significant church building, both architecturally and as a historic monument. With its many royal chapels, the cathedral reflects the changing European architectural history over 800 years.

Danish architecture made a big impression locally and across Europe with the Copenhagen City Hall, Københavns Rådhus, of 1905 by Martin Nyrup, which synthesized various influences to forge a striking landmark, but it was not until 1930s that Denmark could be considered the equal of Finland and Sweden on the international scene.

Copenhagen City Hall, 1905 by Martin Nyrup

visitdenmark.it

Modernist Danish architecture

The Danish “functionalism” style of the 1930s was the first local version of modernism. Many functionalist buildings are still in use today, including a large number of apartment buildings. One architect who worked in both the functionalist style as well as the later international style was Arne Jacobsen, known around the world as a furniture designer for his Swan and Egg chairs. His best-known buildings include Aarhus City Hall and the SAS Radisson Hotel in Copenhagen, for which he also designed furnishings. Several Danes embraced Functionalism and one in particular, Arne Jacobsen, emerged as an architect of the caliber of Aalto and Asplund. Jacobsen’s notable projects included an elegantly designed Functionalist beachfront community in the 1930s comprised of Bellavista Apartments, Bellevue Theater, and beach structures, including sleek lifeguard stands, on the outskirts of Copenhagen and his SAS House of 1960, his most accomplished gesamtkunstwerk (total work of art) which spawned the best-selling Egg and Swan chairs.

SAS House, 1960 by Arne Jacobsen

de.phaidon.com

Contemporary Danish architecture

Danish contemporary architecture prioritises natural light, sustainable energy systems, and a comfortable environment for the people using the building, either for working or living. In the twenty-first century Danish architecture has become popular all over the world, lead by Bjarke Ingels of BIG . Ingels' approach is holistic. His buildings are great places to be for the people using them and rely on sustainable energy. Ingels has won many awards. In 2016, Time Magazine named Bjarke Ingels one of the 100 Most Influential People in the World. Currently, Danish architecture is enjoying a new golden era. At the forefront and arguably the hottest firm on the planet at the moment is Bjarke Ingels Group. Its buildings in Denmark, such as Instagram-favorite 8 House, 8-Tallet, of 2010 in Copenhagen (in the header image) and the National Maritime Museum of 2013 in Elsinore, are known for unconventional design solutions that maximize light and air and public space.

National Maritime Museum, 2013 by Bjarke Ingels Group

domusweb.it

The human aspect

Danish architecture is known for its focus on people. As a result, cities and landscapes provide safe and enjoyable settings, even for pedestrians and cyclists. The human aspect of Danish architecture is closely associated with Danish architect and urban planner Jan Gehl, author of the 1970 classic Life Between Buildings. His theories have had significant influence on the development of sustainable urban environments across the globe. Gehl is famous for his groundbreaking approach to urban development, which focuses on people and the spaces between buildings, such as public squares and cycle lanes. This has inspired cities like Sydney, New York, London and Mexico City.

New Odense Unuiversity Hospital

https://nytouh.dk

ARCHITECT: C.F. Møller
CLIENT: The Region of Southern Denmark
YEAR: 2009-2018/2022

The new University Hospital will be the largest new hospital in Denmark built entirely from scratch. The new University Hospital will draw on the existing University Hospital's long and prestigious history. As the existing University Hospital was built more than 100 years ago, it has become increasingly difficult to readjust the construction to shifting paradigms in treatment and modern innovations and inventions. The intentions are that the new University Hospital will have little limitations in the adaption and adoption of both existing and future technology. One of the main reasons for the new hospital's supposed longevity is inherent in the design. A strong and flexible design is the key stone of the project. The elastic structure can be utilised in order to achieve an even stronger building both functionally and architecturally. The building's placement on the site enables future expansion on all scales - from small extensions of the building to large-scale extensions in direct correlation with the existing building.

nytouh.dk

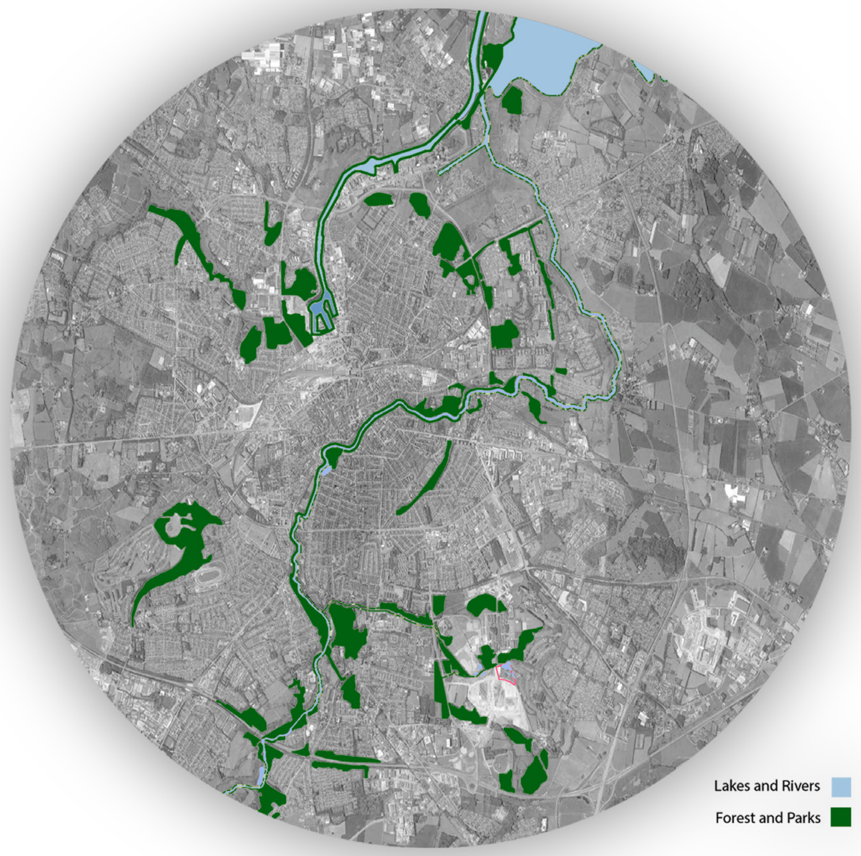
The concept for the design derives from the site's existing characteristics and the vision of a continuation of the University of Southern Denmark's north- and southbound architecture in a more fringed or lacerated structure which incorporates the blue and green landscape elements. The building will be connected to the University of Southern Denmark by the Linking Zone that connects to the Knowledge and Science Axis. The Axis acts as a spine for the building, running down the length of the hospital. The Axis will be home to a wide variety of functions but treatment of patients will mostly take place in the clusters arranged to the sides of the Axis. Each cluster is a group of medical departments. The clusters contain optimised clinical flows where medical departments which are closely linked are situated close to each other and near to the operating rooms and patient wards. Three out of four psychiatric patients suffer from somatic illnesses in combination with their mental ones. To encourage a better interplay a new psychiatric department will be built and connected to the new university hospital ensuring the easy treatment and transfer of psychiatric patients.

The structural correlation between the University of Southern Denmark and new University Hospital is unique for Denmark and provides optimal conditions for knowledge sharing, an outstanding international research environment and a strong centre for education and innovation.

nytouh.dk

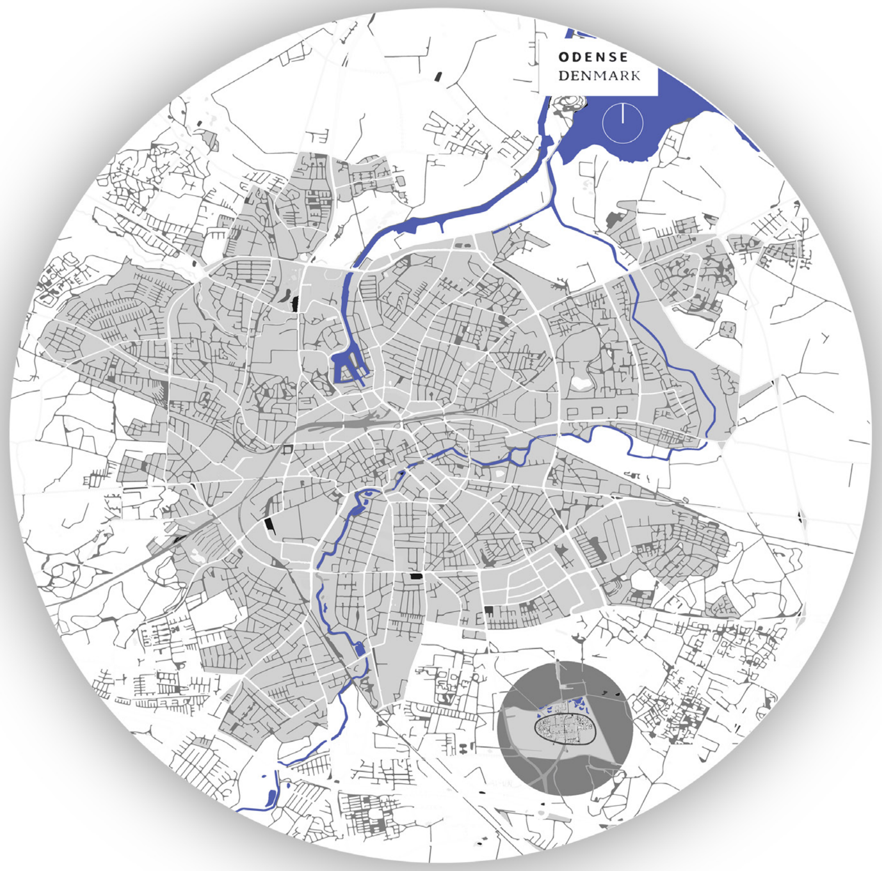
Site analysis

NYT OUH ongoing construction scanned by drone
using pointcloud by author



Odense green belt as the main platform of public activities passing right north of NYT OUH site

Letbane is the railway transport system of Odense with 2 stops in NYT OUH Complex



position of new Odense University Hospital complex
in relation to Odense City

New Odense University Hospital (NYT OUH)
is being constructed in ex-agricaltural ground

Integrated master plan of University of Southern Denmark
in the north and NYT OUH in south

Master plan of NYT OUH

Chapter 3

Case studies
&
Guidlines

PAIMIO SANATORIUM

Architect: Alvar aalto
Designed in:1929-33

Location:Finland, Paimio

The building completed in 1933 as Paimio Sanatorium was of key importance to the international career of architects Alvar and Aino Aalto. Together with Vyborg (Viipuri) Library, completed two years later, it gave the Aaltos an international profile. Finnish architecture was no longer merely the receiver of influences from outside. The building, constructed on the basis of their win in an architectural competition resolved in 1929, was groundbreaking. A tuberculosis sanatorium was particularly suitable for a building which followed the tenets of the new Functionalism, where bold concrete structures and state-of-the-art building services were inseparable elements of architecture and practicality.

Over the years, the hospital buildings have been altered considerably, but the key characteristics of the architecture and much of the original furniture have been preserved. In recent years, hospital functions have been transferred elsewhere and a new use has been sought for the building.

Venderber, Stephen.(2003). Inovations in hospice architecture

1930s-40s: The birches are approx. 10 meters tall. The garden is still relatively open. (Sukkinen in Saarikko 2007,57)

1934:The path with the fountains is completed.Some birches are left next to the walk path.At the east end of the garden the end of grass lawn is seen. (AAM 50-003-266 Gustaf Welin)

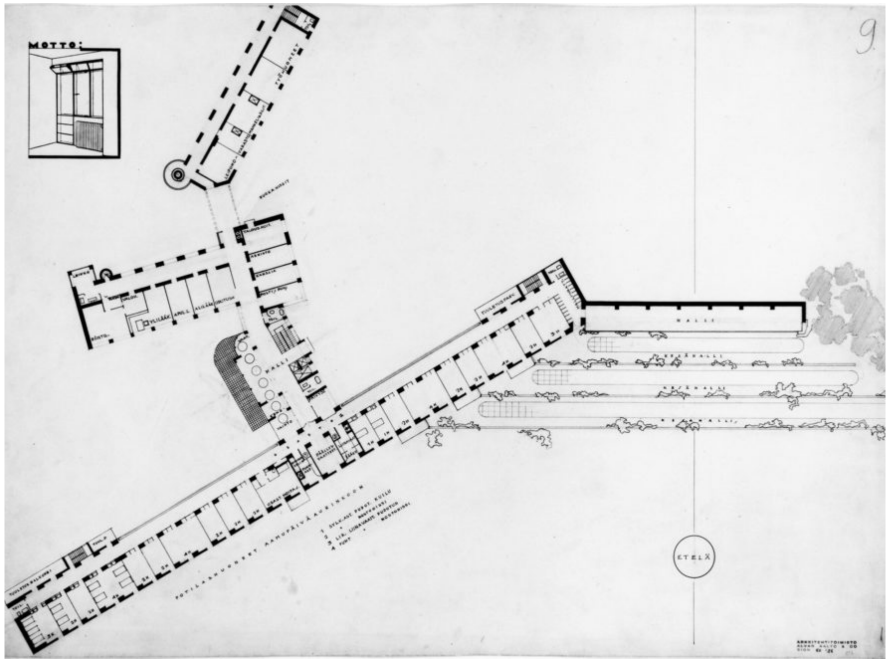
2015: The birche have been cut. The low garden like vegetation front of the former balcony wing. (AAM Malmberg)

2015 : Some of the birches, fountains(exept one), and the path are removed. The mountain pines at the balcony are over grown. The grass lawn covers most of the original garden area. The surrounding forest has grown as well as the survived birches. (AAM Malmberg)

alvaraalto.fi / architectural-review.com

The seven-storey wing housing the wards is by some distance the largest. Accommodating 145 rooms ranged along single-loaded corridors, it is startlingly tall, long and skinny. The wing is oriented so that each room enjoys a south-south-west orientation through a deep-set window that extends from floor to ceiling. A central line of concrete columns allows the corridors to be cantilevered: a feat registered by the continuous strip window that extends along each one. The wing's more prominent end is given particularly dynamic expression through the provision of a glazed lift – the first use of such technology in Finland – bracketed by cantilevered balconies to either side. These represent the most intimately scaled of a range of terraces to which patients had access. The average temperature in Paimio drops to -6°C in February but fur-lined sleeping bags were on hand to encourage use of external areas across the year.

Worpel,Ken. (2009). Modern Hospice Design: The architecture of palliative care



alvaraalto.fi

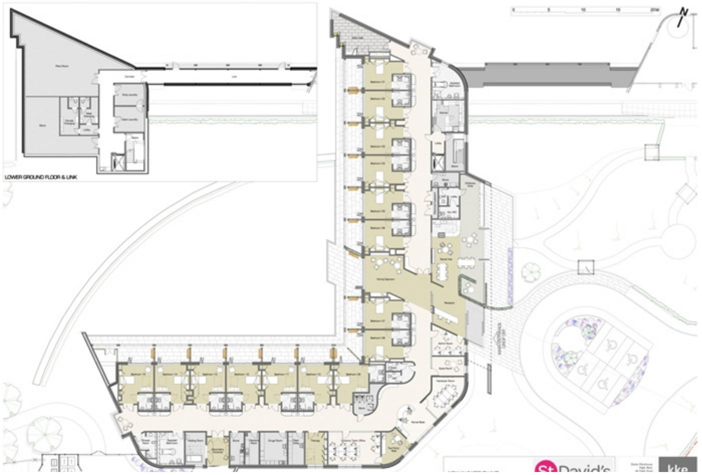
St David’s Hospice

Architect:KKE Architects
Year: 2018

St David’s Hospice Care’s brief was for fifteen patient bedrooms all with en-suite bathrooms. In support of these bedrooms are further rooms and spaces including clinical offices, stores, bathrooms and sluices. The building also connects with the recently built day unit in order to share services. The site for the building was a steep area of grassed amenity land. The in patient unit is set out in an ”L” shape created to give optimum views and aspect for the patients bedrooms which face a leveled garden area retained by gabions filled with local stone. A campus feel and connection with the existing day hospice building has been achieved by using the longer leg of the new building, to define a rectangular landscaped quad garden. The building also retains levels to make the space usable for fundraising events. The location of the building was further influenced by a carefully retained sweet chestnut tree and the wish to set the building below the ridge of the hill thus reducing the development’s impact on the adjacent housing estate. The materials used incorporate timber shingles and stone from a local quarry and harmonize with the initial build and the open landscape.

architecture.com

The site being steeply sloped (in the foothills of the Brecon Beacons) set some significant challenges in relation to how external levels would be managed. Firstly in order to enable level access out onto the terraces into the landscape directly from the bedrooms, which creates a ground level close to the building. The Terrace outside the café and social hub has been created by levelling the quad garden area by extending a retaining wall from the previous build and further enclosing the terrace locally to ensure level access to this pleasant space. As with the bedroom terrace, bi-fold doors allow any width of access and allow the feeling of being outside even for those too vulnerable to go fully out of doors. Immediately in front of the entrance there is a large drop off round-about that allows for the easy drop off to enable comfortable wheelchair and ambulant access directly to the building, Within this area are positioned four accessible parking spaces. The other parking spaces are to the South of the building, here levels have also been carefully managed to enable relatively comfortable ambulant access with no gradients steeper than 1 in 21 on the pathway to the entrance. Furthermore there is a level pedestrian route from Blackett Avenue all the way to the in patient entrance.



architecture.com

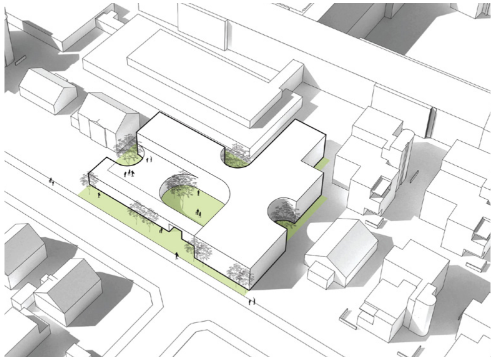
URBAN HOSPICE BY NORD ARCHITECTS

Location: Denmark - Copenhagen

Designer : NORD Architects

Year: 2016

The Urban Hospice is situated in a densely populated area of housing and beautiful historic buildings in Copenhagen. It was an essential criterion to fit the building neatly into the surroundings while meeting the demands and wishes for its functionality as urban hospice. This has been achieved with a building design that reflects and supports the idea of architecture as a healing factor, which can help create a positive and relaxed atmosphere among patients, relatives and staff. The Urban Hospice is developed together with the deaconess community as a place that provides a peaceful environment in an urban setting for people to get palliative treatment. The overall form and concept were heavily influenced by the complex site conditions and the proximity of the neighbouring built context. Within these parameters, the vision was to create a protecting atmosphere that also offers a glimpse to the outside world. The design derives from combining a curved and rectangular formal language that allows for an optimal functional layout. The traditional patient corridor is broken down into smaller units, and, as a special gesture, the house's common area is designed in a curved formal expression, built around a private inner courtyard that works embracingly and protectively. The façade's varying composition of quality rich materials gives the house a warm and tactile look.



nordarchitects.dk

Once inside the building, it becomes clear that the layout encourages a selfcontained community. On the ground level, staff quarters occupy the western side of the floor, with patient rooms on the east, and the largest courtyard between the two. The second floor is devoted completely to patients, including the roof terrace. Designed to accommodate a total of 16 residents, each room has a sofa that can convert to a bed for visiting family: there are also two separate guest rooms in the facility. Specific technical requirements can be met easily: electric hoists are integrated into the rooms to help staff move around those who are immobile; soundproofing solves acoustical needs, and even the thick doors have rubber seals. Windows throughout the building are triple-glazed for acoustical and thermal insulation, including the large curved ones around the courtyards ("an expensive detail," says Gregersen). Surfaces are tough and washable. And though the rooms have operable windows for use when appropriate, each is air-conditioned in such a way that they can be easily refrigerated following a death by lowering the thermostat. There is no separate morgue: the bodies remain in place for 24 hours, so that families and friends can visit to pay their final respects. Often, in hospices, there is a separate, out-of-sight service entrance for undertakers. Here you can encounter (as I did) a family group of all ages accompanying a casket as it is wheeled through the public areas of the building and out the front door to the hearse. This way of doing things is part of the brief: "Death and life share the same entrance," says the hospice's director, the straightforward and cheerful Helle Tingrupp. "It shouldn't be hidden away."

SIGNAL architects. (2005/2006). Programme for the good hospice in Denmark

Level 0

frameweb.com

Level 1

Guidelines

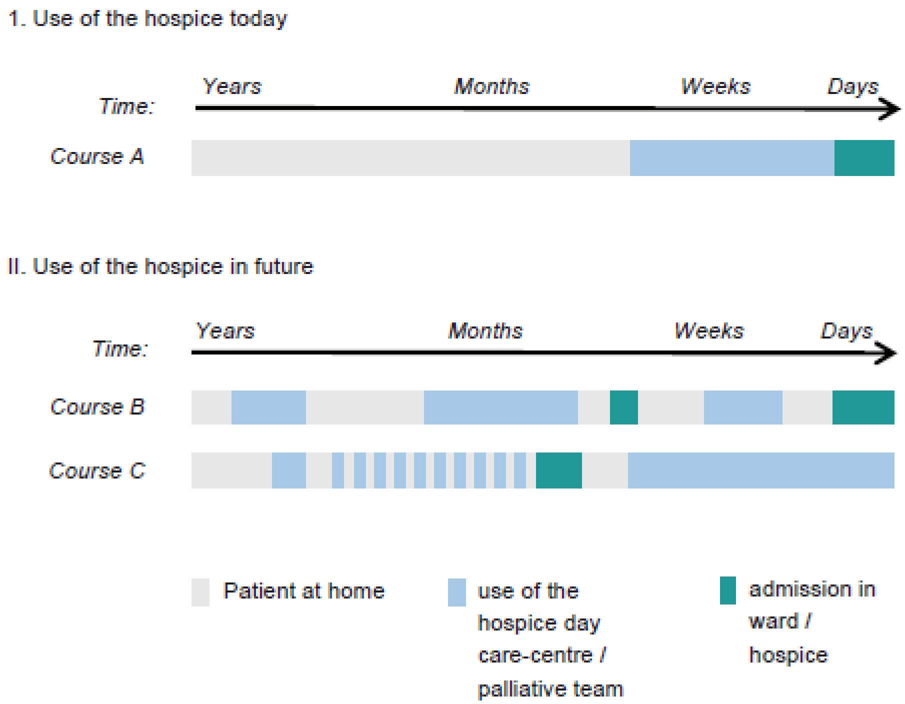
This topic is from" Programme for the Good Hospice in Denmark"
Prepared in 2005/2006 by SIGNAL architects for the Realdania Fund

TEN TARGETS OF ARCHITECTURAL POLICY IN DENMARK

01. Greater architectural quality in public construction and development
02. Promoting private demand for architectural quality
03. Architectural quality and efficient construction must gohand in hand
04. Innovative architecture must create healthy, accessible and sustainable buildings
05. Greater architectural quality in subsidized housing
06. High priority on architectural quality in planning
07. The architectural heritage must be maintained and deveoped
08. Better conditions for exports of Danish architecture
09. Danish architecture must have a strong growth layer
10. Danish architectural studies must be among the best in theworld.

New patterns of patients ate a hospice

A changed patient basis and wider palliative care over time will create new ways of using hospices. For one thing patients/relatives will be offered palliative care much earlier in the course of their disease than before, for another they will use the different services available to them at different times, to a larger degree. A hospice day centre is just one possible solution. At the day centres existing in England you meet patients diagnosed with a terminal disease, but who may still live several years. Here, the day centre has a more social function at the beginning of the course of the disease, but over time its function as a provider of various palliative interventions becomes more pronounced.


1. Use of the hospice today
Time:
Years
Months
Weeks
Days
Course A
II. Use of the hospice in future
Time:
Years
Months
Weeks
Days
Course B
Course C
Patient at home
use of the hospice day care-centre / palliative team
admission in ward / hospice

Analysis of the physical properties of the buildings

In order to get an even better understanding of how a hospice can be shaped and work, we have chosen to conduct an analysis of the physical properties of the buildings, where we go through four different hospices from the angle of the physical details of the buildings. To have the widest possible representation in the data material, we have chosen to focus on hospices which differ from the perspective of the building (three are new buildings, one is located in an existing building); they also represent cultural/geographical diversity, as one hospice is located in the middle of a town, two are outside town and the last one is located in an area of natural beauty.

Conditions and limitations

Comparisons of the physical properties of these hospice buildings have certain obvious limitations. There are some cultural differences between the two countries, as the tradition for voluntary work and wards with several beds etc. is more deeply rooted in England and the financial systems and the construction of the English and the Danish hospital systems also differ. Subsequently, the administrative section takes up more space in the two English hospices to meet the physical requirements of the fundraising staff and the much bigger number of volunteers.

Hospice	*DK1*	*DK2*	*UK1*	*UK2*
Type	New building	Existing building	New building	New building
Contents of Services and patient capacity:	Beds: 12	Beds: 12 Palliative team (Year): 517	Beds: 14 Day-centre: 12 Palliative team (Year): 560 OP dept. (Year): 575	Beds: 15 Day care centre: 12 Palliative team (Year): 250 OP dept. (Year): 119
Number of employees[35]:	30	42[36]	91	163
Shape of building:	T-shape	L-shape	XO-shape	XX-shape
Floors:	2 - patients and employees on both floors	2 - patients and employees on both floors	2 - patients on the ground floor and administrative departments on the first floor	2 - patients on the ground floor and administrative departments on the first floor
Position:	In an area of natural beauty, at a distance from other buildings and bigger cities	Located in the middle of town	Close to the centre of town	At the outskirts of town
Gross area (approx. areas):	2,423 m²	1,776 m²	2,689 m²	2,792 m²
Net area (approx. areas):	1,704 m²	1,015 m²	1,701 m²	2,181 m²

Hospice DK1 is a new building, located further away from town than the three remaining hospices. The development of this hospice has been based on the experiences from other hospices inside and outside Denmark. Hospice DK2 is a highly regarded and well-run hospice, which has been running for a while, locatedin an existing building in the middle of a larger Danish town. Hospice UK1 and UK2 are new buildings, where existing hospices were used previously but which have now become outdated. The establishment of thesetwo hospices has been underway for a couple of years and it has been based on experience and information gained from running hospices for nearly 20 years.

35 Number of employees recalculated into fulltime positions
36 Incl. employees at the palliative team

KamillianerGaardens Hospice, Aalborg

KamillianerGaardens Hospice in Aalborg is a good example of a modern, well-run Danish hospice. Kamillianer Gaarden is located in the centre of Aalborg, close to the Limfjord, in the old building of the catholic Kamillianer Order. The building dates back to the beginning of the 19th century and was originally established as an eye clinic. As the hospice is restricted by the physical size of the original building from the early 1900s, it has been necessary to prioritise the utilization of the spaces. Creating patient wards of a reasonable size with a nice view has been the first priority, followed by communal rooms, and finally support services like offices, filing, medicine and storage rooms have been allocated the remaining space. As a consequence the existing patient wards are fairly big, while offices, meeting places and storage have limited space. Fortunately, it is possible to share some of the facilities of the palliative team, and bigger meetings usually take place in the meeting room of the team. The building is L-shaped and has four floors, out of which three are used by the hospice. In the basement there is a café, which was originally intended for the use of everybody at the hospice, but it became apparent over time that patients and relatives very seldom used the room, and today the café is therefore mostly used by the staff for breakfast/lunch, and for get-togethers and presentations with the support group of the hospice, among others.

DK2

hospice-aalborg.dk

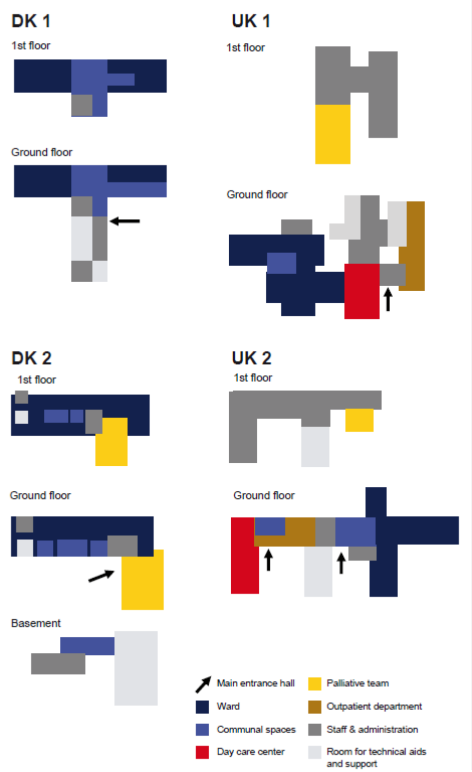
The Hospice of St. Francis, England

The Hospice of St. Francis lies in the northwestern outskirts of London, in the town Berkhamsted, and it opened in 1979. Due to shortage of space the day care centre, the palliative team, the administration and the fundraising section are located in a bungalow next to the original building, and the three day care centres of the hospice are spread out across the region. The new hospice will be located on top of a slope in a green area, just outside the town Berkhamsted. The overall stylistic theme of the hospice is a copy of an old English farm, and as at New Farleigh the building is to be divided into more wings in order to make the building appear less imposing. The drive to the hospice building itself winds its way up the slope. This is intended to give visitors to the hospice an immediate experience of its particular atmosphere - the buildings and the surrounding gardens are revealed little by little, as opposed to seeing everything from the start as one would from a straight access. Most of the administrative facilities have been located on the 1st floor. The Hospice of St. Francis has also chosen the four-leaved clover design for the patient wards in order to minimise the distance to patients and to create a department, which does not appear too big or confusing. Two of the 12 wards have been designed with two beds, and all wards have their own toilet. However, patients have to share 3 communal bathrooms with showers.

UK2

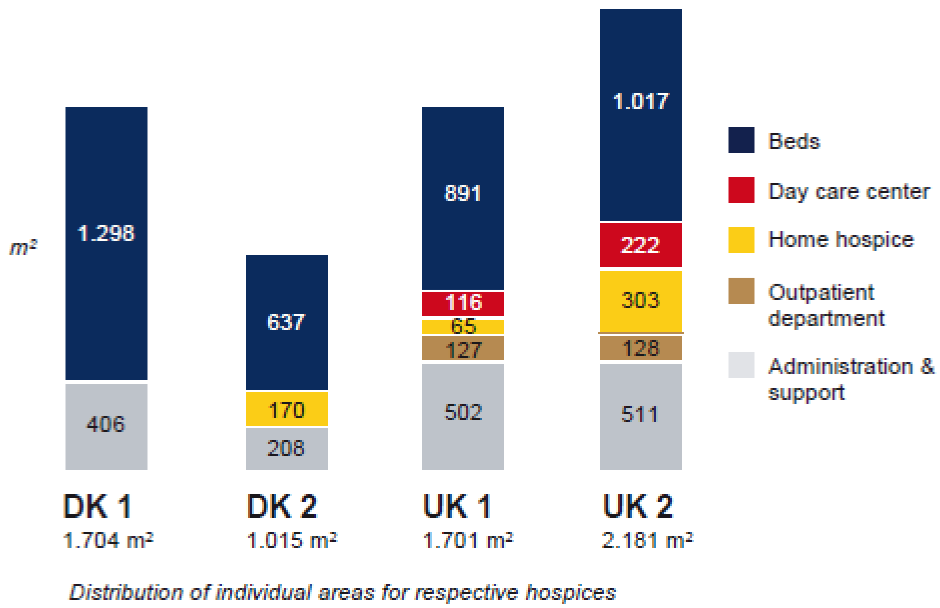
Overview of the organisation of the physical framework.

The physical framework of the four hospices has been organized in different ways. However, they do have one thing in common, as attempts have been made to divide individual departments into smaller sections, so that the wards, the palli tive teams, a possible outpatient department and day hospice are separated. When we have asked questions about this, the answer is that the aim was to create a building that gives a coherent impression, while also maintaining manageability and intimacy for the users, so these do not have the experience of " drowning" in the building. Hospice UK1 and UK 2 have larger patient capacities than the two Danish ones. The division has been emphasised more in order to maintain a feeling of intimacy in the individual sections. Likewise, the administrative areas have been located on the first floor to give patients as much moving space in the hospice as possible, and at the same time keeping the footprint of the building as small as possible. This enables social interaction between patients and relatives to take place primarily on the horizontal level, because patients are situated on one level. At the two Danish hospices social interaction between patients and relatives will happen both on the horizontal and vertical level. Here communal and support areas have been established on both floors, while the two English hospices make do with less space for communal, support and therapy rooms. Another interesting detail is the way the four hospices have laid out their wards. In DK1 a solution with the wards divided into two wings with 3 beds located on two floors has been chosen. Due to restrictions in the original building, hospice DK2 has divided the wards into two sections with 6 beds, and the two English hospices UK1 and UK2, with bigger patient capacity than the Danish ones, have divided the wards into three wings, with 4-5 beds in each.


DK 1
1st floor
Ground floor
UK 1
1st floor
Ground floor
DK 2
1st floor
Ground floor
Basement
UK 2
1st floor
Ground floor
Main entrance hall
Ward
Communal spaces
Day care center
Palliative team
Outpatient department
Staff & administration
Room for technical aids and support

Distribution of net area according to function

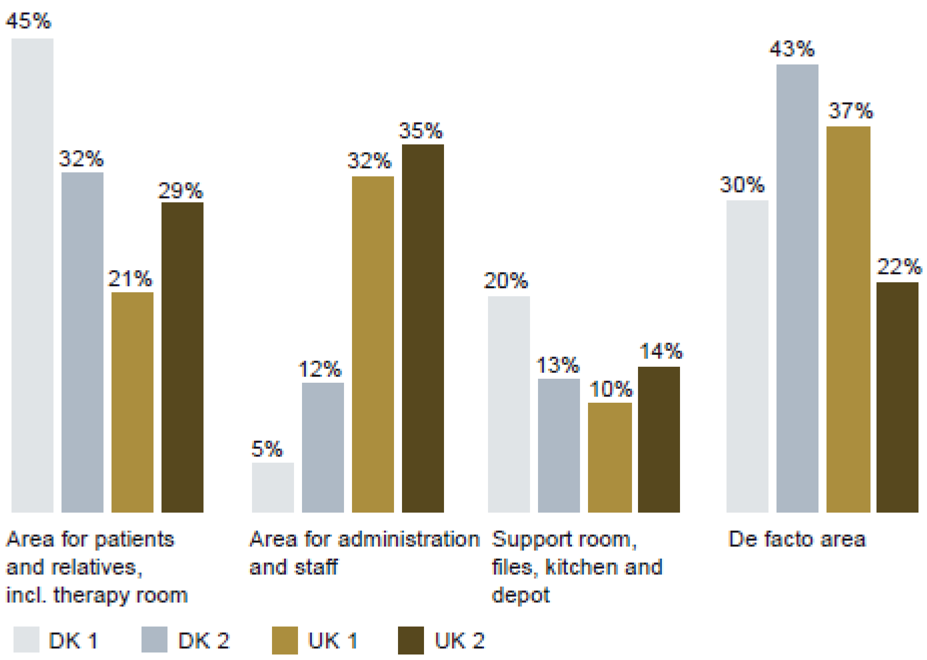
The overview below shows the distribution of areas, in relation to function. Obviously, the size of the areas depends on the capacity of beds, day hospices, palliative teams, outpatient departments and number of staff, respectively. The section reserved for bedridden patients and their relatives takes up more space in the three new building projects. This does not necessarily mean that larger areas for patients provide a better stay for the patient and the relatives, as interviews also show that a smaller, more intimate building could be preferable – the building could quite simply appear too big Furthermore, it is worthy of note that the day hospice section takes up almost double the amount of space at the UK2 hospice than it does at the UK1, in spite of the fact that UK2 has a lower capacity of patients. One of the reasons for this is the choice made at hospice UK2 to place the staff in team based communal offices, which has contributed to freeing more space for the day hospice section, among other things. Apart from the size, the only functional difference between the two day hospices is that UK1 has a special bathroom with a bathtub, which does not exist at UK2..



Distribution of net areas and sub functions for respective hospices

Distribution of net area according to user type

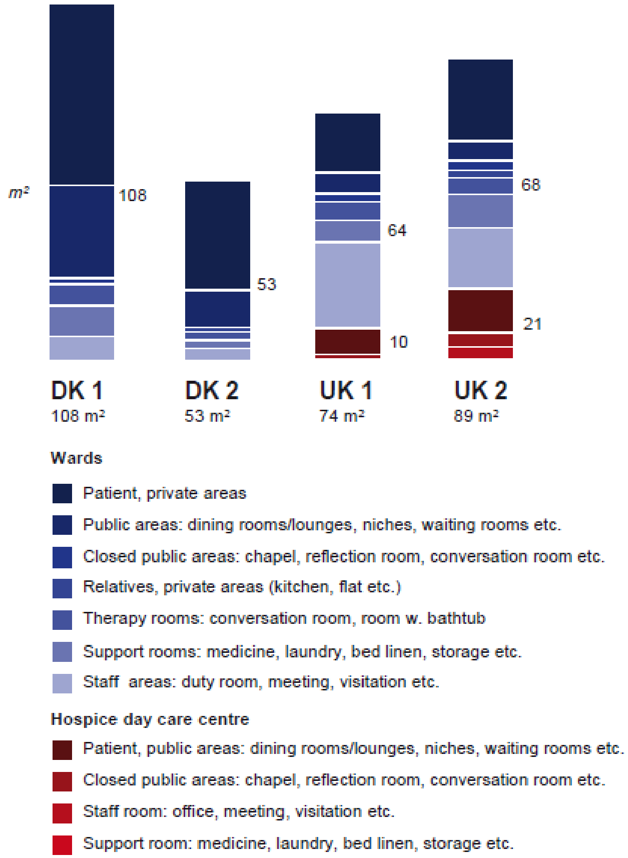
When you group the areas according to accessibility and user type, (areas for patients and relatives, areas for staff, administration an support) it appears that hospice DK1 has relatively little space reserved for staff. At this hospice the choice has been to give high priority to areas for patients, both in the form of considerably bigger wards, but also in the form of more and bigger public areas for ptients and relatives, as well as more space for storage. The high proportion of space reserved for administration and staff for hospice UK1 and UK2 is due to larger staff, including the employment of many fund-raisers, a type of employee, which does not exist in Danish hospic-es. When shaping the administrative areas, different strategies have been chosen by UK1 and UK2; UK1 has established many small of-fices for one or two people, while UK2 works with larger commu-nal offices, divided according to the teams operating at the hospice. This contributes to freeing areas to be used for more meeting rooms for the staff or more space for patients, relatives and volunteers, at UK2.



Overview of distribution of net areas according to user type

Distribution of net area according to sub function and patient

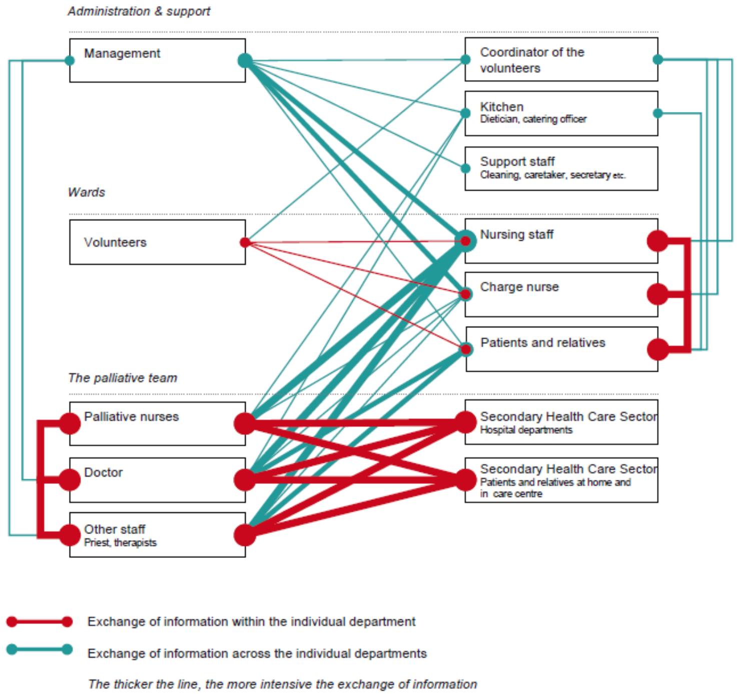
If we take a closer look at the bed and day hospice department and divide the number of square metres by the number of patients in both departments, it becomes obvious that hospice DK1 makes considerably larger public areas available to patients than the other hospices. Included in these public areas are dining and coffee rooms, informal conversation and meeting niches, waiting rooms and the like. At the same time hospice DK1 also has the biggest wards – in point of fact, the wards are more than triple the size of those in UK1. These wards contain a particular room for relatives. It is also interesting to note that the areas for staff in the wards generally take up more space at the two English hospices, with a factor of 5-7 times. Yet the reason for this is that the two English hospices have a specific reception for the ward section and also specifically designed rooms intended for conversations and interviews with patients and relatives.



Distribution of net areas/ patient for respective hospices

How is information circulated in a hospice?

As we realised that the work at a hospice has a distinct information intensive character, we set about analysing how information circulates between patients, relatives, volunteers and staff at a hospice. The diagram below illustrates the circulation of information among the staff, the volunteers, the patients and the relatives at KamillianerGaardens Hospice in Aalborg. Individual users are divided according to function in order to make clear whether information is exchanged between the individual services or internally within the service/d partment. Information exchanged within the specific department is marked with dark red, and information exchanged across the department is marked with a lighter red. It is probably not so surprising that a fair amount of information is exchanged among for example the staff at a ward or internally in the palliative team A good exchange of experience among the nursing staff or between the doctors and the palliative nurses is the very condition for good care and treatment of the patients. It is more surprising that so much information is circulated between the palliative team and the staff on the wards. A good exchange of information between these two departments seems almost as crucial as the internal one within the respective departments, for the work to be done well. The density of the lines indicates a higher degree of circulation of information. Exchange of information within the individual departments is marked with red and exchange of information between the individual departments is marked with blue.



Overview of circulation of information at KamillianerGaardens Hospice, Aalborg

Highlighted Features of Hospice Design

Light

Environmental dialog

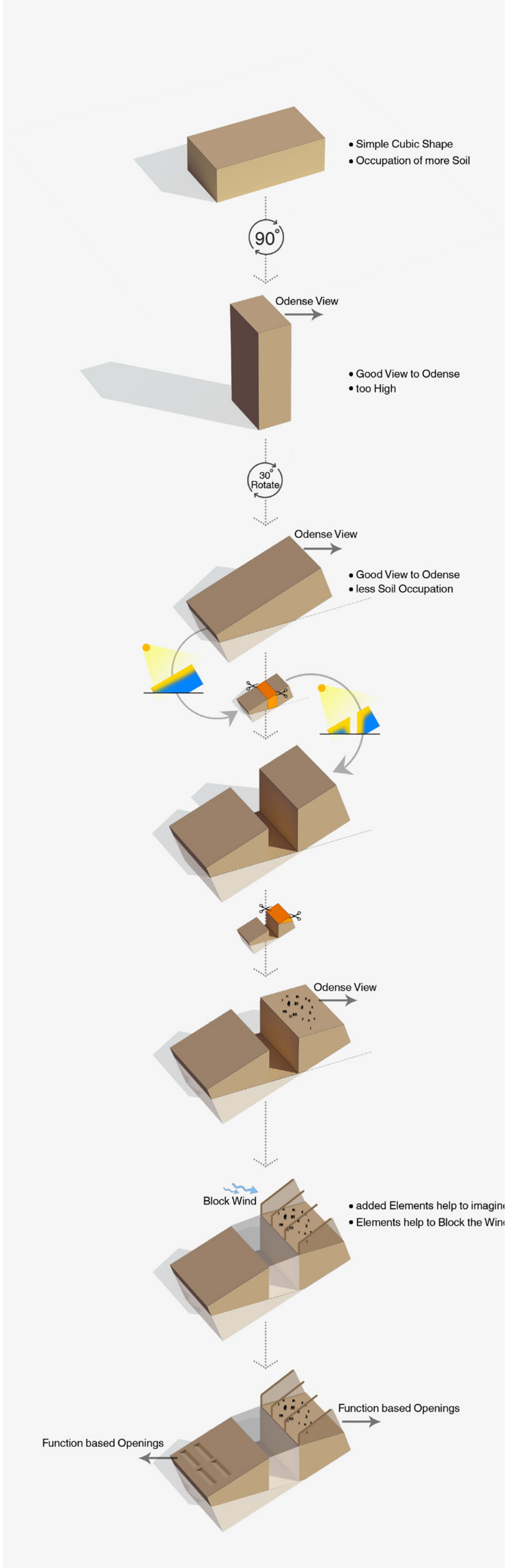
Architecture as psychologic medicine

Importance of patients and staff

Venderber, Stephen.(2003). Inovations in hospice architecture

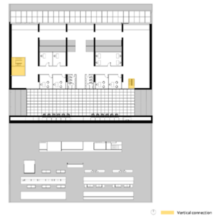
Chapter 4

Design Process



Level 06

This level is designed for **Medical Farming Labs** with help of omega farming system.



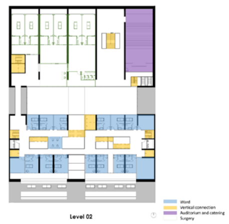
Level 04

This level is dedicated mainly for **administration offices** both in north and south which relate through a cross bridge in east side of building.

There is no access to church from this level and **lunge bar** is implemented in north east of building to provide flexible space for **staff, students and patients.**

Level 02

Second level of ward is connected to **surgical zone** with a bridge cross in west side of the building while the access for **auditorium** in second floor with **catering** area is implemented in the north east side of building isolated from surgical zone.

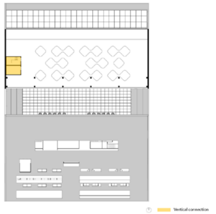


Level 00

This level is mainly dedicated to **logistics** , **accessibility** and **Public leasure** in the building.

The entrance in this level is in south acting as main entrance of hospice.

The **middle patio** is containing trees and a transparent pool letting the light through water to meditation rooms implemented in level -1.



Level 07

The top level is dedicated to roof garden accessible by elevators in the north.

Level 05

This level is designed for **library and study rooms** in the north and **CO2 Ventilation Units** and **HVAC** system in the south.

Level 03

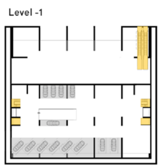
Day-Care and **Clinic** are 2 relevant functions in hospice and it's important for staff to be able to move between.

Day-care is planned to be in southern part above ward In direct connection with clinic in the north with a bridge passing over patio to reach also the **church**, **restaurant** and northern **green yard**.

Level 01

Northern part is mainly dedicated to **University Classes and auditorium** while the **first level of Ward** is being set in the southern part.

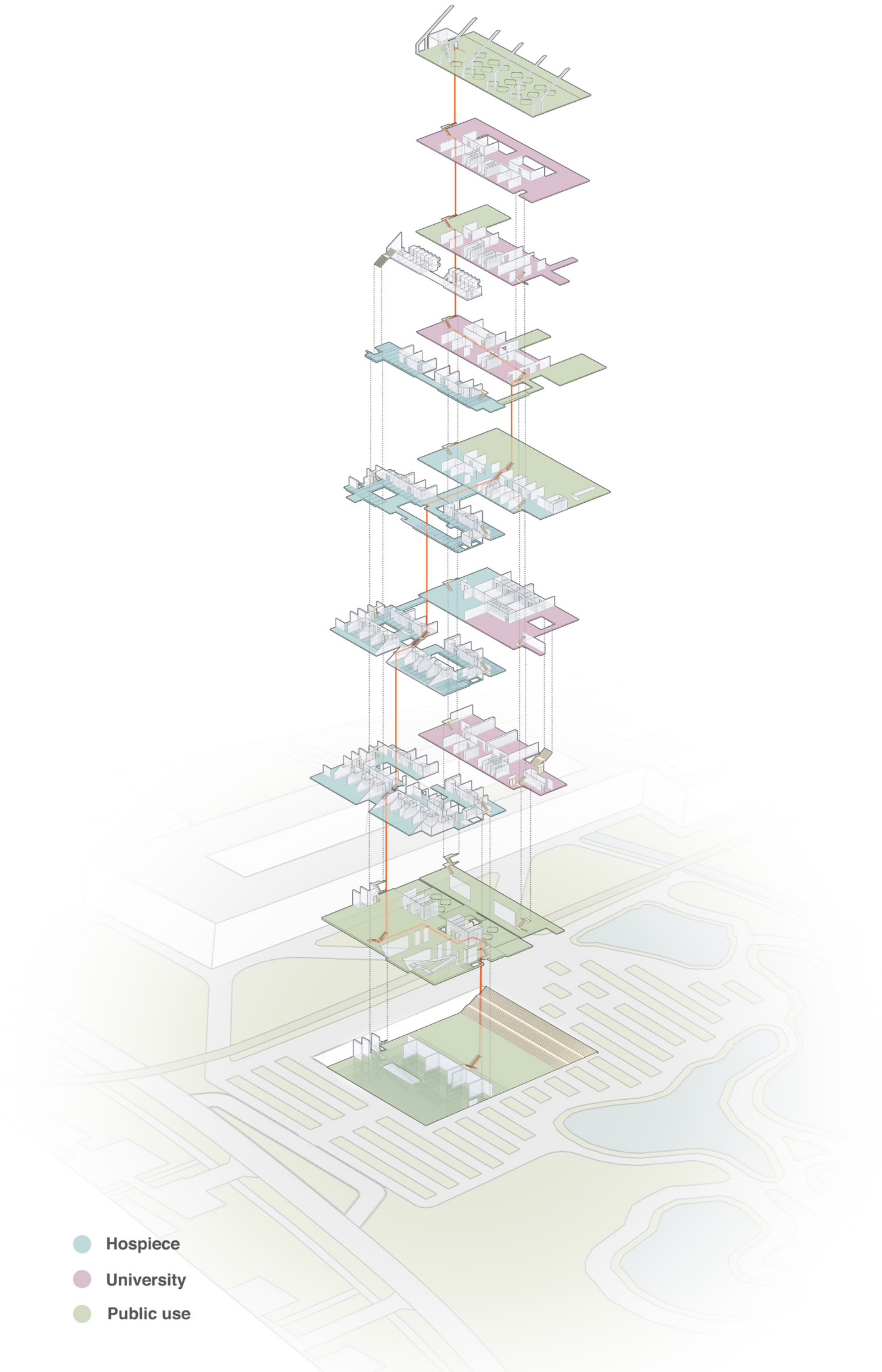
No bridge connections have been planned at this level.

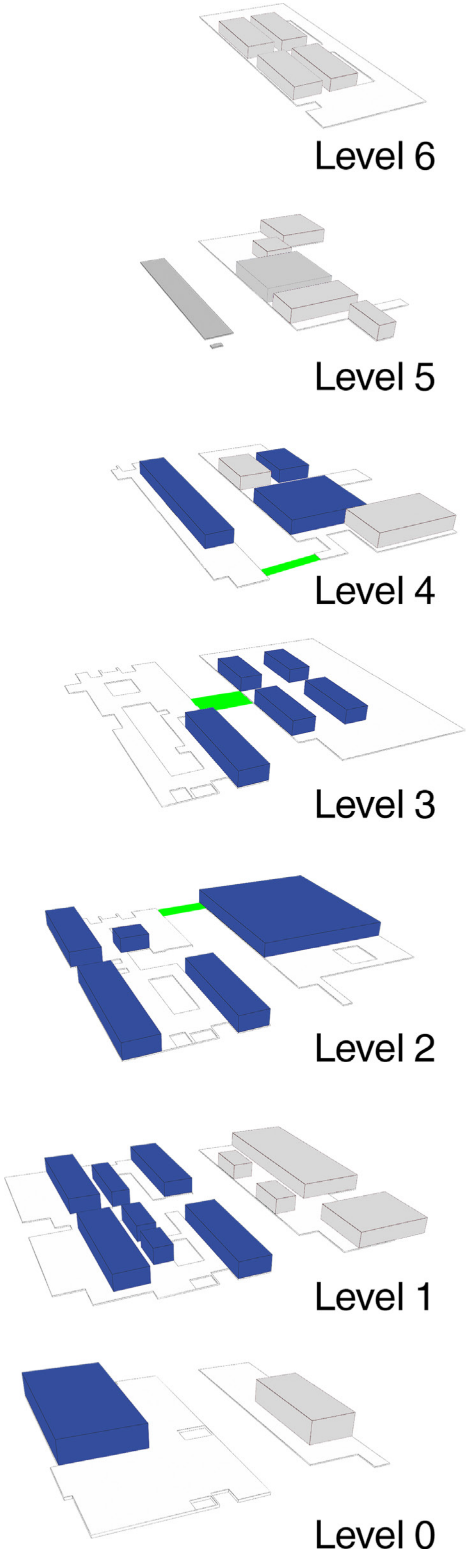


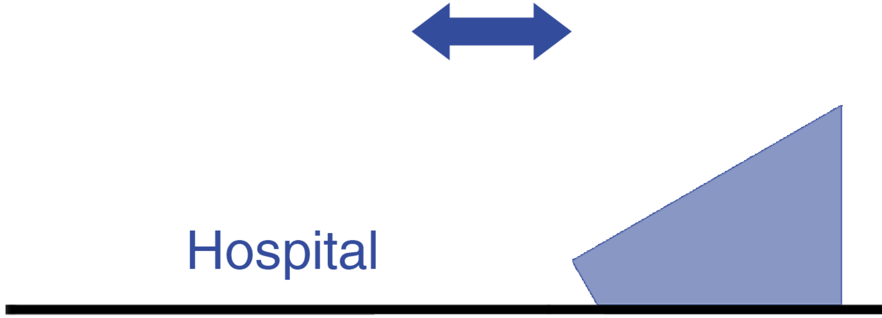
Level -1

This level is mainly dedicated to **entrance of University** and **Parking** in the building.

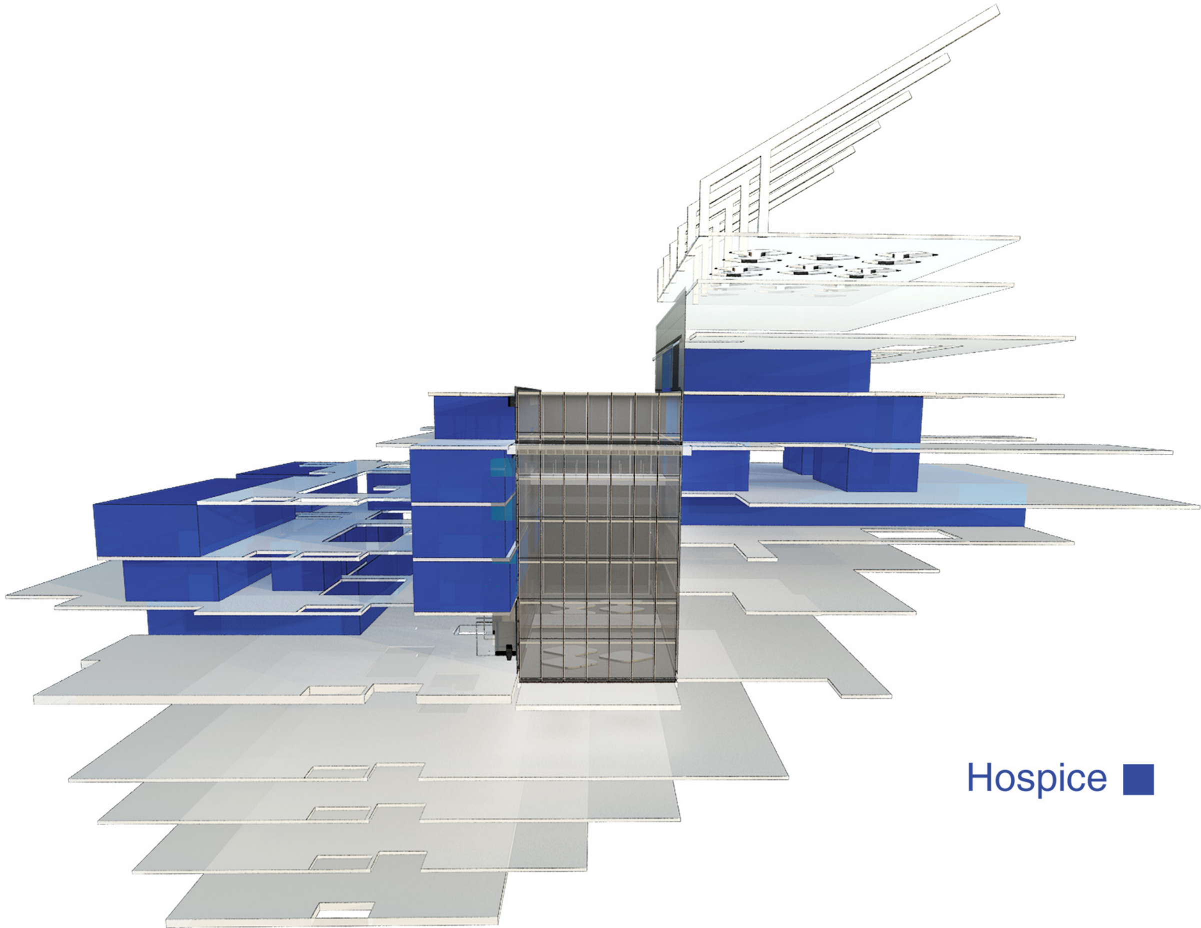
The **middle patio** is containing trees and a transparent pool letting the light through water to meditation rooms implemented in level -1.

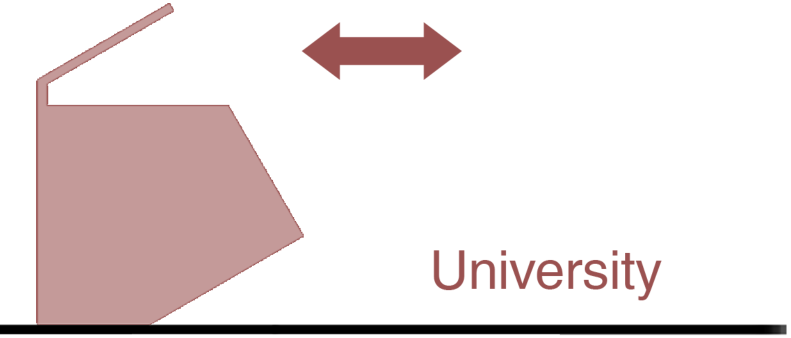




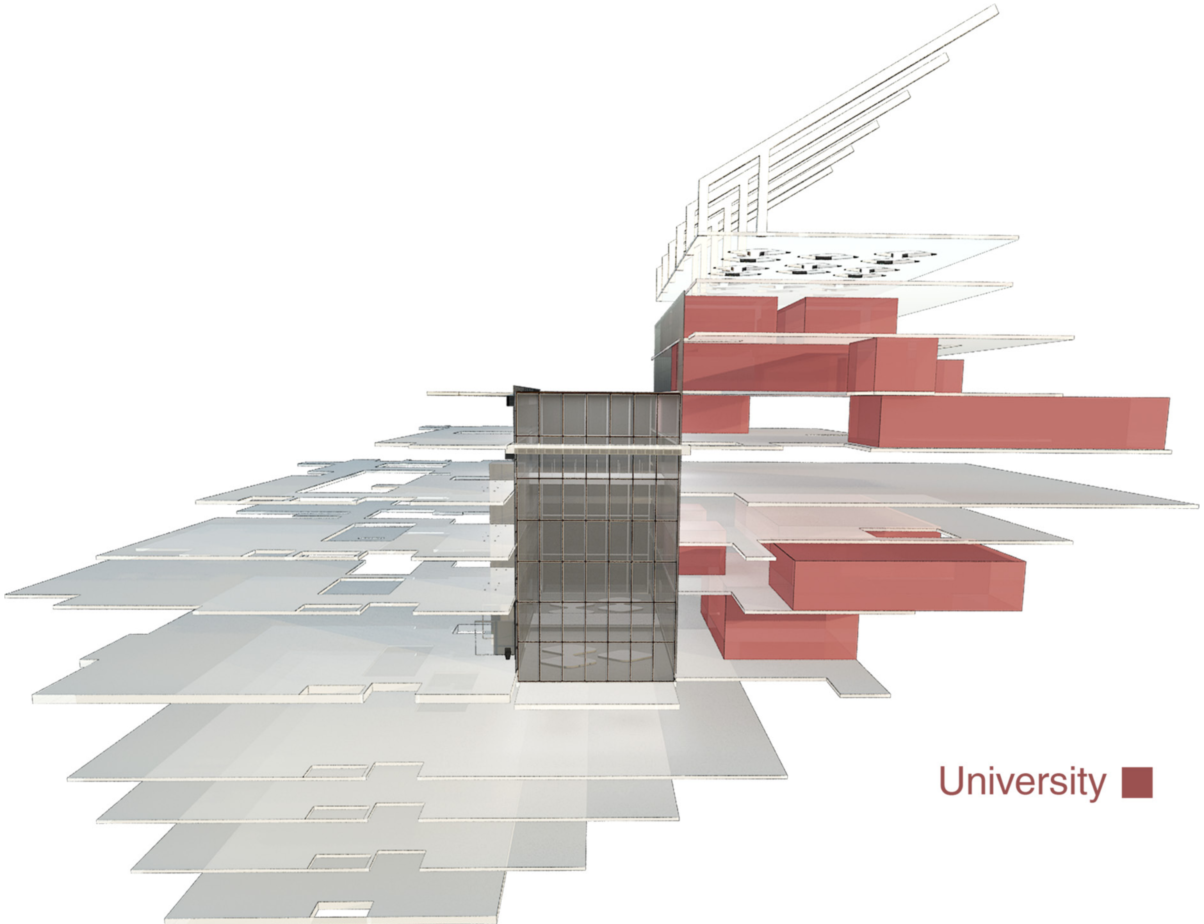


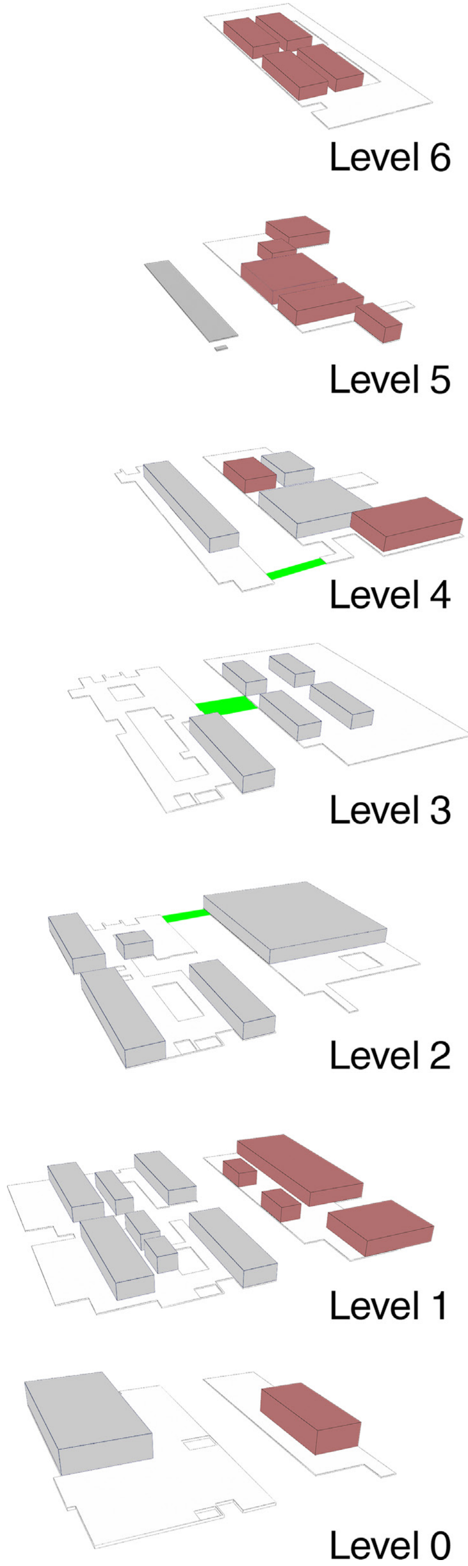
in relation with Odense hospital in S

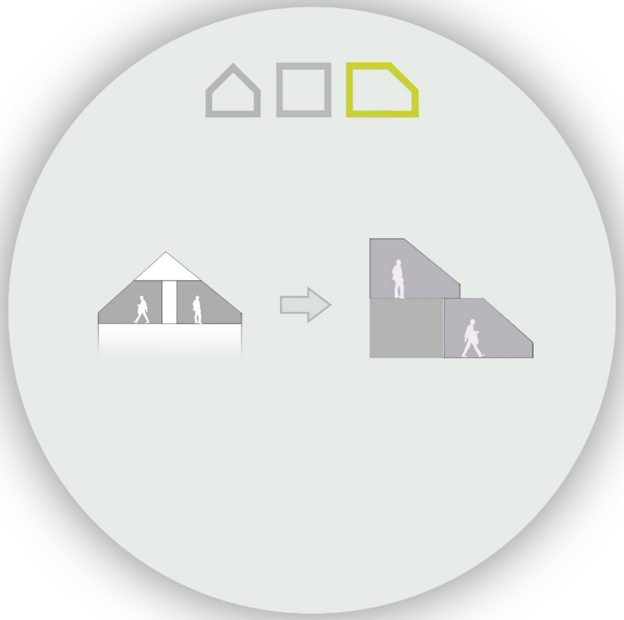


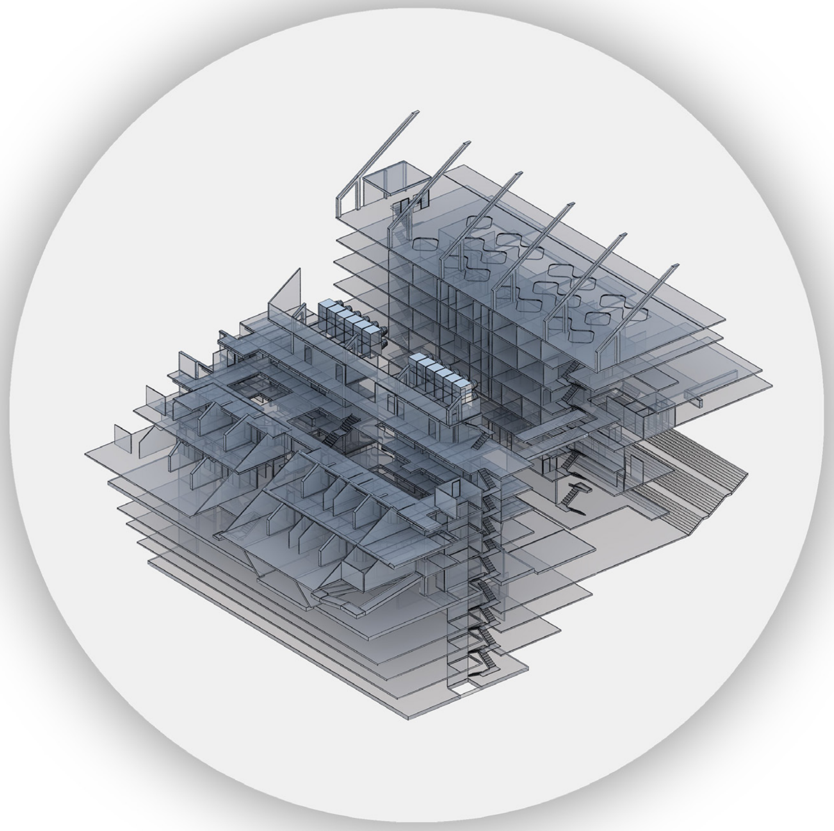


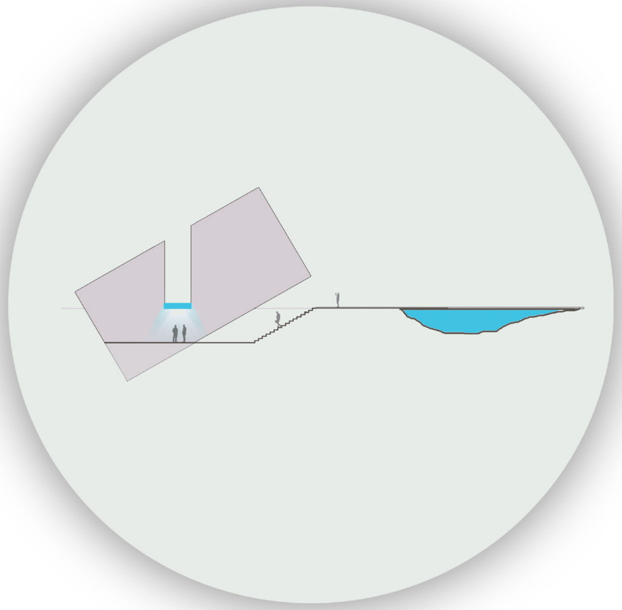
outh and also university in North

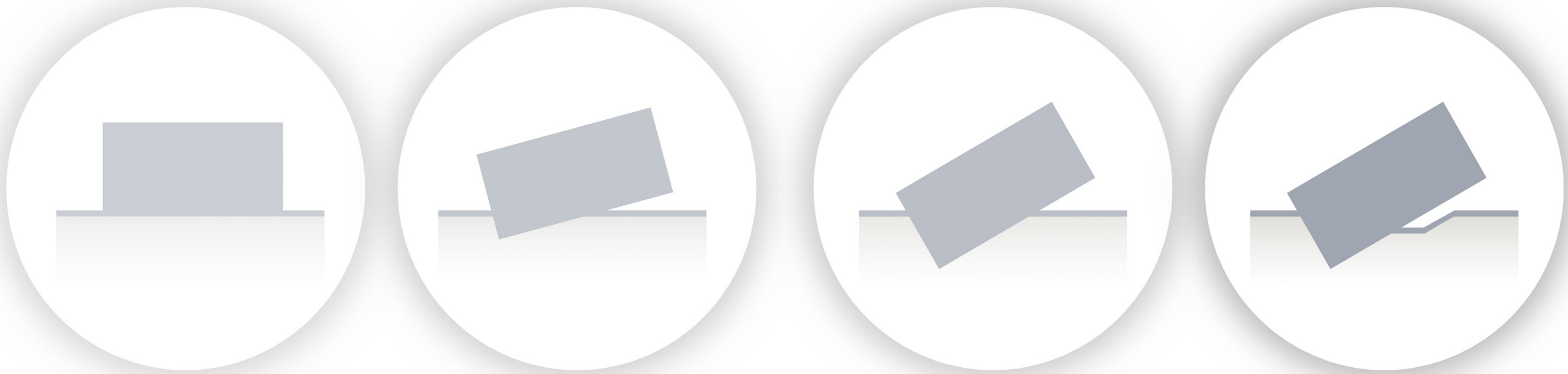






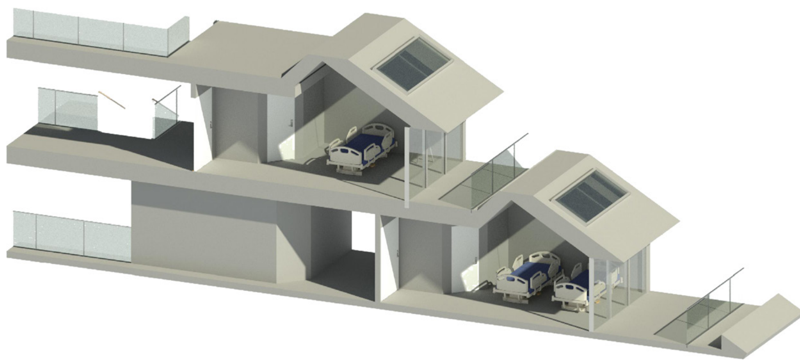


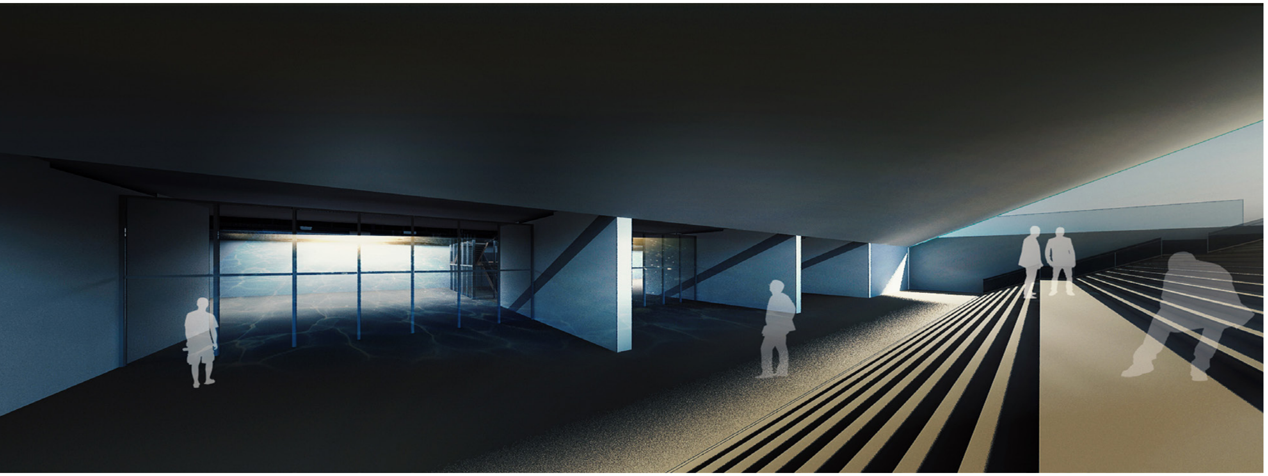


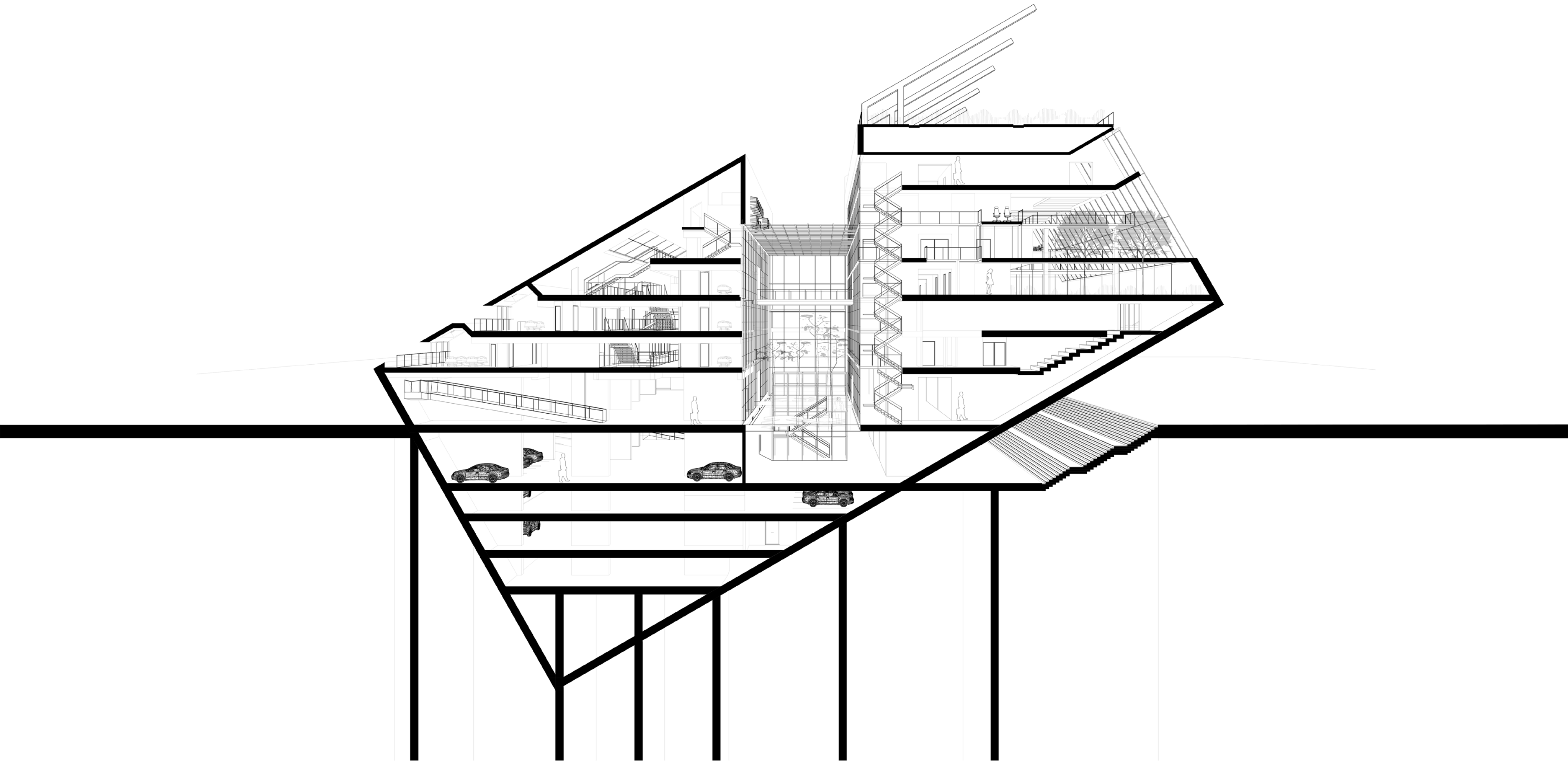


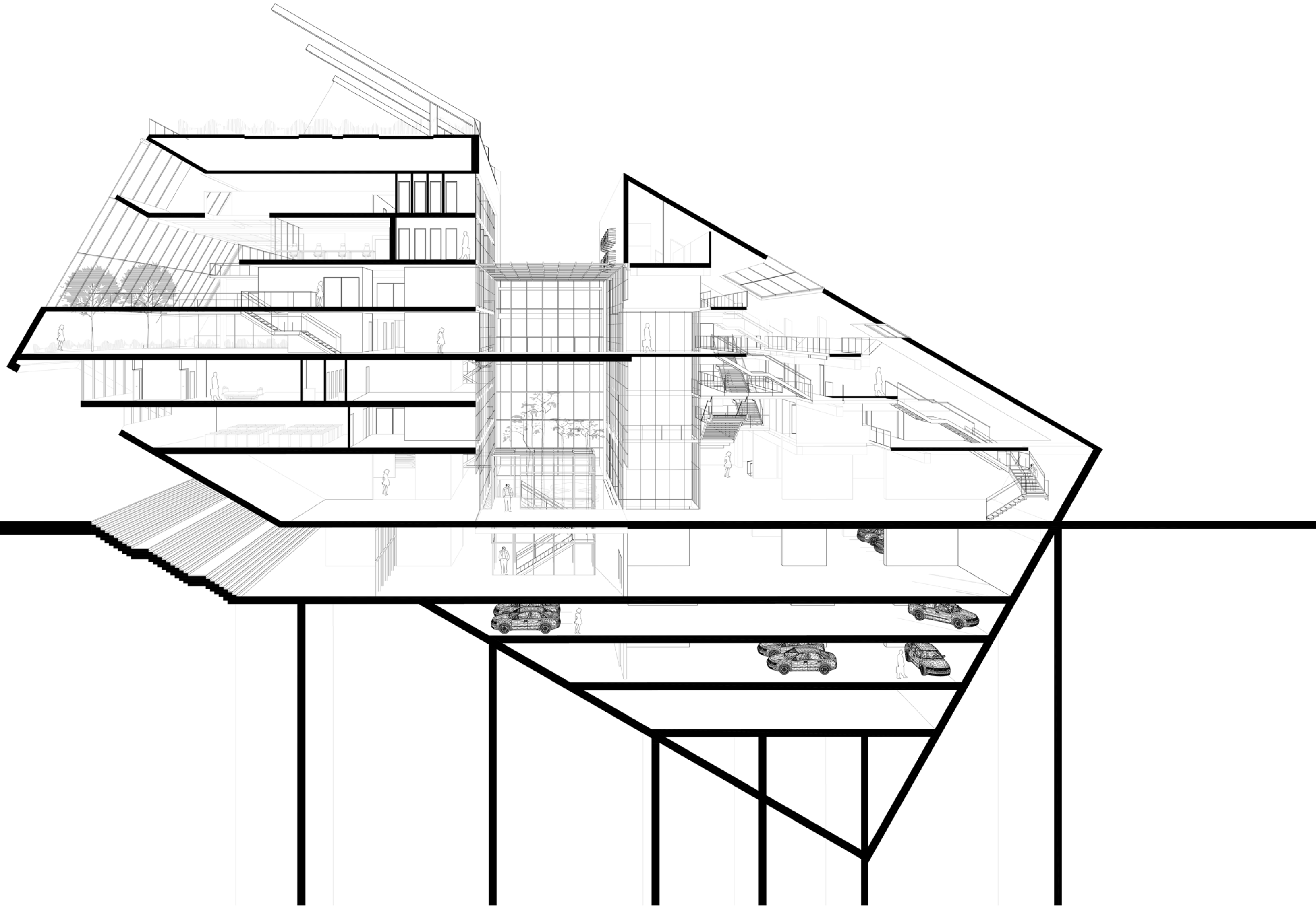
Rotating of building and bringing entrance underground to improve relation of building with soil

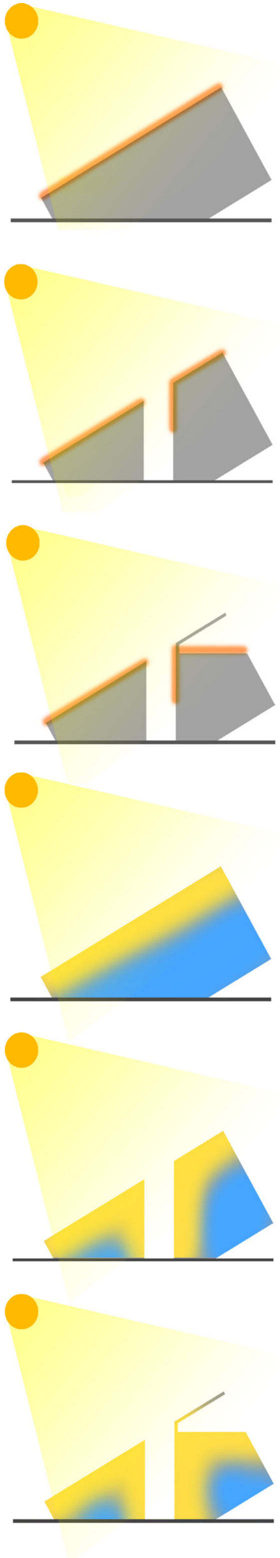
The main idea of this design is to have a compact volume to occupy least amount of land by also placing parkings underground unlike the issue which is detected in this area.

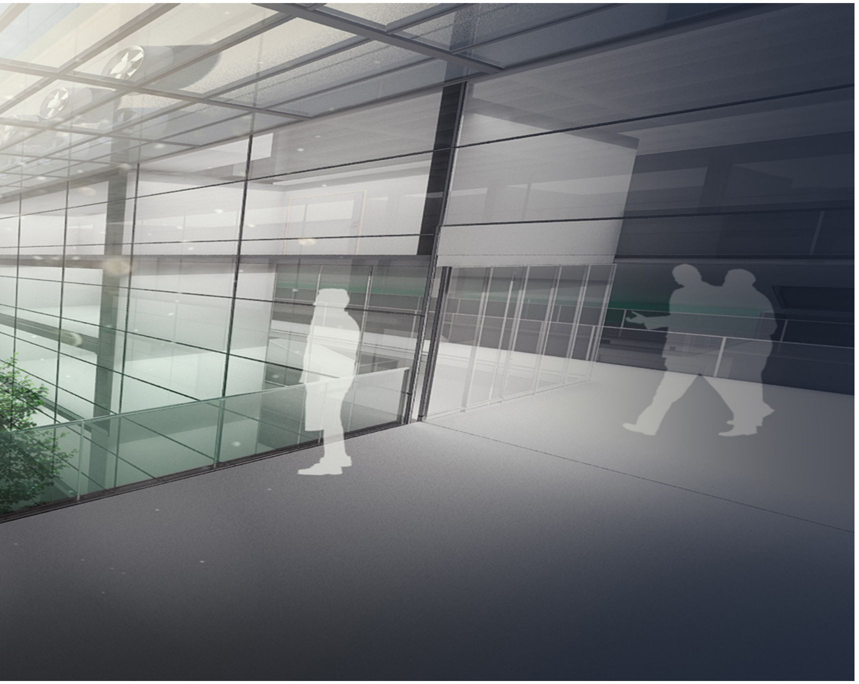




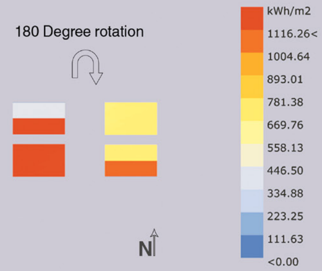




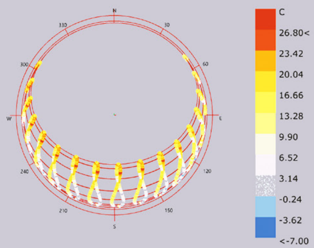




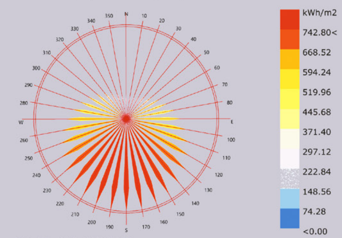
Radiation Analysis



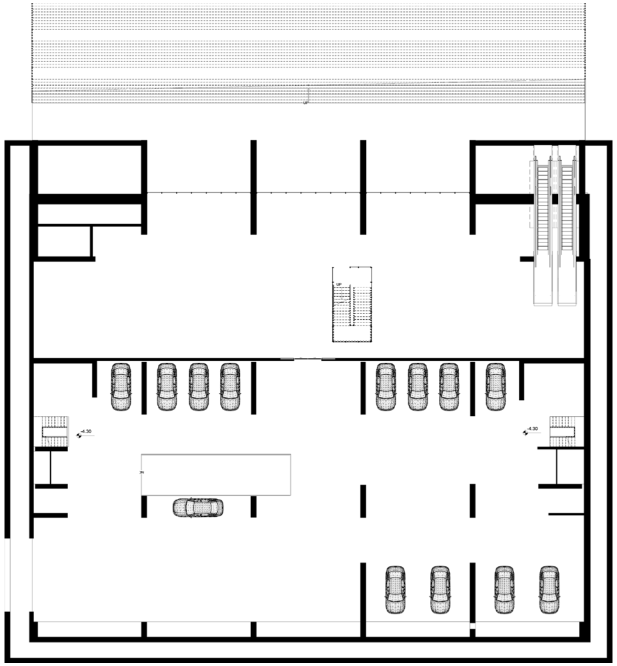
Radiation Analysis
COPENHAGEN_DNK_1983
1 JAN 1:00 - 1 DEC 24:00



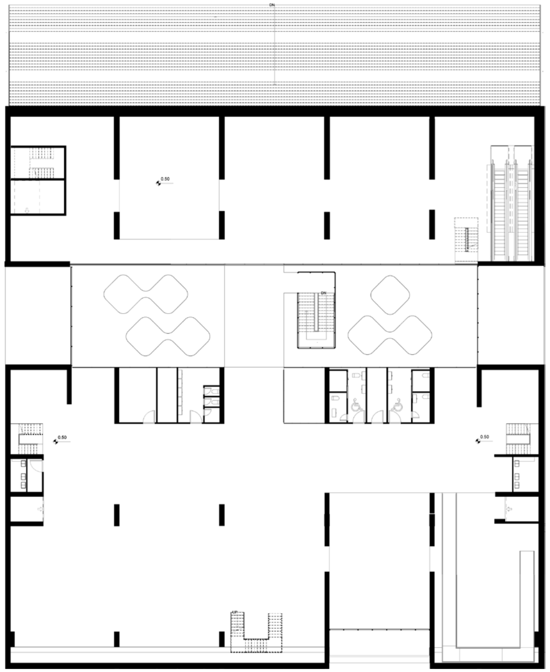
Sun-Path Diagram - Latitude: 55.630000000000003
Hourly Data: Dry Bulb Temperature (C)
COPENHAGEN_DNK



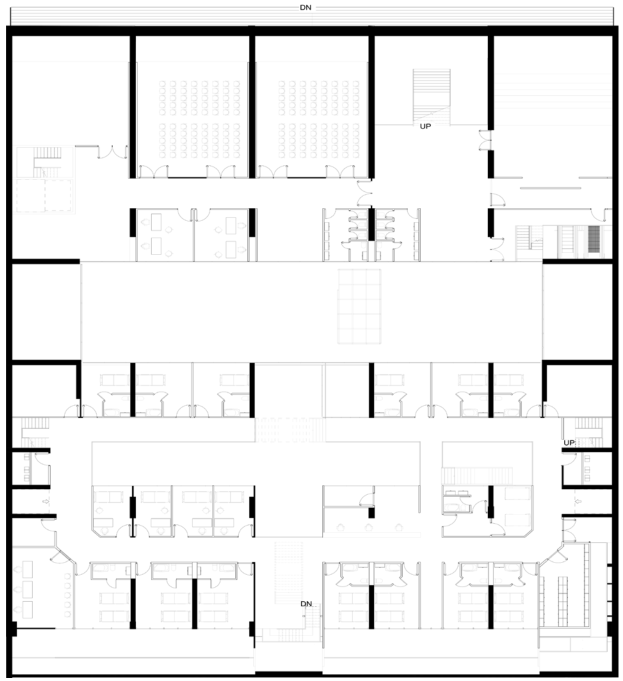
Total Radiation(kWh/m2)
COPENHAGEN_DNK_1983
1 JAN 1:00 - 1 DEC 24:00



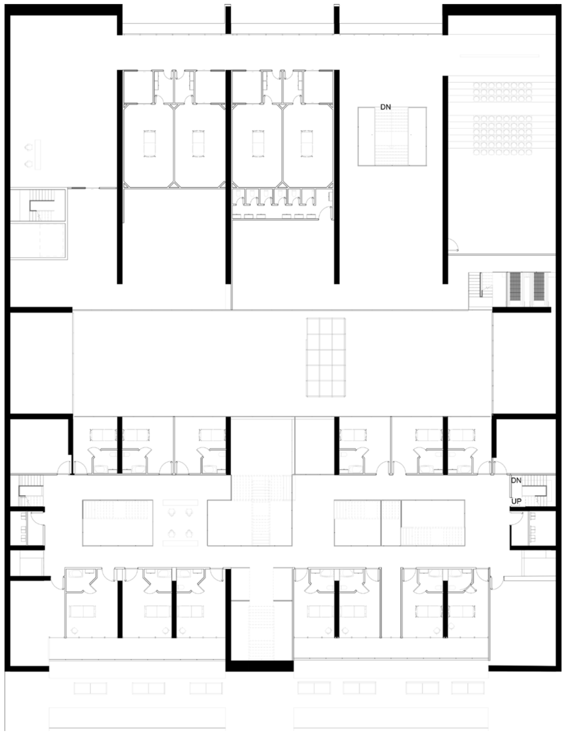
Level -1



Level 0

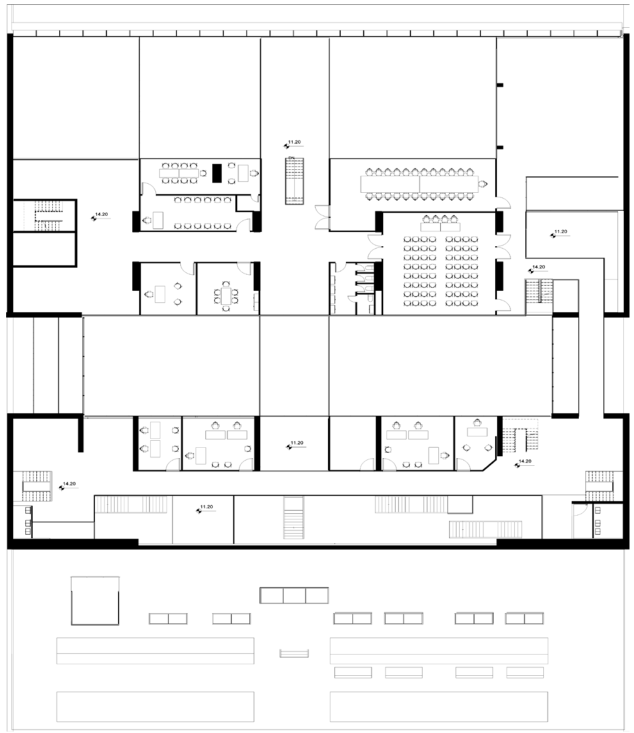


Level 1

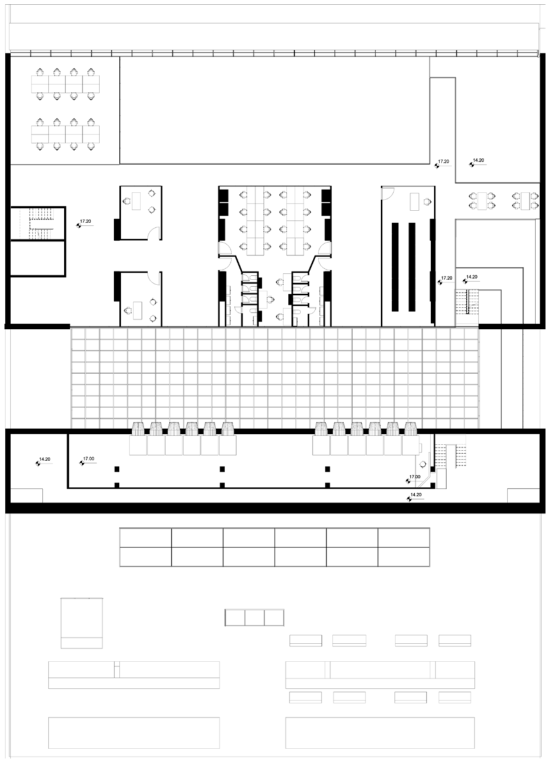


Level 2

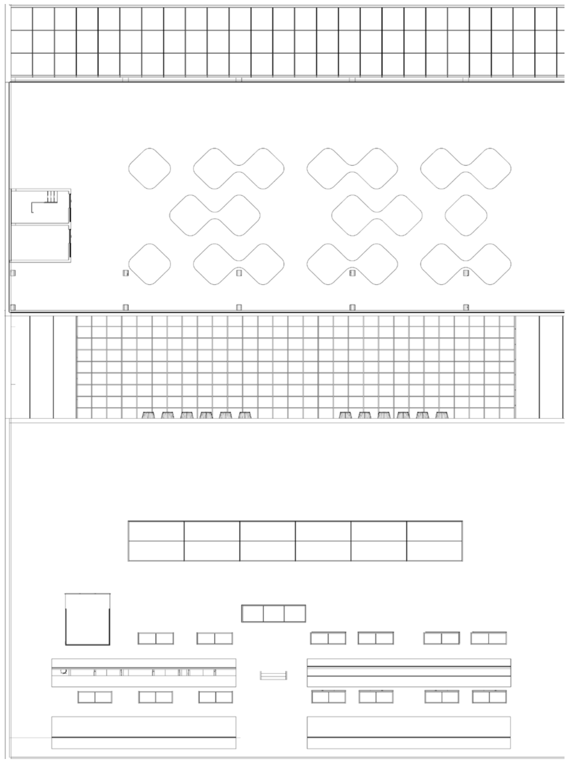
Level 3



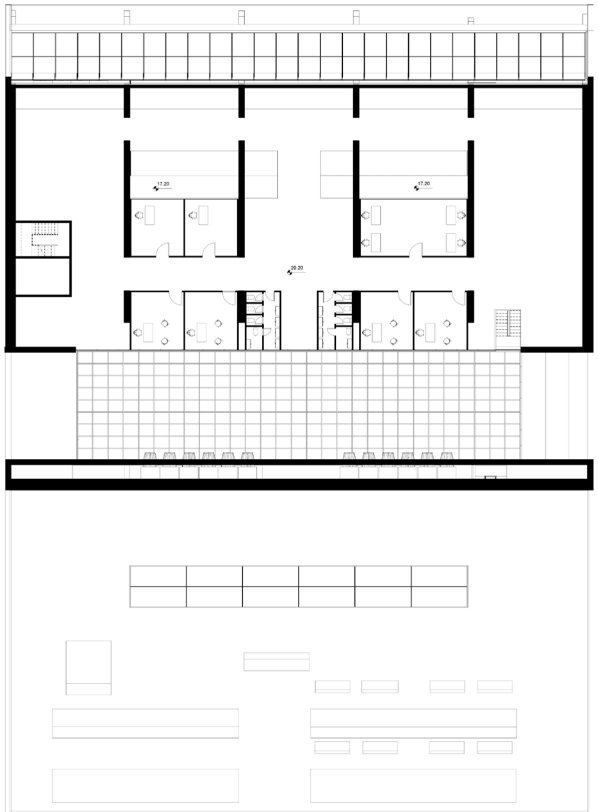
Leve 4



Level 5

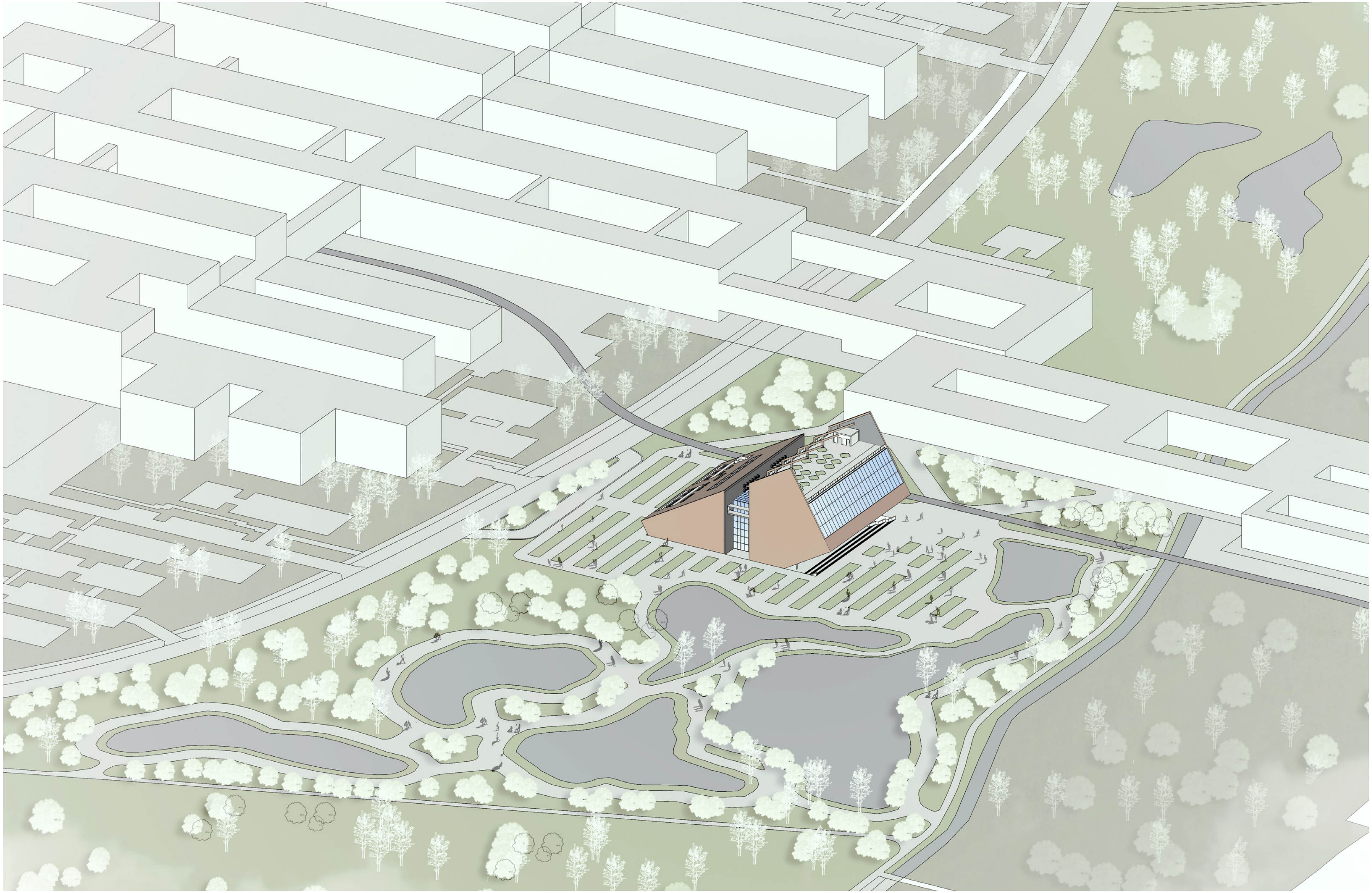


Level 6

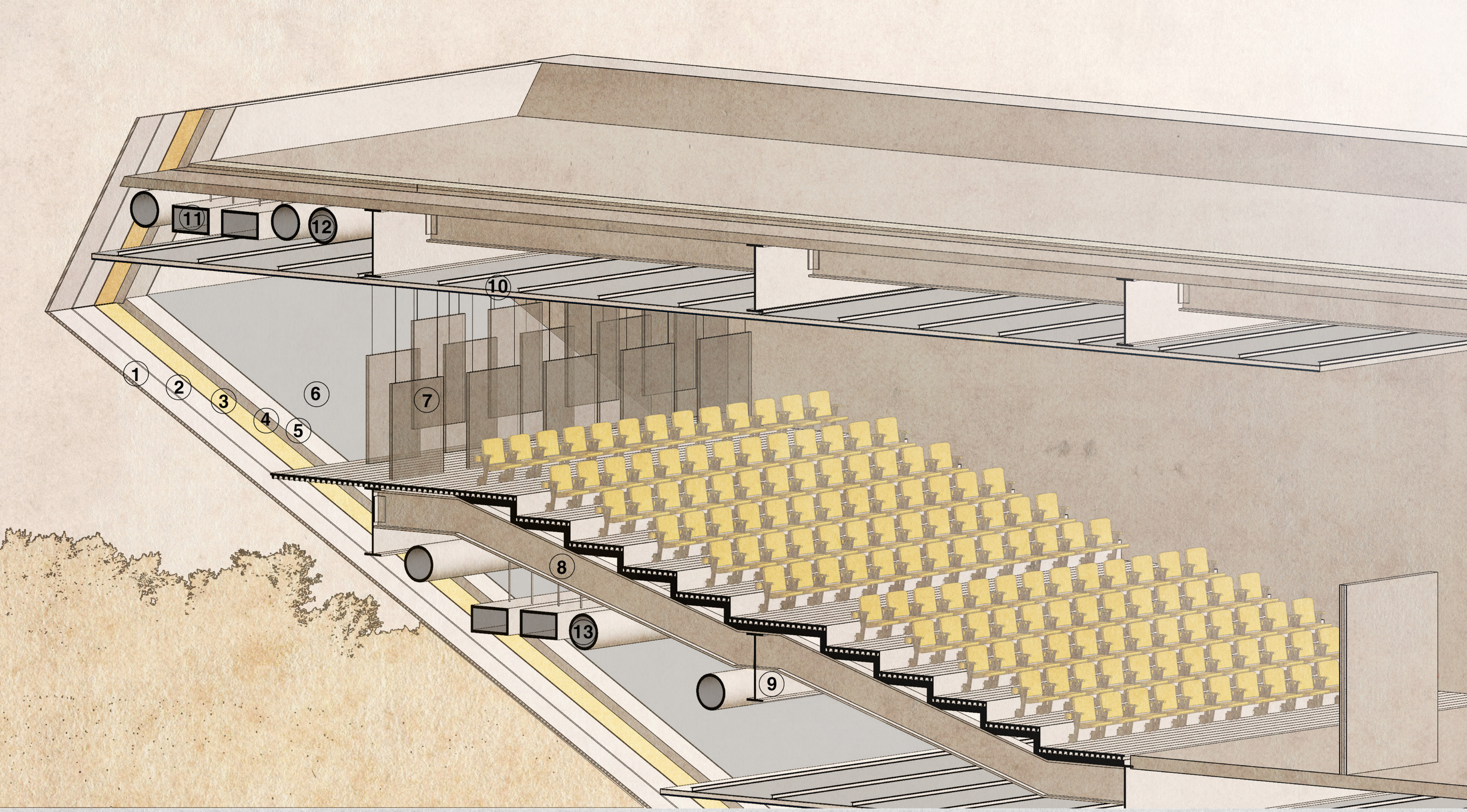


Level 7

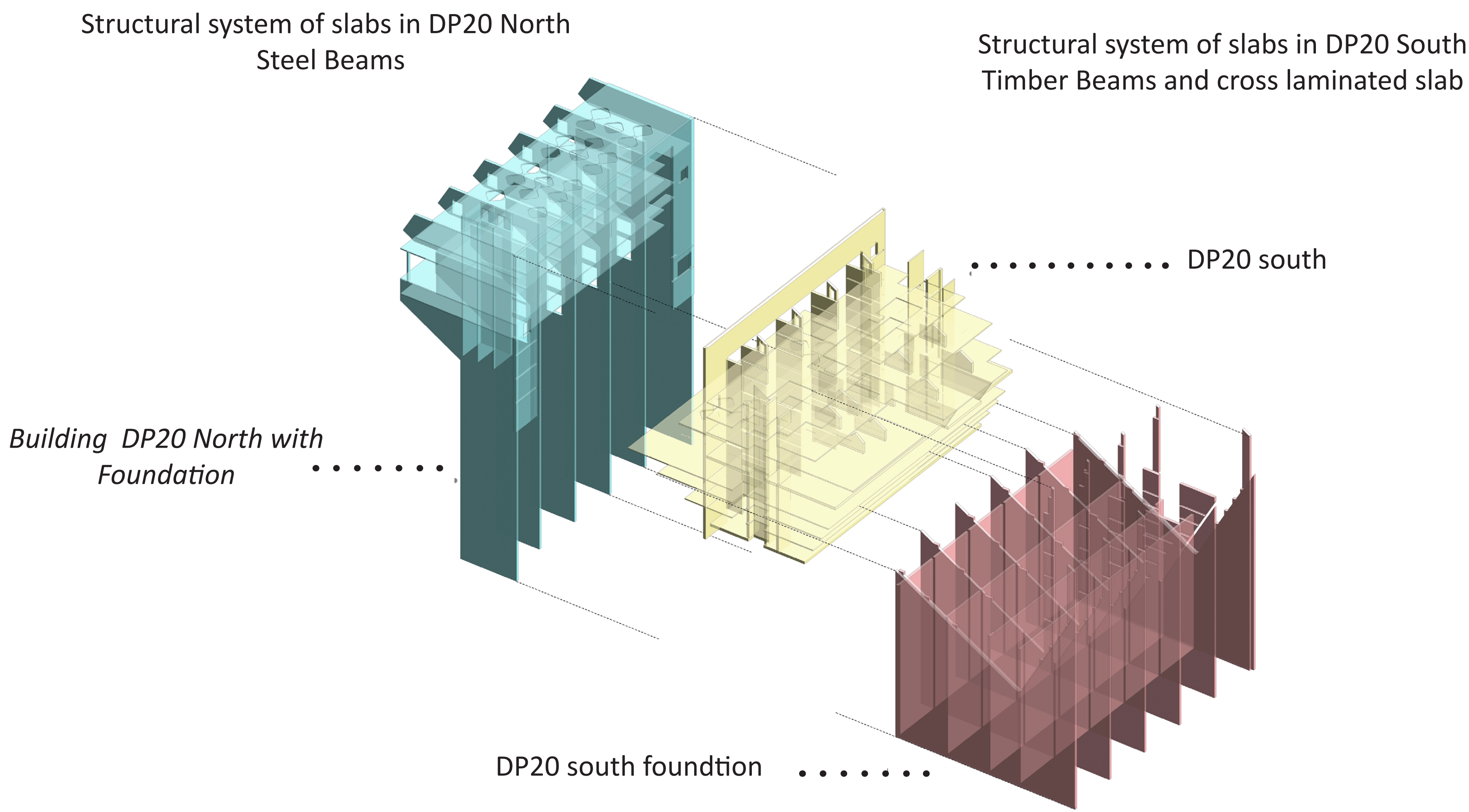
Master plan

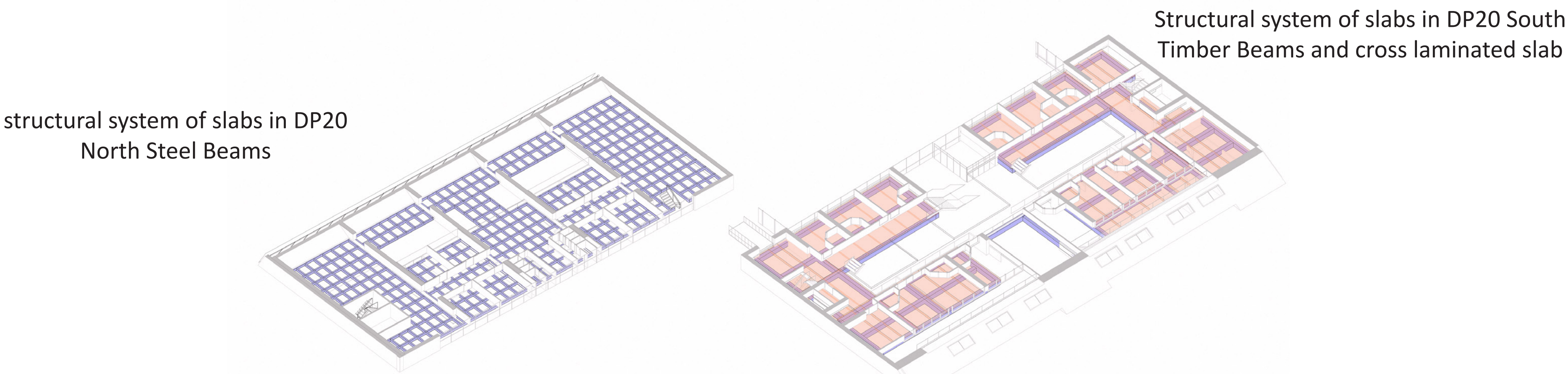


Structure



1. Concrete interior finish
2. Air gap
3. ACTIS BOOST HYBRID
4. ACTIS HYBRIS
5. AIR GAP
6. Wooden finish
7. Acustic panels
8. Steel Beam
9. Special IPE 1000mm
10. Ceiling
11. HVAC system
12. HVAC system circulation
13. HVAC system below seats


Structural system of slabs in DP20 North
Steel Beams
Structural system of slabs in DP20 South
Timber Beams and cross laminated slab
DP20 south
Building DP20 North with Foundation
DP20 south foundtion


Structural system of slabs in DP20 South
Timber Beams and cross laminated slab
structural system of slabs in DP20
North Steel Beams

LOAD CALCULATION FOR BEAM:

NON-STRUCTURAL LOAD CALCULATION:

MATERIAL	THICKNESS (m)	SPECIFIC WEIGHT (Kg/m3)	WEIGHT (Kg/m2)
ANTIBACTERIAL FLOORING	0.005	200	0.001
OSB PANEL	0.02	600	0.08
ACTIS HYBRIS	0.2	9.5	0.19
VAPOR BARRIER	0.01	80	0.08
CROSS LAMINATED SLAB	0.2	471	0.942

LIVE LOAD FROM NTC CLASSIFICATION

C	**Ambienti suscettibili di affollamento**	
	Cat. C1 Ospedali, ristoranti, caffè, banche, scuole	3,00
	Cat. C2 Balconi, ballatoi e scale comuni, sale convegni, cinema, teatri, chiese, tribune con posti fissi	4,00
	Cat. C3 Ambienti privi di ostacoli per il libero movimento delle persone, quali musei, sale per esposizioni, stazioni ferroviarie, sale da ballo, palestre, tribune libere, edifici per eventi pubblici, sale da concerto, palazzetti per lo sport e relative tribune	5,00

	WEIGHT (KN/M²)	AREA (M²)	TOTAL LOAD (KN)	LENGTH (M)	DISTRIBUTED LOAD (KN/M)
Slab	1.3	14	18.1	4.6	3.9
LIVE LOAD	3	14	42	4.6	9.1

LOAD COMBINATION:

(SLU):
γG1·G1 + γG2·G2 + γP·P + γQ1·Qk1 + γQ2·ψ02·Qk2 + γQ3·ψ03·Qk3 + …

(SLE):
G1 + G2 +P+ ψ11·Qk1 + ψ22·Qk2 + ψ23·Qk3 + …

		Coefficiente γ_F	EQU	A1 STR	A2 GEO
Carichi permanenti	favorevoli	γ_{G1}	0,9	1,0	1,0
	sfavorevoli		1,1	1,3	1,0
Carichi permanenti non strutturali[(1)]	favorevoli	γ_{G2}	0,0	0,0	0,0
	sfavorevoli		1,5	1,5	1,3
Carichi variabili	favorevoli	γ_{Qi}	0,0	0,0	0,0
	sfavorevoli		1,5	1,5	1,3

[(1)]Nel caso in cui i carichi permanenti non strutturali (ad es. carichi permanenti portati) siano compiutamente definiti si potranno adottare per essi gli stessi coefficienti validi per le azioni permanenti.

Categoria/Azione variabile	ψ_{0j}	ψ_{1j}	ψ_{2j}
Categoria A Ambienti ad uso residenziale	0,7	0,5	0,3
Categoria B Uffici	0,7	0,5	0,3
Categoria C Ambienti suscettibili di affollamento	0,7	0,7	0,6
Categoria D Ambienti ad uso commerciale	0,7	0,7	0,6
Categoria E Biblioteche, archivi, magazzini e ambienti ad uso industriale	1,0	0,9	0,8
Categoria F Rimesse e parcheggi (per autoveicoli di peso ≤ 30 kN)	0,7	0,7	0,6
Categoria G Rimesse e parcheggi (per autoveicoli di peso > 30 kN)	0,7	0,5	0,3
Categoria H Coperture	0,0	0,0	0,0
Vento	0,6	0,2	0,0
Neve (a quota ≤ 1000 m s.l.m.)	0,5	0,2	0,0
Neve (a quota > 1000 m s.l.m.)	0,7	0,5	0,2
Variazioni termiche	0,6	0,5	0,0

BEAM SECTION **IPE 240-S275** HAVE BEEN CHOSEN

BENDING MOMENT VERIFICATION:

$M_{Rd} \geq M_{Ed}$

$$M_{Rd} = \frac{Wpl \times fy}{\gamma M0}$$

WPL (mm³)	366600
FY (N/mm²)	275
γm0	1.05
MRd (KNm)	96.0

$$M_{Ed} = \frac{W \times l^2}{8}$$

W (N/m)	18
L (m)	4.6
MEd (KNm)	47.61

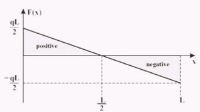
96 ≥ 47.6 **VERIFIED**

SHEAR FORCE VERIFICATION:

$V_{Rd} \geq V_{Ed}$

$$V_{Rd} = \frac{A_V \left(\frac{f_Y}{\sqrt{3}}\right)}{\gamma_{MD}}$$

Av (mm²)	1914
FY (N/mm²)	275
γm0	1.05
VRd (KN)	289.4



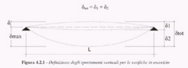
$$V_{Ed} = \frac{Wl}{2}$$

W (KN/m)	18
L (m)	4.6
VEd (KN)	41.4

289.4 ≥ 41.4 **VERIFIED**

DISPLACEMENT VERIFICATION:

$$\delta_C = \frac{5qL^4}{384EI}$$



q (N/mm)	10.3
L (mm)	4600
E (N/mm²)	210000.0
I (mm4)	32900000
δ (mm)	8.7

$$\delta_{max} = \frac{l}{200} = \frac{4600}{200} = 23(mm)$$

23 ≥ 8.6 **VERIFIED**

LOAD CALCULATION FOR COLUMN:

LOAD CALCULATION:

LOAD ON COLUMN = STRUCTURAL LOAD + NONSTRUCTURAL LOAD + LIVE LOAD

LOAD COMBINATION:

(SLU):
γG1·G1 + γG2·G2 + γP·P + γQ1·Qk1 + γQ2·ψ02·Qk2 + γQ3·ψ03·Qk3 + …

(SLE):
G1 + G2 +P+ ψ11·Qk1 + ψ22·Qk2 + ψ23·Qk3 + …

SLU = 1.1× 2.5 + 1.5 × 18.1 + 1.5 × 42 = 92.9 KN

SLE = 2.5 + 18.1 + 0.7 × 42 = 50 KN

AXIAL FORCE:

$N_{Rd} \geq N_{Ed}$

$$N_{Rd} = \frac{Af_{yk}}{\gamma_{Mo}}$$

COLUMN SECTION **HEA 160-S275** HAVE BEEN CHOSEN

A (mm²)	3877
FYK (N/mn	500
γm0	1.05
NRd (KN)	1065.9

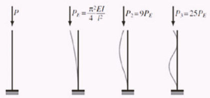
1065.9 ≥ 92.9 **VERIFIED**

BUCKLING:

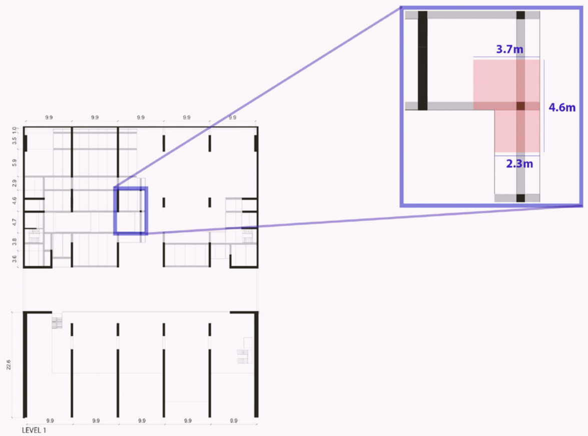
FIRST MODE

$$P_E = \frac{\pi^2}{4}\frac{EI}{l^2}$$

PE = 346.7KN



346.7 ≥ 92.9 **VERIFIED**



FEM Analysis for auditorium

Structural Report of the Amphitheater

The main structure of the building which captures and transports the entire amphitheater load to the foundation is consisted of two 0.5-meter-thick concrete shear walls. Further, the structure of the amphitheater that holds the entire local load (live, dead, and structural) of the space, is comprised of a grid of 9 beams. In detail, three main beams span horizontally between the two shear walls, and other three diagonal sub-beams complete the structural grid. The loads are considered to be transported initially to the diagonal beams, where they transport it as local concentrated loads to the horizontal main beams, at two edges and a central location.

The structural joints between the main and sub-beams are hinge (pin), and the main beams are considered to be fixed (moment bearing joints) to the shear walls. The live load is considered to be equal to 4 (kN/m2), the dead load to be 3 (kN/m2), and the structural load to be equal to the element's mass., as suggested by Eurocode. All the loads are considered to be acting as distributed line loads, imposed on top of the beams. The most sever combinations of ULS (Ultimate Limit State) and SLS (Serviceability Limit State), have been chosen to maximize the internal stresses and global beam deflections.

The main beams are verified to be "HE 1000*579" and the sub-beams are "IPE 550 R", which are both available products in European countries. All the beams are verified according to Eurocode 3 (Design of Steel Structures) in three main categories of, axial force, shear force and bending moment for ULS and global beam deflection for SLS verification. The following figures and table present the results.

According to Eurocode, the global beam deflection should be less than L/300 (where L is the length of the beam). Also, the following formulas for resi rces a

$$N_{axial,Rd} = \frac{A \cdot f_y}{\gamma_{M0}} \qquad V_{pl,Rd} = \frac{A_v \cdot (\frac{f_y}{\sqrt{3}})}{\gamma_{M0}}$$

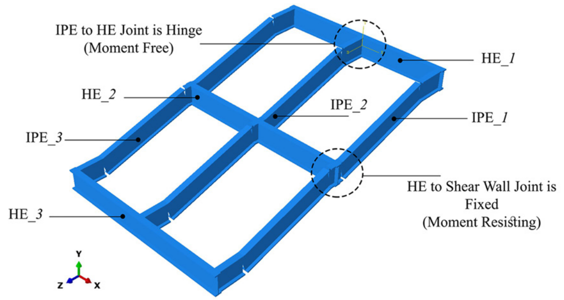
$$A_v = A - 2bt_f + t_f(t_w + 2r)$$

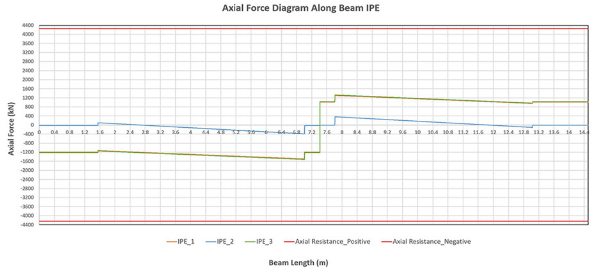
$$M_{pl,Rd} = \frac{W_{pl} \cdot f_y}{\gamma_{M0}}$$

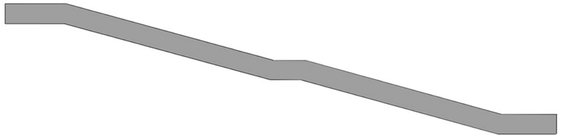
Where, N_(axial,Rd), V_(pl,Rd), M_(pl,Rd), A, A_v, W_pl, f_y, b, t_f, t_w, r, γ_M0 are, axial resistance, plastic shear resistance, plastic bending moment resistance, nominal cross-section, shear section, plastic section modulus, yield stress (250 MPa), section width, flange thickness, web thickness, corner flip radius, resistance factor (equal to 1). The bending resistance is calculated for class 1 or 2 of cross-sections due to the dimensions of the sections. Overall, the ULS verifications has to satisfy:

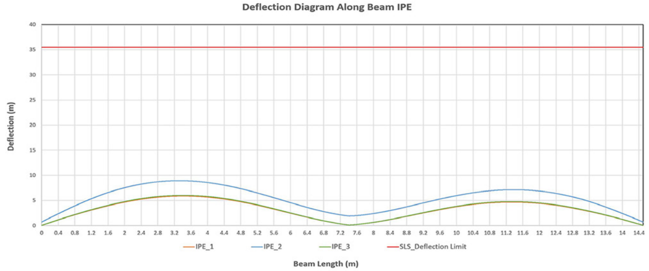
$$\frac{F_{Ed}}{F_{Rd}} \leq 1$$

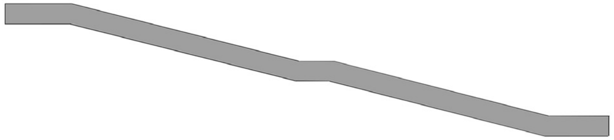
Element / Verification	IPE550R Max. Analysis Value	IPE 550 R Resistance Value Or Limit	Verification State	HE 1000 Max. Analysis Value	HE 1000 Resistance Value Or Limit	Verification State
SLS (m)	8.93 (IPE_2)	35.50	Verified	3.20	31.30	Verified
Axial load (kN)	1326 (IPE_1,3)	4250	Verified	Negligible	18250	Verified
Shear force (kN)	772 (IPE_1,3)	1306	Verified	3346 (HE_2)	5100	Verified
Bending moment (kN.m)	844 (IPE_2)	890	Verified	2875 (HE_2)	5000	Verified

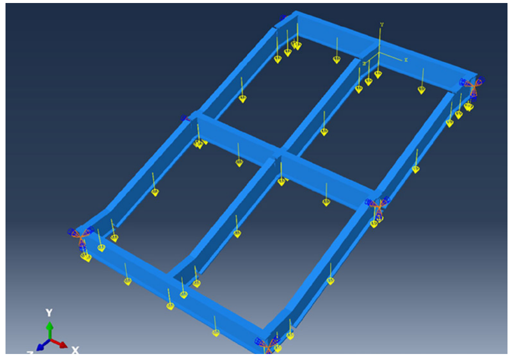


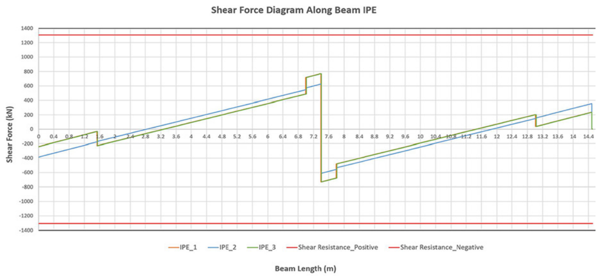

Axial Force Diagram Along Beam IPE
Axial Force (kN)
IPE_1
IPE_2
IPE_3
Axial Resistance_Positive
Axial Resistance_Negative
Beam Length (m)

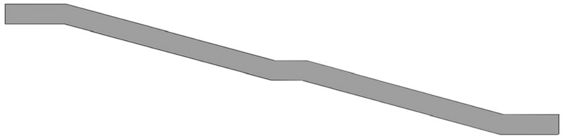


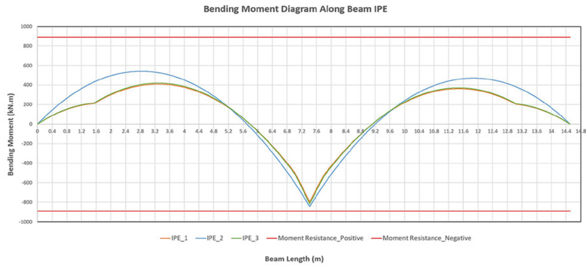

Deflection Diagram Along Beam IPE
Deflection (m)
IPE_1
IPE_2
IPE_3
SLS_Deflection Limit
Beam Length (m)

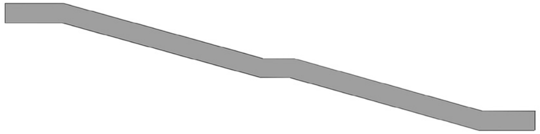


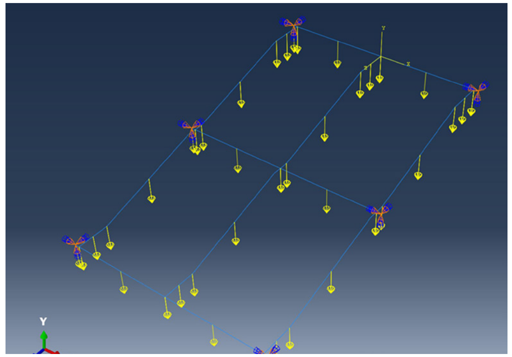



Shear Force Diagram Along Beam IPE
Shear Force (kN)
IPE_1
IPE_2
IPE_3
Shear Resistance_Positive
Shear Resistance_Negative
Beam Length (m)

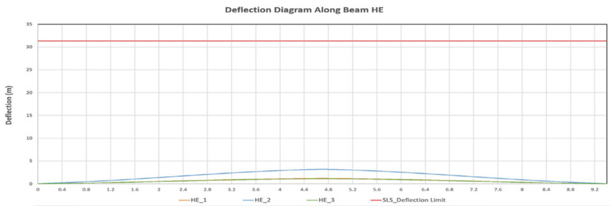


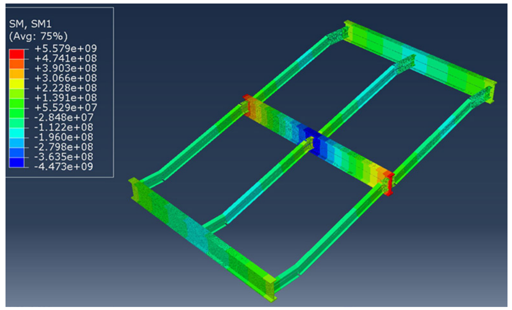

Bending Moment Diagram Along Beam IPE
Bending Moment (kN.m)
IPE_1
IPE_2
IPE_3
Moment Resistance_Positive
Moment Resistance_Negative
Beam Length (m)

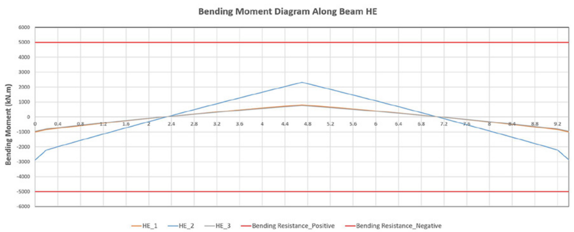


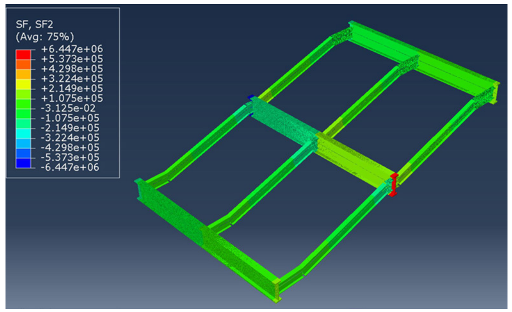


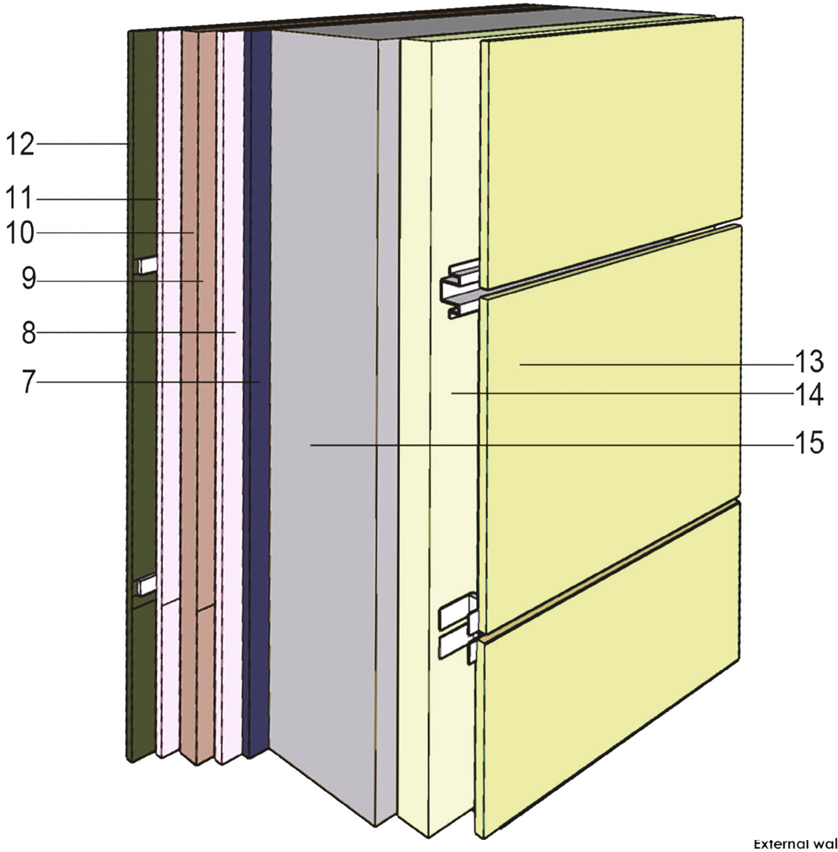

Shear Force Diagram Along Beam HE
Shear Force (kN)
HE_1
HE_2
HE_3
Shear Resistance_Positive
Shear Resistance_Negative
Beam Length (m)

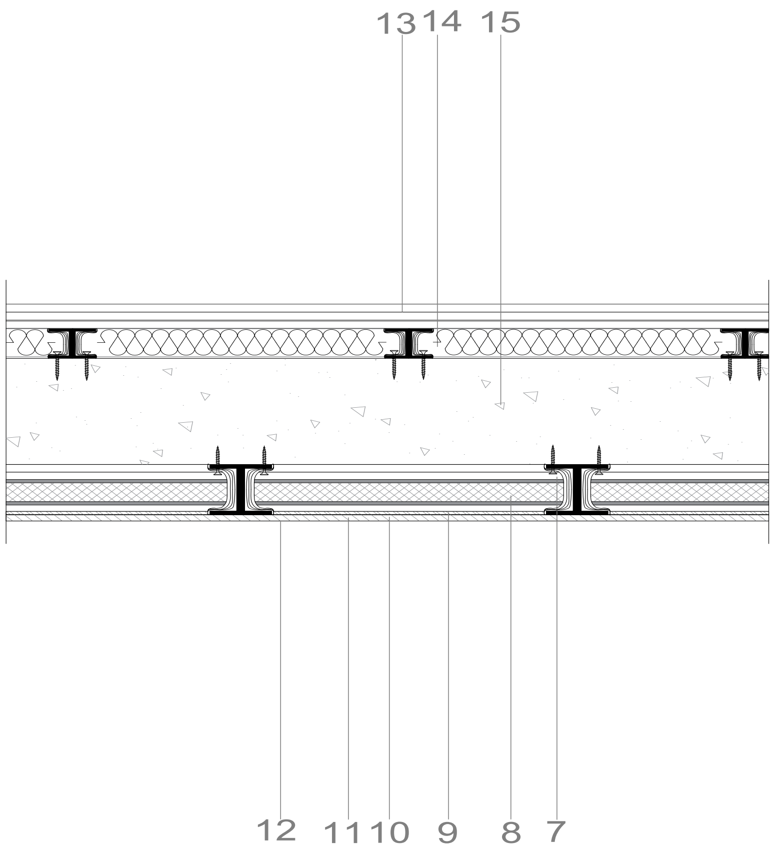

Deflection Diagram Along Beam HE
Deflection (m)
HE_1
HE_2
HE_3
SLS_Deflection Limit


SM, SM1
(Avg: 75%)
+5.579e+09
+4.741e+08
+3.903e+08
+3.066e+08
+2.228e+08
+1.391e+08
+5.529e+07
-2.848e+07
-1.122e+08
-1.960e+08
-2.798e+08
-3.635e+08
-4.473e+09

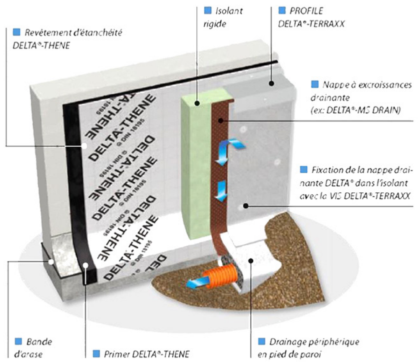

Bending Moment Diagram Along Beam HE
Bending Moment (kN.m)
HE_1
HE_2
HE_3
Bending Resistance_Positive
Bending Resistance_Negative

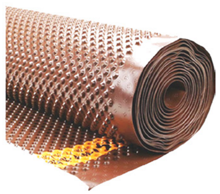

SF, SF2
(Avg: 75%)
+6.447e+06
+5.373e+05
+4.298e+05
+3.224e+05
+2.149e+05
+1.075e+05
-3.125e-02
-1.075e+05
-2.149e+05
-3.224e+05
-4.298e+05
-5.373e+05
-6.447e+06



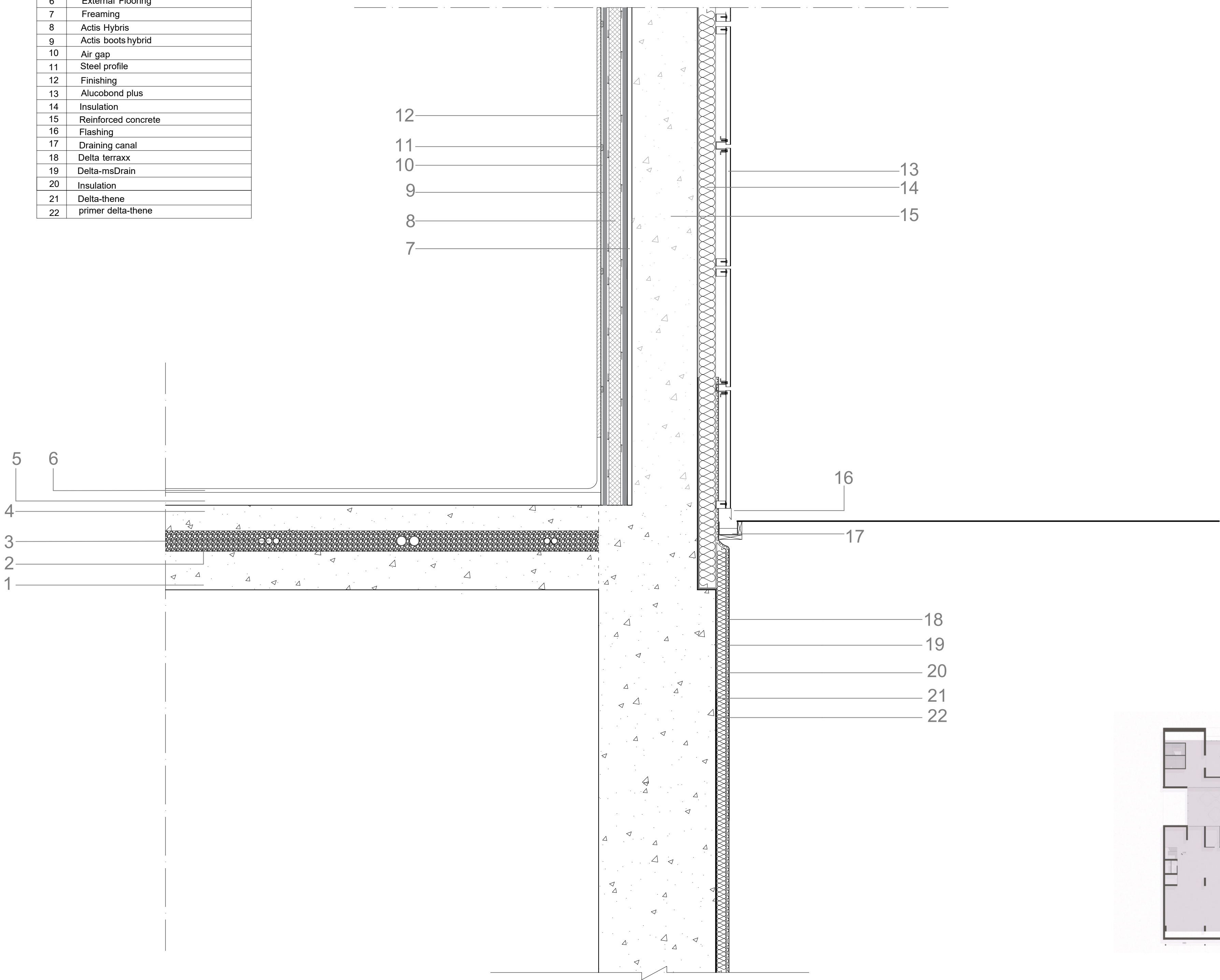


External wall layering (basement)
DORKEN DELTA®-THENE (U-value: 0.325 W / m² • K)



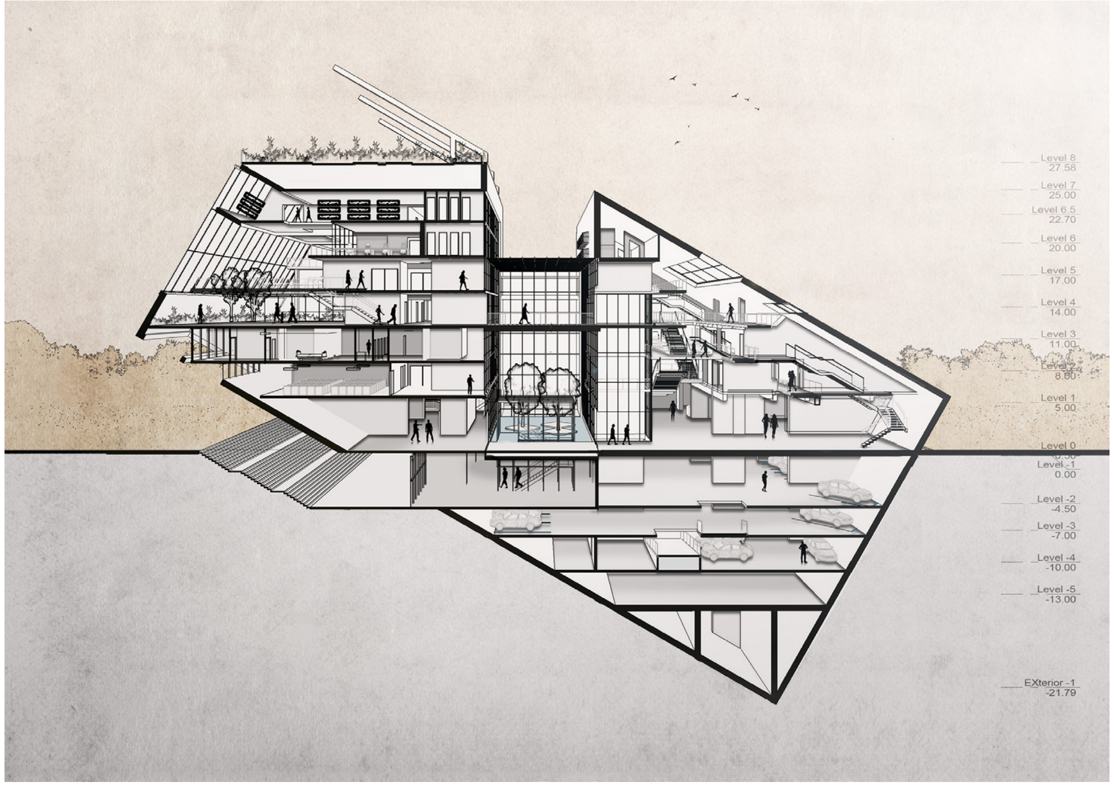


N°	Description
1	Reinforced concrete
2	Gravels
3	Pipe
4	Reinforced concrete
5	Screed
6	External Flooring
7	Freaming
8	Actis Hybris
9	Actis boots hybrid
10	Air gap
11	Steel profile
12	Finishing
13	Alucobond plus
14	Insulation
15	Reinforced concrete
16	Flashing
17	Draining canal
18	Delta terraxx
19	Delta-msDrain
20	Insulation
21	Delta-thene
22	primer delta-thene



To be able to construct this building we need to prepare a stronge platform as a base under the building.

Challeges:



Safety

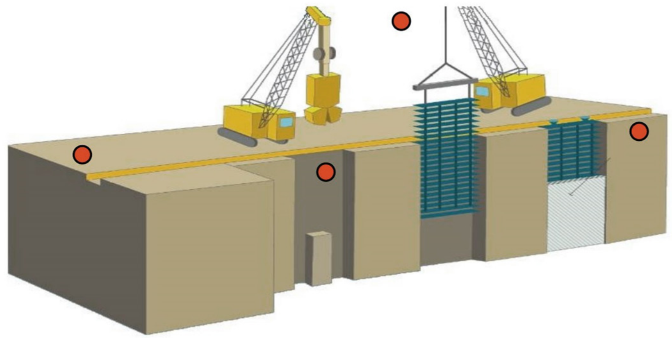
In order to have proper platform, we need to start to make Concrete walls from 40 meters below ground level, so it's extreamly important to have a safe place for worker to perform.

Underground water level

In Denmark and specially in Odense University Hospital site there is a serius issue of having mud in 4m below ground and this makes construction pretty difficult when we need to build underground and it's a big threat both for safety and co

While the most common way of building this construction is to fully excavate till -40m below ground and start to make walls whule it's followed by backfilling in steps, due to the situation of safety and ground water level, we choosed to use diaphragm walls method in below steps:

1. Building all walls of foundation with diaphragm method from below 40m from ground level.
2. Excavating until base of the building.
3. Demolition of diaphragm walls to shape base of the building.
4. Buildinga slopped walls until the ground level
5. Continue the normal construction sequence.

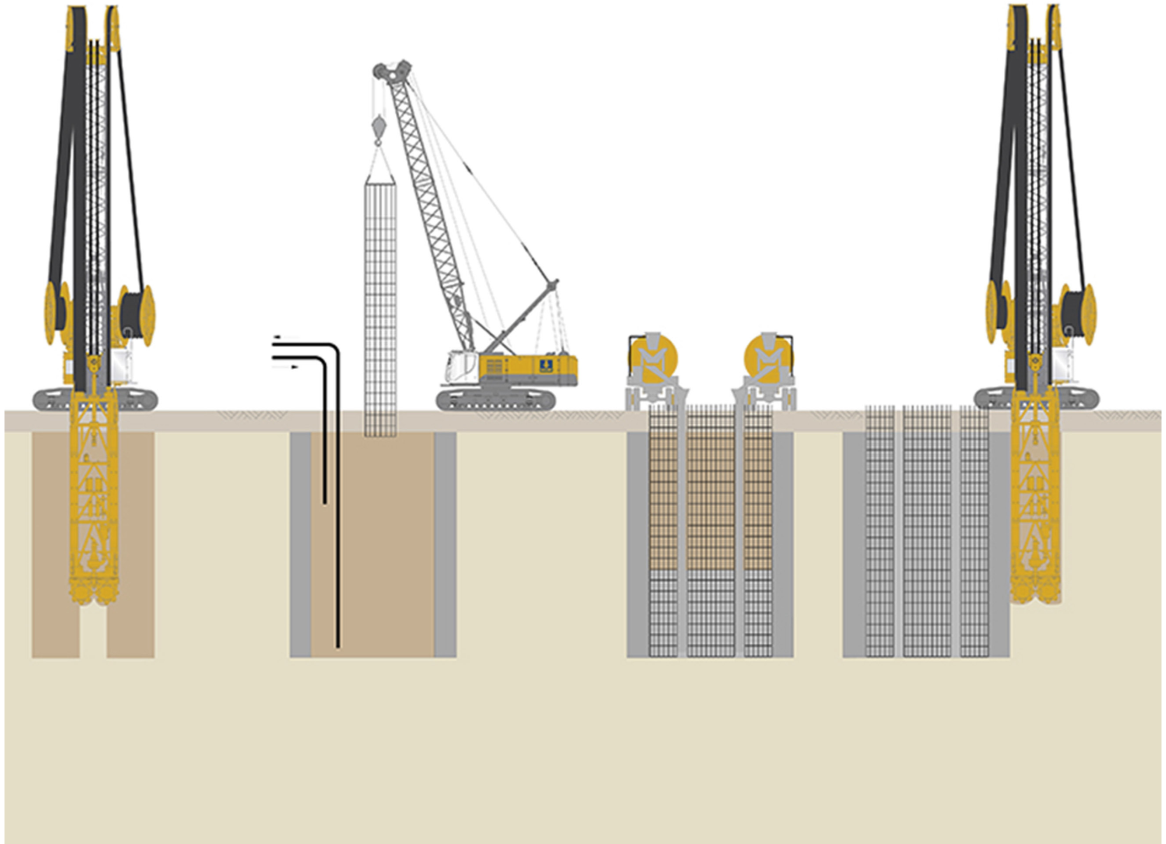


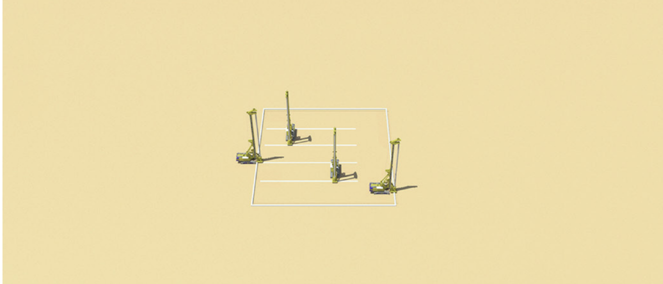
Construction sequence for diaphragm walls

Steps to build diaphragm wall:

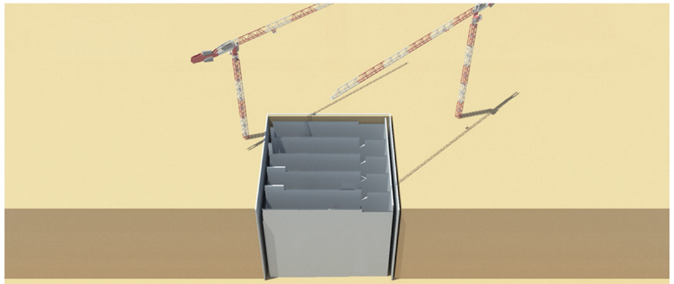
1. Excavation
2. Laying reinforcement cage
3. Casting concrete

To move faster by each crew, we build walls each every other and come back to the middle ones to avoid waiting for concrete to get dry.

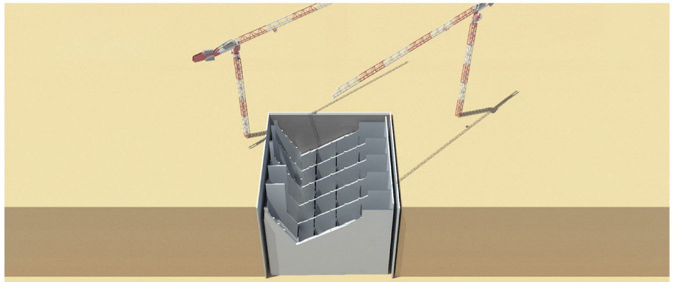




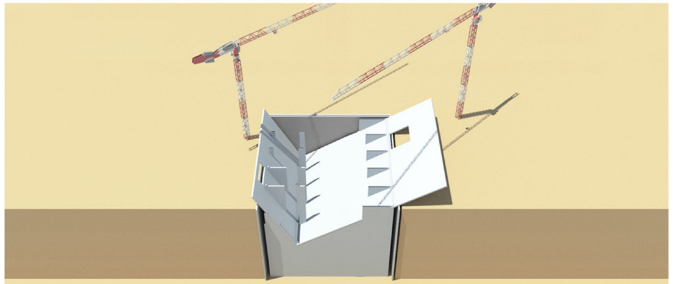
Step 1
Constructig Diaphragm walls



Step 2
Excavation until basement of building



Step 3
Parcial demolition of diaphragm walls



Step 1

WBS definition and 4D simulation for construction

Work Breakdown Structure Definition (WBS)

WBS Level 1	
Contract	
PUH	Pyrite University Hospital

WBS Level 2	
Buildings Division	
DP20n	Building DP20 North
DP20s	Building DP20 South
DPXX	All Buildings

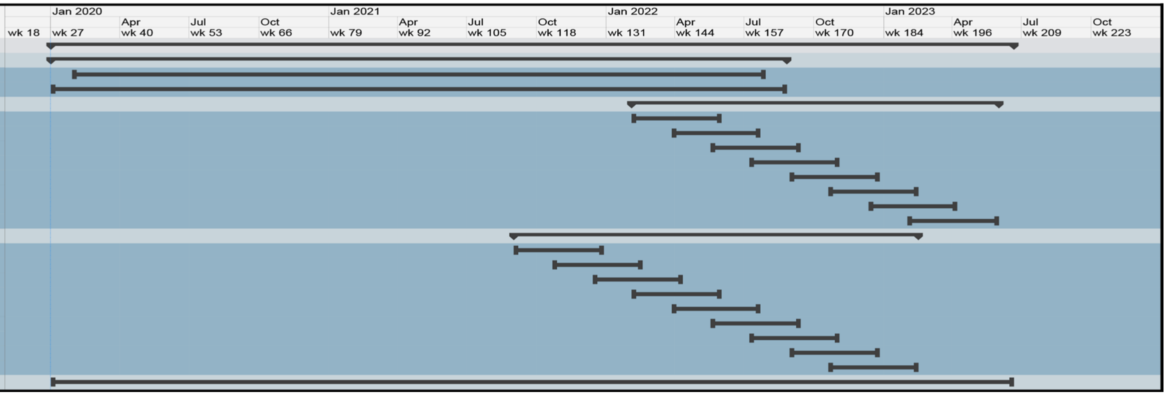
WBS Level 3	
Levels	
LFN	Level Foundation
L-3	LEVEL -3
L-2	LEVEL -2
L-1	LEVEL -1
L00	LEVEL 00
L01	LEVEL 01
L02	LEVEL 02
L03	LEVEL 03
L04	LEVEL 04
L05	LEVEL 05
L06	LEVEL 06
L07	LEVEL 07
LRO	Level Roof
L99	All Levels

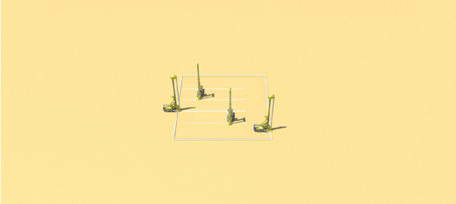
WBS Level 4	
Category of Work	
EM	Earthmoving
ST	Structure
IS	Insulation and waterproofing
AR	Architecture
BS	Building Services

WBS Level 5	
General Activities	
EM	**Earthmoving**
EM.01	Excavation
EM.02	Embankement
ST	**Structure**
ST.01	Structural walls
ST.02	Pillars
ST.03	Beams
ST.04	Slab
ST.05	Foundation Slab
ST.06	Diafragm walls
ST.07	Diagonal Structural Walls
ST.08	Demolition of Foundation
ST.09	Stairs
IS	**Insulation and Waterproofing**
IS.01	Waterproofing
IS.02	XPS Insulation Panels
AR	**Architecture**
AR.01	Partition Walls
AR.02	Doors
AR.03	External Concrete Panels
AR.04	Curtain Walls
AR.05	Pyrite Cladding
AR.06	Internal Wallcovering
AR.07	Railing
BS	**Architecture**
BS.01	HVAC Primary Distribution
BS.02	HVAC Terminals

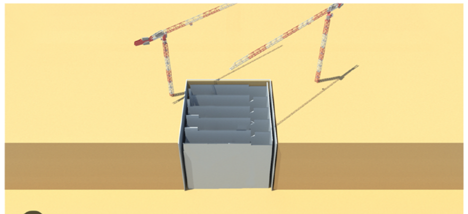
GENERAL TIME PLAN

	ID	Name	Duration	Start	Finish
1	PUH	Pyrite University Hospice	905d, 1h	01/01/20	21/06/23
2	PUH.DPXX	All Buildings	693d	01/01/20	26/08/22
3	PUH.DPXX.L99	All Levels	653d	29/01/20	29/07/22
13	PUH.DPXX.LFN	Level Foundation	693d	01/01/20	26/08/22
41	ST03140	Building DP20n	346d	03/02/22	01/06/23
42	PUH.DP20n.L00	Level 00	85d	03/02/22	01/06/22
59	PUH.DP20n.L01	Level 01	85d	28/03/22	22/07/22
76	PUH.DP20n.L02	Level 02	85d	18/05/22	13/09/22
93	PUH.DP20n.L03	Level 03	85d	08/07/22	03/11/22
109	PUH.DP20n.L04	Level 04	85d	30/08/22	26/12/22
126	PUH.DP20n.L05	Level 05	85d	20/10/22	15/02/23
143	PUH.DP20n.L06	Level 06	85d	12/12/22	07/04/23
159	PUH.DP20n.LRO	Level Roof	87d	01/02/23	01/06/23
176	PUH.DP20s	Building DP20s	381d	01/09/21	15/02/23
177	PUH.DP20s.L-3	Level -3	85d	01/09/21	28/12/21
193	PUH.DP20s.L-2	Level -2	85d	22/10/21	17/02/22
209	PUH.DP20s.L-1	Level -1	85d	14/12/21	11/04/22
225	PUH.DP20s.L00	Level 00	85d	03/02/22	01/06/22
241	PUH.DP20s.L01	Level 01	85d	28/03/22	22/07/22
258	PUH.DP20s.L02	Level 02	85d	18/05/22	13/09/22
275	PUH.DP20s.L03	Level 03	85d	08/07/22	03/11/22
292	PUH.DP20s.L04	Level 04	85d	30/08/22	26/12/22
309	PUH.DP20s.L05	Level 05	85d	20/10/22	15/02/23
325	SITE	Site Layout	905d, 1h	01/01/20	21/06/23

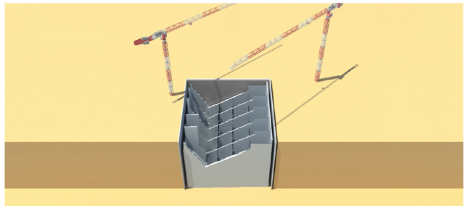




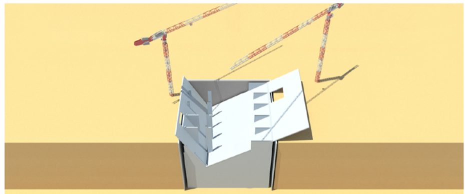
1 Diafragm walls



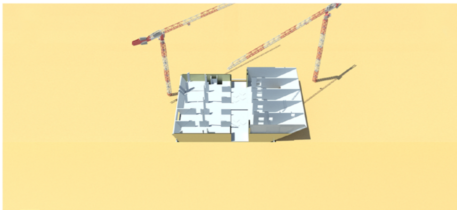
2 step by step excavation



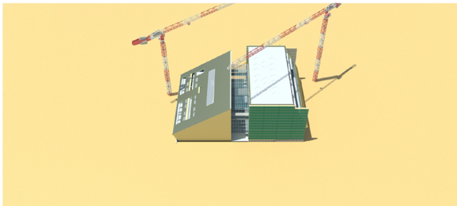
3 Partially demolition of foundation grid



4 Casting diagonal walls on foundation grid

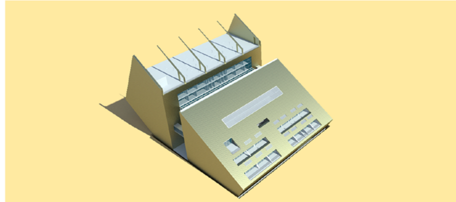


5 ongoing Structure and Facade

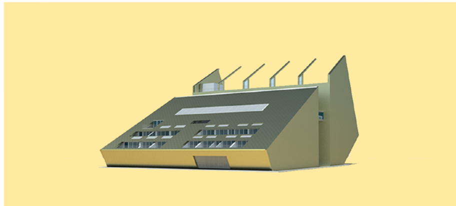


6 Ongoing Facade and interior

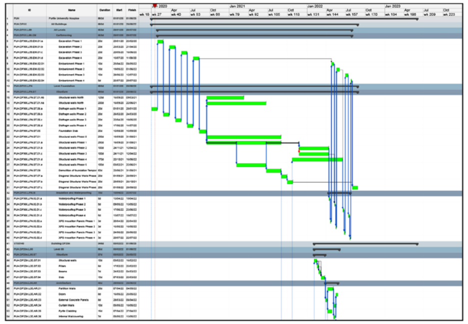
7 internal architectural parts

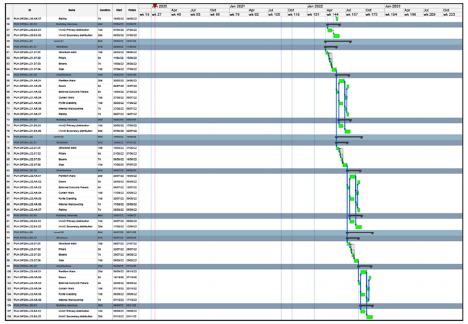


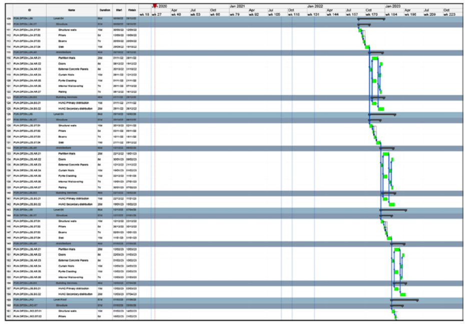
8 MEP and final architectural installations

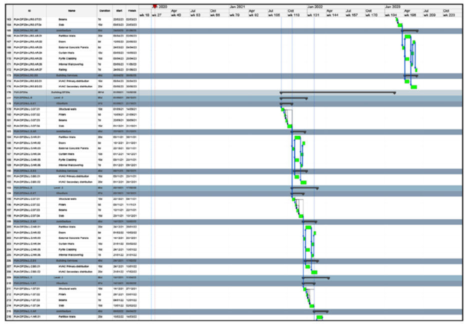


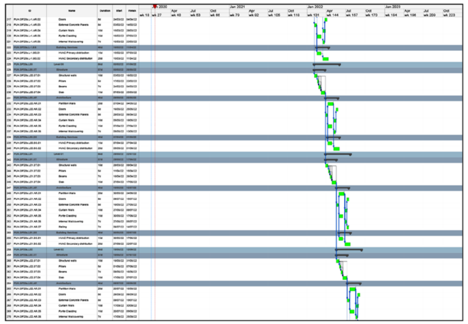
9 Completion of Construction

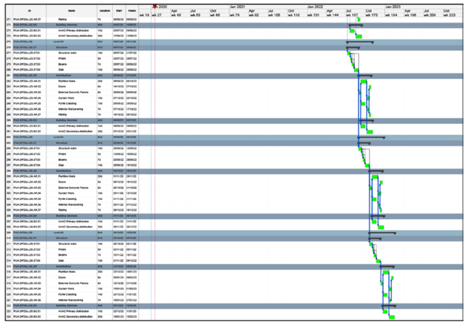


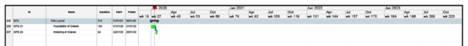












Material

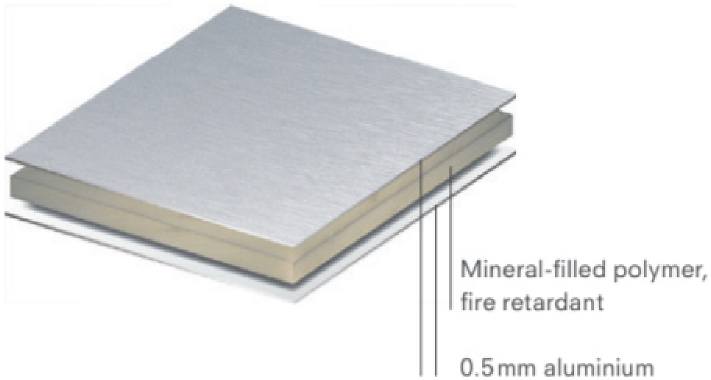
ALUCOBOND

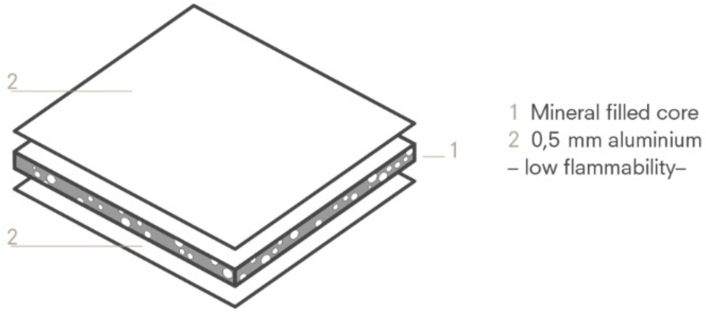
Alucobond is a composite panel consisting of two aluminium cover sheets and a fire-retardant or non-combustible mineral-filled core. The superb properties of this material boost one's inspiration and offer constructing engineers and designers a whole new range of solutions. It is the combination of formability, flatness, stability and weather resistance that characterizes this material. Due to its composite structure, alucobond can take on many different shapes. Though both stable and flat alucobond can be perfectly formed without any loss to its rigidity. Despite its low weight, which makes alucobondeasy to transport and handle in the factory and on site, its rigidity and high strength make the panels keep their shape and remain flat, even when exposed to extreme temperature changes. Alocobond convinces with a multitude of simple processing and installation options. The material can be sawn, milled, folded and bent using the standard tools of metal and façade builders. It can either be riveted or screwed on to the substructure, or else installed as a suspended cassette. On top of this, the aluminium composite panel is available in flame-retardant and non-combustible versions to meet the building's fire safety requirements of the respective country. Alucobond composite panels do not release environmentally hazardous substances at any point in their life cycle. After many years of use, they remain fully recyclable and can be returned to the material cycle. The requirements of current energy guidelines can easily be met with alucobond and a rear-ventilated façade.

alucobond.com

ALUCOBOND PLUS

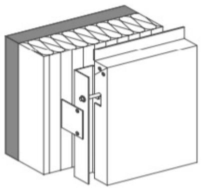
Alucobond plus has been developed exclusively for the more stringent requirements of the fire prevention regulations. Thanks to its mineral-filled, core alucobond plus meets the stricter requirements of the fire classifications. It is hardly inflammable and offers all the proven product properties of the alucobond family, such as f latness, formability, resistance to weather and easy processing. Alucobond plus is a composite panel consisting of two aluminium cover sheets and a mineral-filled polymer core. The superb properties of this material boost one's inspiration and offer architecture a whole new range of solutions – whether your project is a private home, a public building, a corporate headquarter and offices, or a trading or industrial complex – or if your organisation wants to create a new image-building Corporate Design – whether for petrol stations, car showrooms, banks or supermarkets. Alucobond even offers a multitude of application options in the Transport & Industry sector.



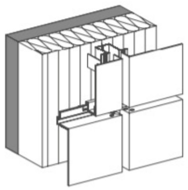


Exapmles of fixing methods

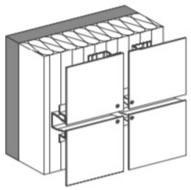
TRAY PANELS
suspended on stainless steel bolts
for vertical panel layout



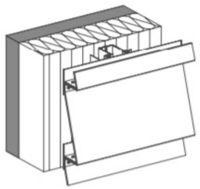
TRAY PANELS SZ 20
tongue and groove design /
horizontal panel layout



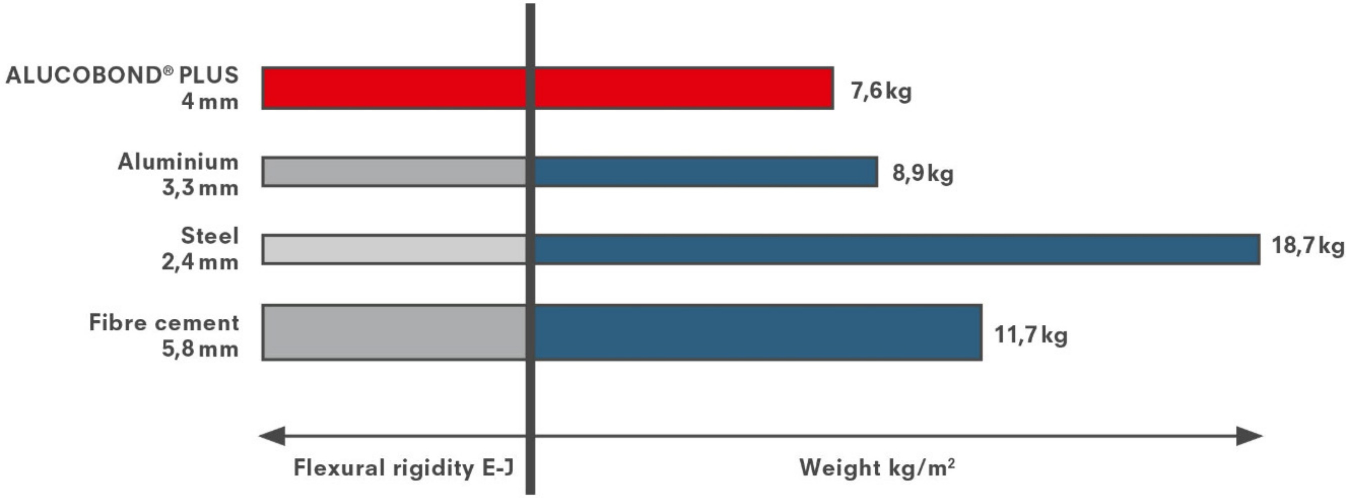
RIVETED / SCREWED
on omega carrier section for vertical
panel layout



RIVETED WEATHER BOARDING
on aluminium substructure



PRODUCT PROPERTIES



ALUCOBOND® PLUS compared with solid aluminium

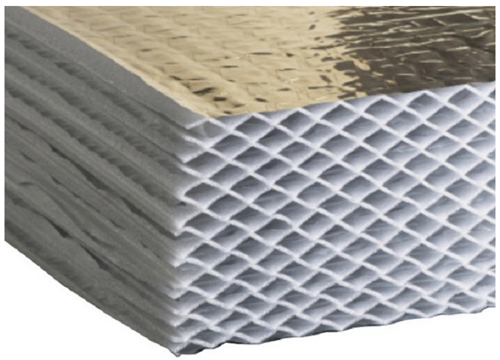
Required thickness and actual weights of panels with same rigidity

ALUCOBOND® PLUS				Aluminium	
Rigidity (E·J)	Section modulus	Thickness	Weight	Thickness	Weight
1250 kN cm^2/m	1.25 cm^3/m	3 mm	5.9 kg/m^2	2.7 mm	7.3 kg/m^2
2400 kN cm^2/m	1.75 cm^3/m	4 mm	7.6 kg/m^2	3.3 mm	8.9 kg/m^2

ACTIS HYBRIS INSULATION

HYBRIS is an honeycomb insulation which ensures winter and summer thermal insulation, acoustic insulation and air tightness of buildings. Its high thermal performance is certified by LABC.
HYBRIS offers durable insulation as it does not slump down. Its components are healthy, respectful of indoor air, without irritating fibers. It is very light and pleasant to install.
HYBRIS is intrinsically airtight, stopping air infltration from the outside and heat loss through convection from the inside.
HYBRIS' external coppercoloured layer is a certifed vapour control layer (Sd > 90m, Z = 450 MNs/g) and is intrinsically resistant to vapour.
HYBRIS is resistant to air infltration; it can efectively control noise and provide sound insulation. A masonry wall with 125mm HYBRIS installed can achieve Rw (C; Ctr)> = 67.7 (-2; -4) dB.
HYBRIS is also easy to store and source with a nationwide distribution.
HYBRIS is an innovative insulation material for timber frame or masonry walls, pitched roofs, ceiling and suspended timber foor applications.
HYBRIS is available in panels of 1145mm x 1200mm and in a range of thicknesses from 50mm to 205mm. HYBRIS is easily installed between rafters, timber studs or within foor joists. It accurately fts all widths, held in place by compression. Hybris is also durable and doesn't slump down over time. HYBRIS is light weight, less than 9.5kg/m3, thus easy to store and transport.

HYBRIS signifcantly reduces building energy consumption while providing maximum comfort. With a core declared thermal conductivity (λD) as low as 0.033 W/mK, HYBRIS provides a thermal resistance as high as 6.20 m2 K/W for 205mm. Easily recognisable HYBRIS has a copper-coloured internal face with a very low emmissivity of 0.06 (external face e = 0.10). With an air gap on either side HYBRIS can reach a total thermal resistance as high as 7.05 m2K/W for 205mm in a roof application. HYBRIS is classifed A+ for internal air quality according to ISO 16000 and is clean to use so doesn't generate dust or fbre while cutting or installing. TIME SAVING HYBRIS reduces the installation time without changing installation procedures. HYBRIS is easy to cut with an insulation saw, standard hand saw or an electric alligator saw if preferred. HYBRIS will 'friction ft', no additional fxing is required.



THERMAL PERFORMANCES

		ROOF	WALL
THICKNESSES	CORE THERMAL RESISTANCE	WITH TWO AIR GAPS	WITH ONE AIR GAP
50 mm	**1.50**	2.35	2.10
60 mm	**1.80**	2.65	2.40
75 mm	**2.25**	3.10	2.85
90 mm	**2.70**	3.55	3.30
105 mm	**3.15**	4.00	3.75
125 mm	**3.75**	4.60	4.35
140 mm	**4.20**	5.05	4.80
155 mm	**4.65**	5.50	5.25
170 mm	**5.15**	6.00	5.75
185 mm	**5.60**	6.45	6.20
195 mm	**5.90**	6.75	6.50
205 mm	**6.20**	7.05	6.80

PROPERTY	TEST METHOD	DECLARED VALUE
Thickness	EN 823	**50** to **205mm**
Weight/m³	EN 1602	9.5 kg/m³
Length	EN 822	1200mm
Width		1145mm
DECLARED THERMAL PERFORMANCE		
Thermal conductivity λ_o	EN 16012	**0.033 W/m.K**
Declared core thermal resistance		**1.50 m2.K/W (50mm) to 6.20 m2.K/W (205mm)**
Emissivity (inner/outer) after ageing		**0.06/0.10**
TENSILE STRENGTH (BEFORE AND AFTER AGEING)		
Longitudinal direction	EN 1608	>45 kPa
Transversal direction		>45 kPa
RESISTANCE TO TEARING, NAIL SHANK (BEFORE AND AFTER AGEING)		
Longitudinal direction	EN 12310-1 part 1	>150 N
Transversal direction		>150 N
WATER VAPOUR TRANSMISSION		
Permeability (W)	EN 1931	<2,3 E-12 Kg/m².s.Pa
Vapour Resistance (Z)		450 MNs/g
Diffusion eq.air layer thickness (Sd)		>90m
WATERTIGHTNESS	EN 1928 Method A	Watertight, W1
AIR PERMEABILITY	EN 12114	Airtight
HEAT CAPACITY	2300 JK/Kg.k	
REACTION TO FIRE	NPD (No performance determined)	

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