VIA UNIVERSITY COLLEGE

Differences in the construction between Denmark and Spain

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Dissertation 7 semester BATCOM

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1.1 BACKGROUND INFORMATION AND PRESENTATION OF THE SUBJECT

This is a compulsory dissertation of the 7th semester in the Bachelor of Architectural Technology and Construction Management education in VIA University College in Horsens, Denmark. The main topic of this report is going to be the difference in the way of building between Denmark and Spain.

The information has been researched by looking for Internet, doing interviews, library books and also from notes that had been taken during my studies in Spain.

Special thanks to Benny Leon Olsen, for being so patient with me and provide me the information due to his experience to accomplish my report. Also to Vidar and Mapi who helped me to know the main aspects in the construction in the countries.

1.2 REASONS FOR CHOICE OF ELECTIVE – PROFESSIONAL RELEVANCE

Why did I choose to talk about the construction in these two different countries?

I chose this topic because I'm Spanish and I was studying Technical Architecture in the Universidad Politécnica de Valencia but after being here in VIA University College I will get the double diploma in Construction Management. So I think it is completely necessary to know how to build in both countries.

I feel that is very important to know about the culture in the place you live, moreover if it is a possibility to me to work here as a Constructor manager and is my liability to create comfortable places to be for everyone.

Besides it is also to compare how to building both countries cause maybe we can incorporate techniques or construction material from one country to the other one.

1.3 PROBLEM STATEMENT – RESEARCH QUESTIONS

The main question I ask to myself is:

Is the construction in Denmark different to the Spanish one?
In a first sight we could answer, yes it is, but this state takes you directly to the second question to do, **why?**

So that is what I'm going to do in this report, explain why is different, which factors make buildings to be different here and there and since then.

I will also focus on the management of the building site with examples of both countries which is going to answer the 3rd main question, **how are organized the phases in the building site?** I will answer to this explaining the time that we spend constructing, a phase, how many workers do we need, the money that it costs, the materials used on it, the necessary equipment. So those answers, will conform the shorter questions attached to the main one.

1.4 DELIMITATION

The most important delimitation is that I won't write about other countries apart from Spain and Denmark.

The contents about the differences in the management will be focused in two building sites. The Danish one is located in Vestergade 30-38, 8700 Horsens the city I live nowadays.

The Spanish one is located in Valencia, the city I come from, between the streets Igancio Hervás and Barraques de Llacer.

This explains that I won't write about other building site's management.

Moreover, I won't write neither about design, and other specific subjects concerning to architects more than constructing managers.

1.4.2 KEY WORDS

Building in Denmark and building in Spain

Foundation and excavation

Prefabricated concrete elements, driven piles, slurry wall, coronation beam and anchors

Reinforced and corrugated steel

Topography, climate and population

The ages in the history of architececture as: Baroque, Neoclacissim or Modernism

Renewable energies: solar, hydropower, wind power, tidal or biomass.

1.5 CHOICE OF THEORICAL BASIS

I will do a research based on internet, notes from the lessons and university library to look for the main differences between both countries considering how is the country, the natural resources and the weather, renewable energies, as well as to investigate about how to build, also to explore about the most famous architects in both countries

and their buildings and at last to search some important building companies in both countries.

I will do some interviews to investigate about how to work in a real building site in Spain and also in Denmark.

1.6 CHOICE OF RESEARCH METHOD

I will use basically a secondary research, where I will look for quantitative and qualitative data. The secondary research means that I will look for information already given or written, like on the internet. I'm going to find exactly data, which imply the quantitative data, like dates, definite buildings and comparisons about both countries in the weather, the altitude or the amount of the population.

I will also find some qualitative data due to the primary research which means that I will investigate by my own, for example I will do interviews to the constructor manager in a site in Valencia, Spain and in Horsens, Denmark, and those answers will form the qualitative data.

1.7 OVERALL

In this dissertation I will focus on the differences between the way of building in Spain and in Denmark. By doing so, I will try to answer this main question that involves the whole dissertation:

What is different between the construction in Spain and in Denmark?

These will be the research questions, which will answer the main question:

1. Which are the differences in the geography, weather and population between Denmark and Spain?

2. Which are the differences in the buildings on a first sight? Do we have similarities?

3. What the story tells us about the construction in both countries?

4. How can we use wisely the weather?

5. How do we build in both countries?

1. WHICH ARE THE DIFFERENCES IN THE TOPOGRAPHY, WEATHER AND POPULATION BETWEEN DENMARK AND SPAIN?

TOPOGRAPHY IN SPAIN

Spain is a country located in southwestern Europe, occupying most of the Iberian Peninsula, the Balearic Islands in the Mediterranean, the Canary Islands in the Western Atlantic Ocean over 108 km off northwest Africa, and five places of sovereignty on and off the coast of north Africa: Ceuta, Melilla, Islas Chafarinas, Peñón de Alhucemas, and Peñón de Vélez de la Gomera.

The Spanish mainland is bordered to the south and east almost entirely by the Mediterranean Sea and to the west by the Atlantic Ocean and Portugal.

With an area of 504,030 km², Spain is the second largest country in Western Europe and with an average altitude of 650 m, the second highest country in Europe.

Its total area is 504,782 km2 of which 499,542 km2 is land and 5,240 km2 is water.

Atlantic coast is 710 km long. The Pyrenees mountains extends 435 km from the Mediterranean to the Bay of Biscay.

The Meseta Central is a vast plateau in the heart of peninsular Spain, which has elevations by mountains from 610 to 760 m high.

The Sistema Central, described as the "dorsal spine" of the Meseta Central, divides the Meseta into northern and southern subregions. The Sistema Central shows its highest mountain, Pico Almanzor, of 2,592 m. The mountains of the Sistema Central, which continue to Portugal, display some glacial features; the highest of the peaks are snow-capped for most of the year. Despite their height, however, the mountain system does not create a major barrier between the northern and the southern portions of the Meseta Central because several passes permit road and railroad transportation to the northwest and the northeast.

The southern portion of the Meseta is further divided by twin mountain ranges, the Montes de Toledo running to the east with the Sierra de Guadalupe, to the west. Their peaks do not rise much higher than 1,500 m. With many easy passes, including those that connect the Meseta with the Andalusian Plain, the Montes de Toledo do not present an obstacle to transportation and communication. This chain of lower mountain ranges is separated from the Sistema Central to the north by the longest river in the Iberian Peninsula: the Tagus (Tajo) River.

Forming the southern edge of the Meseta Central, the Sierra Morena merges in the east with the southern extension of the Sistema Iberico and reaches westward along the northern edge of the Rio Guadalquivir valley to join the mountains in southern Portugal.

The massif of the Sierra Morena extends northward to the Río Guadiana, which separates it from the Sistema Central with a maximum height of 1,300 m.

The Cordillera Cantábrica, a limestone formation, runs parallel to, and close to, the northern coast near the Bay of Biscay. Its highest points are the Picos de Europa, surpassing 2,600 m. The Cordillera Cantábrica extends 182 km and abruptly drops 1,500 m some 30 km from the coast.

The Sistema Ibérico extends from the Cordillera Cantábrica and, close to the Mediterranean, spreads out from the Río Ebro to the Río Júcar. The slopes of this mountain range cover an area of close to 21,000 square kilometers. The mountains reach a maximum height of over 2,300 m east of the headwaters of the Rio Duero.

The Pyrenees, extending from the eastern edge of the Cordillera Cantábrica to the Mediterranean Sea, form a solid barrier and a natural border between Spain and both France and Andorra that, throughout history, has effectively isolated the countries from each other. Passage is easy in the relatively low terrain at the eastern and western extremes of the mountain range; it is here that international railroads and roadways cross the border. In the central section of the Pyrenees, however, passage is difficult. In several places, peaks rise above 3,000 m, the highest, Pico de Aneto, surpasses 3,400 m.

The Sistema Penibético extends northeast from the southern tip of Spain, running parallel to the coast until it merges with the southern extension of the Sistema Ibérico near the Rio Júcar and with the eastern extension of the Sierra Morena. The Sierra Nevada, part of the Sistema Penibético south of Granada, includes the highest mountain on the peninsula and continental Spain, Mulhacén, which rises to 3,479 m. Other peaks in the range also surpass 3,000 m.

The islands of Spain are the Balearic and the Canary Islands, located in the Mediterranean Sea and the in the Atlantic Ocean respectively. The Balearic Islands form a total area of 5,000 square kilometers.

The Canary Islands have a volcanic origin. Tenerife and Gran Canaria, have the highest peaks. Pico de Las Nieves, on Gran Canaria, rises to 1,949 meters, and the Teide, on Tenerife, to 3,718 meters. Teide, a volcano, is the highest peak of Spain and the third largest volcano in the world from its base.

From the 1,800 rivers and streams in Spain, only the Tagus is more than 960 kilometers long. The river with the most abundant flow in Spain is the Ebro, which flows eastward to the Mediterranean. Rivers in the extreme northwest drain directly into the Atlantic Ocean. The northwestern coastline is also truncated by rias, waterbodies similar to fjords.

Certain Spanish regions can be considered vulnerable to both flooding and erosion like Valencia and Murcia.

Water lack, threats the most of Spain. Water scarcity is a significant issue in many regions throughout Spain and climate change may aggravate the problem, with longer

periods of dry weather. Overall, the regions in the south-east of Spain are particularly vulnerable to water shortages. Furthermore, large areas of the Mediterranean are affected by saltwater intrusion.

Figure 1. Topographic map of Spain

WEATHER IN SPAIN

Three main climatic zones can be separated, according to geographical situation and orographic conditions:

- The Mediterranean climate, characterized by dry and warm summers, it is dominant in the peninsula.
- The semiarid climate, located in the southeastern quarter of the country, especially in the region of Murcia and in the Ebro valley. In contrast with the Mediterranean climate, the dry season extends beyond the summer.
- The oceanic climate, is located in the northern quarter of the country, especially in the regions of Basque Country, Asturias, Cantabria and Galicia. In contrary to the Mediterranean climate, winter and summer temperatures are influenced by the ocean.

Apart from these main types, other sub-types can be found, like the alpine climate in the Pyrenees and Sierra Nevada, and a typical subtropical climate in the Canary Islands.

POPULATION IN SPAIN

The total population in Spain in 2010 by the municipality was formed by 47,150,819 inhabitants. Madrid is the capital city of the country with an amount of population of 3,3 million people. The second biggest city in Spain is Barcelona with 1,5 approximately inhabitants and the third one is Valencia with almost 800,000 inhabitants what means a big decrease if population from this third one to the following cities.

TOPOGRAPHY IN DENMARK

Denmark is a Nordic country located in Northern Europe. It consists of the Jutland peninsula and several islands in the Baltic Sea. Denmark is located southwest of Sweden and south of Norway and is bordered by the Germany to the south.

Most of Denmark is surrounded by coast, about 7,314 km shore. Denmark has 443 named islands, of which 72 are inhabited.

The local terrain is generally flat with a few gently rolling plains. The territory of Denmark includes the island of Bornholm in the Baltic Sea and the rest of metropolitan Denmark, but excludes the Faroe Islands and Greenland. Its position gives Denmark complete control of the Danish Straits (Skagerrak and Kattegat) linking Baltic and North Seas. The country's natural resources include petroleum, natural gas, fish, salt, limestone, stone, gravel and sand.

The country of Denmark is overall flat, the highest point is Møllehøj which reaches 171 m, and the lowest point is -7 m in Lammefjord. What means that Denmark is a really windy country.

The Kingdom of Denmark is a unitary state that comprises, in addition to Denmark proper, two autonomous constituent countries in the North Atlantic Ocean, Greenland and the Faroe Islands. They have been integrated parts of the Danish Realm since the 18th century, however, due to their separate historical and cultural identities, these parts of the Realm have extensive autonomy and have assumed legislative and administrative responsibility in a substantial number of fields. The Faroe Islands gained home rule in 1948 and Greenland in 1979, having previously had the status of counties.

Figure 2. Topographic map of Denmark

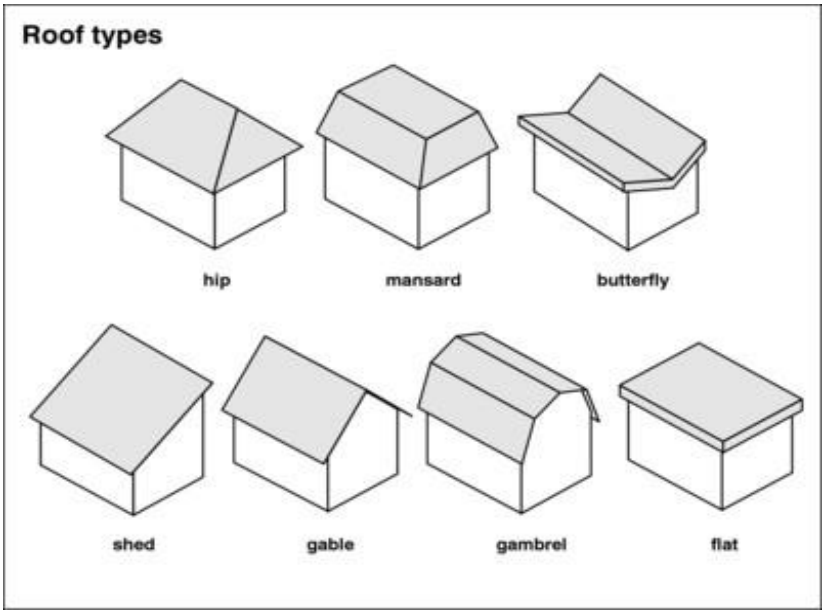
WEATHER IN DENMARK

Denmark has a temperate climate, characterised by mild winters, with mean temperatures in January and February of 0.0 °C, and cool summers, with a mean temperature in August of 15.7 °C. Denmark has an average of 121 days per year with precipitation, on average receiving a total of 712 millimetres per year, autumn is the wettest season and spring the driest.

Because of Denmark's northern location, there are large seasonal variations in daylight. There are short days during the winter with sunrise coming around 8:45 am and sunset 3:45 pm (standard time), as well as long summer days with sunrise at 4:30 am and sunset at 10 pm.

POPULATION IN DENMARK

In 2012 Denmark had a population of 5,543,453. About a quarter of Danes live in the capital city Copenhagen, with an urban population of 1,246,611 is the second largest in Scandinavia. The area and populations of the regions vary widely; for example, the Capital Region, which encompasses the Copenhagen metropolitan area and the



island of Bornholm, has a population three times larger than that of North Denmark Region, which covers the more sparsely populated area of northern Jutland.

Aarhus is the second largest city in Denmark and the country's main port. It is located on the east coast of the Jutland peninsula in the geographical centre of Denmark. The city has a population of 259,754 inhabitants.

2. WHICH ARE THE DIFFERENCES IN THE BUILDINGS ON A FIRST SIGHT? DO WE HAVE SIMILARITIES?

On a first sight, the main difference I could say about the buildings in both countries could be the high. In Spain we are used to build dwelling buildings about seven or eight floors each one, nowadays we can even build 20 floors edifications as a common use.

Figure 3. Herlev hospital

On the other hand, Denmark has also tall buildings as Herlev Hospital the tallest one with 120 m high in Herlev, near the capital city.

Anyway, living in the city of Horsens we can't find buildings taller the three or four floor each one.

The second main difference on a first sigh in the buildings between Spain and Denmark is the kind of roofs.

The most of the buildings in Spain have a flat roof while in denamrk I can see most of them with gable roof.

This difference has completely sense, because we build roofs to protect the edifications of the inclemency of the weather. And as I said at the first main question's answer Denmark has an average of 121 days per year with precipitation

which means 1/3 of the year raining. A roof with slopes helps the water to go out of the building better than a flat one.

And not only in Denmark, but also in the north of Spain rains a lot and that is why the buildings are more similar to the buildings I could see here.

What is more, about the differences between both countries, in Spain we usually erect them with a parking in the same building. We are used to have at least 1 floor of parking, but in many cases we arrive until 4 floors under the ground. However in Denmark we can find normally parkings outside the building and a small building of storage which is often used to keep the bikes that they use every day.

Moreover there is another big important difference between the buildings to study. Windows in Denmark are composed by several crystals at least two, when in Spain as maximum we use two only crystals in only one window.

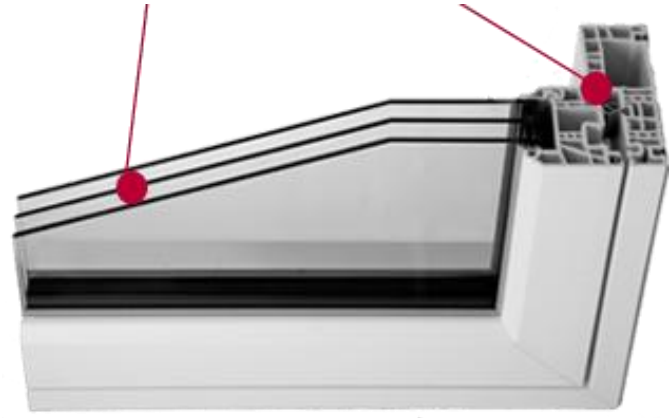


Figure 5. Windows in Denmark

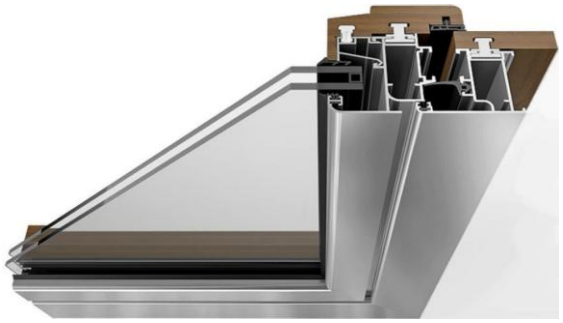


Figure 6. Windows in Spain

Comparing the pictures apart from the double camera which gives more insulation to the room, we can advert that the frame is also different and I could say that the Danish one is thicker that the Spanish one, protecting even more from the outside weather.

Is a really relevant difference because in Spain we usually spend more time being out from home, and until I know Danish love to spend the free time in family at home. What is more, in Spain we have a lot of buildings with terraces and swimming pools in the inside of them while in Denmark I could only see spaces inside the buildings with benches or even terraces in the roof top but they are used only during the summer due to the weather.

Figure 9. Finca roja with an interior park

Figure 8. Inside building swimming pool

To continue listing differences I realized than in Denmark when they build saving money, one of the savings is not build a main door as in Spain do, the building is a block with the door which goes directly to the flat. Otherwise in Spain, we do a big building with a main door which takes you to a common space and this one to the stairs and the elevator.

Besides almost all the new dwelling building I see in Denmark they have the facades made by bricks instead concrete walls covered by monolayer paintings. Anyways depending on the zone of Spain we can find many bricks facades buildings. In addition to this, in the south part of Spain there are many towns with white painting covering the facades due to not to help the absorption of the sunbeams.

The last difference I would like to write about is the quantity of insulation. Of course it depends also in weather, is not the same to insulate temperatures within several months which arrange to minus x degrees. So insulations in Denmark as we studied in the fifth semester could be about eight centimeters wide while in Spain they put only the half of that, just four centimeters.

3. WHAT THE STORY TELLS US ABOUT THE CONSTRUCTION IN BOTH COUNTRIES?

DANISH HISTORY

The earliest traces of Danish architecture have been found through excavations of the **Viking Ages** from around 1,000 AD. The conversion to Christianity around 960 introduced to Denmark a new building culture: church building. The fisrts churches were built in wood but when first **Romanesque** appeared it changed to stone churches about the twelfth and thirteenth century, as the church of Our Lady in the picture.

Towards the end of the 13th century and until about 1500, the **Gothic style** became the norm with the result that most of the older Romanesque churches were rebuilt or

adapted to the Gothic style in the fifteenth century. It was during this period that, in a country with little access to stone, brick became the construction material of choice, not just for churches but also for fortifications and castles. Although most Gothic architecture in Denmark is to be found in churches and monasteries, there are examples in the secular field too as Glimmingehus.

Under the influence of Frederick II and Christian IV, both of whom had been inspired by the castles of France, Dutch and Flemish designers were brought to Denmark, initially to improve the country's fortifications, but increasingly to build magnificent royal castles and palaces in the Renaissance style. By the same time, the **half-timbered style** became popular for ordinary dwellings in towns and villages across the country. One of the oldest in Denmark is Anne Hvides Gård, a two-storeyed townhousein Svendborg which was constructed in 1560.

During the **Reinassance**, Dansih architecture was dominated by the building of manor houses such as the sixteenth century. Among the royal buildings of the period, Kronborg Castle was completed in 1585 while the Frederiksborg Castle was built bweteen 1602 and 1620 and is the largest Renaissance palace in Scandinavia. In both castles the architecture was the preferred Dutch reinassance

style with sandstone on red brick background. In 1614, Christian IV began to work on the construction of the then Danish Kristianstad in Scania, now in the south of Sweden, completing many of its buildings in the Renaissance style.

Particularly impressive is the Church of the Trinity erected between 1618 and 1628.Christian IV also initiated a number of projects in Norway that were largely based on Renaissance architecture.

While stone buildings became more and more common as town houses, farms continued to be half-timbered, sometimes in conjunction with a single stone house. Ordinary people continued to live in half-timbered houses.

Late in his reign, Christian IV also became an early proponent of **Baroque** which was to continue for a considerable time with many impressive buildings both in the capital and the provinces. As during the Renaissance period, the Baroque one was again principally Dutch influenced, although many of the features originated in Italy and France. Symmetry and regularity were primary concerns. The Baroque style influenced Danish architecture from modest town houses to Royals building projects.

The main Danish Baroque buildings include the Church of Our Saviour in Copenhagen from 1682 to 1696 although Charlottenborg (1672–83), on Kongens Nytorv in the centre of Copenhagen, is said to be the most important pure Baroque building remaining in Denmark. Several other mansion houses in Denmark have been based on its design.

Nyhavn Canal was designed to become Copenhagen's new harbour by a Ducth engineer. It was not, however, until 1670 when it was completed the work. Over the next few years, numerous town houses were built along the northern or sunny side of the canal. The oldest, Number 9, was completed in 1681.

Following on closely from the Baroque period, **Rococo** came into fashion in the 1740s. Nicolai Eigtved became the main character in Rococo style in Denmark. His principal achievement was the laying-out of the Frederikstaad in Copenhagen in 1749. This quarter was organised around the octogonal square surrounded by

the four Amalienborg palaces. The finest outcomes are the Amalienborg Palace complex, Frederik's ChurchI n its immediate vicinity and Frederiks Hospital.

Neoclassicism came initially from France but was slowly adopted by native Danish architects who increasingly participated in defining architectural style inspired by ancient Rome and Greece.

Caspar Frederik Harsdorff, turned out to be Denmark's most prominent eighteenth century architect and is known as the Father of Danish Classicism. He undertook a considerable amount of redesign work, including work on the Royal Theatre 1774 where he introduced a classical temple style with a wide entrance and large hall.

After Eigtved's death another architect had to continue the work on the main monument of the Frederiksstad, the Cathedral. The idea developed towards a considerably more severe classical style dominated by clean and simple forms, the **Classicism**. From 1800, Christian Frederik Hansen was in charge of all major building projects in Copenhage, including the city hall, the Church of Our Lady in 1826 and the new Christiansborg palace from 1829 which was burnt in 1794. But unfortunately, it was burn again in 1884.

A productive period of **Historicism** ultimately merged into the 19th century style. With the arrival of Historicism in the second half of the nineteenth

century, special importance was attached to high standards of craftsmanship and proper use of materials. This can be seen in Copenhagen's University Library, 1861.

Ferdinand Meldahl, also a main archictect of the Historicism, completed the reconstruction of Frederiksborg Palace after the fire in 1859 and designed the Parliament Building in Reykjavík, Iceland, at that time a Danish colony. However,his greatest achievement was, the completion of Frederik's Church in Copenhagen.

The trend of using high standards of craftsmanship as well as truth and honesty to materials was developed into **National romanticism**, which found its main expression in Copenhagen City Hall from 1905.

Earlier in the twentieth century, the Council for Design Assistance had been established and their aim was to provide guidance to the population, so that good and healthy family houses keeping the Danish architectural tradition would be built all over the country. **Nordic Classicism** continued to the beginning of the century until about 1930. While the movement had its greatest level of success in Sweden, there were a number of other important Danish proponents: Bentsen, with the assistance of Thorkild Henningsen, designed Denmark's first terraced houses in the Bellahøj, district of Copenhagen. Very appropriately Klint, working with Bentsen, adapted the design of Frederiks Hospital to serve as the Danish Museum of Art & Design. Carl Petersen's main achievement was the Faaborg Museum built for collections of art from Funen. Steen Rasmussen is remembered above all for his town planning activities and for his contributions to the Dansk Byplanlaboratorium.

Functionalism, which began in the 1930s, relied on rational architecture making use of concrete, iron and glass, preferably to meet social needs. One of Jacobsen's masterpieces was the Aarhus City Hall which he designed together with Erik Møller in 1937 and completed in 1948.

It was not until the 1960s that Danish architects entered the world scene with their highly successful **Modernism.** This has evolved into more recent world-class masterpieces such as the Sydney Opera House and the Great Belt Bridge paving the way for a number of Danish designers to be rewarded for excellence both at home and abroad.

Due to its historical and geographical diversity, Spanish architecture has drawn from a host of influences. Iberian architecture started to take shape in parallel with other architectures around the Mediterranean and others from Northern Europe. In the Stone Age, the most expanded megalith in the Iberian Peninsula was the dolmen.

The most characteristic constructions of the **Celts** were the Castros, villages usually on the top of hills or mountains. They were developed at the areas occupied by the Celts in the Duero valley and in Galicia.

The Roman Empire conquest of Hispania started in 218 BC. Roman culture was deeply assumed by local population, military camps and Iberian, Phoenician and Greek settlements were transformed in large cities where urbanization highly developed in the provinces. Civil engineering represented in imposing constructions like the Aqueduct of Segovia, architecture is represented by such buildings as the theaters, like in Merida, circuses, temples, funerary monuments and Arches of the Triumph that we can visit nowadays.

The term **Pre-Romanesque** refers to the Christian art after the Classical Age and before Romanesque art and architecture. Spanish territory has a rich variety of Pre-Romanesque architecture.

The kingdom of Asturias arose in 718. **Asturian Pre-Romanesque** is a singular feature in all Spain, which, while combining elements from other styles as Visigothic and local traditions, created and developed its own personality and characteristics, reaching a considerable level of refinement, not only as regards construction, but also in terms of aesthetics. Its most important church is San Julián de los Prados, in Oviedo but the Holy Chamber of the Cathedral of Oviedo, San Pedro de Nora and Santa María de Bendones also belong to it.

The **Moorish** conquest of the former Hispania and established his capital city in Córdoba. It was to become the cultural capital of Occident from 750 to 1009. The architecture built in Al-Ándalus couldn't have been imagined by the European kingdoms of the era. The most outstanding construction is in Córdoba the Great Mosque, built in consecutive stages. The Caliphate disappeared and was split into several small kingdoms called Taifas. The Almoravids invaded Al-Andalus from north Africa in 1086, and unified the taifas under their power,they also imposed Islamic ultra orthodox and destroyed almost every significant Almoravid building. The best known piece of Almohad architecture is the Giralda, the former minaret of the Mosque of Seville. The synagogue of Santa María la Blanca, in Toledo, is a rare example of architectural collaboration between the three cultures of Medieval Spain.

After the dissolution of the Almohad Empire, the scattered Moorish kingdoms of the south of the Peninsula were reorganized, and in 1237, was established their capital city in Granada. The architecture they produced was to be one of the richest produced by Islam in any period. The palaces of Alhambra and the Generalife are the most outstanding constructions of the period.

Romanesque first developed in Spain in the tenth and eleventh centuries, simultaneously with the north of Italy, as what is called "First Romanesque" or "Lombard Romanesque". It is a very primitive style, whose characteristics are thick walls, lack of sculpture and the presence of rhythmic ornamental arches.

The full Romanesque architecture arrived with the influence of Cluny through the Way of Saint James, which ends in the Cathedral of Santiago de Compostela. Spanish Romanesque also shows the influence of Spanish pre-Romanesque styles, mainly Asturian and Mozarabic. In the thirteenth century, some churches alternated in style between Romanesque and Gothic.

The **Gothic style** arrived in Spain as a result of European influence in the 12th century when late Romanesque alternated with a few expressions of pure Gothic architecture like the Cathedral of Ávila. The High Gothic arrived in all its strength in the 13th century, with some of the purest Gothic cathedrals, with German and French influence: the cathedrals of Burgos, León and Toledo. The most important Gothic styles in Spain are the Levantino and Isabelline Gothic. Levantino Gothic is characterised by its structural achievements and their unification of space, with masterpieces as La Seu in Palma de Mallorca, Valencia's silk market, and Santa María del Mar in Barcelona.

In Spain, **Renaissance** began in the last decades of the 15th century. The style started to spread by local architects, which are the cause of the creation of a specifically Spanish Renaissance that brought the influence of South Italian architecture, sometimes from illuminated books and paintings and mixed with gothic tradition. As decad es passed, the gothic influence disappeared and the research of the classicism reached high levels. The highlight of Spanish Renaissance is represented by the Royal Monastery of El Escorial. The symbolism of the scarce decoration and the precise granite cut were established as the basis of a new style that would influence Spanish architecture for a century.

In contrast to the art of Northern Europe, the Spanish art of the **Barroque** appealed to the emotions rather than seeking to please the intellect. The Churriguera family, which specialized in designing altars and retables, revolted against the sobriety of the Herreresque classicism and promoted an intricate, exaggerated, almost capricious style of surface decoration known as the Churrigueresque. Within half a century, they transformed Salamanca into an exemplary Churrigueresque city.

Two of the most important creations of Spanish Baroque are the energetic facades of the University of Valladolid from 1719 and Hospicio de San Fernando in Madrid from 1722.

The Royal Palaces of La Granja de San Ildefonso, in Segovia, and Aranjuez, in Madrid, are good examples of baroque integration of architecture and gardening, with noticeable French influence, but with local spatial conceptions which in some ways display the heritage of the Moorish occupation.

Rococo was first introduced to Spain in the Cathedral of Murcia, west facade, 1733. The greatest practitioner of the Spanish Rococo style was a native master, Ventura Rodríguez, responsible for the interior of the Basilica of Our Lady of the Pilar in Zaragoza from 1750.

Spanish **Neoclassicism** was spread by the Royal Academy of Fine Arts of San Fernando, founded in 1752. The main figure was Juan de Villanueva, who designed several summer houses for the kings and reconstructed the Major Square of Madrid, among other important works. Villanuevas´ pupils spread the neoclassical style through the center of the country.

During the second half of the nineteenth century, the architectural revivals dominated the scene in Europe, and so happened in Spain. Architects focused in choosing which was the most appropriated historical style for each use or occasion. Neoclassicism opened the gates to Neo-Gothic, Neo-Egyptian, Neo-Byzantine, Neo-Romanesque, and so on. This all led to a particular new style made of the mixture of several old styles in the same construction: the **Eclecticism**. The Communications Palace of Madrid is one example of this kind of mixed architecture.

During the **Industrial Revolution**, the new use of iron and glass as the main materials for building construction was, applied specially in train stations, winter houses industrial buildings and pavilions for exhibitions.

When the city of Barcelona was allowed to expand beyond its historic limits in the late nineteenth century, the resulting Eixample became the site of architectural known as the **Modernisme** movement. Modernisme broke with past styles and used organic forms for its inspiration in the same way as the concurrent ArtNouveau and Jugendstil movements in the rest of Europe. Most famous among the architects represented is Antonio Gaudí, whose works in Barcelona and spread in other parts of Catalonia, León and Cantabria mixing traditional architectural styles with the new, were a precursor to modern architecture. Perhaps the most famous example of his work is the still-unfinished La Sagrada Família, the largest building in the Eixample.

It is necessary to add that due to differences in the climate and topography in Spain, it counts on many several styles of popular architecture. Depending on the region we can find diverse materials to build as limestone, slate stone, granite, clay, straw or wood. Also it changes the structures. And they all have a different name: cortijo, hórreo, barraca, alquería, masía o molino.

4. HOW CAN WE USE WISELY THE WEATHER?

Sustainable development meets the needs we have in the present without compromising the ability of future generations to meet their needs, as defined by the World Commission on Environment and Development United Nations did in 1987. To achieve this, we must count on the architecture of our cities, recycling habits, sustainable energies, transport powered by renewable energies and the waste we generate.

Renewable energies are those energies that come from natural resources that you can use permanently. Their environmental impact is zero in the emission of greenhouse gases is such as CO2. Renewable energies are considered, solar energy, wind, geothermal and hydropower. May also be included in this group biomass and tidal energy.

- Solar Energy: Is the type of energy the sun provides us as electromagnetic radiation; light, heat and ultraviolet rays mainly. Using the sun's energy can be derived in solar thermal energy, hot water used to produce low temperature for sanitary and heating or solar photovoltaic, through semiconductor plates that are altered by solar radiation.
- Wind energy: It is the kinetic energy produced by the wind. Through wind turbines or windmills the winds currents pass and is transformed into electricity. In wind energy, we can find the offshore wind, which wind farms are located in the middle of the sea.
- Geothermal energy: It is one of the less known sources of renewable energy and is stored under the earth's surface as heat and linked to volcanoes, hot springs, fumaroles and geysers. Therefore, it is coming from inside the Earth.
- Hydropower: It is produced by the falling water. Hydroelectric plants use water in dams retained in reservoirs or swamps at high altitude. Water in drop passes through hydro turbines, which transmit power to a generator which makes electricity.
- Biomass energy: It is from the use of animal and plant organic matter or agro-industrial waste. Includes waste from agricultural livestock and forestry, as well as products of the food industry and wood processing.
- Tidal energy: The movement of the tides and currents are able to generate electricity in a clean way. If we speak specifically of the energy produced by the waves, we would be producing wave energy.

From dates taken in 2013 China, Germany, and Japan, were the three world's four largest economies, as well as India, generating more electricity from renewable energies than from nuclear power. But what about Denmark and Spain?

Renewable energy in Spain represented 12.7% of total energy generation in 2009. Overall 23% of Spain's electricity was generated from wind and solar in 2010. Spain has set the target of generating 92% of its energy needs from renewable sources.

Spain is the world's third biggest producer of wind power, after the United States and Germany.In 2005 Spain became the first country in Europe to require the installation of photovoltaic electricity generation in new buildings, and the second in the world after Israel to require the installation of solar hot water systems.

Solar power in Denmark contributes to a goal to use 100% renewable energy by 2050. The goal of 200 MW of photovoltaic by 2020 was reached eight years early, in 2012. Many solar-thermal district heating plants exist and are planned in Denmark.

Denmark was a pioneer in developing commercial wind power during the 1970s, and today a substantial share of the wind turbines around the world are produced by Danish manufacturers. Wind power provided 33% of Denmark's energy consumption in 2013 and 41% of Denmark's electricity consumption in the first half of 2014.In 2012 the Danish government adopted a plan to increase the share of electricity production from wind to 50% by 2020. Because of the quantity of wind there is in Denmark, it is allowed to export some of it to its neighbors, Sweden and Norway. Also is one of the biggest manufacturers of wind turbines.

5. HOW DO WE BUILD IN BOTH COUNTRIES?

In this part of the dissertation I will compare the way of building in two different building sites. Although the building in Denmark is almost finished, overall I will write about the first phases which compound the excavation and the foundation, due to the building in Spain has no more phases completed.

The first one is located in Valencia, the city I come from between the streets Igancio Hervás and Barraques de Llacer. Its name is Torre Del Alba and is a twenty floors building, which will be composed by ninety one apartments and three basements for parking, it is also provided by a gym and a swimming pool as well as pieces of garden that will be give out to the owners. This tower is part of a complex with two buildings, the other tower will have thirteenth floors but it is not built already. The constructing company which is in charge of the construction is called Lobe.

To start constructing this building after all the constructive previous performances, as cleaning the surface of the solar ground, they take part on the foundation. Due to the water table they built a slurry wall (muro pantalla) I kind of concrete wall attached to the ground which principal function is not to let the water go inside the building.

To build this kind of wall there are different phases:

- "Murete guia" : is built in parallel and is a short concrete wall which guides where the limits of the building site are and let you dig the ground vertically to introduce the reinforcing steel of the slurry wall between both short walls.

In this case the measures were 0.15x0.8 m, it began to be built the 11/06/2014 and it was finished the 18/06/2014 which means 7 days of work. They made 129.24 running meters and it cost 90.50 € per square meter.

They dig 64.87 m3 to build up the small wall and it cost 8 € per m3.

There were 3 workers doing it, and they used 47.54 m3 of concrete (HA-15) with 1773.96 kg of corrugated steel.

This phase in total cost 55.70 €/rm which means 7199 €.

- Excavation of the trench alternating:

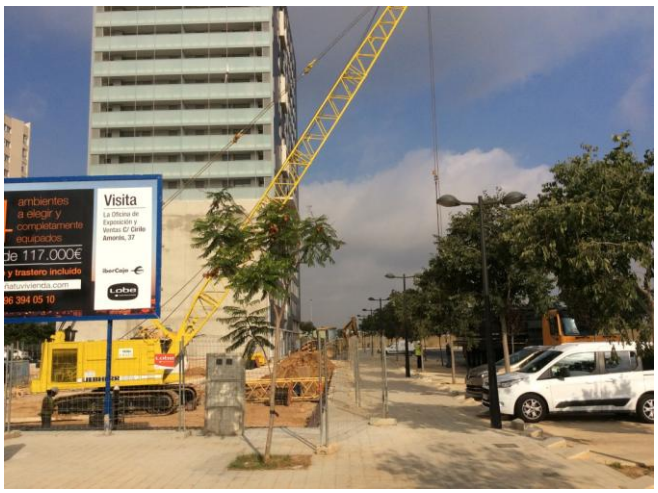
The length of the panels to be excavated is, about and 6 m, so they did two rings of the whole process. Then they used the grapple to excavate the space were the slurry wall was going to be.

- Execution of the slurry wall: once they have done the hole, is time to put the reinforcing steel. The steel must be pre-assembled. To place the steel is raised by a crane, and is introduced into the panel. The steel cannot rest on the bottom of the trench, as well as, cannot be in touch with the walls of the excavation because it can lose lateral concrete coating. Therefore it is to be hung from the parapet guide, and laterally is mandatory to use separators that are placed on the frame to avoid contact with the ground.
  Before putting the concrete, they disposed lateral formwork or joints between the excavated panel and the panel will be excavated.
  While is being throwing the concrete, the trench is filled with bentonite mud. To prevent contamination by mixing concrete with these it is necessary to start the process of concreting from bottom to top through a pipe. Like the density of the concrete is higher than the bentonite mud, the concrete will be below the mud, and these can be extracted in surface.

In this case they executed 2100 m2 of slurry walls in 27 days, from 25/06/2014 to 37/07/2014, which cost 77.7 m2/day.

There were 82,500 kg of corrugated steel which cost 61,050 € and there were 1151.1 m3 of concrete (HA-30) which cost 60,453.75 €.

Including workers, machines and other resources this phase cost 190,046.95 €.



- Coronation beam: once the slurry walls are finished we have to build this beam joins the top of each slurry and has two missions; make all work jointly to the walls and to remove the concrete of the top, which may be contaminated by the bentonite mud.

This beam has three parts in this building site; in 89.90rm is 1 x 0.45 m section, in 18.76 rm 0.6 x 1.4 and in 7.5 rm 0.8 x 1.4 m.

The beam was built in 16 days of work, from 17/07/2014 to 08/08/2014 and it cost 232.71 €.

They used the backhoe for 90 hours, and they put 10,694 kg of corrugated steel and 113, 99 m3 of concrete (HA-30).

There were some incidents in this phase as overstaffing and low qualifications will increase the costs, too much reinforced steel to modify once has arrived to the building site, not let whole for the installations in the steel and the phase was retarded so it retarded the rest of the phases.

-Anchors for the slurry wall: Anchors help to maintain the stability, cause these walls are so thin thickness in relation to the depth excavated, so they receive important thrusts of the earth and also the effects of the water, so this resource will helps to strengthen and ensure its stability. These anchors work by embedded cables with small holes injected with cement, then they pulled to apply the same or higher, than the ground, efforts.

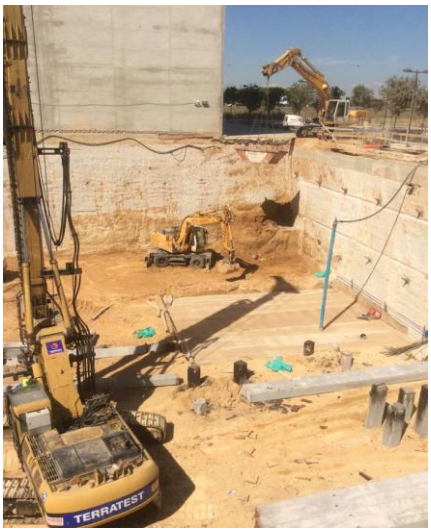
In this phase there were 3 workers and they did the anchors by rows, the first one was started the 30/07/2014 till 18/08/2014, so in 15 days they cover 189 rm of wall which cost 10725.75 €. In the second row they covered 598 rm of wall from 19/08/2014 to 1/09/2014 which cost 33936.5 €.

They used 1298 rm of cable, 200 m3 of water, 680 kw of electricity and 29065 kg of cement, and they managed it with a backhoe. Everything in this phase cost 70,139.34 €.

- Excavation: once they have covered the perimeter of the building site with the concrete walls, they can start with the excavation.

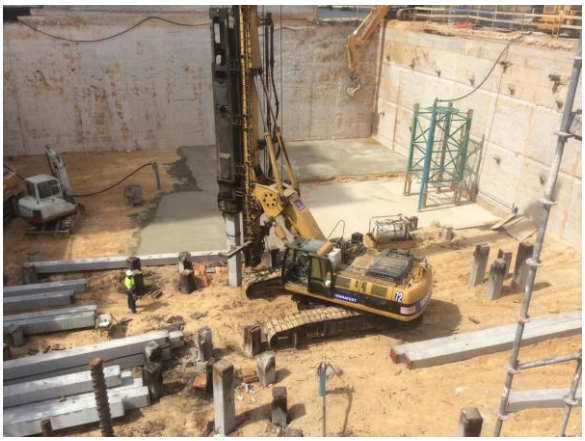
This excavation is about three basements to the first level they last 10 days, and they extracted 3300 m3, the second level last 6 days and they took 4000 m3 and for the last one which were 5200 m3 they last 20 days.

To do the excavation they used two different backhoes and a dumper. The total cost reaches 83,520 €.



- Driven piles: Driven piles are deep foundation elements driven to a design depth or resistance. If penetration of dense soil is required, predrilling may be required for the pile to penetrate to the design depth.

Piles in this building site were built in 11 days of work from 3/09/2014 to 17/09/2014, they put 24 piles of 35x35 cm and 55 piles of 40x40 cm. and the longitude was 22 rm in both cases. They used a crane to move them and they were working three workers.



- Slab: to finish the foundation and excavation works we need a floor, the main one is the slab that unifies all the slurries.

In this building site there are two slabs, with different width. The first one was done in 5 days of work and the width is 1.10 m. The second one is 0.70 m width and is also last 5 days of work to be built.

In the first one were necessary 20,326.56 kg of steel and 121.5 m3 of concrete with pump. This one cost 183.94 € and there were working at the moment four workers.

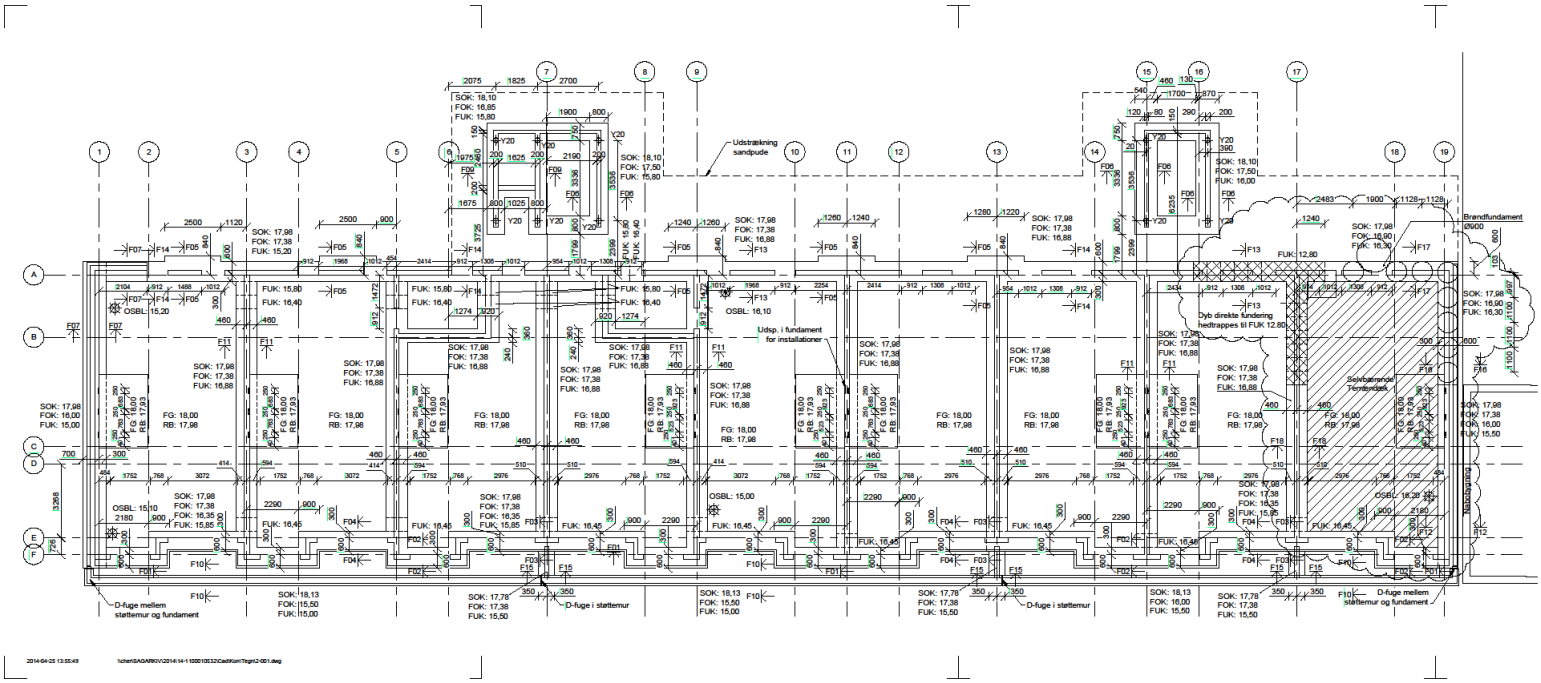
On the other hand, in the second one they need 34,020.43 kg of steel and 330.5 m3 of pumped concrete. This one cost 135.32 € and there were working at the moment five workers.

The second building site to compare is located in Horsens, the city I live in, in Vestergade 30-38. It is a four floor buildings without basement with thirty five apartments and eight on the top floor. It will have an outside parking and a storage building for bikes. This building is part of a complex of two exactly the same buildings which will be used to low prices loans. As a new thing in this kind of buildings each

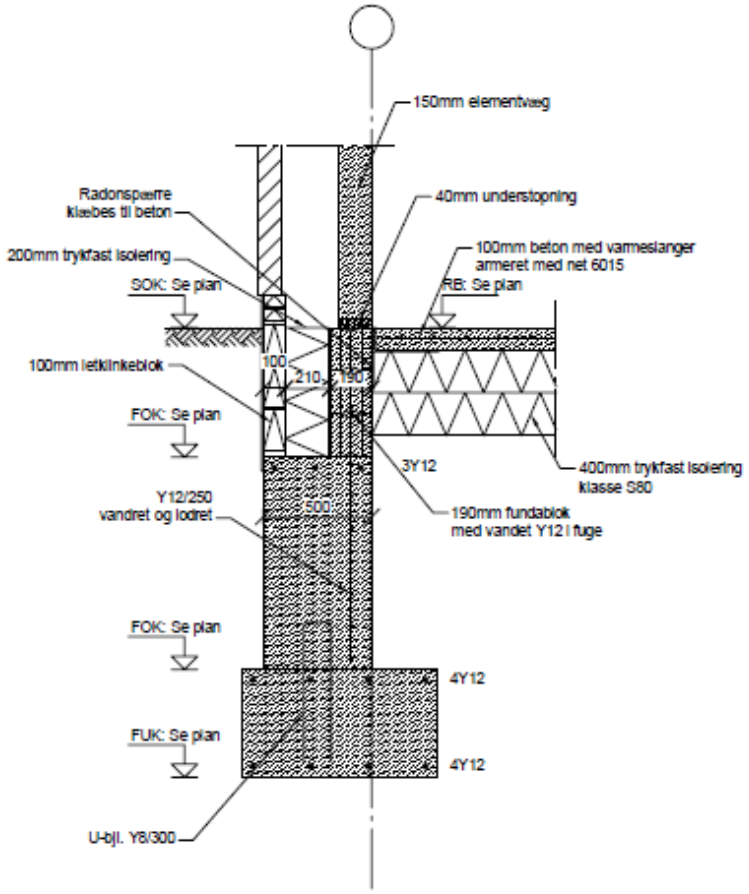
apartment had its own ventilation system to let the roof top as a terrace to enjoy during in good weather, free of pipes and ventilation devices.

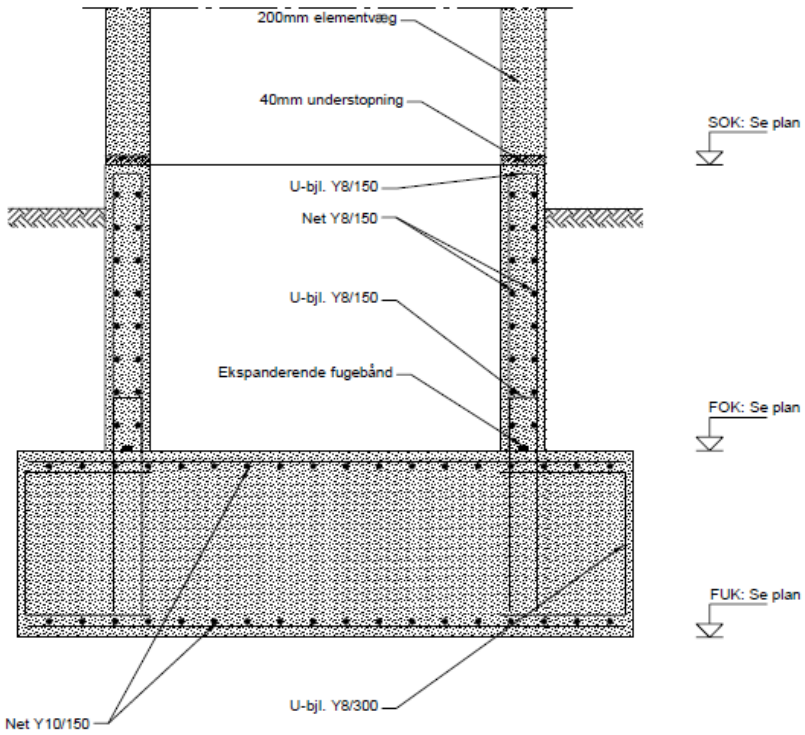
The constructing company which is in charge of the construction is called CASA, the biggest one in Horsens. The prevision of the building site finish is the 27/02/2015, which means one year since 10/03/2014 until they can give the keys to the owners. When I visited the building site, the organization were accomplished, by the 7/10/2014, they were painting and putting the carpentry.

Comparing with the Spanish building is a really basic type of foundation. The maximum excavation cote is 17.45 m and the foundation is made by prefabricated concrete of 25 Mpa. The reinforcement is B 500Fyk. During the excavation were necessary 6 workers and they used backhoes and dumpers to take off the ground and 10 workers in the foundations works using cranes. We have no dates about how much do they cost to compare with the Spanish building site, but we know that it is more expensive to use prefabricated systems.



This is the basement plan but the most important difference to comment is the way to build it. Due to the general climate conditions in Denmark it is impossible to build with reinforcement concrete walls not prefabricated. However prefabricated concrete elements are more expensive, they are built around perfect conditions, what guarantee the perfect shape and finished in the elements, as well as, the strength they have to reach. Here we have some example of prefabricated concrete foundations details.


150mm elementvæg
Radonspærre klæbes til beton
40mm understopning
200mm trykfast isolering
100mm beton med varmeslanger armeret med net 6015
SOK: Se plan
RB: Se plan
100mm letklinkeblok
100
210
190
FOK: Se plan
3Y12
400mm trykfast isolering klasse S80
Y12/250 vandret og lodret
500
190mm fundablok med vandet Y12 i fuge
FOK: Se plan
4Y12
FUK: Se plan
4Y12
U-bjl. Y8/300


200mm elementvæg
40mm understopning
SOK: Se plan
U-bjl. Y8/150
Net Y8/150
U-bjl. Y8/150
Ekspanderende fugebånd
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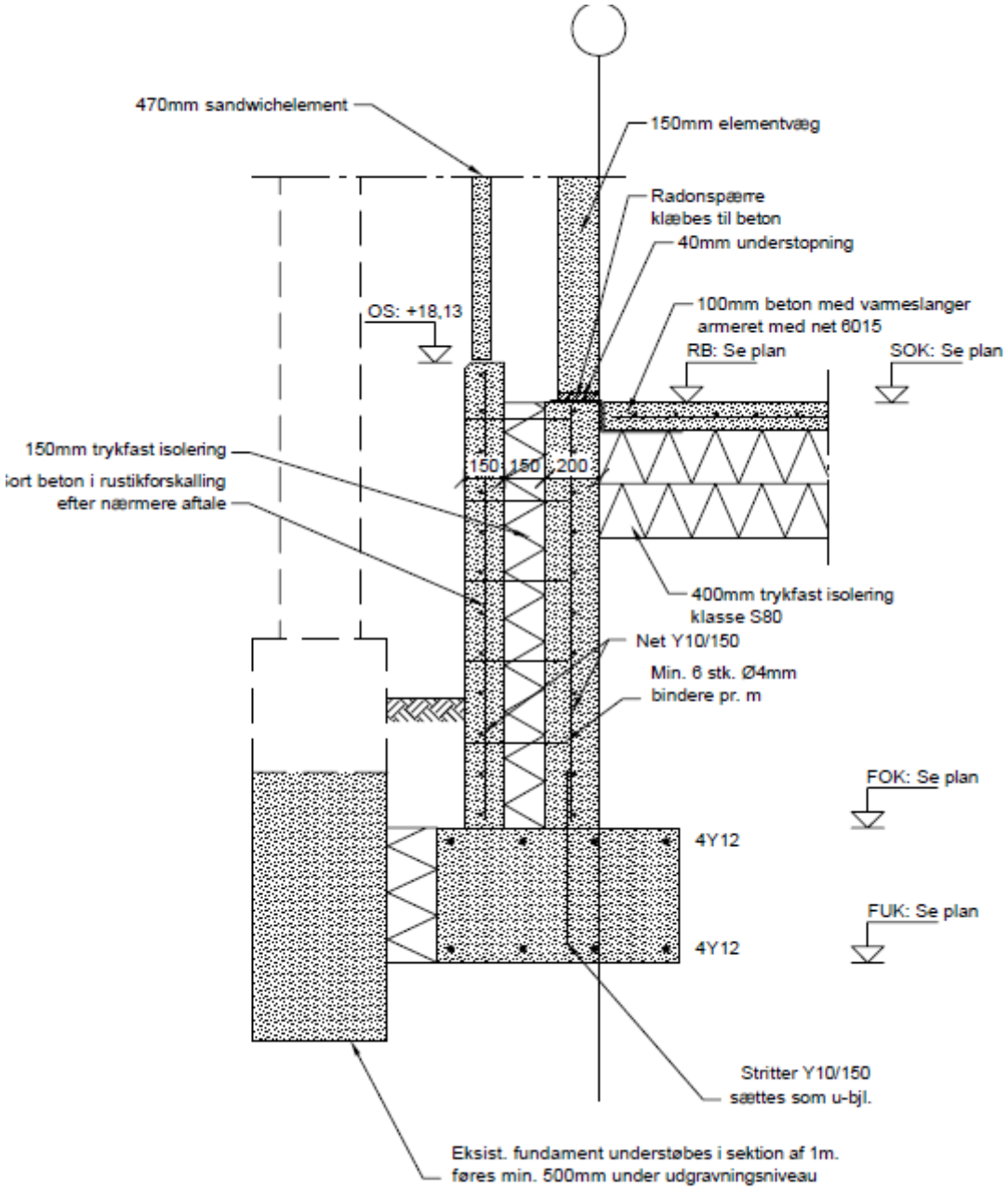
Net Y10/150
U-bjl. Y8/300



WORKING PROCESS

I have researched information about both countries trying to compare them every moment. Based on my analysis I would like to give a reasonable conclusion for each point of the dissertation.

CONCLUSION

I chose this subject because studying in both countries you never know where are you going to work on.

I tried to talk about different aspects of both countries but always related to the construction. And finally I have tried to give an answer to the research question asked at the beginning of the report.

By doing this I hope to be able to know more about each country, as well as carry out my knowledge since this moment till I start to discover new ways of constrcuction.

1. WHICH ARE THE DIFFERENCES IN THE GEOGRAPHY, WEATHER AND POPULATION BETWEEN DENMARK AND SPAIN?

Before talking about many technical aspects I had to compare why the countries are different. This means all this answer, is an introduction to take place and visualize how is the living there. By knowing that, then we will know how to start planning the architecture.

2. WHICH ARE THE DIFFERENCES IN THE BUILDINGS ON A FIRST SIGHT? DO WE HAVE SIMILARITIES?

The answer of this question is all based in my knowledge and my common sense. In my opinion as a future constructing manager is very important to observe what is surrounding you and know how to read.

By answering this question you can see the main differences in the buildings in both countries only in a first sight. And of course I conclude that there are many differences but also similarities.

3. WHAT THE STORY TELLS US ABOUT THE CONSTRUCTION IN BOTH COUNTRIES?

To achieve a well management nowadays I think it is very important how our last generations did it.

We base the actual architecture on the main bases as the old one, and even today we surprise and we ask ourselves in many cases, how could they do that? The main thing about older constructions is that they work mostly perfectly, because the most of them are actually erected.

Comparing both histories you realized that the past was completely different, and what happened before is always reflected in the future.

I have to add in this section that nowadays architects from both countries build all over the world with great success.

4. HOW CAN WE USE WISELY THE WEATHER?

Of course I had to write about the renewable energies, because they are the future in architecture.

If we do not use them the world as we know nowadays could disappear. Anyway as we could conclude due to the report, both countries are really conscious with this problem and achieve very good dates for the future human being.

5. HOW DO WE BUILD IN BOTH COUNTRIES?

This is the most technical point in the dissertation, and by myself is the most critical. I mean critical in the way of diverse. I could only focus on the foundation because the building to study in Spain was in that phase.

But only in this case we could find all the differences possible. In addition to this, I am not going today which works better or not, I think in fact that the both work and are really good ideas to solve the problems each one has.

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