Construction of foundations in Finland, compared to Belgium

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Bachelor's thesis
Spring 2016
Construction engineering

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ABSTRACT

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As an Erasmus exchange student from Belgium, currently living in Finland, the author of this thesis was very interested in buildings and in particular the difference in foundations between these two countries. That was the reason for this subject.

The purpose of this Bachelor’s thesis was to gather information on foundations in general and also point out the biggest differences between foundations in Finland and Belgium for small- to normal-sized buildings.

The information that was used to write this thesis was first of all extracted from several specialised books. Secondly there were the meetings with the supervisors, who were very interesting and educational. Most of the special other structures were taught during those meetings.

The results from these meetings were summarized in this thesis, together with extra information added from educational books and reports.

The conclusion of this thesis is that both countries have differences in their construction of foundations and that some differences may be interesting to investigate more. Some structures on the other hand are just not useful in the other country, because of the difference in climate.

Key words: foundation, durability, Finland vs Belgium, soil

CONTENTS

1 INTRODUCTION

In this Bachelor's thesis the main goal is to make clear what a foundation is and to describe the different types there are nowadays. Every type of foundation has specific characteristics who will determine for which type of building or type of soil it will be useful. Thus the different and most common soils in Finland will be explained. There will also be a comparison between Finland and Belgium for the most common types of foundations and type of base floor, particularly for small- to normal-sized buildings.

Foundations in general are not that different in Finland and Belgium, but the extra measurements Finland has to take care of are not that common in Belgium. These other constructions, frost insulation, radon-gas and drainage, are explained elaborately in this thesis. The frost insulation is something that foundations/buildings in Belgium do not need because of the difference in climate. Radon-gas in Belgium is not as common as in Finland, so this is a total new structure. Drainage on the other hand is an extra structure that Belgium is familiar with.

The thesis will also have a small chapter handling the durability of foundations. The basics of the bearing capacity and settlement will be explained. Of course government has some regulations about this topic, so this will also be clarified.

As a conclusion you can find a personal opinion of the comparison between the two countries. Are there details/structures where the both countries can learn from each other? Are there structures that the author of this thesis will remember and maybe use in the future?

2 TYPES OF FOUNDATIONS

The foundation is the element of the building that transfers the loads (its own weight, snow load, wind pressure, etc.) directly into the ground. The type of foundation that is used, is generally based on the soil (safe bearing capacity, stickiness, etc) that is beneath the future building. Nevertheless the size and weight of the building is necessary to consider. For this reason we can divide foundations into two main groups, deep foundations and shallow foundations which refer to the depth that the foundations penetrates the soil. The depth can vary between 0,5m for the shallow and up to 65m for deep foundations (of course there are exceptions which go deeper). This chapter will briefly discuss the most common types, in order to sketch the topic ‘foundations’. Next chapter will go deeper into the topic of shallow foundations for small- to normal-sized buildings. (Understanding Construction. 2016. Types of foundations.)

2.1 Foundations based on different soils

The choice for a specific kind of foundation is based on the soil type of which the building makes contact with. One of the big differences between the foundations in colder climates, such as Finland’s, meaning a protection against the freezing temperatures is crucial. This topic will be discussed later in more detail.

Thanks to a soil investigation with tests like PLT (Plate Load Test) and Penetration tests, it is possible to know the soil in greater detail. These tests provide information such as; what the bearing capacity is, how sticky the ground is, settlement of soil, etc. Each type of foundation and its characteristics will be explained in more detail. (Weisgal, S. 2011. What is a foundation.)

2.1.1 Column footing

Individual footings (as seen in figure 1) are one of the most simple and common type of foundations. The weight of the building is transferred by individual columns resting on this footings. Generally speaking all types of shallow foundations can be referred to as spread footings. Usually the columns are connected by a horizontal beam (this can be underneath the ground or at ground level), which support the loads of the walls. These foundations are called ‘open foundations’ because they are visible when they are cast/poured. These types of shallow foundations are most likely to be placed in a very firm soils. (Allen, E. & Iano, J. 2014. Fundamentals of Building Construction, Materials and Methods.)

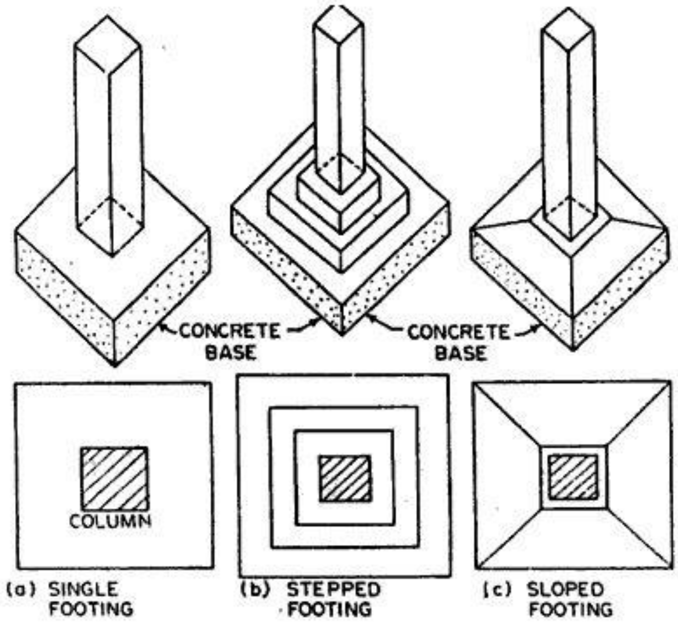

Figure 1, Individual footings with columns, www.abuildersengineer.com

2.1.2 Strip foundation

This is the most traditional method and is widely used in areas where the ground is known to freeze. Yet the fact it is most commonly used it is the cheapest type of spread footing foundation. In order not to let the concrete of the foundation suffer from the freezing temperatures, there can be insulation in the ground. Together with the first one (individual footings), they are called ‘open foundations’. This is because they are visible (open) when they are cast/poured. Firstly the footing is poured, and on top of this you have a smaller (width) wall. Over this wall the slab (floorplate) is poured. Underneath the slab there is a bed of gravel which provides drainage (figure 2).

A little comparison between Finland and Belgium: In Belgium contractors will dig up to 0,8m and this is most of the time the depth where there is no risk of freezing. On the other hand, in Finland there will be insulation around the footing in order not to let the foundation freeze.

This method is the most traditional, and nowadays it is still used frequently. In Finland this is the most common type of foundation similar to Belgium where it is also very common. (Allen, E. & Iano, J. 2014. Fundamentals of Building Construction, Materials and Methods.)

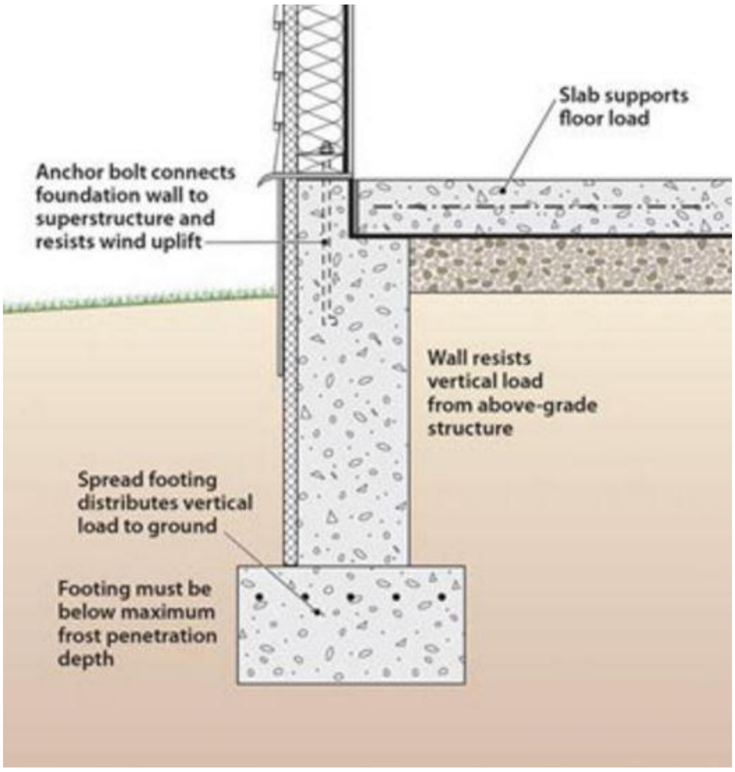

Figure 2, Structural components of Strip foundation with spread footing, www.thefoundationexpert.com

2.1.3 Raft foundation

When using Raft foundation (figure 3), the depth required is less than the Strip foundation. But this type is in a way more difficult to execute because of the floorplate (slab) that has to be poured with the concrete foundation at the same time. Reinforcing rods strengthen the thickened edges, so the structure would be very though and won't show any cracks. Like the T-shaped foundation, the floorplate rests on gravel to improve the drainage underneath. This kind of foundation is mostly used when the soil is soft, because the weight is spread evenly therefore the settlement is smaller. This kind of foundation is not very common in Finland and is used only for small buildings. (Allen, E. & Iano, J. 2014. Fundamentals of Building Construction, Materials and Methods.)

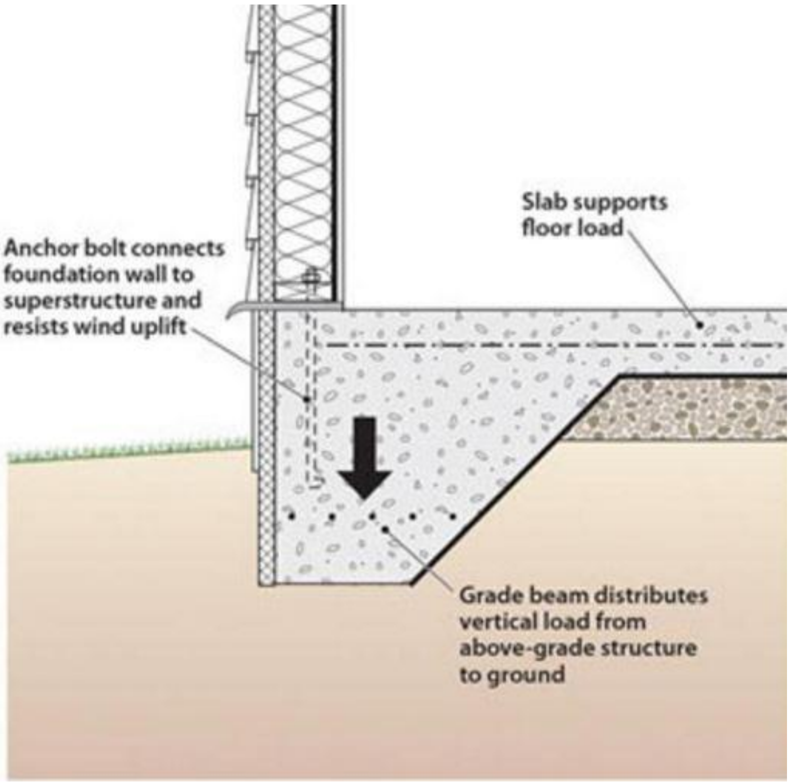

Figure 3, Structural components of Raft foundation with grade beam, www.thefoundationexpert.com

2.1.4 Pile foundations

Pile foundations are mostly used when the top soil is weak but there is a stronger soil (or bedrock) underneath. There are two types (figure 4) who both work differently. The first one is called 'End bearing piles'. They basically push long tubes (mostly concrete) in the soil so that the building's loads can be distributed to the stronger, deeper soil. The second type of piles are 'Friction piles'. These piles work different, they normally don't go as deep as the 'end bearing piles', but they use their surface to create friction between the piles and the soil (which has to be non-cohesive such as loose sand). The loads they can carry are directly related to the height of the pile that is pushed in the ground. For this reason pile foundations are capable of taking higher loads than the more normal strip footings.

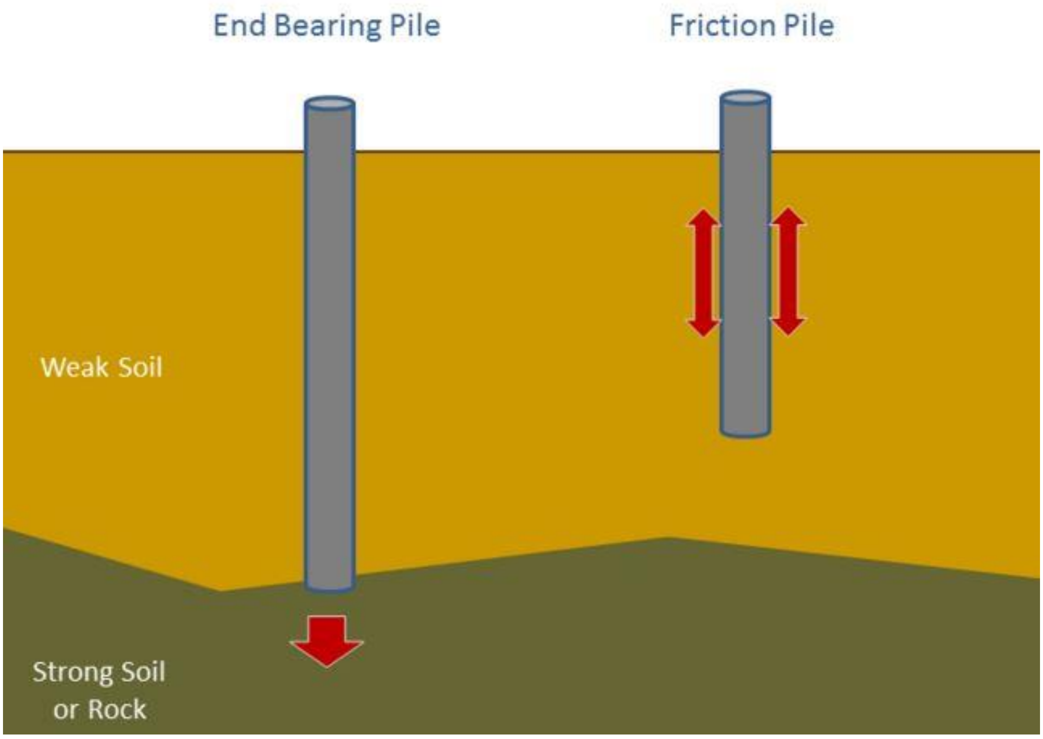

Figure 4, The different types of piles, www.understandconstruction.com

The piles that are used can be made of wood, concrete or steel. Wood is naturally very strong and capable of carrying big loads. The city of Venice for example is completely built on wooden piles that resist (or at least until now) the corrosive seawater. Wooden piles can resist water thus it is known not to fail due to water. However whenever the water level is not at the same position all the time, wood begins to rot. But maybe the biggest problem with wood is the length of one pile. The tree should be very straight and tall (10 to 20 metre), something that's not easy to find in nature.

Steel H-piles are the strongest of the three, but in very corrosive soils concrete is a better option. Sometimes concrete and steel are mixed, so the result is a very though pile with an average length of around twelve metres. In Finland steel pipes (driven piles, cylindrical) are mainly used for smaller buildings thus concrete (square 300 x 300) is mostly used for bigger buildings (figure 5). The biggest advantage of these steel pipes are the small machines that are needed to push them in the ground. The machines that contractors have to use for concrete piles are much bigger and take a lot more space on the building site. (Das, B.M. 2004. Principles of Foundation Engineering.)

Figure 5, Concrete pile foundation, photo taken by Hannele Kulmala

2.1.5 Bedrock foundation

The large amount of bedrock in Finland resulted in contractors having to think of special ways to make foundations in/on bedrock. There are two possibilities to do this: glued/anchored in bedrock (figure 6) or using dynamite. Gluing and anchoring means drilling a hole (as big as an iron bar used to cast concrete), filling this hole with a strong two components glue or a glue based on cement and putting in the iron bar. When the glue/cement has dried it is possible to start anchoring the column foundations to the bedrock using the iron work inside the foundation. Finland is known for its hard bedrock, which is sometimes impossible to excavate. For this reason dynamite is used to blast away the bedrock. After the blasting contractors make sure that there is at least one metre of boulders and gravel (from the explosion) between the bedrock and the bottom of the foundations. In between there is also a layer of fine crushed aggregate from at least 30 centimetres to work away every unevenness.

Figure 6, Steel anchors glued in the bedrock, photo by Hannele Kulmala

2.2 Foundation based on different types of buildings

As already mentioned before, some foundations are better in carrying heavier loads and are able to withstand big forces. The more shallow foundations are designed for better/firmer soils and small buildings. Whereas the deep foundations are for weaker soils with a stronger soil (or bedrock) underneath and of course for bigger buildings such as apartments, sport complexes, large offices,… Normally when the stronger soil is on a depth of 5m, they will use a pile foundation resulting in a very strong, but expensive foundation.

3 TYPES OF BASE FLOOR

There are three main types of base floors (for shallow foundations): slab on grade, crawlspace and basement (figure 7). The foundations underneath these different types can vary and can be any of the types that were discussed in the previous chapter. Also the difference in design and its different components from the base floor is discussed.

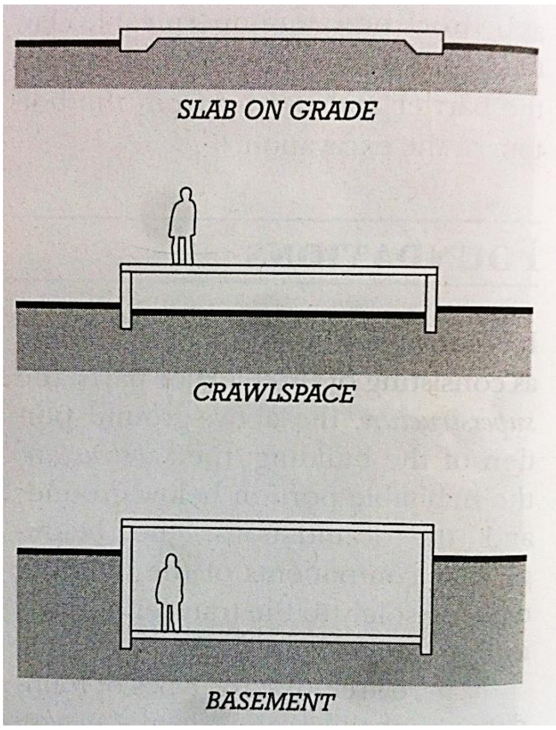

Figure 7, The three main base floors, Fundamentals of Building Construction, Materials and Methods, p52

3.1 Slab on grade

If the floorplate rests directly on the soil and it is poured in one time together with the foundation, it is called slab on grade. The best thing about this type of floorplate is the forces who get divided evenly across the whole floorplate, and not only to the foundations. So the floorplate basically acts also as a foundation, as described previously. This is totally different when the foundation type is strip footing. The floorplate also rests directly on the ground, but the forces go immediately to the foundations instead of also going through the floorplate.

3.2 Crawlspace

When a building is not directly resting on the ground, but an open space is between the soil and the floorplate, than we call this space a crawlspace. Because of this crawlspace the forces on the floorplate are diverted directly to the foundation walls/piles into the ground. So in this case the foundations need to have more bearing capacity than when slab on grade is used.

3.3 Basement

A basement as floorplate is almost the same as slab on grade floorplate but has a big difference, namely the amount of insulation that is needed under the cellar. When there is a basement, the amount of insulation can be reduced if the frost line is deep enough. Under the basement there can be every foundation type described in the previous chapter.

3.4 Design from base floor

The different components and materials that are used in a base floor will be discussed in three different scenarios; floorplate in contact with soil, foundation with crawlspace and foundation with a basement. This will be done for Finland and Belgium.

3.4.1 Finland

Floorplate in contact with soil

On figure 8 you can clearly see all the insulation, frost as thermal insulation. This thermal insulation divides the floorplate from the soil. There is also insulation in the foundation wall, this is why we can conclude that this wall is precast. Also drainage is present.

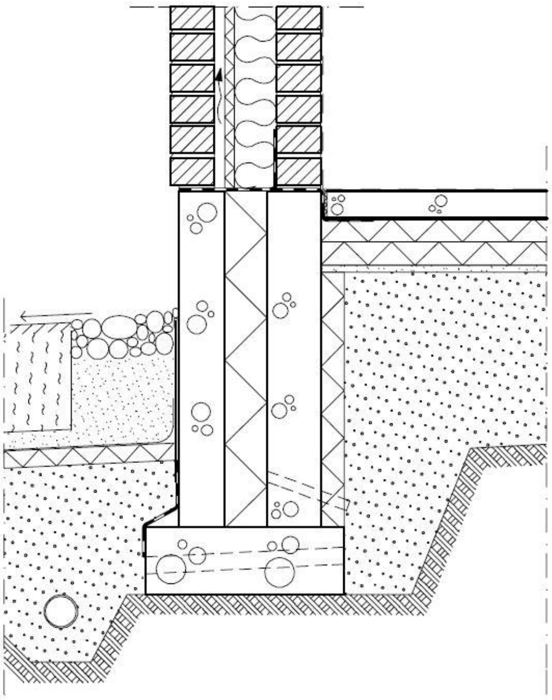

Figure 8, Floorplate in contact with soil, RT 81-10854, p6

Floorplate with crawlspace

In figure 9 there is a crawlspace between the floorplate and the soil. Above this crawlspace is the floorplate, but first we have some insulation. Above the floorplate we have again insulation and the floor decking. Crawlspace can contain some moisture, this area has to be ventilated, as we can see on the picture.

There is frost insulation on both sides of the foundation. The left side is above the drainage, and the right side makes sure that the crawlspace will not become too cold.

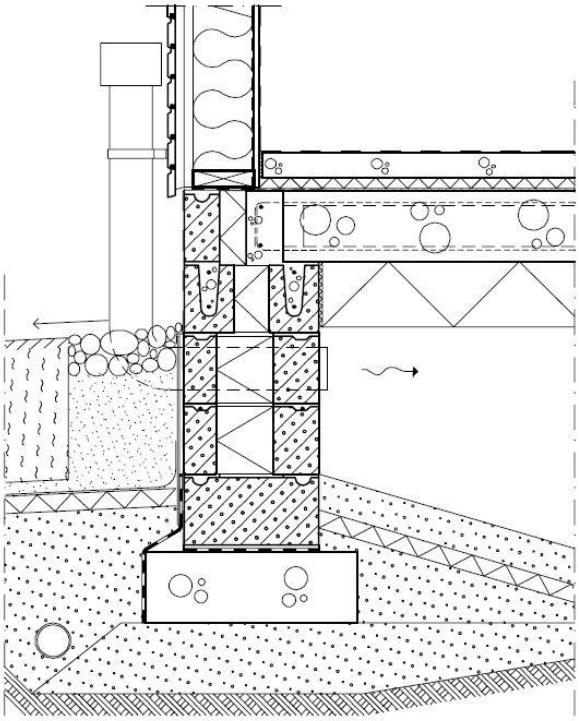

Figure 9, Floorplate with crawlspace, RT 81-10854, p8

Floorplate with basement

As shown on figure 10, there is no frost insulation horizontally. There is some insulation on the outside of the foundation wall, and also under the floorplate of the basement. Also drainage is present.

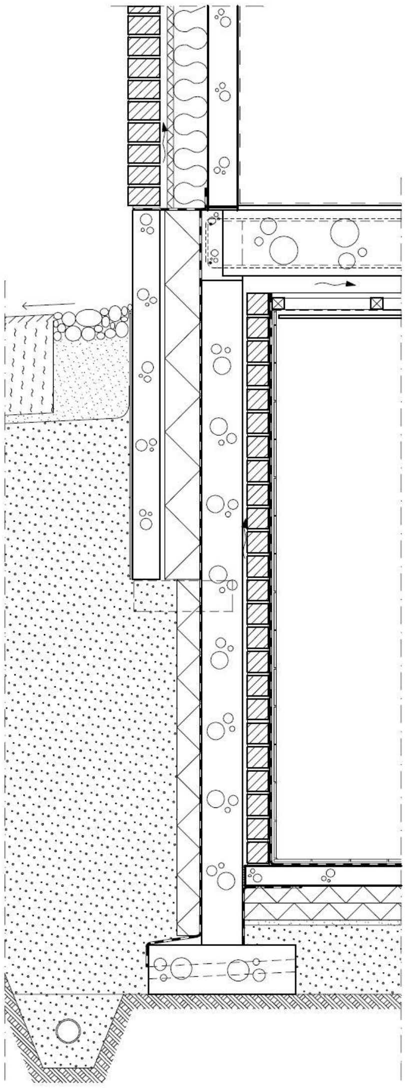

Figure 10, Floorplate with basement, RT 81-10854, p15

3.4.2 Belgium

Floorplate in contact with soil

Figure 11 shows the foundation and floorplate of a passive massive building in Belgium. There is clearly a difference between this one and Finland its construction. In Belgium there will almost always be insulation above the floorplate, and not underneath and above the soil. There is also a filling layer between the floorplate and insulation. Above the insulation we have again a filling layer and above this the decking. Another big difference is the frost insulation that Belgian foundations do not have. Drainage is not shown on this picture, but it can be installed, in the same way as done in Finland.

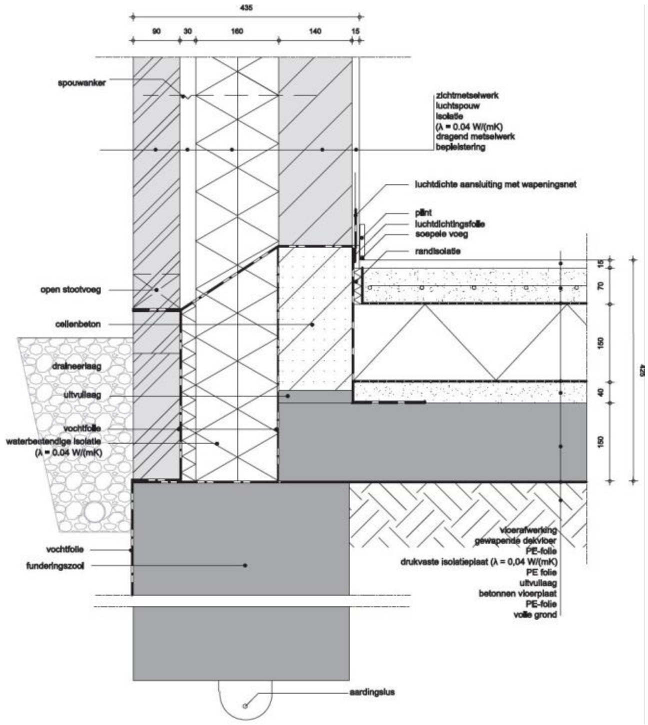

Figure 11, Floorplate in contact with soil, www.bouw-energie.be

Floorplate with crawlspace

Again the same differences as previous case, no frost insulation and no drainage in the picture. This time insulation is added underneath the floorplate, like in Finland (figure 12). The crawlspace is in this case not ventilated.

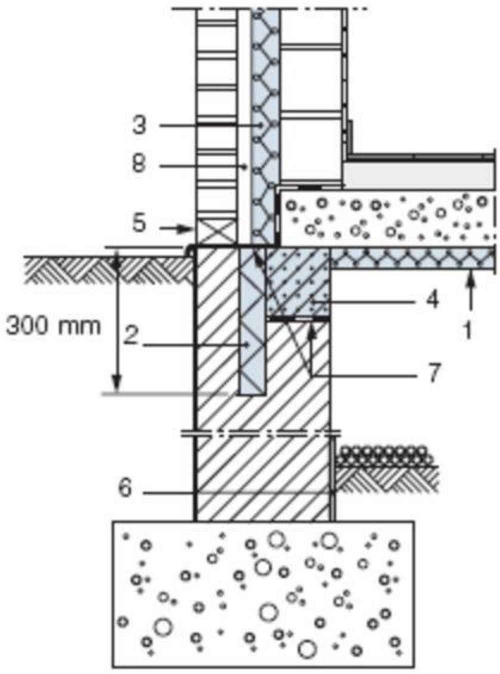

Figure 12, Floorplate with crawlspace, www.wtcb.be

Floorplate with basement

When there is a basement in Belgium, this area is not counted to the protected volume, so this means that this room is not insulated. This is shown in figure 13, there is no insulation underneath the lowest floorplate, but there is insulation above the 'normal' floorplate. Furthermore there is no frost insulation. Again there is no drainage in the picture, but if this is necessary, it can be added and it is installed in pretty much the same way as in Finland.

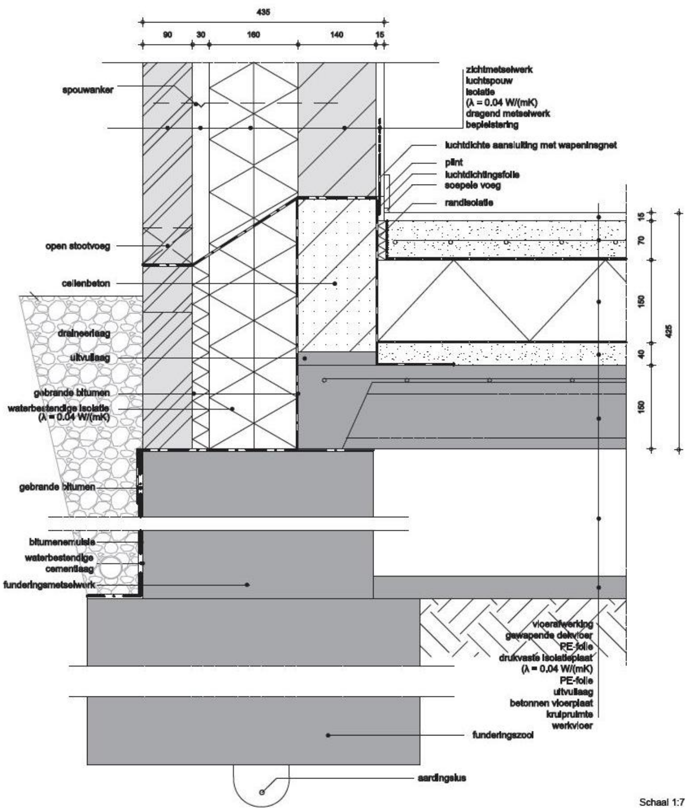

Figure 13, Floorplate with basement, www.bouw-energie.be

4 FOUNDATIONS OF SMALL TO AVERAGE BUILDINGS IN FINLAND

This chapter discusses most of the different soil types which can be found in Finland, along with the types of foundation which is chosen most frequently for small to average new buildings.

4.1 Foundations on different soils

In Finland there are many different soils and therefore the foundations have to adapt to that. This chapter’s making a distinction between five of the most common soils in Finland and hereby the best suiting foundation.

4.1.1 Clay

Clay is a sedimentary rock, namely with particles smaller than two µm. Clay exists of clay minerals, which are not very water permeable. In dryer times this is a good thing, they hold the water for longer, contrasting in wet conditions when the water will simply rest on top. One of the characteristics of clay is that it is unstable. For example a heavy load is placed upon it, the reaction of the clay will be similar as the particulate material to that of a fluid. In other words, the load will sink. This is the biggest problem of clay resulting in clay being an unstable soil because it is weak especially in regards to big settlements. The regions where you can find the clay are near the coast and near rivers. In Belgium it is the same, near the coast they have a lot of clay for several kilometres. Clay is not the best type of soil to start a foundation, so if the layer of clay is not that deep, contractors will have to dig until they find a firmer layer of soil. However if the layer of clay is very deep, the best option is to have a pile foundation.

4.1.2 Silt

Silt is a sediment (soil) which particles vary between two and 65 µm. This means it is bigger than clay, but smaller than sand. (Gonzales, C.R. 2013. Foundations on Sand and Nonplastic Silt.) Compared to clay, silt is not sticky at all. The foundations used in silt may consist of spread footings, grade beam or piles, depending on the density of the silt.

4.1.3 Sand, gravel

Sand is a naturally granular material, bigger than silt but smaller than gravel. Sand is between 65 µm and two mm, whereas gravel starts at two mm up to 64 mm. Sand and gravel are usually considered favourable from the standpoint of foundation support, although water can be a problem. If water comes in contact with the sand or gravel, it can create unstable conditions. When sand (or silt) is not cohesive enough, it will rapidly be noticed because of the settlement of the loads. The density should be at least 60 percent or to a density of about 90 percent or more of the maximum density obtained in a laboratory test. So the foundations used in sand/gravel may consist of spread footings, grade beam or piles, depending on the density of the sand/gravel. (Gonzales, C.R. 2013. Foundations on Sand and Nonplastic Silt.)

4.1.4 Bedrock

In Finland there are lots of types of old bedrock with a much younger surficial deposits on top of it. The oldest is called the Siurua gneiss, a very common bedrock in Finland. (Nenonen, J. & Portaankorva, A. 2009. The geology of the lakeland Finland area.) Foundations on bedrock are difficult to make. The footings can be 'glued' to the bedrock together with a steel anchor, or in case there are freezing temperatures involved, the footings will be excavated into the bedrock. So normally the choice will go to foundation with column footing. The only problem in Finland is that bedrock is so hard that it sometimes impossible is to excavate the bedrock, so dynamite has to be used to blast it. The gravel that the explosion creates is than later used as a bedding for the floorplate.

4.1.5 Moraine

Moraine is a glacially formed accumulation of unconsolidated glacial soil and rock. It is a typical soil in Finland that does not exist in Belgium. It is basically a collection of rocks of any size that came together because of the force of the moving ice in past ages. Soil is called moraine whenever the gravel (particles > two mm) percentage is ≥ 5% and the silt (particles < 0,06 mm) percentage is ≥ 5%. (Kasari, A. 2015. Soil Science and engineering: name of the soil.) These collection of rocks are typically sub-angular to rounded in shape because of the many collisions they had on their way with the glacier.

4.2 Most common foundation

The most common foundation we can find in Finland is the strip footing foundation. This type is used most for small to average buildings because it can carry and spread the loads very well as the forces are transmitted into the ground underneath the building. A disadvantage of this type is the digging that has to be done. The whole building site has to be digged for the foundations to pour.

5 DURABILITY OF FOUNDATIONS

This chapter handles over the factors that are part of the durability of the foundations. There are some regulations from the government about durability, but also the settlement and the bearing capacity of the soil are part of this.

5.1 Government

The government (Ministry of the Environment) has some specific regulations that need to be followed when building. These regulations are bundled together in 'The National Building Code of Finland'. (Ministry of the environment. 2015. The national building code of Finland.) It contains technical regulations and instructions, which are given by decree. There are instructions given, which are not binding, but most likely to be the best solution.

5.2 Settlement

Settlement of a building almost always occurs during the construction of a new building. This is normal, but sometimes the settlements can be too big and this causes problems. These settlements can be due to the unequal compression on the foundations. It might be a setback at the moment of working, but if the problems come in an early stage, they can be dealt with in the right way without any further consequences.

5.3 Bearing capacity

Bearing capacity is the capacity of the soil to support loads (in this case foundations) applied to the ground, in other words: is that ground or soil capable of bearing the building that is being built. If the soil its bearing capacity is not big enough this can lead to collapsing of the future building and to severe problems to the building itself. There are many theories handling this bearing capacity (Kulmala H. Bearing capacity, written report. Foundation engineering post-graduate seminar.), and what is happening with the soil when a load is put on it. Most of these are kind of the same, or are based on each other. The soil where a load is put on will shift and come up next to that load, mostly in the form of a triangle (see figure 14, Terzaghi's bearing capacity theory). Also the bearing capacity from the foundation itself is very important; the footing (if it handles column or strip foundation) has to have enough strength in order not to break.

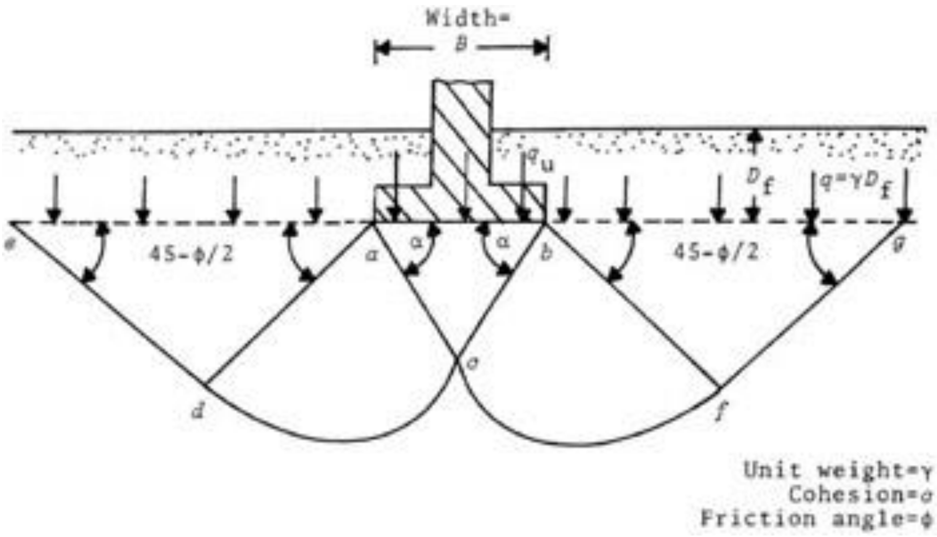

Figure 14, Terzaghi's bearing capacity theory, www.globalspec.com

5.4 Comparison Finland to Belgium

Belgium has similar regulations as Finland concerning the construction of buildings and in this case especially foundations. Also settlement and bearing capacity is not different in both countries, because these durability factors are soil-related and not country-related.

6 OTHER STRUCTURES

In this chapter some typical structures that can be found in Finland are explained. These structures can also be found in other countries that are more up-north.

6.1 Frost insulation

Something typical for colder climates, such as Finland's, is frost insulation. The freezing temperatures, the moisture and water inside the soil will freeze and expand. If this expansion is under the footings of the foundations, it will push the building upwards, causing cracks and problems in the walls. In order to prevent this expansion, frost insulation is used. This type of insulation is put into the ground to make sure that the foundations are protected against the cold environment. (Jääskeläinen, R. 2009. Pohjarakennuksen Perusteet.) The insulation that is provided is placed in two ways (figure 15).

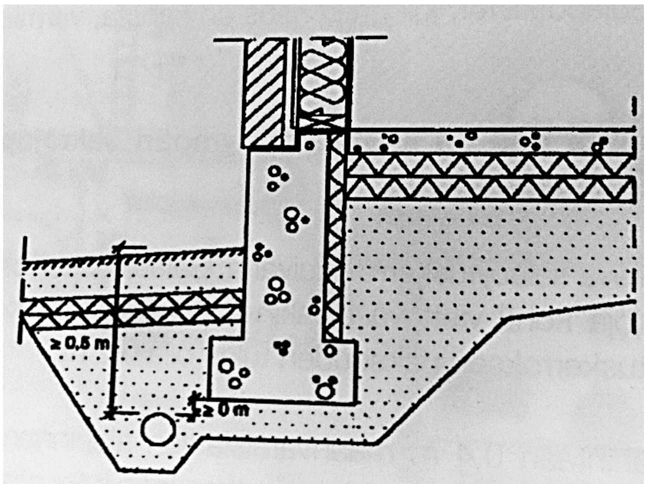

Figure 15, Foundation with drainage pipe and frost insulation, Pohjarakennuksen perusteet, p134

First of all there is insulation underneath the floorplate, so between the soil and the floorplate (also called 'slab' when the foundation is slab-on-grade foundation). This insulation is not frost insulation, but just a normal thermal insulation. The second insulation exists of two pieces of insulation. One piece is placed against the concrete of the outer side of the foundation and the other piece of insulation is nearly horizontal in the ground. Sometimes the piece of insulation that is placed against the foundation wall is in the concrete itself when the foundations are precasted. The depth of the foundation depends on the depth of the frosting line of the soil in that particular area (figure 16).

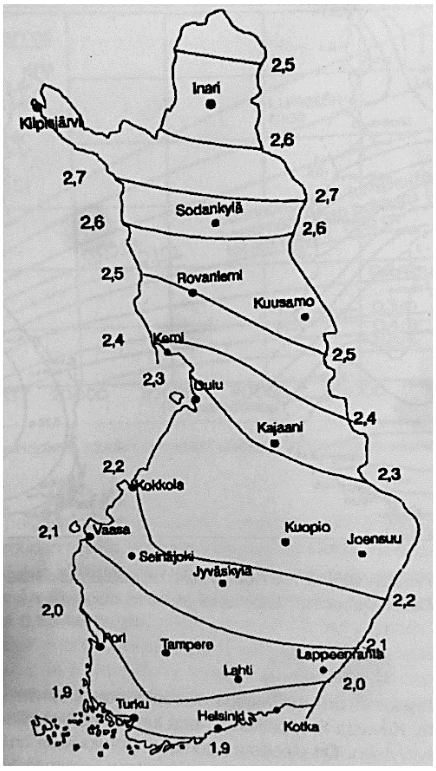

Figure 16, Depth of the frosting line, without a protective snow mass on top of it, Pohjarakennuksen perusteet, p152

Most of the time the length of the insulation is around 1.2m, and the width of the insulation depends on the width of the insulation under the floorplate. The more insulation there is underneath the floorplate, the more frost insulation needed. This is because of the warmth that a building radiates, so if there is a lot of insulation between the floorplate and the foundations, the warmth will stay inside the building and won't reach the foundations. There is a need of more frost insulation in order to not let the cold reach the foundations. Sometimes if the foundations are deep enough or there is a cellar, there is no need for frost insulation.

If the building is built with a free space between the soil and the floorplate, it is possible to have also the second insulation also on the 'inside'. Buildings who have this free space, will also need some openings in the foundation wall in order to ventilate this area. The ventilation is needed because of the moisture coming from the soil. To prevent moisture coming in this free space, insulation is placed under the entire building instead of only two short pieces. These openings unfortunately makes the air underneath even colder (figure 17).

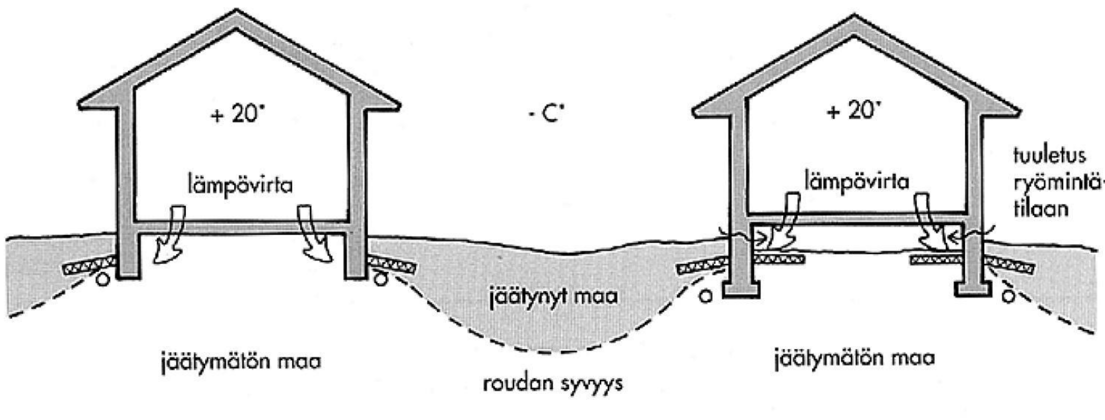

Figure 17, On the left normal frost insulation, right frost insulation with ventilated crawl space, RT 81-10590, p3

6.2 Drainage

Water damage is one of the biggest problems in modern buildings, so there are two options to prevent this: drainage and waterproofing. The goal from drainage is to lower the water level in the ground and does this by taking away all the water that is above and around these drainage pipes. (Kubal, M.T. 2008. Construction Waterproofing Handbook, 2nd edition. The McGraw-Hill Companies, Inc.) The topic of drainage handles over the collecting of rainwater (water on the roof of your house) and the water that pours in the ground. The drainage pipes are usually placed close to the bottom of the foundation, or sometimes even lower than the foundation footing (figure 15).

In order to let the drainage work properly, contractors often place a drainage system against the foundation wall, so the water can flow fluently to the drainage pipes and would not get to the foundation walls (figure 18). The building, in particular its foundations, should also be protected not to let water enter. Here we can find the waterproofing membrane of the building. When building in a very wet or humid soil, this membrane is one of the best precautions you can take. This waterproofing is done with some sort of sheet, consisting bentonite, that makes the foundations sealed from the surrounding soil.

Figure 18, Foundation wall drainage, www.armtec.com

Recently constructed buildings have also another piping system in the ground in order to prevent the water from the roof to enter the ground. This way this other rainwater pipe system can prevent the drainage pipes from overload. All the water is collected via these pipes in one big collector and afterwards transferred to the public water transport system (figure 19).

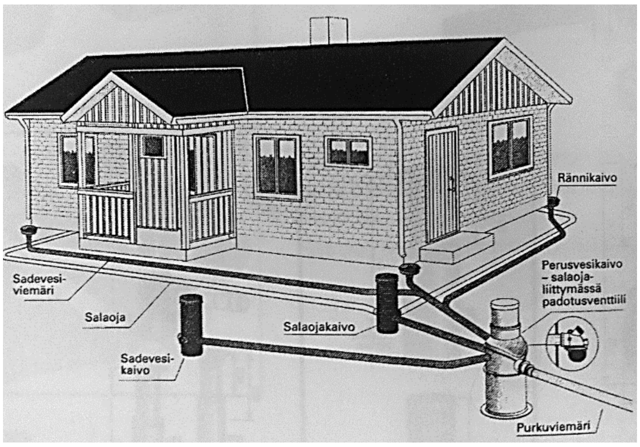

Figure 19, Piping system with collector, Pohjarakennuksen perusteet, p134

6.3 Radon-gas

This chemical element (Rn) is a radioactive, colourless, odourless, tasteless noble gas which is formed by uranium in the soil and rocks. In Finland this is quite common (see figure 20; this figure shows the indoor radon-gas concentration in buildings), so there has to be a solution for this problem because this very toxic gas can result in lung cancer. (Kojo, K. 2015. Radon in Finland.)

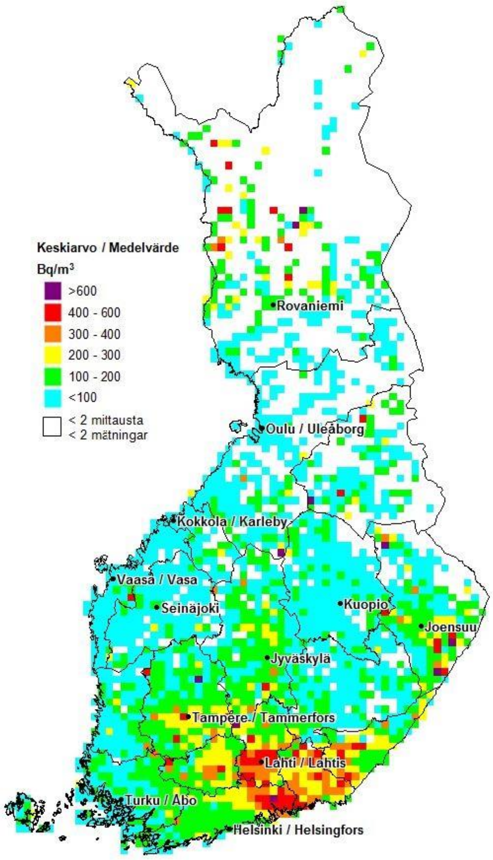

Figure 20, Indoor radon concentration in low-rise residential buildings, www.stuk.fi

The gas enters the house through every single hole there is. Even if the hole is not visible, the gas can penetrate and enter the housing area (figure 21).

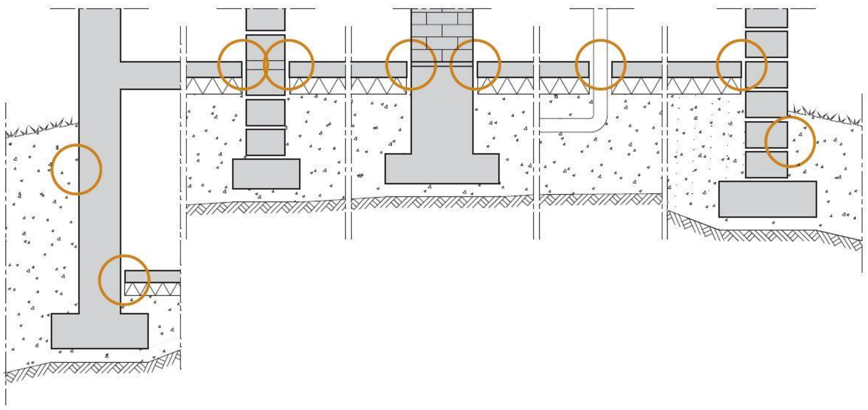

Figure 21, Specific places where radon can enter the housing area, RT 81-11099, p2

In order to not let the Radon-gas enter the house, there are some solutions while building. Most of the time there will be a usage of bitumen to make sure there are no openings so the radon gas can't enter the house anymore. The bitumen are placed between the insulation and the floorplate and between the foundation and the actual wall (figure 22).

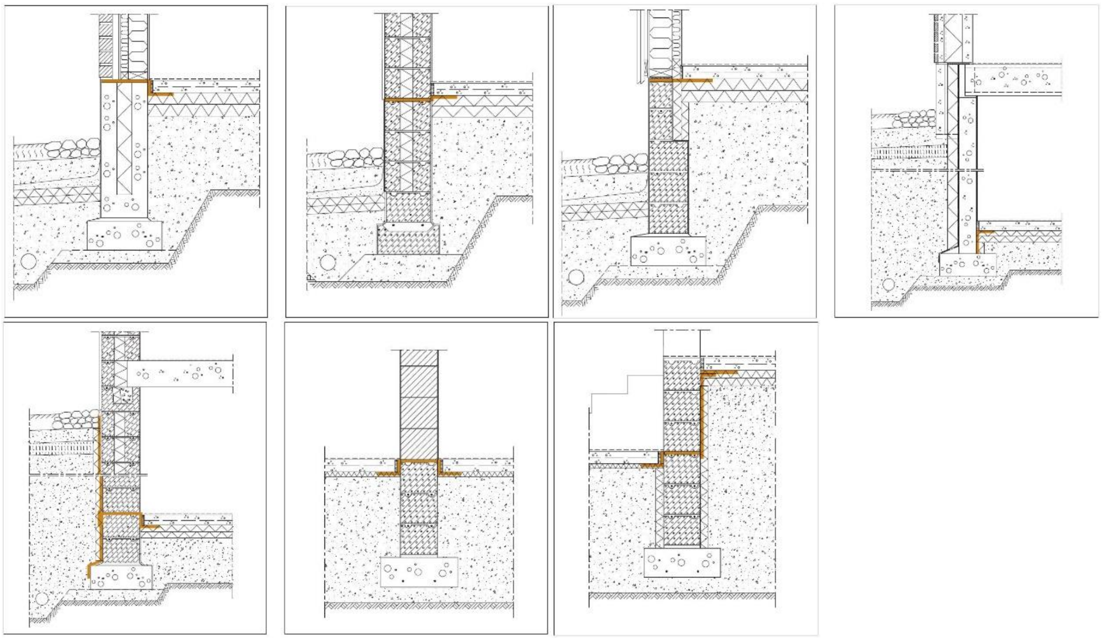

Figure 22, Solutions with bitumen. Bitumen is always under the insulation, RT 81-11099, p6-7

The other solution for this problem is some sort of ventilation of the radon gas that can be found in the soil. This solution can be seen as some sort of drainage, because the working is quite similar. Pipes are placed in the ground under the insulation of the floorplate (figure 23) in a layer of gravel (which is gas-permeable) and a fan, that is mostly located in the attic, garage (unless there is a living space above them) or even outside of the house. Also above the layer of gravel, and underneath the concrete slab, there is a gas-impermeable plastic sheet or membrane. The fan sucks the radon gas out of the soil/gravel and transports it to outside of the the building. Together with this fan and piping system, it is recommended to install some sort of controlling device/performance indicator in order to know if your system is still working. This can be a simple manometer that measures maintening of a vaccuum in the system, or a power control system. Generally the radon gas is reduced to the maximum allowable radon level of 200 Bq/m³ (Becquerel per cubic meter). The ventilation must vent at least 30cm above a roof of the building and more than 3m away from other openings (windows, ventilation, …). The foundation type is the most important factor in deciding the type of radon gas control, it is quite obvious that a building with a pile foundation is easier to control than the 'normal' strip footing foundation.

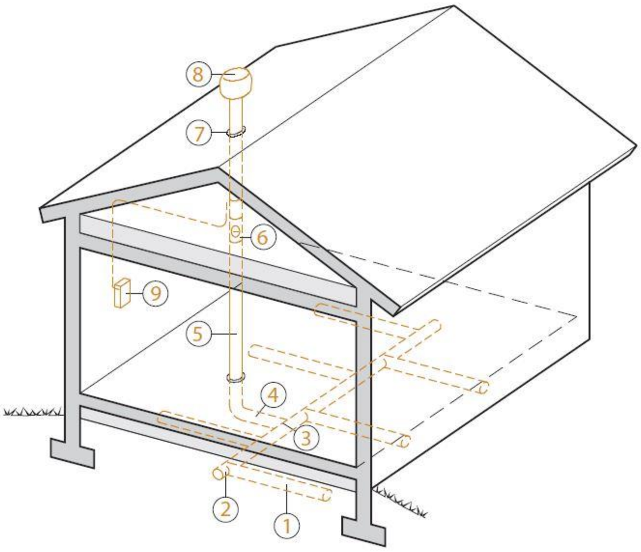

Figure 23, Piping system under building for radon gas, RT 81-11099, p9

6.4 Comparison Finland to Belgium

A big difference between Belgian and Finnish insulation is the insulation under the floorplate. In Belgium the insulation is normally placed above the floorplate instead of between the floorplate and the soil (figure 24).

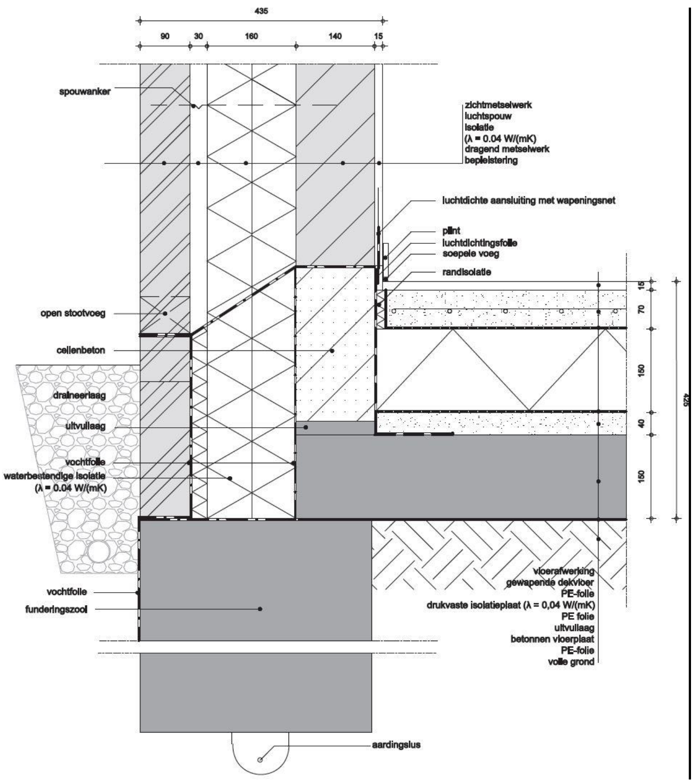

Figure 24, Foundation of passive building in Belgium, www.bouw-energie.be

There is also no use of frost insulation in Belgium because the climate is not as cold as Finlands. So this means that the foundations do not have insulation, but the insulation start above the foundation, between the inner wall and the outer wall.

The drainage of the water in the soil is also common in Belgium. It is not necessary in every situation, but in the lower areas in Belgium it is highly recommended because in winter the water level in the soil rise a lot, therefore in order not to have any water damage, drainage is used.

Older buildings in Finland have a typical way to drain water from the roof. The roof collects the water and transfers the water to the ground via a pipe. This pipe ends on the sidewalk in some sort of gutter in the sidewalk. But as it was mentioned before, the newer buildings their watering is in the ground.

In Belgium there is also radon gas (like everywhere else in the world), but not in the same concentration as Finland. In Flanders for example there is almost no fear of this radon because of the sandy soil. In Wallony there are more rocks and so more chance of higher radon concentrations. The average radon concentration is almost twice as much as in Belgium (96 Bq/m^3 in Finland compared to 53 Bq/m^3 in Belgium). (Van de Meersch D., De Wilde K. 2015. Detectie van radioactieve bronnen door middel van meetpoorten.) In Belgium we have the same solutions as in Finland. Most of the time the first option is to prevent, so the bitumen. If the building already exists and after a test it is clear that there is radon gas, the pipe system is used, but most of the time the pipes (and the fan as well) are placed on the outside of the building.

7 DISCUSSION

In the discussion chapter, the author will conclude his findings on this topic and give his personal opinion on the differences between the two countries. The different types of foundations are in both countries quite similar but there are a few differences. The frost insulation for example is a construction that does not exist in Belgium because of the simple fact that the climate is not as cold as in Finland. It is amazing to see how the construction of a building has to adapt on the climate and certain circumstances. Another great example of this is the radon-gas concentration in the soil. Thanks to some sort of drainage (but then upside down), the toxic gas cannot enter the building.

Something else that is not so frequent in Belgium is the foundation in bedrock. The two techniques that are used to solve this problem show again the great inventively of contractors in Finland. Also the use of a crawlspace is a smart idea to prevent frost damage. Looking closer and more detailed to for example the insulation, there is also a big difference. In Belgium insulation is placed on top of the floorplate instead of Finland, where insulation is between the soil and the floorplate.

To conclude the author will answer the questions asked in the introduction. Yes, both countries can learn from each other’s constructions. But because of the difference in climate and soils, it is simply not necessary to change certain things to their foundations. So would Belgium use some of the structures from Finland and vice versa? No.

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