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Phenotypes and genotypes of traditional Norwegian wooden farms

Space Syntax analyses of Norway's smallest settlement units

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ABSTRACT

The spatial arrangement of wood buildings on traditional Norwegian farms represents the smallest settlement unit in Norway. The length of the timber and the challenge to heat these structures has influenced the arrangement of Norwegian farms. Typically, they consisted of a group of several buildings containing one or two functions. Historic maps were used to conduct the following Space Syntax analyses of the original spatial layout of twelve farms: VGA analyses, all-line analyses, and segment analyses. As the results show, the highest integrated spaces of all farms are related to the location of the primary living building, named 'stugu'. From the stugu the head of the farm has the largest overview and, topologically, the shortest routes to all the other buildings. Moreover, the Space Syntax analyses showed that the three identified phenotypes of the farms have also three different genotypes; which is influenced by the type of landscape the farm is located. When using Hillier's types of the simplest spatial relationships (Hillier and Yang 2019), the row farm has the linear b-type of spatial organization, the square farm, the circular farm (c-type), and the cluster farm – (d-type). In this paper detailed spatial analyses of five farms is presented. As it turns out, the number of stugu's on a farm determines the number of 'rings' or the spatial arrangement between the buildings.

KEYWORDS

Traditional wooden farm houses, phenotype, genotype, j-graph, ethnography, settlement

1 INTRODUCTION

Norway has a very short urban history. After the pandemic in the 13th century, Norwegian society was set back in terms of political and societal development. Most of the human activities were

built up on agriculture and hunting taking place on farms located across the country. This is mirrored in the architecture of Norwegian farms up until the 19th century. In general, there is an absence of renaissance and baroque influences in Norwegian architecture. Likewise, villages are absent until the end of the 19th century. Some towns around the coastal areas existed and developed in Norway, like Bergen, Oslo, Tønsberg, Arendal, Kristiansand and Trondheim before the industrial revolution. However, farms have existed in the valleys and along the fjords throughout the country since the 11th century (Bugge and Norberg-Schulz, p. 5).

The traditional wooden farm buildings represent a rich history of Norwegian wooden architecture during a long period of a society dominated by farming, forestry, and hunting from 1100-1850. Due to this, old Norwegian wooden farms consist of a group of small buildings, the spatial arrangements of which represent the smallest form of a settlement tradition in Norwegian society.

The aim of this contribution is to reveal the spatial arrangements of the various types of Norwegian farms. Most traditional farms consist of a several buildings, each of them containing a single function. The length of the timber and the required energy use for heating influenced the size of the houses. Therefore, there is a separate house for living, another for food storage, a horse stall, pens for the pigs, another for cattle, and another for the iron workshop etc. Due to the surplus of timber in Norway, the buildings are constructed with logs. Log construction provides good isolation for people and animals, especially during winter which can last half the year.

The way these buildings are placed in relation to each other depends on the topography of the landscape in the region in which they are located. The spaces shaped by and located in between the groups of buildings are named ‘tun,’ which is related to the English old word for ‘town’ (Norberg-Schulz 1971). The Norwegian farms can thus be considered as the smallest unit of a built environment. How can Space Syntax then contribute to our understanding of the social logic of space in these micro sized settlements? How can the analyses of the extrinsic properties of space identify similarities or differences between the various types of farms in Norway?

Descriptions of daily life and the building traditions of Norwegian farms are well documented from the ethnologist Eilert Sund in 1850. The period in 1850 is called ‘brytningstid’ in Norwegian history, which can be translated as ‘time of change’. The industrial revolution started around 1850, and Sund used this opportunity to look back and forward in time. His books are unique, due to the large documentation of the old farms, descriptions of daily life activities on the farms at that time, and the lively description of eyewitnesses from that moment (Sund 1862). The title of Sund’s book from 1862 can be translated as ‘About the building tradition on the countryside in Norway’ and has been an important source for studying the life and building tradition for Norwegian farms through history for several researchers (Christensen 1992, p. 5).

In 1992 the ethnologist, Arne Lie Christensen, published a book about the Norwegian building tradition with a focus on the practices of daily life. This book builds further upon the work of Sund from 1862 and adds work from other researchers on Norwegian traditional architecture since 1850. This book is an important source for finding information about how the farm buildings were used.

In 1969 Gunnar Bugge and Christian Norberg-Schulz published a book on traditional Norwegian wooden architecture. The book contains drawings and images of preserved traditional farms in Norway which have not been modernized through the years. Several drawings from their book are based on Gunnar Bjerke's book from 1950 about the Norwegian building tradition on the countryside. During the 1930's, Bjerke made drawings of the buildings and site plans of traditional farms, and he included the functions of each building in his drawings. These are useful as a background for conducting a Space Syntax analysis.

All authors dealing with traditional Norwegian farms identify three main types of the morphological location patterns or phenotypes of various farms based on the location arrangements of houses: (1) 'klyngetun', translated as 'cluster farm', (2) 'rekketun' translated as row farm, and (3) 'firkant tun' translated as square farm. The latter one consists of three sub-variants, such as 'dobbelt firkant tun' (double farm), 'åpent firkant tun' (open square) and 'lukket firkant tun' (closed square) (Bugge and Norberg-Schulz 1969). Christensen also uses the same categories for farms as Bugge and Norberg-Schulz did, but he adds one type named 'tilfeldig spredt bebyggelse', translated as randomly spread buildings (Christensen 1992, p. 254). These types of farms are few and found in the large forest along the Swedish and Finnish boarder. Most of these farms are built by Finnish immigrants who earned they living on forestry. The Finnish immigrants had a different heating system and a sauna, which required the buildings not to be located too close to each other due to fire risk.

According to Eilert Sund, the location pattern of farm buildings is related to the types of landscapes. The cluster farm is located at the hilly Western part of Norway. Here the landscape consists of deep fjords, high mountains and steep hills. Wherever there is an almost flat area in the landscape, the farm buildings are located and clustered together. The land around is mostly used for animal food production and animal grazing areas. The row farm is located in a deep valley along the road running through the valley. These types of farms are mostly located in the valley "Setesdal" and some of its parallel valleys, running from the southern part of Norway towards the higher mountains.

The square farms are located on the Eastern parts of Norway. The landscape is less hilly, and the production consists of agricultural products as well as animals. The open cluster farm is found in the South-Eastern parts of Norway, whereas the closed cluster farm is found in Trøndelag (Central Eastern parts of Norway). The double square farms are found in Gudbrandsdal, a valley

running from the South-eastern part of Norway up to the mountains. This area is hilly, but the valley is broad and has several flat areas for agricultural production.

In Bill Hiller's last keynote lecture at the 12th international Space Syntax symposium, held by Tao Yang, four elementary spatial relationships were discussed (Hillier and Yang 2019). Three of these spatial relationships are applied to the location pattern of buildings from the Norwegian farms. The b-type applies to the row farm, whereas the c-type applies to the square farm, and the d-type to the cluster farm. Figure 1 shows an example of all the three main typologies with images of the farms and the type of landscape they are located in.

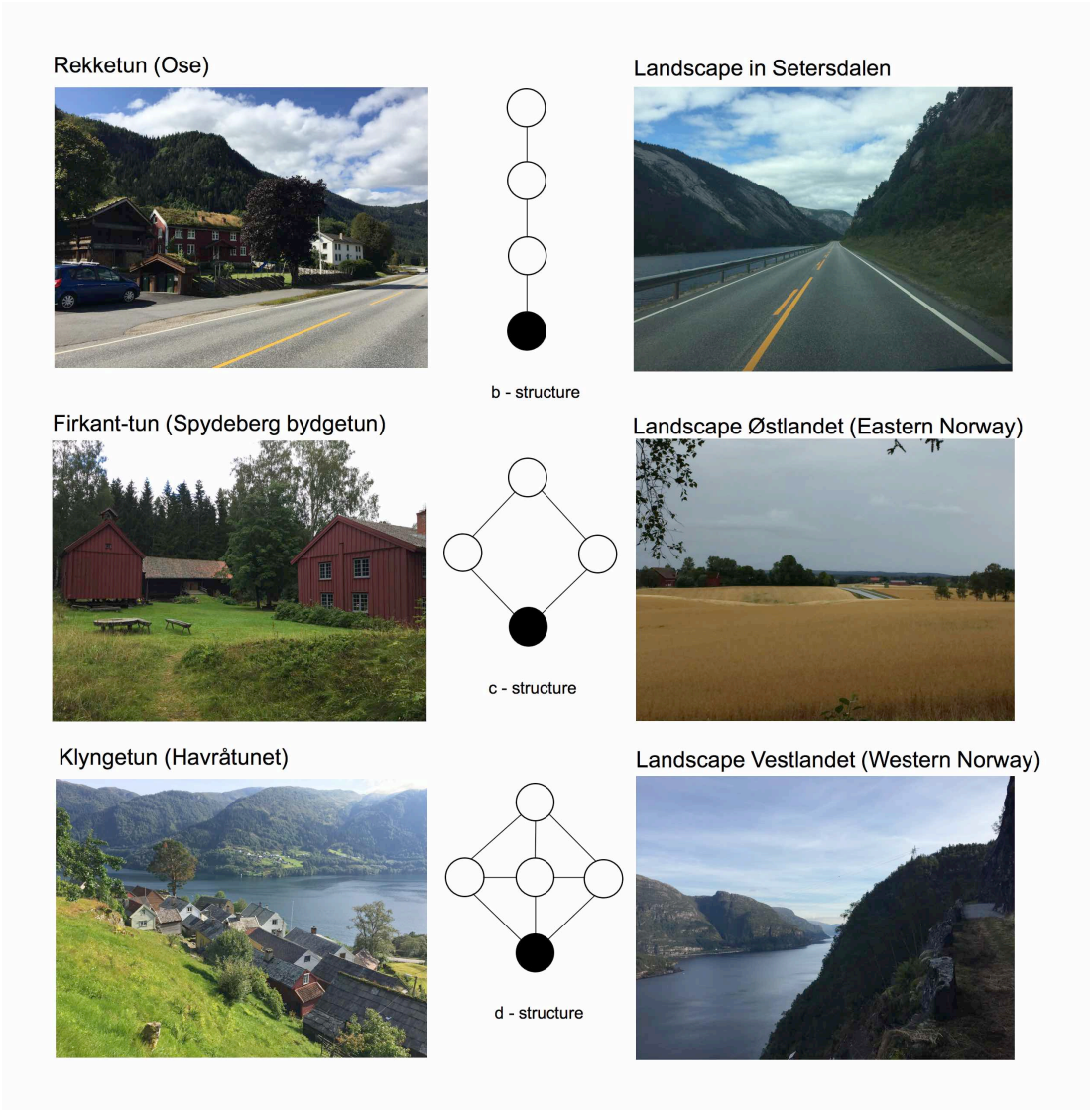

Figure 1: Images of the three types of farms (Osetunet in Ose, Bygdetunet in Spydeberg, Havråtunet in Ostøy) with their spatial principles and landscape types.

The three identified typologies are based on the phenotype of a settlement – i.e how the spatial arrangements of the farms immediately appear to us (van Nes and Yamu 2021, chapter 1). As it

turns out, the use of Space Syntax shows that the spatial arrangements of the three types also have different genotypes. However, when conducting a VGA analysis and an all-lines analysis of the farms, the position of the living house ('stugu') in relation to the inner open space ('tun') has the highest integration in all three typologies. The entrance of the stugu is located on the highest integrated spaces of the tun.

In the next chapter the method of investigation is presented. In chapter three the main findings from the ethnographic literature on the daily life and practices of Norwegian old farms are presented, whereas in chapter four the results from the spatial analyses are presented. In chapter 5 some reflections are made on what space syntax adds to the understanding on the spatial arrangements of the smallest settlements unit of Norway.

2 METHOD OF INVESTIGATION

Most research on traditional Norwegian wooden farms from an architectural perspective takes a phenomenological approach with a focus on the intrinsic properties of space. The focus is on the building materials, texture and ornaments of the exterior as well as interior, and how all these aspects relate to the surrounding landscape. There exist a lot of writings with a focus on variations of construction techniques, ornaments, and variations between various regions (Norberg-Schulz 1971, 1980). The classification of the types of the farms is based on the placing of the buildings in relation to the landscape where the various farms are located.

The drawings in Gunnar Bjerke, Gunnar Bugge, and Cristian Norberg-Schulz books from 1950 and 1969 contain several hand drawn maps (plan and sections) of the oldest farms in Norway. These maps were used to conduct the following Space Syntax analyses of 12 old farms: Visual graph analysis (VGA), through vision analysis, all-lines and choice analyses. Applying VGA and all-lines analyses on past built environments requires that the maps provided represent the right time period (van Nes 2018), which mean that later alterations affecting the location pattern of buildings are not taken into account into the spatial analyses. Most of the modernisation of traditional Norwegian farms took place in the 1960's and 1970's (Christensen 1995, p. 289).

In addition, justified graphs are applied to 5 farms, based on the location of the living house ('stugu'). The 'stugu' is the root of the graph, because it functions as the main building or the 'brain' of the farm for organising the daily life of the farm owner(s).

For each typology several farms are analysed. In this paper, an example of each type is presented. Some of the old farms are modernised after 1969, and some of them function as a local open-air museum. There exist many farms in Norway that are 200-300 years old. However, the modernization of farming has contributed to the construction of new larger buildings located outside the original settlement or broken up the original spatial arrangement. An example of the best-preserved farm for each type will be presented in this paper.

Applying Space Syntax in past built environments requires researchers to rely on the location of the various artefacts found inside the buildings from the archaeologists (van Nes 2011), or from interpretations of old texts or paintings from the past (van Nes an Yamu 2021, chapter 5). In the case of the traditional Norwegian farms, the careful descriptions of social life and social practice from Eilert Sund from 1862 and from Arne Lie Christensen from 1995 are important sources. These authors describe, in detail, how the various building types were used before the industrial revolution.

3 ETHNOGRAPHIC DESCRIPTION OF THE DAILY LIFE ON THE FARM

Most of the descriptions on daily life practices on the traditional Norwegian farms are based on the descriptions from Eilert Sund's research conducted around 1850. Interesting enough, the modern farms in Norway still use the names of the old farm buildings related to their function. The purpose here is to find information about the function of each farm building and the functions on the spaces between them.

The Norwegian language makes a distinction between the concepts of 'innhus' and 'uthus'. It is related to the users of the building. 'Innhus' means that people use the buildings, whereas 'uthus' are buildings housing animals (Christensen, p. 83). Examples of innhus are the living house, the food storage building, and the buildings where people work (black smith, brewery, etc). Examples of uthus are the stall, the barn, and the stable.

The main building of the farm is the living house, named 'stugu' or 'stova'. The name is from the English word 'stove' where the food is made and where there is heating (Christensen, p. 85). Norway has very long, dark, and cold winters, and in most of the country, access to wood comes from the forest. Therefore, heating and fire heavily influences the spatial setting of the living house. The oldest living houses, named 'Årestua' had fire in the middle of the room with a hole in the roof for the smoke to escape (Christensen, p. 156). Around 1700, new types of stoves were developed with a chimney. In addition, windows and the petroleum lamp were imported from that time period. That contributed to that the heating source were placed from the centre to the corner of the main room in the living house, windows became more common, and the hole in the roof was closed. The new types of stoves contributed to lesser use of wood for heating, the heat could stay longer in the living house, and many living houses got a second floor for sleeping (Christensen, p. 160-173).

The living house (stugu) is mostly located on the highest parts in the landscape of the whole farm. The only entrance of the stugu is both oriented towards the inner space and is on a sunny spot of the building. This is the place where all people returned home after work in the fields, forest, fjords etc to for eating, sleeping, and for social life. Often several families used the living house for sharing the heating during the winter months in the oldest type of living houses.

The stugu was the family room for everyone living on the farm, containing one to three rooms. The largest rooms were used for eating, sleeping, and indoor handiwork. For living houses with three rooms, the other rooms are small and are the entrance hall and the small storage and sleeping room. The latter one was used more for storage than sleeping (Christensen, p. 84).

The spatial arrangement and furniture inside the large living room were arranged in line with hierarchic principles. The head of the farm was sitting at the end of the long table, at the window with the only cabinet diagonally across the stove. The women and the servants were sitting closest to the fire due to preparation of food (Christensen, p. 85). Later when the living houses were modernised, a separate firehouse were used for making food. Often the old living house was converted to the firehouse and a new living house with a stove and chimney was built next to the original living house. Often the firehouse was used as the summer living house for the warm summer months (Christensen, p. 91).

The exterior of the stugu has almost no decorations. In contrast, the interior is richly decorated. The stugu is thus an inward oriented building. According to Norberg-Schulz, the idea is to bring memories from the summer, because families spend a lot of time during the dark period inside the stugu (Nordberg-Schulz 1971).

The food and clothing storage building is named ‘stabbur’ and this type of building dates back to the year 1000. In contrast with the stugu, the stabbur’s exterior is richly decorated with woodcarvings. This type of building is standing on piles made of stones for keeping mice and rats away. Due to the long winters, the storage building was an important building for storage of dried meats, sausages, crops and potatoes. Often the storage building was used for housing guests in the summer months (Christensen, p. 94).

The stugu, stabbur, and the firehouse were the most important buildings in the first part of the Middle Ages. Around 1200 the attic building (loft) or lift appeared on many of the large and rich Norwegian farms. The building was used as the guest and representation building for the farm. Often large ceremonies, such as weddings and funerals were held in the Loft. Like the stabbur, the attic building exterior is richly decorated with woodcarvings. In contrast, the living house is richly decorated from the inside. The attic building had no heating, so therefore this building was only used during the summer months (Christensen, p. 96).

Workshops buildings with use of fire, such as the brewery house and black smith were located outside the tun due to fire risk. The same accounts for the sauna building.

Buildings which housed people are named ‘innhus’ and are located on the highest part in the landscape were the farm is located. While buildings containing animals, named ‘uthus’, are

located on the lower part in the landscape. Animals produce also body heat. One of the reasons as to why the living house and animal houses were separated is due to the moisture from the animals which caused moisture damage to the wooden building. Rebuilding one building costs less than a whole farm.

The stable is the horses' house and has the highest ranking of the 'uthus' buildings. The horse transports people and goods and is the engine for preparing the ground for crops. Therefore, the entrance to the stall is located towards the innhus area, whereas a separate door for the removal of the horse manure is towards the uthus area (Christensen, p. 102).

The barn (in Norwegian named 'fjøs') is the house where the animals are housed during the winter months. When the animals were grazing in the fields in the summer, often people cleaned the house and use the barn as a summerhouse. At farms where several families that shared fire in the long winter period, the barns were used as summer houses or as a separate living room for each family during the summer months when the animals were grazing outside. On some farms, the family moved out to the barn as an exchange from the inside life in the stugu. Some farms consisted of several barns, one for the pigs, one for the cows, and one for the sheep. Barn for storage of animal food and preparation and storage of crops is named 'låve' in Norwegian. The building is found mostly in the Eastern parts of Norway where there is the production of crops (Christensen, p. 103).

These building types have remained stable since the Middle Ages, and these building names are still used in present Norwegian farms. Farms in the coastal areas underwent a transformation due shipping and trading activities with continental Europe, whereas the daily life and building traditions on farms located in the deep and remote valleys and fjords remained stable since the Middle Ages up to the end of 19th century. There were some economically prosperous periods resulting in the improvement and alteration of farm buildings. However, the location of these building has had the same location pattern throughout centuries. Due to the solid loft construction, the buildings are well preserved. In many farms, the original old living house is kept in the expansion and alterations of the living house buildings.

In farming language, the concepts 'innmark' and 'utmark' are used. The innmark is the area in the landscape used for grazing animals and for agricultural production. These areas were fenced and often belonged to a particular farm. The 'utmark' is the untouched nature, the forest and the mountains. Often these areas were used for everyone (Christensen, p. 80).

In the innmark area, the farmhouses were grouped around an inner space shaped by the wooden lofted buildings, named 'tun'. A distinction is made between the various tun types, based on the morphological location pattern of the farmhouses. How houses are placed depend on the shape of

the landscape, the climate, flood risks, strong winds, and drainage problems. The innhus is located on a higher position than the uthus.

Ethnographic accounts of the spaces between the buildings consist of descriptions of the ground from a hygienic perspective. The ground is described as muddy and full of manure from the animals. Due to the humid weather on the Western part of Norway, the ground was very wet and muddy, whereas the ground consisted of dry ground in the Eastern part of Norway. In the winter, the ground is covered by snow. However, there exist few descriptions on the daily practices of how the spaces on the tun were used in the past. The only description is that the tun was used as a working space, some tuns have invisible boarders where one part was used for working actives and another part for representation (visitors, weddings, funerals, etc). Other tun had fences with the purpose to separate the animals from human beings. The next step is to reveal what the application of Space Syntax can add to the understanding of the social logic of space of the smallest settlement unit in Norway.

4 THE TYPES OF FARMHOUSES AND THEIR SPATIAL CONFIGURATIONS

Seemingly, the landscape and weather conditions of Norway have influenced the location pattern of the buildings on traditional farms. The cluster farm type is mostly found in the Western part of Norway. The steep slops and hilly landscape contribute to the building of clusters on the few flat spots with good weather conditions such as sun and shelter for rough weather. The row farms are mostly found in deep long valleys in the Southern part of Norway. These farms are mostly located on the sunny side of the valley along a travel route running through the valley. There exist some row farms in the North-Western part of Norway too, located in narrow valleys. The square farms are found in the Eastern and Northern parts of Norway with a relatively flat landscape or lesser dramatic landscape setting.

Figure 2 shows the areas in Norway where the various types of farms are located. The locations of the examples discussed in detail in the next chapter are shown on this map. Christensen admits that we know very little about how these various farm types have developed. As he states, the climate, communication, topography, the organisation of the workload, and aesthetic considerations have probably influenced the location pattern of the buildings (Christensen 1995, p. 251).

Regarding the ownership of land, most farms had a strip of land leading from the bottom of the valley or the fjord up to the higher mountains (Våge 1990, p. 80). Most production of the food was for self-supply for the farm's dwellers up to 1850s (våge 1990, p. 81).

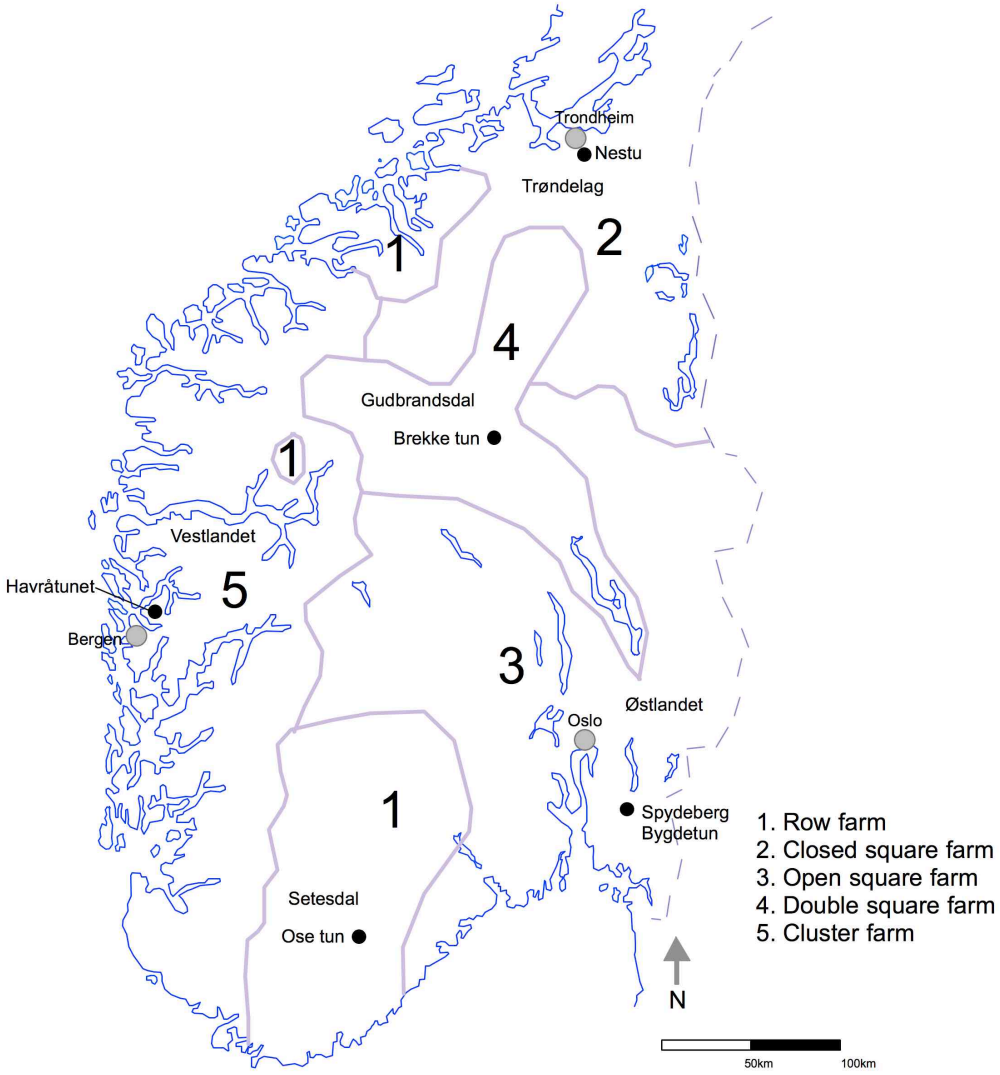

Figure 2: Map showing the location of the various types of traditional farms in Norway.

4.1 'Rekketun' – the row farm

The buildings of a row-farm are located in a line. It is considered the smallest and simplest location of the buildings of a farm, where the placement of buildings follows a primary route running through the valley. Some of the buildings tend to be located on both sides of this main road (Bjerke 1950, p. 18).

The row-farm typology is mostly found in the 'Setesdal' valley and some smaller valleys in Telemark province. There exist some row farms in some narrow valleys in the inner areas of Vestlandet and along the coastal areas north of Vestlandet (see figure 2). The Setesdal valley runs northwards from the southern point of Norway towards the high mountains. This valley was, until recently, poorly connected to the rest of the country due to the complex topography of the

landscape. There are almost no roads running over the high mountains to other side valleys. Therefore, the old traditional farming culture with wood carving, wood cladding, knitwear, and folklore music has long been preserved until the road improvements to the valley from the South were implemented after the 1980's.

Most of the row farms tend to be located along the main route running through the valley. The row farm has many variants, depending on the direction of the sun, the landscape setting, and the view setting of the valley. Some farms are located only on one side of the road and others on both sides of the main route running through the valley. The 'innhus' are located on the higher side of the road and the 'uthus' on the lower side of a hill slope due to drainage issues (Våge 1990, p. 95).

Most row farms in Setesdal were populated by one family. The row farms from the North-Western part of Norway consisted of continuous rows with farms owned by several families. The farms located in the Voss area in Western Norway were located in three rows (Christensen 1995, p. 257). Here in this case, the Space Syntax analyses of one of the smallest row farms is presented.

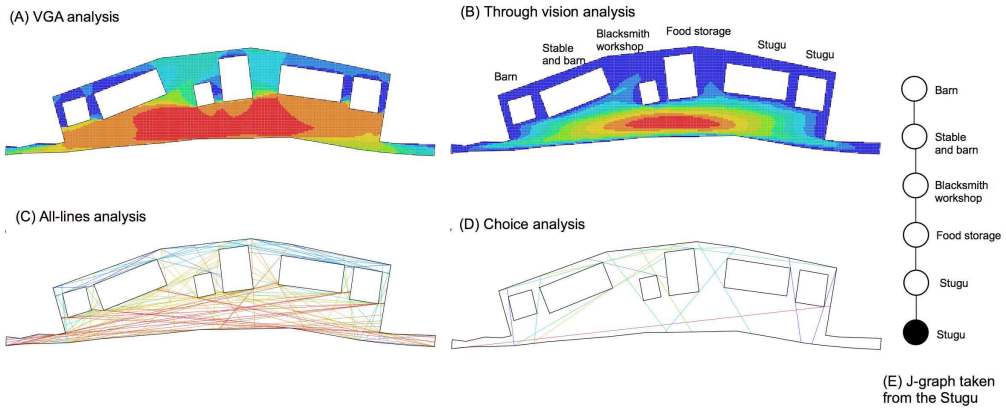

Figure 3: Space Syntax analyses of Ose farm in Austad in Ose municipality.

Figure 3 shows the results from the various Space Syntax analyses of Ose farm in the 'Setesdal' valley. Ose farm is a row farm in its simplest form, with buildings located at only one side of the road with all building entrances oriented towards the East where there is a view over the valley. The analyses are taken from old maps of the farm. Today the 'uthus' buildings such as stable and barn are replaced with a large modern building. The farm is thus still in use, and people live in the two stugu. The exterior of the two stugus are wood clad, in which the old loft construction of the walls is preserved. The oldest stugu is still kept. That is where the root of the j-graph is taken from. The j-graph also shows the hierarchic relationships between the farmhouses, where the most important 'innhus' is located closest to the old stugu, and the 'uthus' furthest away.

The innhus are located on the left and the uthus on the right side in figure 3. The food storage building 'stabburet' has the highest integrated space, followed by the stugu. The oldest stugu has the highest values on the choice analyses. This is where the root of the j-graph is taken from. This stugu has long kept its oldest fire form with a hole in the roof. The other stugu is a result of the improvement of heating from 1850. The stabburet is richly decorated of carved wood in its exterior.

Even though the buildings are in a row, their slightly curved position creates a highly integrated inner space. The living room houses (Stugu) are located at the end of the row, at the highest level of the farm due to drainage issues. The pigs' barn is located furthest away from the stugu due to the smell. The food storage building is located closest to the 'stugu'. All buildings have their entrances oriented towards the main route and toward the view over the valley.

4.2 'Firkant tun' – the square farm

The square farm with its circular organization consists of three subgroups. These subgroups are related to local weather and landscape conditions in the Eastern regions of Norway, named 'Østlandet' and 'Trøndelag.' The closed square farm is found in Trøndelag, while the open square farms is found in Østlandet. Both landscape types are relatively flat. The double square farm is only found in the valley 'Gudbransdalen', consisting of hilly – but not steep – fields, surrounded by mountains. The valley runs from the Eastern part of Norway towards the high mountains.

The square farm type consists of an inner space shaped by the farm's buildings. The closed and open square farms consist of only one ring, whereas the double square farm consists of two rings. According to Bjerke, the square farm is the youngest type of a spatial organisation of the farm buildings. The houses are located 90 degrees to each other, shaping a square shaped inner space (Bjerke 1950, p. 19).

Most existing square farms have undergone extensive modernization. Some of the original buildings are replaced with modern ones during the 1960's and 1970's as the size of the machines increased in line with the technological developments. In many farms, these new large buildings are placed in such a way that the square shape of the 'tun' is preserved, whereas in others, the buildings are placed outside the 'tun.' Therefore, the examples analysed here are based on the drawings from Bjerke, Bugge and Norberg-Schulz. Most of the best-preserved farms with the original locations of the buildings are found in open-air museums.

4.2.1 ‘Closed firkant tun’ – the closed square farm

The closed square farm consists of relatively long and narrow two floor buildings creating a closed square. The houses of each farm are located around an inner open space. If there were several farms, each farm was located close to each other, where each farm created their own closed square. These types of farms are mostly found in the Trøndelag region, adjacent areas to this region and across the Swedish boarder (Christensen 1995, p. 258).

Figure 4 shows the Space Syntax analyses of Nestu farm, originally located in Innerøy municipality. The farm does not exist anymore. Only some buildings are placed in an open-air museum in Trondheim city. However, the plan of its original spatial arrangement is presented in the book of Bjerke from 1950. The purpose of the closed arrangement of the buildings is to protect the inner space from the strong winds when the weather is bad.

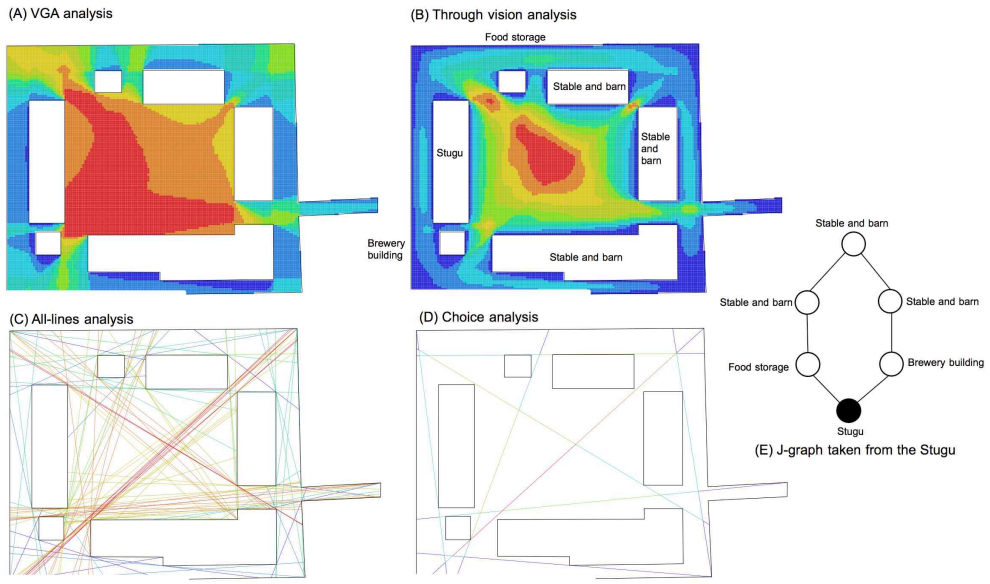

Figure 4: Space Syntax analyses of Nestu farm, Sakshaug on Innerøy in Trøndelag.

All buildings have their entrances located towards the inner space. The stugu’s entrance is located on the highest integrated space in the VGA analyses. The food storage and the brewery are located on each side of the stugu building. The other buildings are storage spaces for farming equipment and animals. They are located furthest away from the stugu.

All buildings are located in a circle around the ‘tun’. Most of the tuns tend to have one tree located in this space, named ‘tuntre’. Unfortunately, the drawing did not show any location of such a tree. A location of a large tree can affect the results from the VGA, all-lines analyses and through vision analyses (Yamu, van Nes and Garau 2021). Innhus and uthus are located on each separate part of the circle in the j-graph. The closed square farm has a clear c-structure.

4.2.2. ‘Åpent firkant tun’ – The open square farm.

The climate in Southeast Norway is dry and warm in the summer and can be very could in the winter. However, the wind is not so strong as in the Western and Northern parts of Norway. As presumed, the buildings are not enclosing the central space in the farms located in these parts of Norway.

Often the building on the open square farm have space between them. In many farms one or two ‘walls’ of the inner space lack buildings. The ‘innhus’ are located on the one side of the inner space and the ‘uthus’ on the other side. However, the ideal was to have a square space between the buildings. Most of these types of farms are on Østlandet. The landscape is relatively flat, and the region is not as windy as in Trøndelag. Anyway, the ‘innhus’ were located on the higher part of the landscape in relation to the ‘uthus’ (Christensen 1995, p. 258).

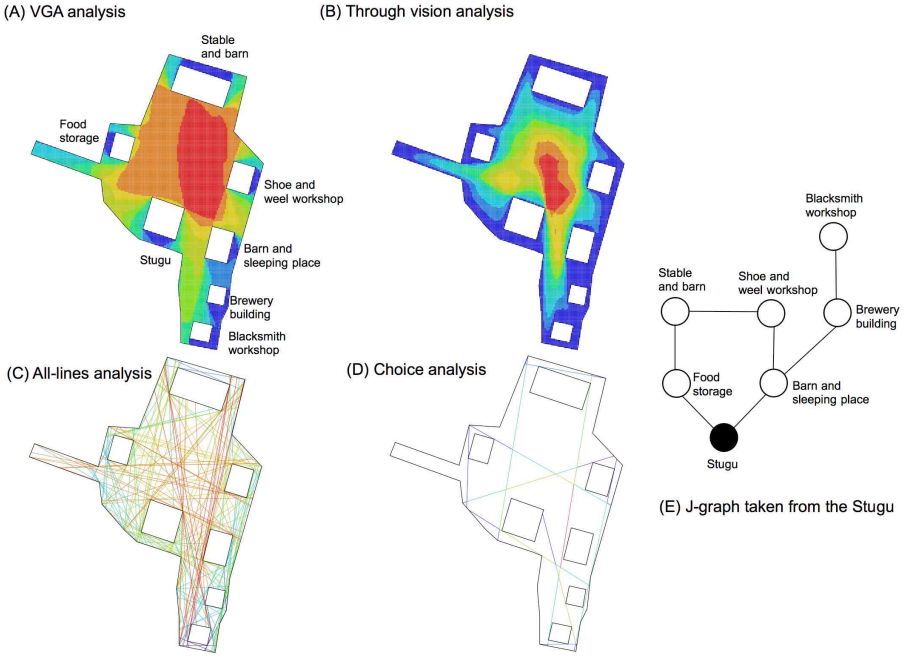

Figure 5: Space Syntax analyses of Bygdetunet in Spydeberg.

Figure 5 shows various Space Syntax analyses from Bygdetunet in Spydeberg municipality. The building containing the highest level of human activities also has the highest values in the spatial analyses. It is the Stugu, and the horseshoe and wheel workshop place. The j-graph is taken from the stugu. When including the buildings with high fire risk, the farm as a c-structure with an extra ‘arm’. However, the main farm has a typical c-structure with innhus and uthus located at each part of the circle. The people circulate on the most integrated part of the tun.

The farm is an open-air museum, with an intact interior and surrounding buildings. The most integrated spaces are between the stugu and the barn with the extra sleeping place and the shoe

and wheel workshop. The innhus buildings have the highest integration in most of the spatial analyses. That is where most of the daily activities took place. Due to the dry climate in the Østland area and high fire risk, the blacksmith is located outside the tun and furthest away from the other buildings. The food storage and the barn with an extra sleeping place are located closest to the stugu.

4.2.3. 'Dobbelt firkant tun' – the double square farm

In the previous two cases, the buildings encircle one open space. In only one region, there exist farms with two open spaces, named 'dobbelt firkant tun' – translated to double square farm. The region or valley, named Gudbrandsdal is hillier than the areas in Trøndelag and Østlandet. However, the hills are not so steep as the Western areas of Norway and the valley is not as narrow as Setesdalen. With two circles, the spatial arrangement of the double square farms is more complex than the previous ones discussed.

The double square farm makes a clear distinction of the spatial arrangement of the innhus and uthus. The innhus and uthus are located around each separate inner open space. Therefore, these inner spaces are named 'inntun' and 'uttun' – translated as the outdoor space for the people and outdoor space for the animals. Often the inntun is the representative outdoor space, whereas the uttun is the working outdoor space and for the animals (Bjerke 1950, p. 19).

The building types that are dividing these two spaces are often the stall or the stabbur buildings. According to Sund, the original idea behind the development of these two types of outdoor space has to do with new attitudes for hygienic standards developed around 1700. The oldest types of the double square farms date back to that time (Christensen 1995, p. 257). During an economic boom after 1700, the tendency was to build more houses instead of larger houses in the Gudbrandsdalen region (Christensen 1995, p. 258).

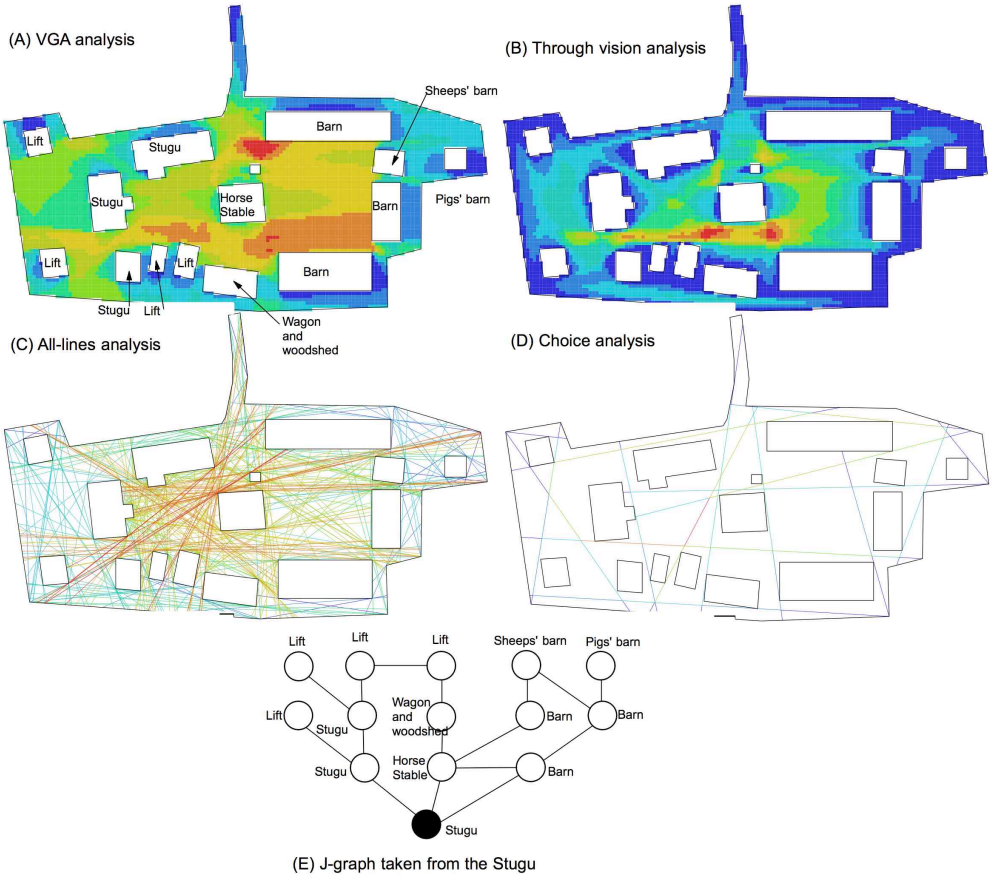

Figure 6: Space Syntax analyses of Brekken Tun in Sel.

Figure 6 shows Space Syntax analyses of Brekken Tun in Sel municipality. There exists little information about Brekke tun, and the farm does not exist anymore. The basis for the Space Syntax analyses is a map provided by Bjerke's book from 1950.

The Stugu and the horse shed have the highest values in the all-lines and choice analyses, whereas the areas around the horse stable have the highest value in the VGA and through vision analyses. When entering the farm, the first buildings that are visible are the buildings where people are living. The horse stable has the most central position because the horses are used for transporting people and to use as an 'engine' for the food production (Våge 1990, p. 95). Whereas the cultivation of cereals domintates the closed and open square farms, the double square farm has also the food production from animals as well.

The two different tun's got also two different names. The representative tun is named 'stuegard' which can be translated as 'living home space', whereas the working tun is named 'nautgard'.

The j-graph is taken from the main stugu. The farm consists of two main circles and a small circle. The smelliest barns and some loft buildings are located outside the tun and thus outside the circles. Often one large family populated a large double square farm. Brekke Tun has two stugu's, where each generation of one family have their own stugu.

4.3 'Klyngetun' – the cluster farm

The cluster farm is mostly found along the fjords in Western Norway. The suitable place for the houses of the cluster farm and the ground for agricultural production is scarce along the whole Western coast of Norway (Bjerke 1950, p. 19).

The cluster farm is mostly based on food production from animal slaughtering and fishing. Some crop production also took place, but on a small scale (Våge 1990, p. 81). The cluster farms are located on the few existing, almost flat, plateaus along the steep hills around the deep fjords. Many of these farms have a summer farm consisting of one to two buildings ('seter') located in the higher mountains for the animals. The transport of food to other places took place by foot along the fjord when it was not frozen, or on ice when it was thick enough for transport.

Often, up to 20 families were located on one cluster farm. The reason is that many farmers made a living through fishing, boat building, trading, and hunting. Due to this extra income, there was a lesser need for ground for food production. Therefore, the farm could be split up into several smaller farms. Often the ground and forest were shared among the different farmers (Christensen 1995, p. 255).

The location pattern of the cluster farm depended on the risk for landslides and avalanches and that there were few suitable plateaus for locating a settlement in the hilly Western Norwegian landscape. The golden age for the cluster farm was from 1700 to 1850. Due to population growth and inherit traditions, the production plots became complicated and ineffective for food production.

At this moment there are only two intact and preserved cluster farms in Norway: Havråtunet and Agatatunet (Christensen 1995, p. 256). The implementation of new property laws in 1821 about the division of 'innmark' areas contributed to breaking up of many cluster farms. Families broke down their buildings and rebuilt them at other places. New production modes made it no longer feasible to run a farm in this way (Christensen 1995, p. 288).

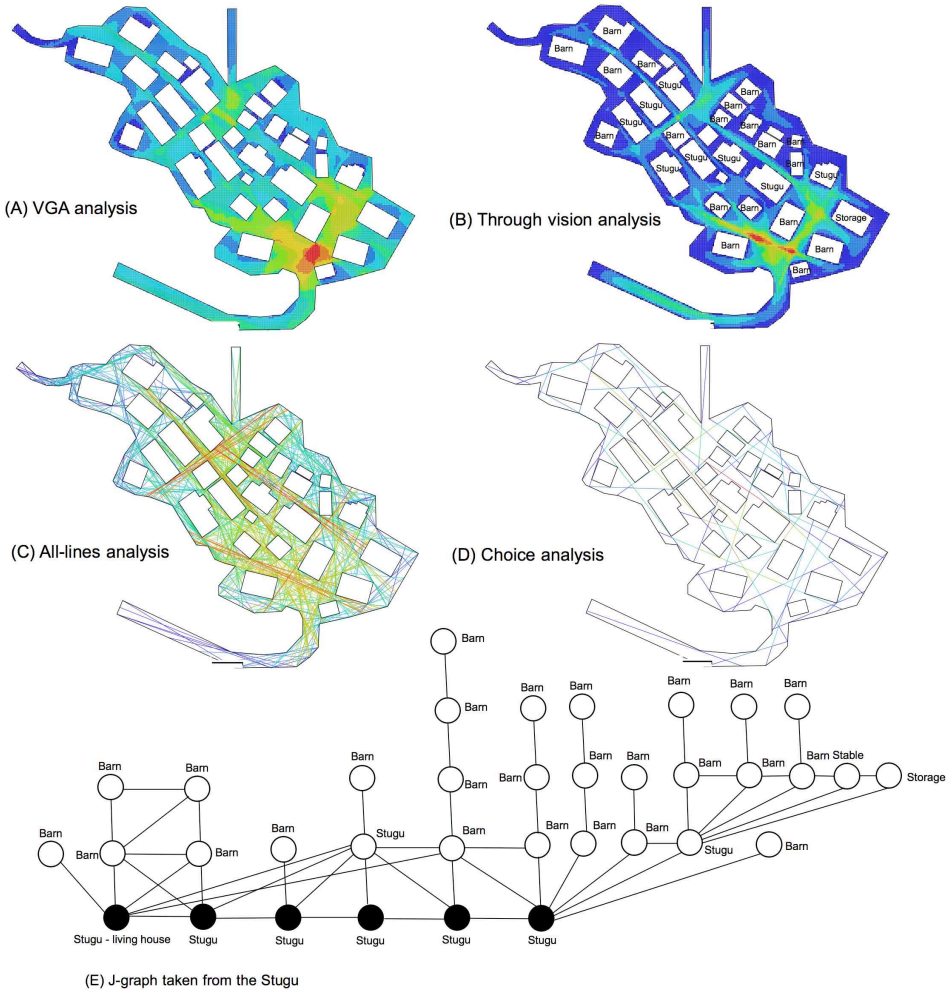

Figure 6: Space Syntax analyses of Havråtunet on Osterøy

The cluster farm 'Havråtunet' dates to around 1300 (Gjerdåker Skre 1994, p. 151). Several families were living on this farm, and all families shared the innmark areas. The farm functions today as a dwelling place and as a museum in the summer months. The whole farm, with its surrounding landscape, has been a tourist attraction since the 1930's. Therefore, the whole farm has been protected by law since 1973 (Gjerdåker Skre 1994, p. 160).

The location of the buildings in a cluster farm seems randomly placed in the hilly landscape. However, a Space Syntax analysis clearly shows a spatial logic of the arrangements of these buildings. The location pattern of the buildings looks like a small village.

Figure 7 shows various Space Syntax analyses of Havråtunet on the island Osterøy. When revealing the results from the all-lines and choice analyses, the stugu buildings are located along the highest integrated lines. Even though the word 'tun' is used, the cluster farm consists of a set

of several small spaces created by the buildings. The main route into the farm is located at the lowest part of the farm, and these spaces have the highest value on the VGA and through vision analyses. The stugu's of the farm are located in a row with the entrances located inwards towards the inner spaces of the farm. This inner space that has the highest integration in the angular choice and all-lines analyses is where the entrances of all stugu's are located.

The J-graph is taken from 6 of the 8 stugus. Interesting enough, the two other stugu also shape rings on the graph. Whereas the linear farm has a b-type of structure, the square farm a c-structure, and the cluster farm has a d-structure. In contrast to the linear and square farm, the cluster farm consists of several families.

The j-graph of Havråtunet shows that the location of every stugu has a central position in the farm. The stugu building creates a ring of movement to other buildings. The number of rings is dependent on the numbers of stugu's of the farm. Here in the case of Havråtunet, it has eight rings.

5 CONCLUSIONS

As the results from the spatial analyses show, highly integrated spaces of the farms are related to the location of the main living room building 'stugu'. From the 'stugu' the head of the farm have the largest overview and topological shortest routes to all the other buildings. For all types, the location of the entrance of the 'stugu' is oriented towards the highest integrated space of the inner space named 'tun'. Regarding the inner meeting space, the tun has similarities to the role of a main square of a small town. Otherwise, the entrances of all farm buildings are oriented inwards, towards the 'tun'. Building located outside the tun have their entrances located towards the tun.

Applying Space Syntax to traditional Norwegian farms shows that the identified three phenotypes of the farms have also three different genotypes, in which is influenced by the type of landscape the farms are located. When using Hillier's types of the simplest spatial relationships (Hillier and Yang 2019), the row farm has the linear b-type of spatial organization, the square farm the circular c-type of spatial organization, and the cluster farm the d-type of spatial organization.

Therefore, the geno- and phenotype of farms are also related to intrinsic and extrinsic properties of space. Each phenotype also has a matching phenotype, related to the elementary spatial interrelationships proposed by Hillier and Yang (2019).

What does Space Syntax add to ethnographic studies of traditional Norwegian farms? The discipline of ethnography has a long research tradition, in comparison with studies on built environments, in terms of offering detailed descriptions of daily practices from the past. In many

ways, ethnographers retrieve the hidden logic in the everyday life taking place inside and outside buildings (Jasper 2019, p.5). However, ethnography lacks spatial concepts for describing the spatial logic of social practice. Conversely, architects are focused on the form and materials used in buildings. Often the descriptions of the daily life and practices are lacking in their work. In many ways ethnography and architectural studies fulfil each other (Stender 2010, p. 12-13). As this investigation shows, Space Syntax seems to fill this gap. However, more farms would need to be analysed in order to draw precise conclusions on the relation between space and society and the arrangement of buildings of the traditional Norwegian farms. In addition, Space Syntax analyses and correlations of current daily social practice of some of the newer farms in a present context is needed to gain an understanding from the spatial analyses of past farms.

The place phenomenologists have developed precise concepts about describing the intrinsic properties of spaces of Norwegian traditional farms, such as texture, sphere, ornaments, settlement patterns, and building characteristics (van Nes 2012). This has contributed to an identification and description of the different phenotypes of the traditional farms, with a focus on built form and meaning (van Nes and Yamu 2021). What Space Syntax adds into the understanding of built form and daily practices of traditional Norwegian farms is a description of the relationship between built form and function, thus extrinsic properties of space or the genotype of the settlement structure (van Nes 2012, Yamu et al 2021).

These findings are in line with Hillier's models on the most elementary spatial relationships in built environments. The row farm and the square farm are the smallest types of settlements. Names on the very small settlements can also be found in other languages, such as 'reihendorf' (row village) and 'rundling' (circular village) in German (Bugge and Norberg-Schulz 1969), or 'lindtdorp' (row village) and 'brink' (circular village) for describing small old villages in Dutch. The larger the farm, the more the buildings begin to form rings. The cluster farm shapes a network of movement routes between the buildings. The number of rings in a system depends on the number of stugu's on a farm. The higher number of stugus of a farm, the higher number of rings in a system. Only one stugu in a farm implies that a farm consists of mostly only one ring or a simple row.

Finally, what Space Syntax adds to the research on traditional old farms are indications of how the inner space tun was used in the past in relation to the functions and hierarchy of the surrounding farm buildings. Probably most outdoor activities between the buildings took place on the highest integrated spaces, which is in line with the theory of the natural movement (Hillier et al 1993).

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