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The problem of implementing sustainable mobility means in average sized Norwegian towns

Spatial analyses and diagnosis of Notodden and Førde

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ABSTRACT

During the last 30 years, enhancing sustainable cities has been on the planning agenda in Norway. The focus is on finding solutions for sustainable mobility means in densely populated urban areas, and to put large investments in solutions for public transport. At present, it seems that the large cities are better at implementing sustainable planning measurements than the smaller towns in Norway. Therefore, the aim of this short paper is to reveal the results from the spatial analyses of two average-sized Norwegian towns Førde and Notodden and discuss these results in terms of sustainable planning measurements.

As it turns out, both towns have a spatial layout on several scale levels that enhance private-car dependency. The local integration of the street network is low, the areas are monofunctional, the street profiles of most streets enhance private car usage, the building density is low and building entrances are turned away from street and roads. Likewise, the towns' centres are planned in such a way that do not encourage walking, and the central squares are used for parking. At the end we discuss what actions these two towns can take to achieve a greater degree of sustainability in their built environments.

KEYWORDS

Spatial diagnosis, mid-size towns, sustainable development, car-dependency, urban sprawl

1 INTRODUCTION

Since the Brundtland Commission presented the report "Our common future" in 1987, both the UN and Norway have fronted sustainable development in various policy documents, with a focus on long-term improvements. The concept of sustainability was first incorporated in planning through Norwegian national guidelines in 1993, and then substituted by governmental planning guidelines in 2014 (Kommunal og moderniseringsdepartementet 2016).

Increasing attention to climate and the environment means that considerations of sustainability play an increasingly important role in regional and municipal spatial and transport planning. This is reflected in several general guidelines where the Planning and Building Act, national expectations, national policy planning regulations, state planning guidelines, and numerous parliamentary reports and reports published in the last 30 years can serve as examples. Through restrictive municipal plans and mutually agreements with state bodies, the large cities have shown the ability to act and to take the national guidelines seriously (de Koning et.al 2020). However, the mid- and small sized towns are lagging behind.

In order to ascertain whether the mid-sized towns Førde and Notodden have been planned in accordance with sustainability policies since 1993, we have prepared a set of indicators which builds on the conditions given within the guidelines. These indicators are distance between the new housing areas to schools, services, existing town centres, and to what extend these new planned areas are contributing to urban sprawl into the countryside. These indicators are applied to about 30 accepted land use plans in Førde and Notodden within the period of 1993-2018. The result of the analyses of these new land use plans, however, shows that the progress of becoming a sustainable town has had a negative development in Førde since 1993, and a slightly positive development in Notodden.

In 2015, Notodden decided to reduce 180 acres of virgin land in favour of one hundred new residential plots for single family houses. This took place at the same time when the state planning guidelines emphasize the potential for densification and transformation in existing urban areas. Four years later, a plot near the car-based shopping centre area outside Notodden centre was granted permission to expand from space-intensive trade to retail. At the same time, we observe that current regional plans discourage development inside existing town centres, which lead to a decline and increased private car dependency.

Since 2014, the national transport plan has had an objective of zero growth in private car usage. Nevertheless, the municipal plans of Førde facilitated land for new housing areas 8 km from the town centre in 2015. In the same year, 70 acres of fully cultivated topsoil land was decided to be reallocated from agricultural purposes in favour of a new commercial park 1.5 km from Førde centre. The goal was to reduce the trade leakage in the region even though Førde has a trade offer, five times as large as the population would need.

During the recent decades the following has taken place in both towns:
• Large car-based shopping centres are established and expanded outside the town centres
• Agriculture and natural resources are being demolished for new buildings plots
• Important functions (homes, workplaces, etc.) are established far from each other
• The proportion of dwellings that require much space, energy use for transport and land resources is high, such as the development of new detached houses
• The private car is given high priority as a means of transport in the towns, despite increased government investment in more climate- and environment-friendly modes of transport such as walking, cycling and public transport
• Important central public spaces are occupied by cars rather than being arranged for activity and accommodation for the city's residents
• Large residential areas are established far from the town centre, contributing to increased car-dependent activities in the areas close to the city centre.

Based on the government's guidelines and the overall policy framework, these development features serve as examples in contrast with current sustainable development policies. Rather than enhancing compact and walkable towns, we experience that the current development contributes to urban sprawl into the countryside.

2 THE SPATIAL ANALYSES OF THE TOWNS

Førde is located in Vestlandet county. Førde has over time benefited from important infrastructure measures that have helped to strengthen the position of the city. Notodden is located in Vestfold & Telemark county. With proximity to the river Tinnelva, floating and hydropower soon became an important industry for the municipality.

The similarities between Førde and Notodden include population numbers and expected future growth. Both settlements are centrally located in relation to the regional road network and are today regarded as regional traffic hubs and regional centres for trade. How have Førde and Notodden developed since the appearance of the state planning guidelines for coordinated housing, area and transport planning from 1993?

The spatial indicators presented are based on several criteria for the compact city, such as degree of inter-accessibility of the street and road network (Space Syntax), degree of land use mixture (MXI), degree of building density (Spacematrix), the type of street profiles, and the building-street interface (urban micro scale tools).

In sum, all the analyses give an indication on the spatial parameters on how sustainable Førde and Notodden is, based on the current situation. These findings will form the basis of strategies needed for making sustainable and attractive towns.

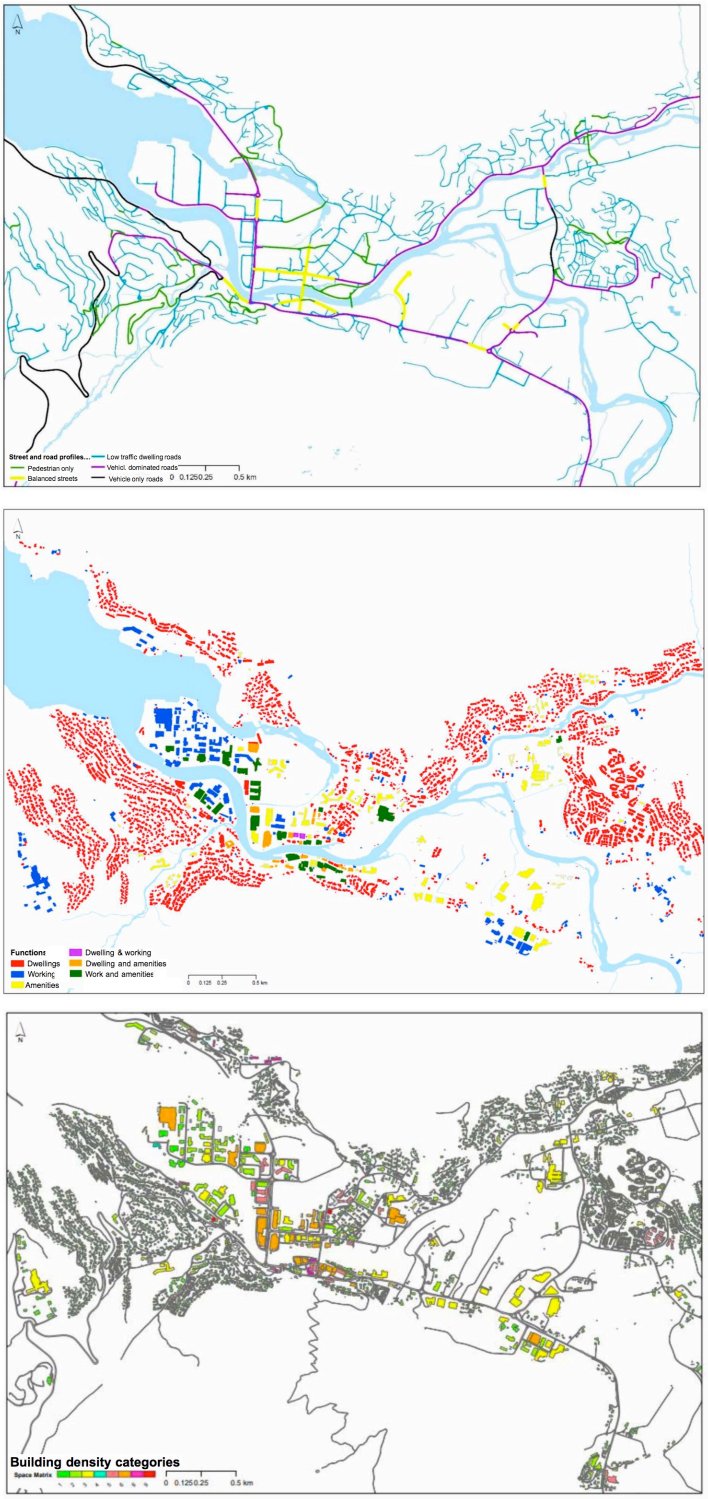

Figure 1: Spatial analyses of Førde

Figure 1 shows the results from the spatial analyses of Førde. The image on the top shows the analyses of street profiles based on Eldijk's work (Eldijk et.al. 2014). The purpose of the analysis is to examine how the street and road network is used by the various road user groups, and who

dominates street use. The scale ranges from black to green, where black is roads that can only be used by cars while green is streets that can only be used by cyclists and pedestrians. Moreover, we have chosen to divide the car-dominated category into car-dominated streets with high traffic and residential roads with low traffic (lacking pavements). As the analyses of the street profiles of Førde show, most of its movement network consist of dwelling roads with no pavements.

The image in the middle shows a degree of function mixture of Førde. The purpose of the MXI analysis is to identify which areas in a given location are mono-, bi- or multifunctional. The analysis method was developed by van der Hoek and is based on a triangle matrix where the degree of mono versus multifunctionality can be easily quantified (van der Hoek 2009). Monofunctional areas can be described as areas consisting of buildings where one of the three main functions defined by van der Hoek is present. As the analyses of Førde show, the area is mostly mono-functional. Only some bi-functional and multi-functional buildings can be found along one street in the town centre.

The image below in figure 1 shows a spacematrix analysis of Førde. Spacematrix is an effective tool for analysing and quantifying the building morphology in a given location (Rådberg 1996, van Nes et.al 2012). The analysis looks at the relationship between built-up area and usable area (Ground Space Index (GSI) vs. Floor Space Index (FSI)). We have first categorized the buildings in ArcGis according to shape as shown under GSI. The shape is either a point, strip or block to identify whether the building takes up a small part of the plot, a strip of the plot or the whole plot. Based on this, we have given each form a number through the "add field" function in the attribute table in ArcGis. Building shape has been given the numbers 1-3, where 1 is a dot, 2 is a stripe and 3 is a block. Furthermore, we have used the same procedure for FSI, by selecting buildings based on floors, where "1-2 floors" gets the number 1, "3-4 floors" gets the number 2, and "5-6 floors or higher" gets the number 3 The sum of these numbers will give 9 different answer alternatives where for example the building form «point» and «1-2 floors» gives a sum of 1 and 1 which get a green colour, while 3 and 3 show the form «block» and «5-6 floors or higher », which hence gets the colour red. In total, there are a total of 9 possible categories.

Figure 2 shows the various spatial analyses of Notodden. Like Førde, the area is very monofunctional with some multi-function areas along two streets in the town centre (middle). The street profiles consist mostly of dwelling roads with no pavements with low car-traffic (top). The spacematrix analyses show that Notodden cosists mostly of low-density single-family houses (below).

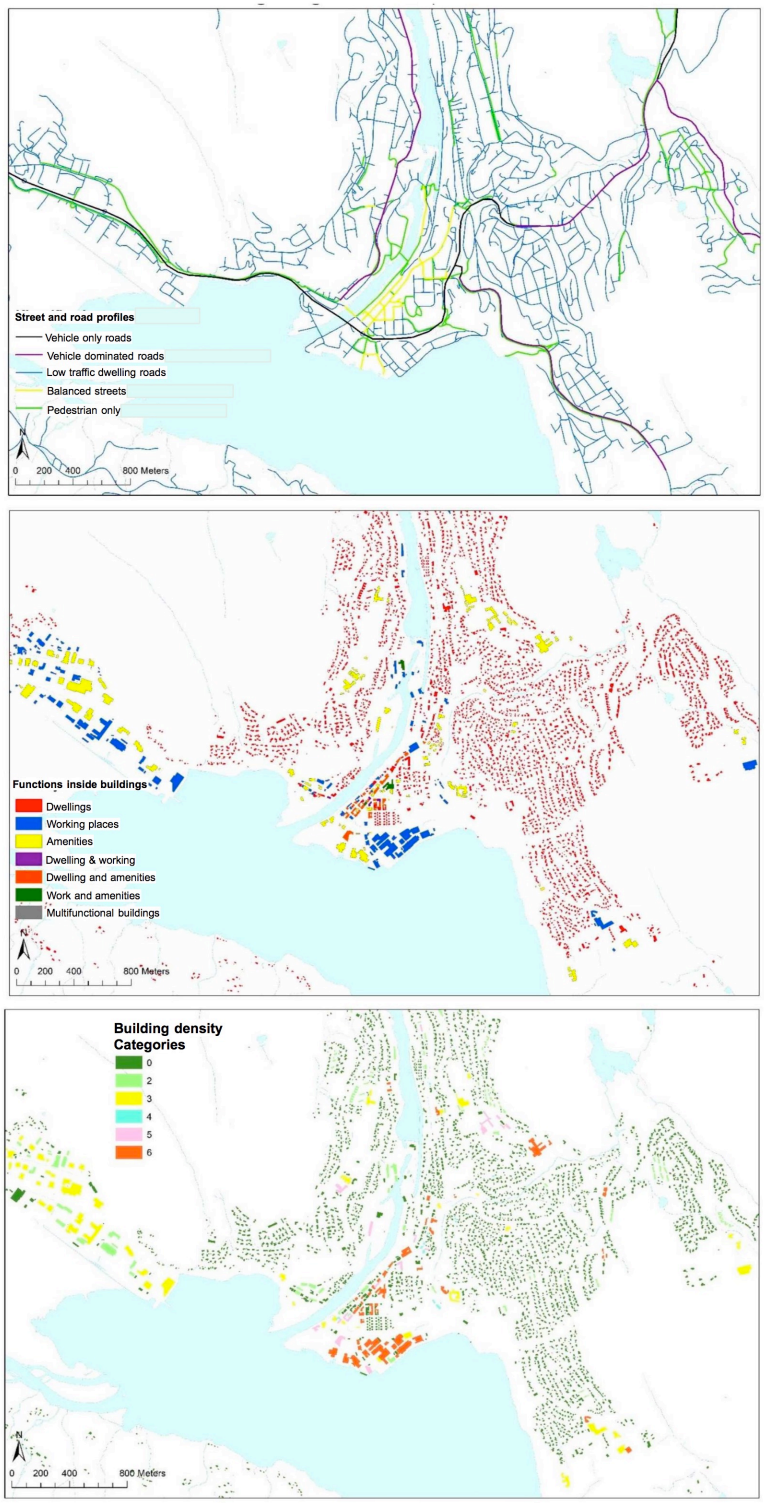

Figure 2: Spatial analyses of Notodden

Regards the urban micro scale tools for analysing the building-street interface (van Nes and López 2010), analyses of street intervisibility and constitutedness were conducted for both towns. As it turns out, there are very few street segments that are inter-visible and constituted in both

towns. Notodden have more constituted and inter-visible streets in its town centre than Førde. These streets have also high integration values in the various space syntax analyses. Outside the town centres all streets are un-constituted and lacks inter-visibility. Most of the residential houses in Førde and Notodden are detached houses, and for that reason they rarely have a direct connection to the street or are transparent.

Various space syntax analyses were conducted of both towns. The town centres are the only place where the choice analyses with high and low metrical radius is high. The same results accounts for the segment integration analyses. In general, both towns lack urban centres with a locally well integrated street network (shown in figure 3).

3 DISCUSSION

Both towns score low on street network integration on a local scale, degree of building density and degree of functional mixture. Regards the theory of the natural urban transformation process, if an area has a low degree of street network integration, this will naturally be reflected in the degree of building density and functional mix (Ye and Van Nes, 2014). Again, these spatial parameters have impact on the degree of street life in built environments. In this way, both Førde and Notodden serve as examples of cities with locally poorly integrated street networks, a low degree of density and a high degree of mono-functionality.

The space syntax analyzes of Førde and Notodden show that both cities have challenges when it comes to the degree of attractiveness from the surrounding street network and the potential for through traffic for pedestrians. The residential areas come out particularly poorly, where most areas turn out to be segregated from the main network, with a tree-structured street pattern. A street structured street and road network enhance private-car dependency (Carmona et al, 2010, pp. 91-93, van Nes and Yamu 2021). Overall, Førde's centre is more private-car dependent that Notodden's centre. The downtown areas of Notodden have several functions for pedestrians such as retail and a better integrated street network than Førde at a local level. This may be the reason why Notodden has chosen to establish a shopping centre outside the city, because of the high accessibility to the globally integrated highway.

Although Notodden scores higher on pedestrian to-and through movement potentials than Førde, both town centre areas in both towns are dominated by high car traffic accessibility and access to large areas used for carparking. In line with the theory of the natural movement (Hillier et al 1993, van Nes 2021a), the shopping centre areas are located along the car-based thoroughfares in the city centre of Førde. The road network has the highest potential for car traffic, and hence it is more difficult for pedestrians to walk to and in the city centre, which in turn enhance car-based trading solutions.

If one is to succeed in achieving sustainable cities with multifunctional surroundings and high land utilization, the spatial configuration of the street network must support this (van Nes 2021b). This is especially challenging for Førde. The space syntax analyses have revealed that the street network has poor inter-accessibility on all levels in Førde. Førde centre is planned for private car accessibility. Notodden has a much older centre, developed in a time where people were to a greater extent dependent on non-motorized means of transport.

Enhancing pedestrian inter-accessibility requires to establish a fine-meshed street network around and in the town centres, where the street profiles are designed in a way that equates driving, cycling and walking (van Nes 2021b).

As both cities score low on the degree of mix of functions and low space utilization, this indicates that the distances between important functions such as housing, work and facilities will be unnecessarily large. In addition to increasing car dependence, the cities' low land utilization will be reflected in unnecessary land encroachment, higher energy consumption in the buildings and increased resource consumption during the construction of the buildings, as well as during their maintenance and operation. Therefore, implementation of new dwellings needs to be enhanced in a densification plan within and around the existing town centres.

The best examples of unsustainable areas in Førde and Notodden are the large out of town car-based shopping centres at Tuven and Brulandsvellene. These are also located at a great distance from nearby residential buildings. In addition, these centres are inappropriately large, monofunctional and have low space utilization. Car-based shopping malls are again dependent on large parking spaces. Many of these buildings have car-parking on the ground floor in which reduces the degree of attractiveness to walk or stay in the public spaces in these centres. Moreover, these centres tend also to drain the old centres for shops and services.

4 CONCLUSIONS

There are several factors that are important to consider if Førde and Notodden are to succeed in becoming sustainable where residents are more encouraged to use the town centres and make these areas more vibrant and attractive. These factors or conditions are listed below. The list is not exhaustive, but is intended as a call that Førde and Notodden municipality should emphasize in the development of their centres for the coming time:

• Buildings adjacent to streets and public spaces should be designed with active facades
• Buildings in the town centre should be connected to the street in the form of windows and doors
• All streets and urban spaces should be made up of high-quality materials and given a design that invites use and stay in the public spaces adjacent to them
• All streets that should be adapted for pedestrians and cyclists in the form of mixed traffic (balanced streets)

• Building quarters should be short to ensure good accessibility and potential for frequent changes of direction
• Buildings should have a high degree of functional density in the town centres and facilitate many different types of activities
• Buildings in the town centres should have a high density of buildings

First, the underlying driver for a natural urban transformation, is the spatial structure of the street and road network (Ye and van Nes 2014, van Nes and Yamu 2020). If the path network is solved first, all the other aspects will follow (Seamon 1994, Yamu et al 2021). Therefore, we make an urban design experiment by proposing some new connections inside and on the areas adjacent to the existing town centres. Figure 3 shows a spatial segment integration with a metrical radius of 500 meters of the existing situation and with our new planning proposal of Notodden (top) and Førde (below).

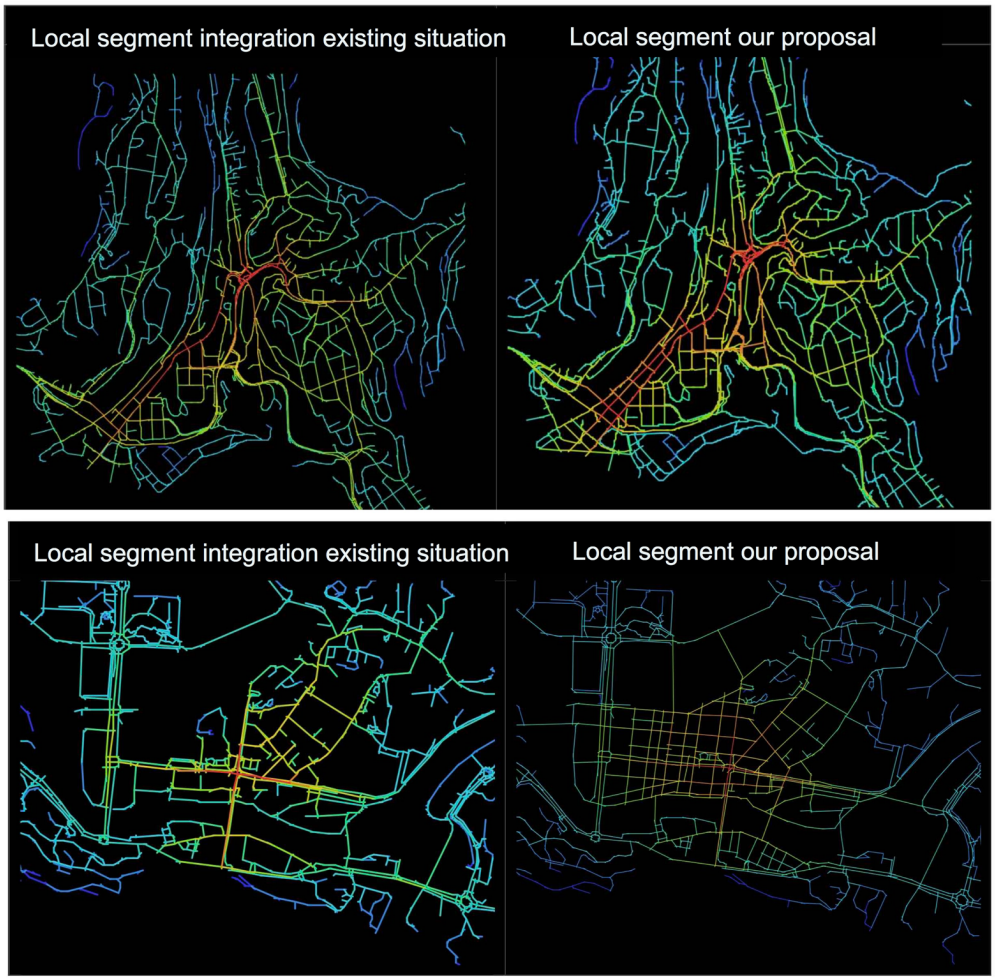

Figure 3: Design proposal for Notodden (top) and Førde (below)

In order to make the road network as robust as possible, arrangements should be made for a differentiated street network where different road user groups are mixed. The street profiles

should at least be arranged with a wide pavement that provides space for pedestrians with double-sided sidewalks. Cycling should be ensured access through the establishment of pedestrian and cycle paths or separate cycle paths that provide efficient and good accessibility between important transport destinations in the town centres.

The strategy regarding road and street networks is therefore based on establishing a dense and fine-meshed street network structure in the town centres and further making minor improvement measures in the residential areas adjacent to the town centres, especially with the aim of increasing local integration.

We recommend increasing the functional mix primarily by increasing the building density and by establishing more buildings with residential purposes in the town centres. Establishing jobs in the monofunctional areas far outside the town centres with the aim of increasing the degree of functional mix is not recommended. In the worst case, it can result in an increased need for private car transport, as the inhabitants do not necessarily choose to live in the same area as they work.

By focusing on to increase density and function mixture in the town centres, future dwellers will have good opportunities to reach various functions within a short walking distance. In addition, such an investment could help to provide a more vibrant town centre and to reduce car dependency.

The results from the Space Syntax analyses showed that the central areas of Notodden are best suited for urban transformation, where the through- and to-movement potentials are high at both local and global level. These streets have the highest potentials for attracting businesses and activities for creating a vibrant town centre. In order to make the main street Storgata more attractive for both trade and housing, new cross-connections must be established that increase accessibility to the area. Along these cross connection, densification of new housing areas can be enhanced.

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