

DEVELOPMENT OF A TOOL TO HELP THE REASONED DENSIFICATION OF VILLAGE CORES IN WALLONIA, BELGIUM

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ABSTRACT

Today, the negative impacts of urban sprawl for the environment are known, and Wallonia, which is a region of Belgium, are particularly involved in this phenomenon, which could be symbolized simply by the build-up of detached houses developed around cities and along roads between agglomerations. Faced with this occurrence, which is often the result of high road density, the European Environment Agency published a report in 2016 which explains many ways to develop new urban planning for a apartment in Europe, based for example on a densification of existing cities and built-up areas. It is difficult for town planners to define the exact limits of urbanization today. So this study will target particularities of the Walloon territory and will be interested in the so-called in-between territory and agglomerations which are formed (especially in the rurality). Faced with an uncontrolled consumption of land resources, the objective of the search is to determine to what extent and according to which methodology a densification of village cores can be carried out. By working on the notion of compactness, this study will verify the ability to act on the consumption of space, materials, and energy to efficiently develop regional centralities, in relation to the proposals of the EEA. Also, to densify these villages, the focus will be into the importance of a human scale and quality of living environment. We will take a look at the development of garden cities, the relationship between man and nature and the community feeling that M. Howard wanted to develop in its concept. The research perspectives that will be proposed are committed to respecting the cultural and heritage identity of village cores intended to be densified.

Keywords: urban sprawl, densification, compactness, centrality, garden city.

1 INTRODUCTION

Where exactly does the city begin and where does it end [1]?

This is a simple question which is summarized the whole problematic of urban sprawl, which is a phenomenon could be defined as “the physical pattern of low-density expansion of large urban areas, [...] mainly into the surrounding agricultural areas”, according to the EEA–FOEN report [2].

So, this study is part of a global approach aimed to answer to a need of densification to combat the consequential effects of this occurrence (as a large increase of landscape fragmentation, a high consumption of land resources, a reduction of natural areas, a loss of biodiversity, among other) [2], but it is more particularly involved in a reflexion about urban models.

Indeed, this article wishes to highlight the importance of integrating other variables that go beyond the simple term of densification. Because there is through the concept of compactness the possibility to act on the built form and consumption of space and energy, both on the scale of the city and on the scale of urban block.

In fact, this research is inspired by the latest advances in term of tool development that focused on the design of compact urban models, but it also wishes to take a new look at the way of applying this type of tool, by moving the area studied and by targeting what happens outsidess cities.



The final objective of the thesis is to determine to what extent and according to which methodology a densification of these regional centralities can be carried out.

However, the feeling of this search does not to develop a diffuse regional planning, in the form of subdivision, but to bring thinking about uncontrolled urbanization out of cities.

Because there is a question to which town planner is often silent.

If policy of densification of downtown makes sense facing the challenges of sustainable development, it is important to keep on mind that there is a part of population who rejects conception of very dense urban life.

In this view, this search will target on Wallonia, which is the southern region of Belgium.

For example, it was estimated in Wallonia, according to statistic data collected in 2020, that no less than 30% of people lives on detached houses, and no less than 22.1% lives in semi-closed housing, against approximatively 26.4% living in closed housing [3].

This means that today half of the Walloon population lives in a half-urban or a half-rural environment!

It is an illusion to believe that tomorrow everyone will live in this country in very dense city, like a metropolis, in apartment buildings. So, face to a necessary process of densification, there is certainly a balance to find, which surrounded a whole territory, at scale of a region. It would be incoherent do not consider these regional localities, which are often owned cultural and heritage identity [4].

Thus, this article aims to present the research methodology of the study and it has been divided into three parts. The former will detail the particularities of the targeted territory, Wallonia, about its weakness and its potential for improvement, and will explain the methodology chosen as a reference to deal with both densification and built form. The latter will present some research perspectives about a reasoned densification, based on the reference methodology. At last, a few words will be given to summarize the state of progress of the research work and their potential for development.

2 METHODS AND MATERIALS

This part sets out the theoretical bases and the methodology according to which the study would like to respond to the problematic of urban sprawl, by targeting the spatial dynamics of Wallonia, and based on recent work related to the compactness of built forms.

2.1 Particularities of the Walloon territory

Wallonia covers an approximate area of 16,901 km², which represents a little more than half of Belgian territory and its population was estimated in 2020 to 3,645,243 inhabitants [5].

One of particularities of this territory is the population density, evaluated in Wallonia to 208 inhabitants/km², which is less than Flanders (441 inhabitants/km²), the other Region of the country, but largely more important than the global population density in Europe (32 inhabitants/km²) [6].

But another characteristic of Wallonia is, like Belgium, the presence of an important road infrastructure. For example, at national scale, Belgium has a road density four times higher than the European average [1].

According to Belgian Office of Statistic, “72% of Belgians live less than 5 km from a highway entrance and 82% less than 5 km from a train station” [7].

These last decades have been seen in Wallonia an artificialisation of land in a constant progression, often linked to the emergence of transport infrastructure [6].

This observation is linked to the analysis of EEA–FOEN report in 2016, which had targeted central Europe as an area particularly troubled by urban sprawl [2].



2.1.1 Land use and principal axes of urbanization

From the point of view of land use, Wallonia is currently divided in two principal parts, of which a northern part which is characterized by urban municipality connected in-between with others rather agricultural, and a southern part, which has essentially an agricultural and wooded identity [6].

In fact, this territory is structured by two principal axis which is defined an urban hierarchy. The former is the West–East axis, called as “industrial furrow”, which is generated the most principal urban polarities between France and Germany, and the next is the North–South axis, which is a connexion between city of Brussels and Luxembourg, and which is established the two most important job poles [6].

So, around these trend lines gravitate a serial of polarity, sometimes urban sometimes rural. If the province of “Brabant Walloon” is clearly under land pressure from Brussels, the most artificial land is located along urban poles of W–E axis (Mons, Charleroi, Namur, Liège). Through this structural organization, it is possible to draw two others urbanized axes from Brussels: one to Mons, the other to Namur [6].

2.1.2 An urbanized countryside

Wallonia is mainly made up of rural areas (51% of countryside and forest), but paradoxically the agricultural activity found there is marginal [6].

This paradox reflects a certain form of banalization of territory that has been taking place since the 1970s. Urban and rural lifestyles are now comparable even economically. Today we directly lived in a territory, and rurality is itself become a space inhabited by the city, through the rise of a society characterized by individualism and mobility [1]–[6].

In fact, rural spaces have been weakened by a phenomenon of “rurbanization”, which is significant in Wallonia, due to the existence of a dense network of medium and small towns in the territory, but also to the development of an important road infrastructure [1]–[6].

2.2 Theory and model of tool

How to answer to a need for densification including in regional environment? And how to densify reasonably these rural areas? Maybe through the concept of compactness.

2.2.1 Theory of compactness

These last decades many studies had preconized in answer to urban sprawl to develop the compact city model and had emphasized the advantages which could have the compactness and an urbanism of short distances on mobility [8], [9].

Because, in addition to reducing the car use, this concept had also made it possible to envisage an optimization of the development of public transit use [10].

But the main interest of compactness had also resulted to the capacity of control the land, by “optimizing the usable capacity of a buildable area” [11].

But there is a nuance to be grasped between the terms of density and compactness.

The only term of density expresses a ratio between a quantity of elements and a spatial reference (area, volume, length), and it is linked to a densification process, which defined means of action to increase a density (of element by a spatial reference) [12].

On the other hand, the term of compactness is linked to the shape, the size, and the areas of the outer envelope of an object (at same volume done, more area of the outer envelope decreases, more degree of compactness increases) [12].

In fact, compactness differs from density by integration of third spatial dimension, which involved notions of economy and energy, mainly focused on rational use of land.



In scientific literature, several tools of densification have been developed (as the “Urbanigramme” of Holley or the “Land Use Intensity Rating” of USA Federal Housing Administration [11]), but they were rare those that deal with the typo-morphology of the built and the unbuilt [11]. Same remark for the graphic tool “spacematrix” of Berghausser and Haupt [11]. If it is interesting to underline the multivariable and multiscale approach of the density, and the link established between density and built forms, the volume of the building is not really addressed in this tool, nor the private area of urban block [11].

Indeed, in contrast to compactness, the use of density indicators as built density does not itself make it possible to define a link with the shape (and design) of built [11].

2.2.2 Model of tool focused on the design of compact urban blocks

So, the study of compactness offers the possibility to complete the different indicators of density, as the floor area ratio (FAR), or the built density, among others, and to create a link with built morphologies.

In this regard, this research was interested in the thesis work of De Smet about “the elaboration and the experimentation of a tool of evaluation and support for the design of compact housing blocks according to a target population density” [11].

In this tool, indicators of compactness had been used to be define quantitative criteria linked to a built or unbuilt character, as the use of several areal compactness indicators and the use of porosity indicators, which are the counterpart of compactness and necessary to traduce the ratio between full and empty [11].

In addition to these quantitative criteria, there were also qualitative criteria relating to the comfort of the inhabitants. These criteria can be linked to the quality and the interactions that outdoor spaces can offer, to the proportion of green spaces, the potential of biodiversity, to the management of luminosity, the distance between façades, among others [11].

Another study was continued on the same subject by Meurisse, with the aim of designing a dynamic tool for the development of compact typo-morphologies using local search and game theory methods [13]. The goal is interesting because it tends to propose a prototype of program allowing to manage the important quantity of these criteria sometimes in conflict [13].

Thus, to fight against urban sprawl, the idea is to work on the densification of built-up areas by developing a tool based on the methodology developed by De Smet and aimed by compactness. But to translate this approach into rural centralities, it is necessary to upload criteria face to these new areas.

2.3 Notion of “basis polarities” in Wallonia

But which rural localities should be chosen to densify? Based on what criteria?

As a result of this question, IWEPS, which is an official institute of evaluation, prospection and statistic in Wallonia, developed in 2021 a working paper to determine “basis polarities” throughout the Walloon territory [14].

These centralities represent central and structuring places of the territory, both towns and villages, which concentrate a certain quantity of housing and essential services for the population, especially in theme of education, food trade, health, and public transport (notably bus stops sufficiently served and presence of the railway) [14].

But the main interest of these basis polarities is their potential for densification.

The idea is to promote the grouping of habitats, and at the same time to promote active and softer modes of travel (on foot, by bicycle) to the detriment of individual use of car. The

approach aims to develop various densification processes in the heart of existing towns and villages, where a mix of functions already exists in part [14].

But there is a nuance to be observed in the methodology applied. Based on simulating geographic criteria, three variants (A–B–C) have been proposed to define a centrality as “basis polarity”.

In contrast to variant A (the tightest) and variant C (the most distended), a variant B is made up, as an intermediate analysis which permits for almost all municipalities of Wallonia to have a polarity. This is the choice of a compromise to assure a certain form of cohesion face to criteria which are adapted below municipal limits and sub-regional particularities [14].

If this variant could be put back question (wish to satisfy local politics?), the rest of the study will not question of this methodology but will rely on these tags to concentrate about possibilities and methods of densification.

Table 1: The three variants of “basis polarities” of IWEPS, methodological approach [14].

	A variant	B variant	C variant
CONDITION 1	Concentration of 200 housing minima within a radius of 500 m	Concentration of 200 housing until 50 minima within a radius of 500 m (adapted according to municipality)	Concentration of 50 housing minima within a radius of 500 m
CONDITION 2 (ONE OF THESE THREE CRITERIA)	Presence of three basis services within a radius of 700 m	Presence of three basis services within a radius of 700 m	Presence of three basis services within a radius of 700 m
	Presence of two basis services within a radius of 700 m + 2 bus/hour/direction	Presence of two basis services within a radius of 700 m + 2 bus/hour/direction Until 1 bus/2 hours/direction (adapted according to municipality)	Presence of two basis services within a radius of 700 m + 1 bus/2 hours/direction
	An efficient railway dessert	An efficient railway dessert	An efficient railway dessert
	The most parsimonious	Choice of compromise	The less demanding

2.4 A look towards rural centralities

One of particularities of rural spaces is that it offers more anchorage for population (we lived there for more longer). Cities are rather occupied by young population and isolated peoples. The middle classes tend to leave the city once their life has stabilized on a personal and professional level [6].

This attitude reinforces the phenomenon of “rurbanization” and the tendency of the city to invite itself to the countryside.

On the other hand, the polycentric structure of Wallonia is partly the result of a multitude of agglomerations and localities present often before the emergence of modern road networks [1]. This is the legacy of old village cores, which presents often an own cultural identity.

In principle, the landscape that offers this rural fabric is often not very dense, made up of fine meshes and a network inherited from medieval lines [4]. In the old core, the building is often compact, facing the street, with private gardens on the back [4].

In fact, on a large scale and in a more general way, Wallonia villages are distinguished in country by two tall characteristics in term of structural development of habitat [15].

The former can be based on an agrarian structure of dispersed habitat, which was often the heritage of a bocage structure (as a landscape of enclosed lots, farm dispersed in the countryside). And the latter can be made on a structure of grouped habitat because it comes from an open field landscape. In this grouped characteristic, three general typo morphologies are distinguished: at central core (development following a crossroads), at allonged shape (siting along a main road), and at closed on itself shape (set of streets without apparent structure) [15].



Figure 1: Structure of grouped habitat; examples from left to right: at central core (Merbes-le-Château), at allonged shape (Elouges), at closed on itself shape (Wihéries). (Source: Webgis DGO4 Wallonie, © SPW 2021.)

However, it is important to specify that this initial structure of the localities has sometimes evolved over time. It may have been disrupted by the rise of an industrial activity (which often the case along the “industrial furrow”, with typically the case of “Borinage”), following for example the appearance of new traffic lines and the construction of working-class housing estates outside historic cores.

Then, the study of models of residential fabrics permits to determine the main elements of composition of these rural centralities [4] and to bring out their weakness. Generally, around an old semi-continuous fabric, which represents the historic village core rather compact, it is possible to distinguish three open fabrics where isolated buildings are representative. (It is also possible to find an old continuous fabric in rural area, with narrow street and low building, but this is rarer, and this more often concerns urban cores or larger agglomeration.)

According to these data, it appears that a large part of the Walloon urbanized area is occupied by isolated houses and is located around historic localities. And to draw a parallel with the problematic of urban sprawl, these historic existing village are currently deforced by a large repartition of detached houses in the landscape, not necessary attached to an agglomeration.

So, according to Grosjean [1], if Belgium had known several urbanization waves in his history, the last creating the most disorder was the latter making around 2000 and characterized by urbanization of subdivisions and detached houses. This last point involved a clear cut of articulates between scales (we passed homeplaces to workplaces without

Table 2: Main model of residential fabrics in rural centralities [4].

Model of residential fabric	Analysis (based on Le Fort [4])	
	Particularities, density, and street-space	Occupation of the Walloon urbanized area
OLD SEMI-CONTINUOUS FABRIC	Historic village core. Old habitat. Low residential density and human activity. Compact built fabric at the front of street. Wide gardens, wide street-space, and irregular layout	8%
OPEN FABRIC AS A SET	Urbanization located in periphery of centralities. Low residential density and human activity. Set of isolated houses in regular lots. Homogeneous street-space and architecture. Set back from the street for garden.	34%
OPEN RIBBON FABRIC	Linear urbanization that stretches out of town gates around road links. Very low residential density and human activity. Isolated houses in wide lots. Linear fabric. Dedicated to car.	3%
OLD OPEN FABRIC	Urbanization out of town. Old, isolated buildings. Very low residential density. Human activity mainly focused on agriculture. Does not generate street-space.	11%



Figure 2: Model of residential fabric, illustrations from left to right: old semi-continuous fabric (Angre), open fabric as a set (Baudour), open ribbon fabric (Mignault). (Source: Webgis DGO4 Wallonie, © SPW 2021.)

intermediate scales) [1]. There are the negative impacts of a conception of habitat influenced by a popular inspiration which is exulted the single-family house in model four façades [10].

The problematic is that idealized detached house is opposed to the search of a certain form of polarity and tends to reinforce a diffuse urbanization of the territory.

At last, the demographic projections in Wallonia for the years to come continue to be seen on the rise [6], and face to a crowding demand of housing, the need to limit urban sprawl across the region will be imperative.

3 RESEARCH PERSPECTIVES ABOUT A REASONED DENSIFICATION

Developing a reasoned densification requires a multi criteria approach to the subject. Like the work of De Smet, several quantitative et qualitative criteria need to be used, but they also need to be adapted to the scale of village cores. This is below the two main research perspectives to develop this tool in this state of mind.

3.1 Necessity to define a target population density, which depends on the targeted village

For a designer or a decision maker, it is very important to define a measure to analyse the way to densify reasonably a built core [11].

Because to design only more compact and denser don't suffice, it is necessary to apply it in his context but also to assure the viability of densification project [11].

In this view, the methodology that De Smet has applied is very interested, notably in the writing of a formula which expresses a target population density which is dependent on the average population density of a district and the proportion of public spaces and activities (other than housing) in the consider area [11].

See e.g., the equation of minimal population density eqn (1) below [11].

$$D_{P,block} = \frac{D_{P,district}}{(1-\rho_{public\ spaces})-(1-\rho_{other})}, \quad (1)$$

with D_p as the population density, $\rho_{public\ spaces}$ as the proportion of public spaces in considered area; ρ_{other} as the proportion of other activities than housing in considered area.

For that this formula can indicate a limiting value of population density, the author defines the city according to numerical values (of which $\rho_{public\ spaces} = 1/2$; $\rho_{housing} = 2/3$; $\rho_{other} = 1/3$) [8]. But this equation, in the context of this search, needs to be adapted face to particularities of a village core, because this formula applies generally to an urban context treated at the scale of the urban block (like Paris for example).

The idea of this search is to work on this formula by targeting, not the urban block, but the scale of the village core based on a pedestrian limit distance (a radius of 500 m until to 700 m for example, adapted following the shape of agglomeration).

On the other hand, there is certainly a proportion of private green spaces (as gardens, back yard) to be consider in addition of public spaces, which will be certainly different (place, irregular layout of street, alley), and there is of course a proportion of land, maybe small or large, related to agricultural activity.

This last point is important if the volunteer is not to fall into the trap of a densification which would not be contextualized and would vanish the rural character of the locality. It would reinforce the installation of the city in the countryside, only for the purpose of "landscape" and not of anchoring in regional area.

3.2 To focus on a human scale and a relation between human and nature

The approach of this tool is not to sprawl the village, but to make the core more compact, with the aim of promoting soft transport and the extending of an urban micro-life, a bit like the past when the village was a community of people. The idea is to consider the possibility, into a compact shape, to build all unbuilt spaces (plot background, empty plot) and to develop human activities. But the wish is also to consider a densification approach sized on a human scale, this human dimension which often characterizes ancient built localities.

Maybe first action is to punctuate the agglomeration of small and nuanced places (or reinforce it). The idea is to mark the scales of circulation in village (as the street, the alley, the path, the carrefour, the public, the place), because the design of a city on a human scale is based on mobility and sensory perception [16].

For Gehl, “small spaces and short distances allow warm and intense meeting” [16].

There is a notion of limit, as a comfortable limit distance for gentle travel (pedestrians, bicycle) but also a notion of human field of vision (100 m horizontally and 6.50 to 13.50 m maximum vertically) [16].

This human scale, which is frequently forgotten, is one of the three scales of town planning that any town planner must pay attention. It is not the scale of the city (global planification), nor that of the district (disposal of buildings), but that which represents the city at eye level, and which treats the quality of public spaces and architecture [16].

At last, a regard could be made towards the concept of garden cities and the community feeling that Howard has considered in his project at the beginning of 20th century. Even if the cooperative principle has not really worked, and that later the concept has been quickly overtaken by speculation and transform into a formalist development [17], garden cities appear today as actual in the face of the challenges of sustainable development, especially through the approach of a certain form of balance between individual inspirations and collective needs [18].

In contrast to industrial cities and its unhealth conditions of the time, Howard created a city representation based on a marriage of town and country, mainly focusing on the relation between human and nature, and the necessary reconnexion about its habitat and the land (vegetation, agriculture area). He imagined a serial of diagrams which represented an urban system composed by one central city surrounded by satellite cores, these garden cities, not exceeding a population density of 32,000 inhabitants [19].

These cores are composed by grouped habitat around collective services and public green spaces, and that compactness shape permit to bring workers closer to their place of work and leisure [18], [19]. This general principle is exactly like the approach currently looked for the promotion of a short distance urbanism.

But the most interesting thing of garden cities was the volunteer to create cooperative projects. For example, the presence of many nearby green spaces offered possibilities for creating short production circuits (vegetable gardens, fresh local products for inhabitants) [18]. And this is exactly the idea that this study wants to develop: take advantage of the different spaces (public or land) that make up the village.

Howard's concept was essentially based on a community project, and this element is certainly a starting point to help to extend cultural identity and living in village.

After all, the whole challenge of the tool rests in how to transpose these aspects (notion of human scale and community) into qualitative criteria necessary to ensure a reasonable (and sustainable) densification of village cores.

4 CONCLUSION

The main objective of this research is to respond to a general need of densification of existing cities and built-up area, particularly in the face of the problematic of urban sprawl, this phenomenon which particularly affects Wallonia, due to the existence of a dense network of medium and small regional towns.

To limit this urban sprawl between existing localities, this study proposes to work on both the concept of urban compactness and the compactness of the built form (at the scale of the urban block). To define what localities can be densified, the study relies on the methodological approach developed by IWEPS to determine basis polarities in Wallonia. And to densify reasonably these localities, this research focuses on the approach developed by De Smet for the design of compact housing blocks.

But developing a tool to help the reasoned densification of village cores requires a multiscale approach to the subject studied, not only to consider the different characteristics that structure rural localities, but also to integrate the numerical parameters intended to densify these agglomerations.

And in this point, for the development of a tool, the methodology applied by De Smet demonstrates that is possible to translate into numerical values a whole series of constraints intended to densify compactly housing blocks, and this by means of quantitative and qualitative criteria.

As a future implication, the tool could be perceived as a diagnosis of a starting situation, in which it would be possible to bring out the potential of improvement of an agglomeration by proposing built (and unbuilt) configurations dependent on criteria linked to the study of compactness.

At this state of progress, the research shows now that it really needs to define precisely what a village is, as the sum of different spaces, built or unbuilt, linked to residential life or to another activity. This will be the basis for starting the construction of the tool.

And on the other hand, there is perhaps through the research perspectives based on a human scale an incredible opportunity to extend the anchoring of villages in the landscape and to conserve their owned cultural and heritage identity.

The proposals made previously to achieve a reasoned densification of regional localities are part of a general search for balance to be found between human and his environment. Finally, this is perhaps the whole future challenge of housing and sustainable development.

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