

University of West Hungary
Sopron

Theses of the PhD dissertation

**Research of town structure and green space system of
Sopron, opportunities of development with historical
approach**

Sági Éva

Sopron
2011

Department of Wood Engineering

Doctoral School: József Cziráki Doctoral School of Wood Sciences and Technologies

Head of PhD School: Dr. h. c. Dr. Winkler András

Field: Multidisciplinary engineering

Supervisor: Prof. Dr. Winkler Gábor DSc.

The preliminaries of the research project

Human quality of life is inseparable from the quality of his environment. This in the first place means the settlement where people live their lives. The primary aim of the urban planning is to ensure develop healthy and sustainable settlement development. Villages and cities are not mere architectural construction, urban green spaces form an integral part of the net existence as much as buildings and other architectural establishments.

The manner, the ratio and the distribution of the urban green spaces within the inner-city area influences the degree of their overall effect. Land use with awareness is part of ecological urbanism: coherent system of free spaces belongs to it as well. The green space system of historical towns have organically been adjusted to the city structure formed during long centuries. Today's planning practice tings the situation further. The manner and the structure of green spaces is different at the distinct areas of the settlement with different historical background, street network and character.

The objectives of the research

The aim of this paper is to contribute to the concept and practice of ecological urbanism at historically preserved urban areas. Its main topic is to survey the development of town structure and the urban green space system in the historical town Sopron, and it explores the interrelationship and the quality of correspondence between the town's structure and green space system. The project attempts to point out the green space aspects within historic preservation urban planning by the common study of „stone and green” according to the Washington Charter (1987). The results of this research aspires to complete to the current practice of urban planning with a new approach and additional means.

The research has proved that the normalized difference vegetation index (NDVI) – which is used usually to analyze peripheral surfaces with high vegetation ratio – is well applicable for the monitoring of the inner city area with low vegetation ratio. The examination of the importance of urban green spaces and other green areas may help the process of urban planning to gauge the area ratio and importance of specific urban green spaces. The different surface pattern types determined by the results show the nature of the connection between

historic town structure and its green space system giving a new point of reference to the planning.

The methodology of the research

A town and its surroundings change together: where the built-up area gains ground, other land use categories decrease. The main lines of the research was given by the historical city research, the land use analysis and the analysis of urban green areas. From small scale to large scale: the examination of historical town growth was followed by land use change follows the analysis of sample areas within newly built-up areas.

At the inductive survey of idiosyncratic town parts, the first step was to select sample areas within Sopron's built-up area. This sample areas feature the town parts with different historic background, they show the correspondence between past urbanism, today's town structure and urban green space system. The characterization and the GIS analysis of the pattern samples in Sopron's area is based on historical maps, vistas, satellite imageries and literature review. Military recordings are well applicable on the analysis of land use and town structure, but for surveying urban green spaces 19th century cadastral maps are more effective. Old city maps have helped maintain continuity between past and present.

The historical and structural analysis of urban green space system have been based on literature review, examination of maps from various periods of time, as well as plans and GIS-analyses of satellite imageries. In order to get a more objective approach, the author have used the generally accepted Normalized Difference Vegetation Index (NDVI) for surface analysis. Examination of spatial structure have been supported by field-work and self-made cycloramas.

In this research, the best basic area dimension of raster-based sample areas seemed to be 300*300 metres for a more objective and better presentation of each urban areas with different historical, building up and green area characteristic.

To the present-state urban green area analysis, the multispectral imagery made by the QuickBird earth observation satellite have been applied. From NDVI raster statistics of this imagery green area ratio and secondary indexes have been deduced. These secondary

indexes (named Gross and Net Green Area Indicator by the author) demonstrate the significance of the vegetation at the the sample areas.

The sample areas and they basic building up and green area attributes:

Sample area	Building up	NDVI	GAR	NGAI
1. Old town	Historical building up with tight texture	0,1015	7,68%	0,3
2. Northern „Viertel“: Wieden	Historical scattered development in unbroken row with curved buildings	0,1719	19,26%	1,08
3. Inner town: Krautäcker, towards Vienna	Framed and storied development in unbroken row, built up since the 19th century	0,1952	26,38%	1,71
4. Southern „Viertel“: II. Rákóczi Ferenc street	Historical storied development in unbroken row, here and there scattered	0,2767	41,67%	3,15
5. Inner town: district towards Győr	Framed and storied development in unbroken row, built up in the 19th century	0,1756	22,08%	1,45
6. Inner town: Kossuth street	Partly storied development in unbroken row, partly detached building method with mansions built up in the 19th century	0,2474	36,12%	2,41
7. Alsólóverek: small-townish building up	semi-detached building method, built up in the first part of the 20th century	0,3632	59,73%	4,74

8. Alsólőverek: housing estate „József Attila”	Partly small townish, belted one-storied building up, partly housing estate, born in the 20th century	0,287	44,90%	3,02
9. Felsőlőverek	Straggling detached building method with large gardens, built up since the 19th century	0,4826	83,05%	7,29
10. University	Institution area with pavilions and large park, built up at the end of the 19th century	0,4731	78,31	7,14
11. Egeredi Hill	Belted, detached building method with family houses, built up in the 20th century	0,3073	49,99%	3,32
12. Kuruc Hill	Belted, semi-detached building method, built up at the beginning of the 20th century	0,2716	43,81%	2,67
13. Housing estate at Ravazd street	Small townish, belted, semi-detached building method and and more-storied housing estate, built up in the 20th century	0,2699	41,38%	2,51
14. Pozsonyi street	Mixed small-townish and garden city housing pattern, built up since the beginning of the 20th century	0,251	39,87%	2,28

15. Housing estate „Jereván” and its neighbourhood	Mostly housing estate, partly small-townish development in unbroken row, built up in the 20th century	0,2795	46,39%	3
16. Virágvölgy	Straggling detached building method with large but narrow gardens, has been built up in increasing degree since the end of the 20th century	0,4473	86,27%	6,42
17. Western industrial area	Industrial area with high building up ratio, built up since the beginning of the 20th century	0,0867	8,21%	0,34
18. Residential area between Sopron and Bánfalva	Belted, detached building method with family houses, between the town and the village, built up in the 20th century	0,3607	63,20%	4,43
19. Bánfalva village centre	Traditional scattered village housing pattern	0,4139	68,07%	5,62
20. Eastern industrial area	Industrial area with great detached halls, built up at the end of the 20th century	0,1804	25,34%	1,47

GAR – Green Area Ratio

NGSI – Net Green Area Indicator

The analysis of sample areas has opened the door to determine certain urban surface pattern types, and has pointed the structural relation between the historical town structure and its green space system.

The detailed characterization of sample areas is supplement of the dissertation.

Outcomes, conclusions and proposals

The land use of Sopron and its surroundings went under a multiple change in both quality and quantity in the last 150 years. The modification can be observed in large and small scale too. The explosive growth of the town has carried a loss or decrease of many typical landscape component, so the local landscape harmony is in danger now.

The spatial distribution and character of land use have been changed significantly in the last centuries, but its local character is still preserved. The distribution of surroundings between land use categories have been altered. More and more agricultural land have turned into built-up area during the past centuries. This trend accelerated after World War II. The growth of urban built-up area (suburbanization and desurbanization) is a worldwide tendency, it is well-known by the local experts as regards Sopron. The decrease of traditional building methods along with surrounding gardens and vineyards shows the intensity and significance of changing. The peripheres have been transformed, they have lost their former character, local values are disappearing. New construction lack the appearance of local features.

The non-agricultural land has been increased with its two and a half in the commune of Sopron since 1895. Agricultural land use patterns get farther and farther from the city centre in northwestern and southeastern direction. Paralel with the changes of land use at Sopron's surroundings, the structure of the town itself have gone through quality changes.

The same way as peripheral land use, the use of the city centre and the circle around it have changed and developed. The tight textured old town have lost its original, „elite” inhabitants. The former rural inner city parts, the „Viertel”-s gained a small-townish, at places even metropolitan look.

The size and number of suburbs, the intensity of its building up has increased, their outer frontier have been shifted farther from the inner city. Two big industrial areas have been inserted between old

and new residential areas: both of them generated by railways and main roads. Traditional gardens are vanishing, vineyards decreasing. Because of new industrial and residential areas surrounding the inner city, Sopron's inner city area have been increased, and its character changed. The fast suburbanization of the town have brought about the spread of commercial building up. This changes have social reasons, namely the increasing demand of new residential areas as well as the change of economic structure.

With the growth of built-up area and the increase of built up ratio, people who live there get more and more separated from nature: this process generated the an increasing demand for urban green areas. The first step was kitchen-gardens of the burghers and monasteries (e. g. jesuite order). Later the existence of public green spaces became a communal interest. The mass urban tree-planting of the so-called „Town-adorning Society” coincided with the explosive development of Sopron. The public gardens were organically developed from private gardens (e. g. Elisabeth Garden) and public grounds (eg. Széchenyi Square, Deák Square). In the 20th century, green space system became a fixed part of local urban planning, but there is still much to be desired. Creating open spaces are rarely a component in planning of new built-up areas, conscious green space system forming is neglected.

Theses, conclusions and proposals on the basis of the research:

1. Town structure and green space system are inseparable, they should be developed together in each phase of the ecological settlement development.

The examination of town planning documents of Sopron show that in the 20th century green space system were taken into consideration at town conceptions and plans in, but there are significant deficiencies in realization. The majority of town plans emphasize green spaces first of all, almost exclusively developmental opportunities of these come to the front. These plans often fail, the open space development is hold up frequently by actual economic interests. The green space system as network is a periodic element of town planning, though this fact it is overshadowed. There are few true results regarding the development of green space system. Private gardens could be mentioned in the best case, they are missing from the operative

community development plan.

The regulation documents of the local settlement development process are suitable to help form a better green space system by a network of future green spaces and private gardens. The objects of the green space system should be considered from the bottom (parcel) level of the planning process, as is made possible by law. In case of historical towns, the historical, spatial character of each town part should not be neglected.

2. The role of green areas in the built-up area (e. g. private gardens) are at least so important in the urban ecological network, as open spaces. They deserve a place in the overall settlement development process. The ratio of private green areas should be protected by local commune development documents.

The largest green areas of inner city area are obviously not the public green spaces but the private and institutional gardens with huge biological activity. The urban open spaces fulfill their own function, they are irreplaceable in town structure and the improvement of life quality of the inhabitants, they have an essential role at densely built-up areas.

Green area features of the different residential areas have an impact on the well-being of the inhabitants. The best quality of life is given by built-up areas with low built-up and high green area ratio (suburbs and garden cities), hence it is very important to prohibit the parcel-up sites of these residential areas, to observe the by-law-maximum built-up ratio and to protect and develop private gardens with high vegetation. The subdivisions are similar to housing estate in respect of green area ratio. Local planning should calculate with lower green area ratio in case of subdivisions and it should compensate with public parks or other urban open spaces.

Re-establishing improved green area normatives can help develop the urban green space system, as it is suggested in this paper too.

To develop the green space system, an urban green area cadaster should be recorded, which have been recommended in Sopron many times. This cadaster should cover every element of the green space system. It is necessary to survey the gardens and other green areas of the built-up area beyond open spaces and other part of green

infrastructure.

3. The satellite-imaginery-based Normalized Difference Vegetation Index (NDVI) and the deduced secondary indexes can be applicable to the examination of the relationship between green area and built-up surfaces. The analysis of unisized sample areas can be used to the survey of urban surface pattern.

A direct and detailed measurement of green areas is very time consuming; it can be facilitated by the geoinformational analysis of multi- and hyperspectral imagery. The NDVI derived from the red and infrared band of the multispectral imagineries is an easy calculated data and it impounds the simplified categories of green areas with different vegetation. A disadvantage of this method is that it can not be applied for settlements with larger water surface, because the NDVI characteristic of water surfaces and buildings are very similar. Following the changes is only possible if the conditions of the analyzed imagineries are equal.

The NDVI raster statistics features suitable the districts of inner city area with different vegetation. NDVI-average represents the significance of the vegetation, NDVI-deviation indicates the variability of surface pattern. NDVI-based secondary indexes proved to be suitable to introducing the vegetation of sample areas. Secondary indexes based upon the weighted NDVI-value help to correlate the parts of the inner city area with different function and history in point of vegetation.

On the solid sample areas, the distribution of the different surface patterns can be shown. A close connection can be created between sample areas and urban zones with fitting the sample areas into the functional zoning.

The geoinformational analysis of satellite imagineries cannot replace the vegetation-quality-controlling field-work, but it simplifies the collecting quantitative data and it can enrich the methodology with an objective aspect. The description of urban NDVI-features can promote the development of the new green area normatives. As this method reveals the actual situation it may give a Benchmark thereby.

4. An awareness of the history of settlement structure is necessary to the evaluation of the green infrastructure, beyond

the state, structure and relationship of open spaces and green areas, especially at historical settlements. The former settlement plans may hold such elements which can be imported to the actual development documents. The open space ratio, projected on the whole inner city area, is not enough to describe the complete green infrastructure and give a development policy.

By the methodology of this research, the historical presentation of different town districts will complete the geoinformatical analysis and field-work to describe the green area characteristic. The knowledge of historical past explain the present situation.

Relying upon the data of spatial and historical relations of green areas it is can be stated, that the deficiencies of a combined green space system of Sopron arise from the town structure and its development. The question of the green space system have been always raised in the former further planning schemes and development documents of Sopron. There are ideas among non realized components of these plans which can be put to use and supplement the actual green space system. Such idea was former municipal engineer József Wälde's suggestion about the parks joining urban subcentres. Establishment of open spaces similar to this conception is necessary when developing new residential areas, even though the built-up ratio is low.

The comprehensive green space ratio statistics quoted in the settlement development plan in 2001 do not reflect the deficiencies and disproportions of the green infrastructure and its relation to the town structure. Therefore the examination of the details is necessary at the „green” parts of the community development plans.

5. In the case of the historical city, at city parts in equal zone and with similar function and structure, the green area ratio of some residential areas can be influenced by historical and geographical background.

There is a significant difference between the green area indices of the sample areas in case of Sopron's northwestern and southeastern part. The proximity of the forest have made an impact on the evolution of the western town district through the centuries. Next to the forest the garden city is the greenest residential area of Sopron. The linear infrastructural elements (roads and railways), the heritage of the centuries, influence the usage of open spaces. Railways proved

to be a crucial factor in land use at Sopron, the district between the forest and the railway have a remarkably greater green area ratio than other districts.

6. At the inner city area, the following urban surface pattern types can be determined on the base of the characteristic and relation of built-up surfaces and green areas:

- 1. Storied built-up with tight texture and with little green area**
- 2. Partly storied development with isolated private gardens**
- 3. Several-storied built-up with coherent gardens**
- 4. Townish, framed and several-storied development with per-block-isolated gardens**
- 5. Detached and several-storied building method with relatively large gardens**
- 6. Belted, one- or two-storied building method with belted green spaces**
- 7. One- or two-storied building method with coherent larger gardens**
- 8. Coherent one-storied built-up with coherent backyard**
- 9. Straggling detached building method with large gardens**
- 10. „Housing estate”**
- 11. Institution area with large green space**
- 12. Industrial area**

The surface pattern types may help the application of historical and green area aspects in ecological urbanism.

According to the historical built-up aspect types, this urban surfaces pattern types involve better the relationship between built-up area and its green area. They demonstrate the spatial, structural and green area aspects of inner city areas, thereby the quality of life at the districts. The development of the settlement is illustrated by typical patterns that reveal the historical building methods and quarters. These pattern types can be applied at the Central European, historical, small and middle-sized towns.

Settlement development can be followed through the change of the urban surface pattern types. Some types can transform into others. So

the type „one- or two-storied building method with coherent larger gardens” is evolved from the type „straggling detached building method with large gardens”. In the same way the type „several-storied built-up with coherent gardens” and the type „one- or two-storied building method with coherent larger gardens” can transform into „belted, one- or two-storied building method with belted green spaces”. This last is the most widespread building method with the least local character in the small-townish and garden city districts. The tendency should be taken into account with the actual planning process.

The mapping of these urban surface pattern types may help the evaluation of the vegetation asset of the districts with different history and building methods. They can involve green areas better to the examination of the settlement changes. The relationship between typical building methods and green areas relate to the quality of life at the different town districts, so this methodology may contribute to set perspective opportunities of the community development.

Publications

Publications related to topic of the research:

Történeti térképek digitalizálása – alternatív megoldás településtörténeti forrásanyag feldolgozására. Sopron, 2011, NymE FMK Építéstani Intézet (under coming out)

The brief account of the landscape history of Sopron – Abstract. In: *TransEcoNet Workshop on Landscape History, Abstract volume*, Sopron, Hungary 22. April 2010. Sopron, 2010, NymE EMK. 25-26. p.

The landscape aspects of the settlement history of Sopron. Poszter. TransEcoNet Workshop on Landscape History – 22. April 2010 – Sopron, Hungary

A soproni táj változásainak vázlatos története a 18. századtól napjainkig. In: *Soproni Szemle*, 2009. 2. sz. 147-166. p.

Die Landschaftsgeschichte Soprons. In: *Geographisches Jahrbuch Burgenland* 2009, Band 33. p. 62-84.

Winkler Gábor – Sági Éva: A táj- és az épített környezet állapota. 2.3.7.2. fejezet. In: *Sopron megyei jogú város környezetvédelmi programja 2010-2015.* Sopron, 2009, Nyugat-magyarországi Egyetem Kooperációs Kutatási Központ Nonprofit Kft. 129-161. p. (8 oldal)

Sopron tájtörténeti vázlat a 1700-as évektől napjainkig. In: Flachner Zsuzsanna – Kovács András – Kelemen Éva: *A történeti felszámolás térképezése a Tisza-völgyben.* Szemináriumkötet, 2008, Budapest. Nagykőrű–Eger–Budapest, 2008, Szövet. 62-64. p.

Ízelítő Major Jenő településtörténeti munkáiból. In: *Értékmentő*, 2006. XVI. évf. 1. sz. 12-13. p.

Sopron egyes közterületi faállományainak idősoros összehasonlító vizsgálata. Diplomamunka. Sopron, 2003, NyME Erdőmérnöki Kar, Környezettudományi Intézet

Presentations related to topic of the research:

Települési zöldfelületek szociológiai jelentősége. PhD. szigorlat, Sopron, 2008. febr. 5.

Forráskutatás történeti településszerkezet vizsgálathoz. Sopron, 2006. márc. 14., A NymE FMK, az MTA Erdészeti Bizottság Faipari Albizottság és a Soproni Tudós Társaság tudományos felolvasó ülése

Other publications:

Soproni Szemle – Helytörténeti folyóirat – hatvan éve az építészeti értékmegőrzés szolgálatában. In: *Értékmentő*, 2010. 2. sz. 11-14. p.

- Allgemeine Bauzeitung – Kivételes építészettörténeti forrásértékű folyóirat. <http://ilex.eke.hu/kk275/index.php>, 2010. május 10.
- Rejtett kincsek Bécsben. In: *Értékmentő*, 2008. 4. sz. 12. p.
- Sági Éva – Szabó Péter – Wehofer Valéria: Az építészeti diszciplína története. In: *Az erdészeti felsőoktatás 200 éve*. II. kötet. Sopron, 2008, NymE Erdőmérnöki Kar. 9-21. p.
- A soproni Szent Orsolya Iskola története. In: *Soproni Szemle*, 2007. 1. sz. 23-39. p.
- Faipari kutatások az EFE Építészeti Tanszékén az 1960-70-es években. In: *Faipar*, 2007. 1-2. sz. 39-41. p.
- Egy városvédő építész emlékiratai – életrajz és korrajz (Kubinszky Mihály: Az ion fejezet – Egy építész emlékiratai. HAP Galéria, 2006). In: *Értékmentő*, 2007. 5. sz. 12-13. p.
- Bejő László – Szabó Péter – Andor Krisztián – Sági Éva – Wehofer Józsefné – Karácsonyi Zsolt – Hantos Zoltán: *Faépítés*. Digitális könyv. Nyugat-magyarországi Egyetem Faipari Mérnöki Kar Építészeti Intézet, 2007. <http://www.tankonyvtar.hu/konyvek/faepites/faepites-faepites> (2011. 08. 09) (2-10. fejezet)
- Az Építészeti Tanszék soproni története 1. In: *Vivat Academia*, 2006. IV. évf. 1. sz. 14-15. p.
- Az Építészeti Tanszék soproni története 2. In: *Vivat Academia*, 2006. IV. évf. 3. sz. 31. p.
- Az Építészeti Tanszék selmeci élete. In: *Vivat Academia*, 2005. III. évf. 1. sz. 32-33. p.
- Az Építészeti Tanszék selmecbányai múltja. In: *XXX. Építészeti Konferencia*, Sopron, 2005. május 26-27-28. 9-11. p.
- Jótanácsok forráskutatáshoz, helytörténeteknek. In: *Értékmentő*, XV. Évf. 2005. 5-6. sz. 16-17. p.
- Megjelent Kubinszky Mihály könyve a soproni Lőverről. In: *Vivat Academia*, 2005. III. évf. 6. sz. 31. p.
- A soproni Szent Orsolya Iskola története az alapítástól napjainkig*. Diplomamunka. Sopron, 2003, NyME Faipari Mérnöki Kar Tanárképző Intézet

Other presentations:

- A Széchenyi tér és épületei*. Az „Egészséges, Virágos Sopronért” rendezvénysorozat keretében. Sopron, 2007. szept. 24.
- Hallgatói adatbázis-készítés*. VII. Közgyűteményi Napok, Sopron-Győr, 2007. okt. 19.
- Hallgatói adatbázis-készítés módszertana*. 2. Közgyűteményi nap, Sopron, 2007. november 8.
- A soproni Szent Orsolya Iskola története*. Sopron, Pedagógusok Művelődési Háza, 2008. márc. 5.
- Orosz faépítészeti*. VIII. Faépítészeti Konferencia, InnoLignum Sopron, 2010. szept. 10.
- Szemerey Tamásné Dr. – Sági Éva: *Selmectől Sopronig – A NymE épületei*. 5. Közgyűteményi Nap, Sopron, 2010. nov. 9.
- A felsőoktatás épületei és helyszínei Sopronban*. Levéltári napi konferencia, PTE Egyetemi Levéltár. Pécs, 2010. nov. 18.