Cure for Urban Rupture

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Architecture

Eastern Mediterranean University
April, 2017
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

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ABSTRACT

This research sets out to investigate if there can be a universal approach on how to handle segregation in urban grids. An extensive review of analytical literature on segregated urban grids is conducted surveying different types of segregation such as physical, spatial and social. It is then argued that it is possible to model a new approach on the rehabilitation of cases of segregation. Parent theory of this new approach is Space Syntax. By using space syntax analysis, numerical values representing the urban spaces of the grid were acquired. Then these values were analyzed using a number prediction tool in envisioning possible future behavior of the urban grid. It is discussed that, as space syntax works in numerical values it is in fact possible to analyze them using a mathematical tool used for numerical prediction equations; Fibonacci retracement. It is argued, pinpointing the resulting values on space syntax integration maps provide key locations that would have impact potential on future sustainability of the urban grid. It is then suggested to insert artificial cores containing socio-economically viable functions on those key locations to act as secondary city centers, in observing the increase in space syntax values of integration and elimination of segregated portions of the urban grid; the process is named as the Cure. Analyzed space syntax maps of the applied Cure showed major increases in the levels of integration and even total elimination of drastically segregated areas on some cases. The thesis concludes that it is in fact possible to improve cases of urban segregation by using the proposed method.

Keywords: Segregation, urban grid analysis, space syntax, time-space analysis, Fibonacci.

ÖZ

Bu tez, kentsel ağlar bünyesinde oluşabilen sosyal ve mekansal segregasyon ile nasıl başa çıkılacağı konusunda evrensel bir yaklaşımın mümkünlüğünü araştırmayı amaçlamaktadır. Fiziksel, mekansal ve sosyal gibi farklı segregasyon türlerini incelemek üzere dokusunda mekansal kopukluk izlenebilen çeşitli kentsel ağlarla ilgili analitik literatür incelenip, segregasyon vakalarının rehabilitasyonu için yeni bir yaklaşımın mümkün olabileceği öne sürülmüştür. Bu yaklaşımın ana kuramı Mekan Sentaksı'dır. Mekan sentaksı analizi kullanılarak, kentsel doku dahilindeki alanların her birini temsil eden sayısal değerler elde edilip, bu değerler, kentsel ağ üzerine gelecekte oluşması muhtemel morfolojik senaryoları öngörebilmek için bir sayısal tahmin aracı kullanarak analiz edilmiştir. Sentaksın sayısal değerlerle kentsel mekanları temsil etmesi mümkün olduğuna göre, elde edilen rakamların, tahmin denklemleri üretebilen bir araç kullanarak analiz edilebilmesinin de mümkünlüğü tartışılmıştır. Sözkonusu sayısal yöntem, Fibonacci analizi, sonucunda elde edilen değerlerin haritalar üzerinde temsil ettiği yerlerin, gelecekteki kentsel şebekenin sürdürülebilirliği üzerinde etki potansiyeli olan bölgeler olduğu savunulmuş ve bu mekanlara entegrasyonu artırmayı amaçlayan, sosyo-ekonomik açıdan uygun işlevleri içeren yapay çekirdekler eklenerek mekansal sentaks analizi ile kent ölçeğinde segregasyonun büyük ölçüde giderildiği gözlemlenmiştir; bu sürece 'Kür' adı verilmiştir. Uygulanan model ile analiz edilmiş mekan sentaksı haritaları, entegrasyon düzeylerinin arttığını, hatta bazı durumlarda segregasyonun ortadan kaldırıldığını göstermiştir. Araştırma sonucunda, önerilen yöntemi kullanarak kentsel ayrımcılık vakalarını düzeltmenin aslında mümkün olabileceği gösterilmiştir.

Anahtar kelimeler: Segregasyon, kentsel ağ, mekan sentaksı, zaman-mekan analizi, Fibonacci.

ACKNOWLEDGEMENT

Firstly, I would like to thank the usual suspects; my family and friends for their support and patience during the endeavor that resulted in this thesis.

I also would like to express my grateful thanks to Z. Nilay Bilsel who provided invaluable guidance from the beginning to the end of my research.

Special thanks go to Cemre Peral Yaniker who stuck by me and kept me sane for the past 5 years.

Finally, the biggest thank you goes to my supervisor Prof. Dr. Resmiye Alpar Atun for her never-ending support which was the most significant contribution in completing this grueling research and making this thesis a reality.

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INTRODUCTION

The term 'urban grid' describes how we read our cities; it signifies the only way we can perceive a city. Human faculties only allow for a limited experience of spatial perception so we scale down, translate the cities to into a form we can understand, it has been since term's inception by Greek architect Hippodamus of Miletus around 450 BC (Stanislawski, 1946), when we first started to read and plan our cities. Even a more ancient entity than the term 'urban grid', segregation also existed as long as cities themselves. What is segregation? Literal definition of the term is; 'separation of humans into different groups', which is not much different from its use within urban context.

Urban segregation signifies that a part -or parts- of the urban grid is detached from the rest of the city with its lacking social activity due to its insufficient spatial characteristics. It is possible to observe some degree of spatial segregation on every urban grid which is normal, not every part of a city can have equal amount of integration -opposite of segregation. When the amount of segregation reaches to a degree that certain areas start to be perceived as markedly 'different' -in a negative way- in relation to the rest of the city, that would not be an acceptable level of segregation. Segregated areas tend to decrease social activity, in a city where anti-social activity gains commonality, that behavior in turn would affect other weak points of the grid and urban segregation spreads like a sickness. A sickness that needs a 'Cure'.

So what defines a segregated city? There are many forms of segregation with different names like slums, ghettos etc. Most severe form would be actual physical division imposed upon an urban grid due to external circumstances such as politics, geography, religion, technology. An equally, if not more, severe form would be reversing aforementioned division like it never happened; reconnecting the separated parts after some time, and expecting two halves of a previously whole urban grid to reconnect, in simpler terms, trying to overcome urban segregation by just stitching the grid back together.

In any case, it is possible to say that, more than anything else urban planning is the key thing to accomplish reunion and reintegration of cities that suffered a type of segregation. Looking at past examples, each city had their unique, dedicated attempts to resolve urban segregation. As no two cities are exactly alike, it would be considered impossible to have a universal method to apply on cities of segregation. But what if there was a common method? A formula that can work on different urban grids of cities but produce the same results, detecting crucial points of segregation to make adjustments on, eventually curing urban rupture. This study will try and answer that research question; if it is in fact among the possibilities that a generalized methodology can be introduced to help overcome urban segregation.

In proposing a methodology to resolve the research problem, the research will adopt a set of parent theories stemming from Space Syntax theory. Space syntax' set of analytical approaches offer a variety of measures that inform on socio-spatial characteristics of urban space producing specific, mathematical values for concepts of integration and segregation.

It is suggested, using these values in conjunction with another mathematical theory would point out specific 'key' locations on the urban system that can be used in eliminating overall segregation. It is argued; those 'key' spaces signify locations with the highest potential to have increased socio-spatial and economic activity in the future. The mathematical equation that performs this prediction is called 'Fibonacci retracement'. Naturally stemming from the Fibonacci sequence, Fibonacci retracement is a method of analysis used in finance to predict probable support (low value) and resistance (high value) levels of a stock in the stock market (Brown, 2008). There are two types of stock movements in the market, the uptrend - signifying potential value increase- and the downtrend - signifying potential value decrease- as the spatial aim is to predict integration increase, 'uptrend' ' will be the measure of choice to be used in this thesis. Application of Fibonacci retracement on space syntax integration values of the urban grid produce a set of numbers which can be found as integration numbers on space syntax maps; pointing out to seemingly unimportant axes but with aforementioned potential to have increased socio-spatial and economic activity in the future, these spaces will be called 'Cure locations' in this research. The prediction theory will be tested by applying the whole process on older maps of two small cities and correlating data with their current conditions. Under this hypothesis, it is then argued to insert 'artificial cores' on the Cure locations, specifically designed to increase socio-spatial activity. Artificial cores' aim is to act as secondary -or tertiary- city centers with clear connections within the grid and also to have all the spatial requirements of a self contained area functioning as an integration attractor, a generative space. Hillier (2009) argues that when an urban grid is well integrated -which means easily accessible through any position within the spatial system- and dense enough it constitutes a 'generative' use of urban space; the urban grid supports generating movement along its axis and as it generates movement it encourages social interaction, when an urban grid is segregated and its axial formation is disjointed; it fails to generate human movement, this constitutes a 'conservative' use of urban space that does not support social interaction. Live centrality principle (Hillier, 1999) is when a part of the urban grid -either its is the actual city centre or not- is so well integrated, its generative properties support functional allocations that feed economical considerations, these parts of the urban grid usually incorporate functions like retail, catering and entertainment, thus they act as city centers even though they may not be the actual one. The concept of live centrality signifies what is proposed with the artificial cores.

Following the three step process of space syntax analysis, Fibonacci retracement and artificial core insertion, the ultimate goal is to eliminate urban segregation to a point that the city would have better integration as a network with all its parts working together as they should; the 'Cure' for the disorder as it manifests on the framework that is urban grid, the foundational structure the city is formed upon. Two existing urban grids will be used to develop the methodology and test out the process; the cities of Nicosia and Famagusta in Cyprus, where both cities display a segregated urban structure, the form of segregation differ on each case due to the varied development processes of their respective urban grids.

The last divided capital of Europe, Nicosia is chosen for its severe form of segregation; the island of Cyprus -which Nicosia is capital of- is in a state of division since 1960's making it the longest conflict in the history of United Nations. Years of spatial division fed the socio-spatial segregation that is clearly observable in the city. Current political arguments indicate there are two different possibilities in the future of Nicosia; either the city remains divided forever or it unites once and for all. Spatial analysis indicates the city work much better in terms of urban integration when it is united, than its two separate halves as they are now. The 'Cure' will be applied for both scenarios; the two halves will be analyzed by themselves then the urban grid of the whole city will be the subject of the process.

The secondary case for the application of proposed Cure is the city of Famagusta with its significantly different form of segregation. A portion of this city too is physically divided in 1974 but since the divided part was located at the edge of the city; the whole city was not divided like Nicosia but -for lack of a better word- trimmed. Famagusta formed five distinct self contained areas during its development since; it is argued that all the districts developed their own separate urban identity with different grid characteristics, transforming the city into a collage of five small boroughs. This represents inconsistency in the urban growth of the city, rather than the conventional definition of urban segregation this thesis proposes to overcome. The reason why city of Famagusta is also chosen for the application of proposed methodology is to demonstrate its range of use and underline its practical limitations.

The thesis is comprised of eight chapters; after the initial introduction, the second chapter of the study reviews the previous analytical approaches towards urban grids, Space Syntax is chosen and introduced within this chapter with an extensive review of its methodologies, theoretical background and analytical tools which are employed in evaluating urban space. The third chapter deals with issues of urban segregation on several cities around the world, focus is on observable spatial impact of segregation on cities and their background formation process as well as social and morphological changes inflicted upon the grids. The fourth chapter provides detailed investigation on the case cities Nicosia and Famagusta; historical processes regarding the manifestation of the segregation problem in both cities are reviewed and urban grid structure of both cities are introduced and analyzed with Space Syntax tools. The fifth chapter deals with the proposed model, Cure. The problem definition is provided with the argument on the requirement of a common model to overcome urban segregation. It is also within this chapter the primary methodologies of the Cure, Fibonacci retracement and artificial cores are introduced and the initial testing of the new methodology is conducted. In chapter six, necessary mathematical data is calculated and the Cure is applied using space syntax integration maps of the selected case cities Nicosia and Famagusta, application is performed using several scenarios where cities' physically separated urban grid parts are taken into account, then Cure results are reviewed along with a sub-chapter dealing with real life application of the method. Chapter seven deals with possible counter arguments regarding socio-ethical applicability of the cure; possible socio-economical outcomes and the ethics of proposing artificial urban grids on the naturally evolved grid structures of cities are discussed. The eighth and final chapter summarizes the study and concludes the thesis.

Chapter 2

ANALYTICAL APPROACHES ON URBAN GRIDS

Research on urban networks of cities have a long history spanning three centuries which analytical approaches gained prominence over the last three decades (Al Sayed, 2014). One of the first approaches on cities as complex organizations was that of Jane Jacobs (1961), where she made the suggestion that cities are similar to biological systems in matters of organizational complexity, this also signified the one of the earliest uses of organic analogy in defining urban system. Since then, complexity issue of urban network systems has been investigated by many researchers (Barenblatt, 1996; Batty, 2007; Eeckhout, 2004). Phenomenological philosopher Jeff Malpas explains; place is 'constituted through a gathering of elements that are themselves mutually defined only through the way in which they are gathered together within the place they also constitute' (Malpas, 2012). Wiggins et al. (2012) argue that any form of relationship is perceived by the connections between parts that form that relationship. In understanding relationality, socio-scientific research regularly deals with analytic methodology as it makes it possible to address parts and connections that make up a relational system as empirical values which can be analyzed and correlated (Wiggins et al., 2012). It is possible to find a number of urban concepts that approach cities as systems formed with analytic relations (Al Sayed, 2014; Batty; 2007).

The premise of analytical approach on spatial networks is rooted in the 18th Century (Euler, 1736), where urban networks have been considered to be mathematical objects that can be represented in graphs, engineering and scientific modelling approaches also continued to shape the landscape of this discipline. Theoretical frameworks such as Space Syntax advanced the analytical methodology with focus on the network structure of space and the social logic inherent in its representation (Hillier & Hanson, 1984).

There have been many studies in looking at urban systems as configuration of numbers; the use of mathematics in urban theory consequentially caused it to be perceived as a problem that requires a solution, rather than an all evolving organism which needs an analytical framework The view of urban theory as a 'number problem' led to the formation of numerous mathematical attempts to remedy it; Van der Laan (1983) suggested geometrical applications, arguing that any space, be it urban or architectural, is a universal concept and new spaces can be formed by simply adapting geometrical proportions, Le Corbusier (1929) also employed rigorous use of firm geometry in forming his designs for ideal cities of the future. Where Le Corbusier's use of symmetrical geometry in his designs was aimed at creating non-hierarchical future societies, sole use of simple geometry in planning of whole cities does not go much further than creating formal settlements primarily seen in US cities like New York, Atlanta etc. Urban networks as geometrical systems discussion also led urban patterns to be analyzed through fractal geometry, in which fractals were applied to describe urban morphology (Batty, 1996; Barenblatt 1996) and urban growth (Frankhauser,1998; Makse et al.,1995; Rozenfeld et al., 2011, Batty, 1994).

Almost all analytical approaches dedicated in understanding the nature of urban grid, deal with the concept of segregation. Urban segregation indicates parts of the urban grid is socio-spatially -or even physically- detached from the rest of the city. There have been numerous approaches to analyze and understand segregation in cities. 1974 model of Henderson and Lebow on spatial division is not too dissimilar from Kubler-Ross model in psychology which deals with five stages of grief; Denial, Anger, Bargaining, Depression, Acceptance. Henderson-Lebow model for divided cities, has six stages; Pre-Division Stage, Actual Division, Initial Division (firm division), Mid-Term Division (less hostility, acceptance of coexistence), Rapprochement (cooperation of two sides) and Unification. Where model is useful to chronologically categorize the states of segregation during a research to analyze urban partitions, it only does that, it is merely a literal tool for guidance in academic paper writing, with no actual use on the 'segregation' part. Kliot and Mansfield (1999) used this model to analyze, more correctly, to summarize the states of segregation on a number of divided cities. Caner (2012) implies that the initial cause of urban segregation in cities has little to no relation to its later stages. It is argued, in cities like Belfast and Nicosia, religious and political reasons which initially enforced segregation, later used to frame the spatial division. This could mean, even though the current reasons for segregation in cities are different as a result of local and global evolution of society, the solution attempts -where there are any- are focused on the past reasons and are doomed to be futile. This may just be the definition of how global politics on spatial segregation are formed. Caner (2014) also argues the different proposals to 'fix' segregation in cities focus only on a specific part of the problem, due to their creators' specific interests, quoting Yiftachel (2006) it is implied that such proposals are focused on 'their planners instead of planning' and goes on to propose some new urban reintegration planning policies to be used on divided cities. Yet, similar to the UNDP papers and even Nicosia Master Plan, these proposals, although useful, are still dedicated scenarios focused on resolving the physical outcomes of a single urban problem; the symptoms instead of the disease itself that is segregation.

There is also a critical approach on how to handle urban segregation theoretically. Using Berlin, Stockholm and Jerusalem as case studies, Rokem (2011) suggests there is a 'hole', an academic gap in the divided cites discourse; it is implied the matters of division must be treated under the same umbrella as matters of segregation as they are one and the same. This research supports the aforementioned argument as it is suggested that division is merely a severe form of segregation. Bolen and Caner (2013) bring another critique to urban theories regarding division and segregation. They argue such urban theories mainly surfaced after Chicago school's attempts to classify architectural and urban design theory as social sciences and proposed urban space in cities to be classified with different zones with particular functions. Methodical approach of Chicago school that defined its time period is visible in their perception of urban theory, deducing from this, Caner argues any urban theory -not only limited to the ones dealing with segregation- can only reflect zeitgeist. Meaning no matter what solution we can bring to the division and segregation problems, it will be irrelevant in a few decades. This study implies the opposite; it is argued that urban and spatial design theories do not need to remain as theories, but can evolve into something more. While it is true that 'theories' in general are time dependent, science is infinite and timeless, at least in the context of human perception. The aim of this study is not to form a theory, but a scientific method, based on mathematics, to resolve the issues of urban segregation.

Also a scientific approach, Parametricism, a new architectural style introduced by Patrik Schumacher (2009) is based on defining and inputting constraint parameters of a design to a CAD environment, software then allows the user to simulate any design form without compromising the design requirements -parameters. Parametricist urbanism relies on inputting the elements of urban morphology such as block size and path networks, on Autodesk Maya software -with defined parameters like block height or path width- to get an output of potential path networks, best suited for the given urban area (Figure 1), award winning Kartal-Pendik Masterplan by Zaha Hadid was designed using this methodology.

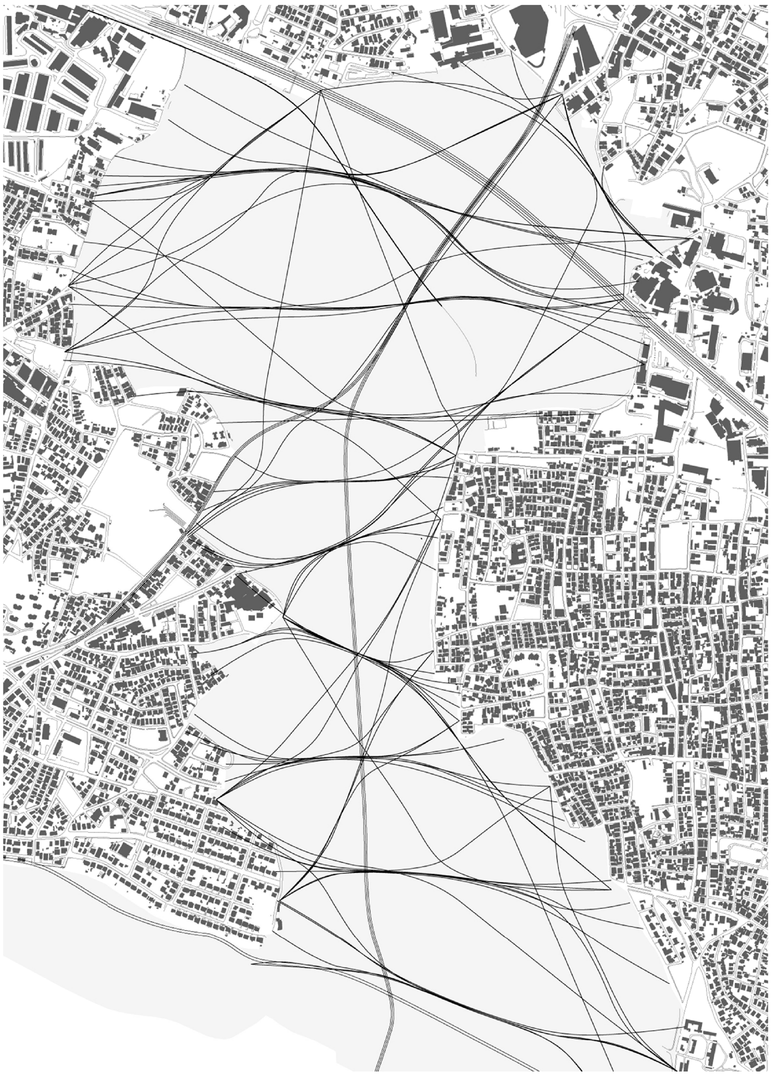


Figure 1: Zaha Hadid Architects, Kartal-Pendik Masterplan, Istanbul, Turkey, 2006

Parametricist urbanism introduces a design tool like no other; conformity of the design with the existing urban grid is guaranteed. But parametricism does not concern itself with socio-spatial aspects of the urban grid; its aim is to form the best possible contemporary design which fits with the rest of its surroundings. As the parameters are derived from the existing conditions of the urban grid, if the part of the grid designed with parametricist approach is a segregated one, then the new design would support that segregation, parametricism is required to address such issues in order to form a socio-spatially viable urban theory that works as good as its aesthetical aspects, its current iteration -powerful as may be- can only be used as a case specific design tool.

Charalambous (2013) brings a different level of approach on the socio-spatial urban segregation issue; temporality. It is argued, just considering social and spatial features, either separately or interconnected is not enough to analyze and resolve urban divisions, and that the element of time must also be considered, not as in analyzing space and social attributes from another time period of a selected area but as it being a constant element on every step of the study, quoting Vaughan (2011) 'society leaves traces on its surroundings and that those surroundings have in turn an influence on how society is structured'. Although admirable, this approach is somewhat utopian as predetermining every possible outcome is not possible on any scenario but there is no denying that urban environment and societal behavior constantly influence each other. A press release by University of Cambridge (2012) takes a solid stance on the issue of urban reintegration of divided cities. It is clearly expressed that as long as any proof of physical division remains present in the city, they will always continue to carry and cause symptoms of segregation, that there is no such thing as post-conflict phase in urban centers as long as element of division continue to exist. This contradicts the notion that led to the decoration of Belfast 'peace walls' in converting their existence to a positive memory. Where there definitely are physical reminders of division that require removal, it can be argued not every element is past redemption. Rappas (2012) confirms this on observing user's changing attitudes towards the buffer zone in Nicosia.

Mulholland, Abdelmonem and Selim (2014) look into a potentially useful concept in helping formerly segregated cities support their reintegration. Subtly named; "Shareness" proposes the selected public spaces in a formerly divided city to be designed such a way that they promote co-existence. There are a few factors for a public space to be eligible for this; built environment must support the cause; there cannot be any old buildings reminding users of past issues, enclosure and landscape must be morphologically suitable not to allow segregation within the space, design characteristics of public space must focus on the shared communal characteristics of formerly separated communities. Even though it's set of rules are not well established, use of the concept of Shareness will be implied on the proposed artificial interventions for the urban grids suggested within this thesis.

Among all these approaches, Space Syntax is one which made a unique place for itself in academic community by introducing functioning, user oriented analytical tools next to conceptual definitions of urban segregation. Space Syntax' analytical applications on urban systems which are main tools to be used on this research for urban analysis of axial maps showing street networks. Street networks are accepted as the most important and articulated infrastructural network, as formative, ever-presented element of urban configurations.

2.1 Space Syntax: The Analytical Assessment Tool for Urban Grids

Space syntax theory is developed to help understand the usage of any space, either it can be at urban scale and/or local scale or even non-architectural. That of course is a very broad definition for a theory which bases most of its analytical tools to simple mathematics. This analytical set of methodologies can be applied to almost every spatial configuration, which of the methods to use depends on the scale of the spatial entity.

Space syntax analyses offer a variety of measures that inform on socio-spatial characteristics of urban space, most of these measures are acquired through space syntax software. The measure of integration is one of the most important measures to be derived from space syntax spatial analysis, its primary function is to point out how well connected and accessible are the spaces that make up that spatial configuration, in relation with the rest of the system; this is determined by the 'step depth' measure. Depth of a space indicate the number of spatial transitions -steps- required to access to other spaces within that system, higher step depth value indicates more spaces to overcome -segregated space- where lower values indicate easier accessibility -integrated space. As the integration measure is based on depth, instead of any distance units, the analysis is topological; this eliminates scalar constraints when comparing spaces of different size (Hillier, 1996).

[1] Step depth in space syntax terminology means the distance from the most integrated axis/space, for instance, if an axis/space is connected to the most integrated one with another axis/space in between them, that axis/space is two step depths away.

Graphical representation of integration through space syntax software is produced by assigning a range of colors from cold to warm, corresponding with the precise numerical integration values of each space in the system.

Since well connected and accessible spaces tend to support more human activity by attracting more users, the measures of integration -and its opposite; segregation- are considered as indicators of high and low social (socio-economic in urban scale) interaction (Hillier, 2009). Space syntax, doesn't classify the use of its methodologies by titling them in accordance with the scale of the space to be analyzed, meaning there are no methodologies that are exclusive to different fields of spatial disciplines such as interior design, industrial design, urban design, but there are methods that are more suited to be used in different scales. It is possible to classify them with two main headings; local -architectural- scale and urban scale which are used in this thesis. Urban scale applications of space syntax are given more prominence globally due to its success in analyzing large scale urban grids and providing real life verifiable socio-economic data. Analyzing urban space, the theory has two important tools that use axial representations of urban grids (Figure 13); axial analysis and segment angular analysis.

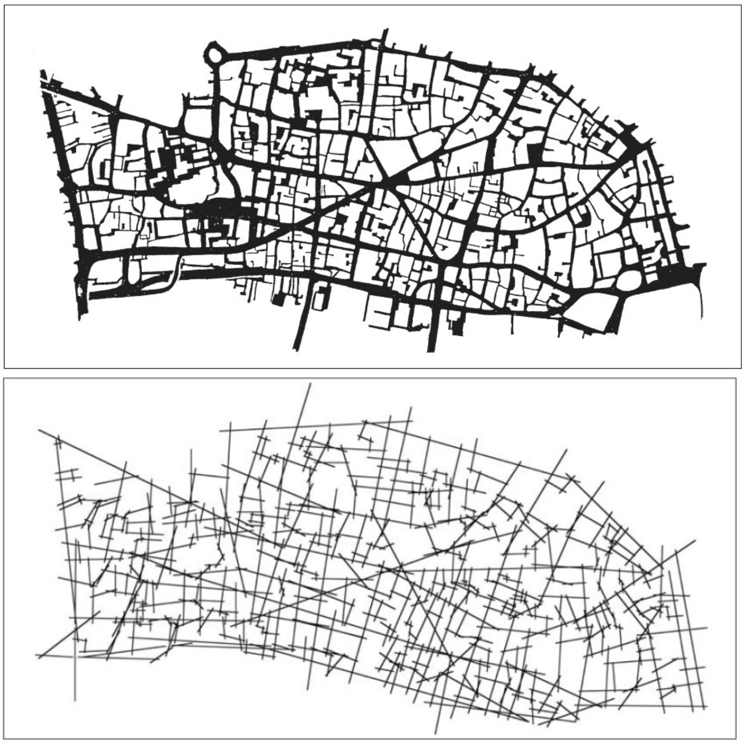


Figure 2: City of London, regular and axial maps
© Space is the Machine (1996) by Bill Hillier

The integration measure as it is used in axial maps (Figure 2) is acquired through syntactic calculation of the position of each axial line that makes up the system, which gives every single axial line a specific value that implies its importance on the whole system. Specific integration values for each line is calculated by space syntax software Depthmap (Turner, 2001a) using the mathematical formula for integration introduced by Hillier & Hanson (1984), these values are then graphically represented on the axial map by colorization of the lines, the most integrated lines being red while the least integrated -segregated- lines being blue.

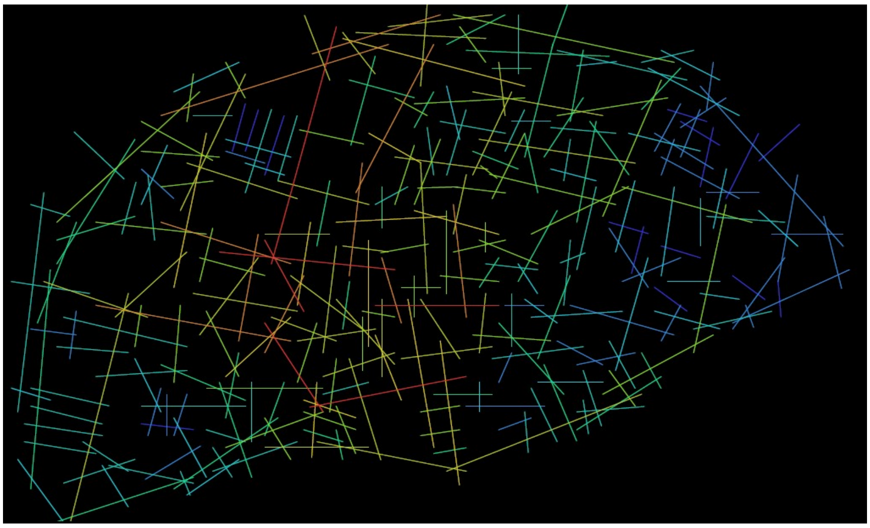


Figure 3: Walled City of Nicosia (north) axial integration map

Correlation of space syntax integration values with real life data is verified in Aknar (2009) with land use maps and movement tracking methodologies used on the walled city of Nicosia (Figure 3). Another important urban scale methodology of space syntax is segment angular analysis (Figure 4) which is based on adjusting integration values of the lines used in axial map according to their angular deviation between line segments, lesser deviation between segments gives the line a higher value (represented with red color) whereas higher deviations gives lesser value (represented with blue color). It is documented that segment angular integration maps mirrors human movement more closely (Hillier & Iida, 2005) but overall city-scale results do not differ much except when there are drastic angular deviations.

DeSyllas (1997) utilized space syntax analysis on a formerly divided city -Berlin- to observe its urban evolution through time. Axial integration maps were produced for both divided Berlin and re-united one. Maps clearly indicate the integration core of the city shifted with the reunion, land use patterns confirm this; then newly formed integration centres became hubs of urban economy. Further analysis of the more recent states of the grid also indicated that the evolution of urban morphology leads the way to the relocation of economic activity.

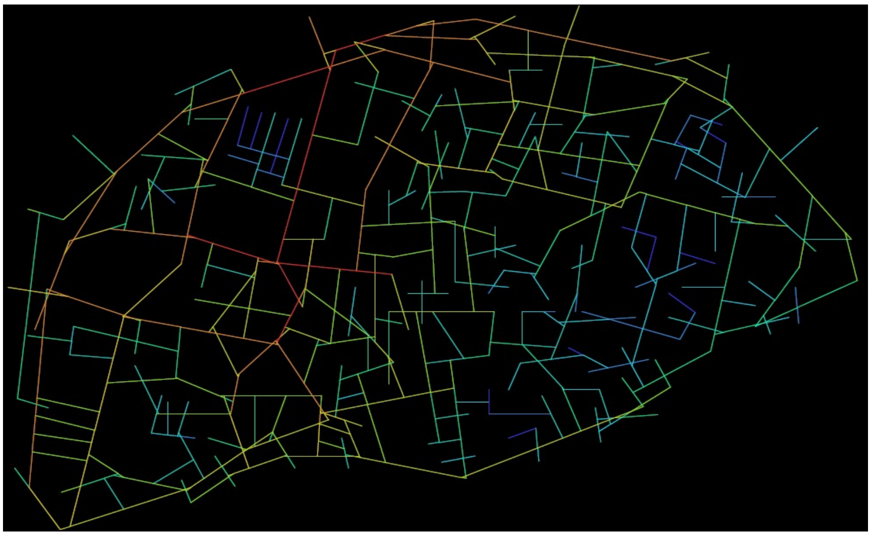


Figure 4: Walled City of Nicosia (north) segment angular integration map

Along with the technical analysis aspect of Space Syntax, Hillier's theories also form the foundation of the theoretical background of the proposed 'Cure'. In the paper 'Centrality as a Process' Hillier (1999) deals with the evolution of city-wide spatial patterns, specifically with the effects of city centres and sub-centres during said evolution. It has been argued, the initial formation of the centre of a small scale urban grid (like a town) tends to be linear and shapes upon the most integrated line within the grid, with the growth of the city a series of sub-centers may form, usually in two step depths[1] away from the initial centre which also forms linear structures in themselves.

In large scale grids, a higher concentration of axial lines in the centre creates a more concentrated urban grid with smaller yet denser urban blocks which forms an overall convex shape with ‘spikes’; axial lines leading in and out of the main centre. This shape which also turns out to be the main characteristic of UK town centers according to Hillier is called a ‘spiky potato’. The mentioned centre forms are the underlying patterns of Batty’s idea (Batty et al., 1998) ‘Live centrality’ in which it is the element of 'centrality' that leads functions like retail, markets, catering and leisure, and define the economical dynamics of an urban centre. It is argued that distinctive spatial components like dense grid clusters with high integration value create ‘Live centrality’ by influencing natural movement that supports economic activity. Spatially this works by influencing land use with using functions that bring higher economic value, in turn generating more human movement, consequently causing 'multiplier effect' which implies the multiplication of spaces with similar functions that also result in high economic activity. This leads to the ‘Siksna process’ which is the formation of smaller block sizes with intensifying urban grid (Siksna, 1997) in order to ease movement in the centre.

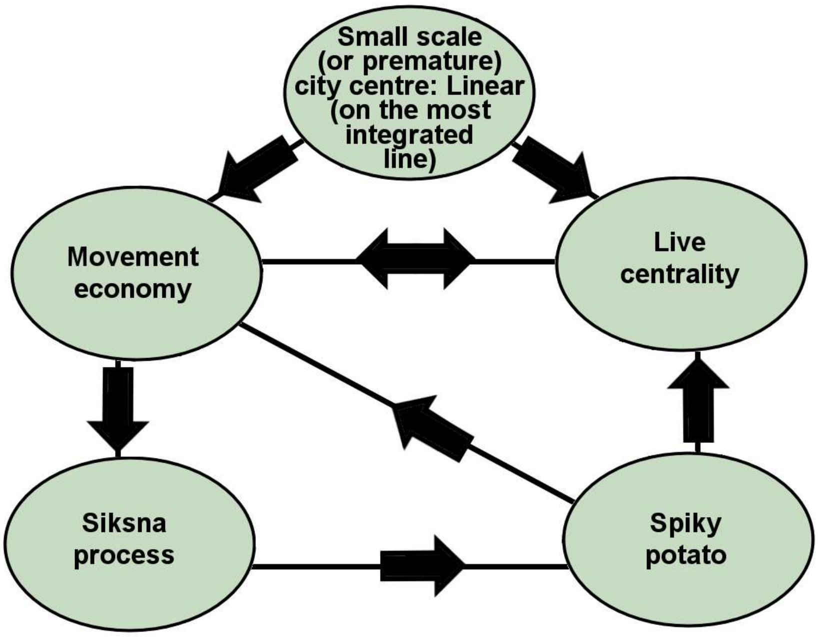
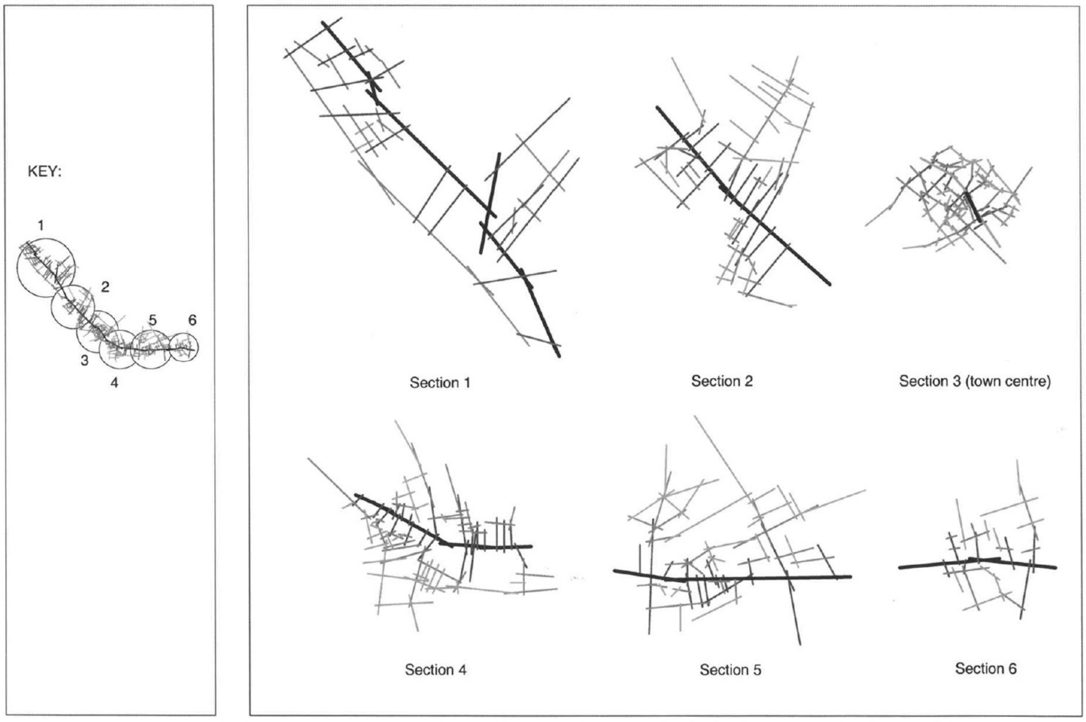


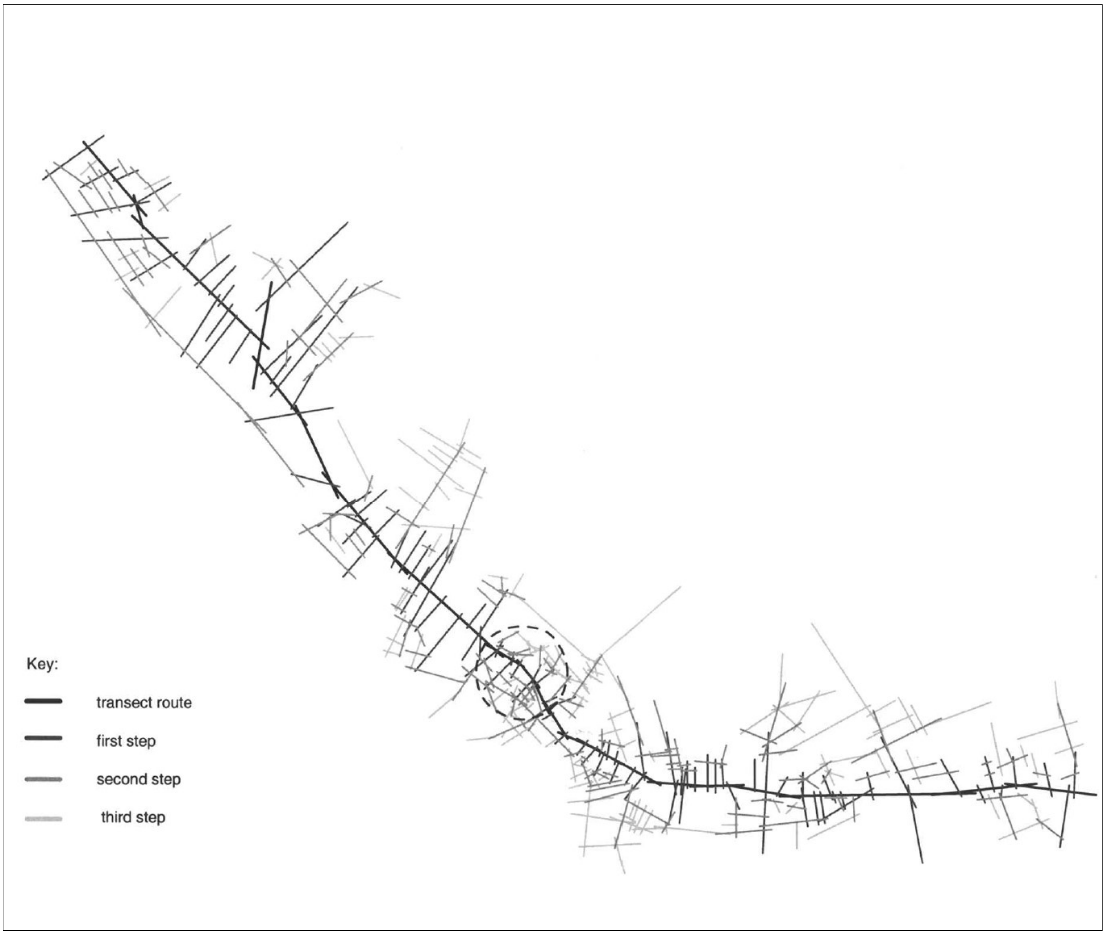
Figure 5: The illustration of 'Centrality process' as a loop (Hillier, 1999)

It is possible to clarify this loop-like process with a diagram (Figure 5). The initial emergence of the city centre happens around an integrated axial line which starts with a linear formation, adding the effects of live centrality model, influences economy by movement generation, then 'Siksna process' occurs in order to ease movement in city centre and as a result of all these, the linear formation transforms into a 'spiky potato' shape which brings a dense urban grid that creates even more movement and feeds the loop.

Figure 6: Integration map of York © Hillier (1999)

In the same study a sub-method of analysis is brought forward, based on space syntax' axial integration map; the transect method. In the transect method, the most integrated route -and interconnected axes- going through the city and its centre is selected and extracted from the axial map, to detect the live and sub-centers. The town of York is used to demonstrate the method; its centre was extracted from the axial integration map (Figure 6), along with the most integrated route going through the city (Figures 7, 8). The initial centre is still the most integrated part of the grid with a spiky potato shape (Figure 9) thus being the live centre, whereas other points of integration along the route form sub-centers, with higher grid densities depending on the proximity of the live centre, also demonstrating multiplier effect. From all this analyses, Hillier argues that a healthy centrality process is crucial to have socially active public spaces.





Figures 7, 8: The transect analysis of York © Hillier (1999)

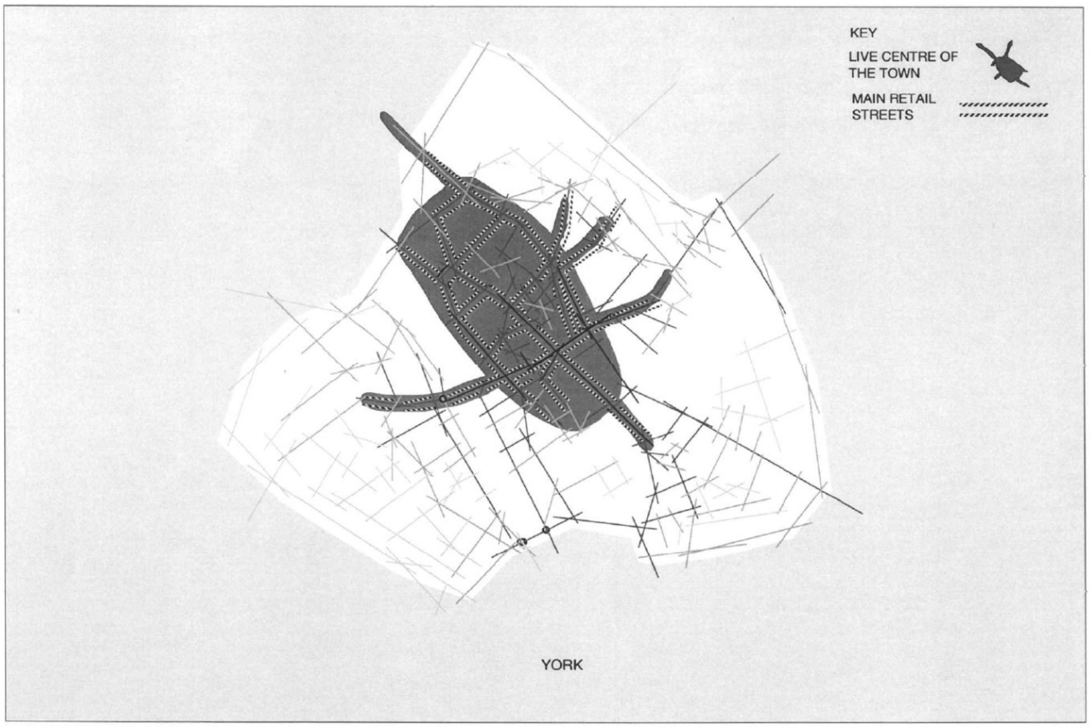


Figure 9: The spiky potato shape of York © Hillier (1999)

Another important space syntax study that forms the theoretical background of this research is ' What do We Need to Add to a Social Network to Get a Society?' again, by Bill Hillier (2009). In this paper, Hillier attempts to link and fill the gap between social and spatial sciences and to create a new ontological model for the definition of society. It is argued that human mind defines the urban environment with constant process of the mind called 'Description Retrieval'. It implies the everyday simplifications our brains use to create rules in order to understand urban image in our minds. For instance, when someone builds a house next to another house, the two of them would have a symmetrical relationship, the next user would follow that symmetry and build his house next to the other one in the same alignment, and this forms an invisible rule which consequently creates the neighborhood. If the user does not retrieve the 'description' -meaning understanding the rule of symmetry- then we would end up with a random and irregular pattern that we would have trouble forming an image of it within our minds and fail to use it properly. We derive rules from the spatial events happening around us, this process is the definition of Description Retrieval[2]. Description Retrieval process occurs in two ways during the formation of a settlement; 'reflexive' implying the random action taken by the user who decided to build the first house in the analogy, and 'non-local' when there is already a large scale pattern perceived by users and they act according to the said pattern. Then it is argued, a society must have two spatial mechanisms to exist; to overcome space, creating non-local groupings and to control space, creating local groupings. Hillier (2009) argues, three socio-spatial grouping models can be derived from these two spatial mechanisms;

1. Correspondence model; members of each spatial group interact only with each other, forming local and territorial relationships. This defines the 'conservative' use of urban space where groups have strong internal rules and strict boundaries.

2. Non-correspondence model; members of both spatial groups interact with each other, forming global and merging relationships. This defines the 'generative' use of urban space where groups have more social interaction and political relationships.

3. Differential solidarities; is where a number of members from each spatial groups have global, and the rest have local relationships within the group. It

[2] Description Retrieval refers to our ability to recognize existing spatial patterns and behaving in accordance with them in forming a logical description for the existing order and adding to it, for instance; in a designated parking area without ground signs, first few cars parked to each other dictate the parking order and remaining users park their cars parallel to them, forming ‘a row of cars’ which is the retrieved spatial description of the example.

has been argued, this type of situation occurs when there are cultural differences within the socio-spatial group, ultimately forming class systems.

With these models in mind, Hillier implies that there are two ways the societal growth can occur; as the population increases either the number or the size of the groups would have to increase. If the number of spatial groups increases then it would be a conservative, correspondence model society with an introverted structure favoring strong belief systems to hold and overcome the dispersed structure. If the size of the spatial groups increases, it would be a generative, non-correspondence model society with a more sociable and extroverted structure favoring political thought to support proximate co-existence.

Uniting the definitions of space syntax, it is possible to say the more integrated and dense the urban grid is, the more generative properties it has, and less, the more conservative. Where the concepts of 'generative' and 'conservative' use of urban space would have applications on many fields regarding urban design, they are the backbone of this study. The proposed Cure comprises of a system of centers, connecting the whole system, influencing generative use of urban space. Importance of the live centrality principle and connected sub-centers would not mean anything if they wouldn't share a global relationship as in the non-correspondence model. Of course it is not possible to incorporate all of these social principles into a mostly technical 'Cure'. Nonetheless, these concepts if applied properly would solidify the sustainability of the proposed notion of urban integration.

2.1.1 The Role of Space Syntax in Identifying Values of Integration and Segregation on Urban Grids

Why Space Syntax? Firstly, we needed a mathematical spatial theory to be able to apply the proposed notion of number prediction. So the social sciences' points of view on space such as Foucault (see; Foucault, M. 1970, The Order of Things) or Thrift's (see; Thrift, N. 2006, Space) spatial elaborations cannot help us. There are numerous mathematical spatial theories and analytical methods as well, such as Christopher Alexander's Pattern Language, where it is possible to deduct mathematical considerations using the method; it is by its nature a literary method using literary tools like vocabulary, syntax and grammar in classifying and analyzing design problems. It is possible to view Van der Laan's geometric approach on Architectonic Space (1983) as a mathematical theory, and to some extent it is, but only to the point in classifying proportions. Van der Laan believed there was only one space on our planet; the surface of the earth and the rest of the spaces we create must be allocated in accordance with natural proportions presented to us on site and that our finished design must use those proportions and their permutations. Where this theory can indeed be useful in smaller, architectural scale, approaching large and complex urban systems with this theory would be impractical as it is impossible to match the proportions of local scale and city scale designs, because the nature itself lacks the overall proportion Van der Laan idealizes in his book.

In order to introduce Fibonacci sequence to urban space, it is necessary for it to have actual, quantifiable data. Space syntax is the only theory where one can point on a space and get a corresponding number value for it using integration analysis.

Even though the concept of 'the Cure' itself stands apart from space syntax, the parent theories that have been utilized in forming the Cure all belong to space syntax, be it spatial like integration analysis or sociological like generative and conservative use of space. The whole backbone of the proposal is built upon the assumption that Space Syntax theories are correct. But what if one argues that space syntax is wrong in the way it analyzes socio-spatial behavior? Obviously, there are numerous inarguable points in space syntax theory; like the angularity principle segment angular analysis is based on, it is a known scientific fact (Emo, & Dalton, 2013) that when we move on foot, we regulate our movements according to the angular changes that are presented in front of us, without a specific destination or intent to explore, we generally walk straight ahead instead of suddenly turning and entering a side street (Dalton, 2003).

Another inarguable concept is the generative use of urban space, meaning denser the grid structure, more social interaction it encourages, this is basically the spatial conceptualization of common sense since there would be more inhabitants in a dense urban grid, there would be more social interaction as well. So what can go wrong with space syntax after all? Ratti (2004) pointed out what he calls some inconsistencies in Space Syntax maps and integration analysis; the third dimension, namely the building heights, are discarded when analyzing the urban grid and it is a factor that must be taken into consideration while calculating the integration value. Along with Ratti, Batty (2001) also argued that space syntax does not take land use into account and the whole analysis is purely based on the axial geometry of space.

Hillier and Penn (2004) responded to the criticism by partly admitting to space syntax' shortcomings but claiming they have little relevance to the whole urban configuration of a city. Three dimensional space may not have been taken into account when analyzing axial or angular maps yet the axes that contain higher integration values tend to have the tallest buildings in real life so in a way the three dimensional space in real life in fact confirms works in proofing the space syntax' methods. While land use also tends to carry correlating characteristics with axial maps, Hillier adds that if a shopping mall like structure is present on an axis its internal configuration can be added on the urban grid, to take its integration boosting features in consideration while determining integration. Apart from these rare criticisms there really is no real way to argue with space syntax's analytical methods without arguing the science of mathematic itself. Space syntax' methods have been used for decades by successfully correlating numerical data with real life situations.

2.1.2 Integration in Detail

Space syntax was chosen for its ability to interpret space into numbers. But space syntax has numerous measures which all provide numbers, the measure of integration is no doubt most important one with its ability to reflect real life socio-spatial situations accurately on the map (Desyllas & Duxbury, 2001). The scientific description of the measure 'integration' -and its counterpart 'segregation'- will be provided here as it is the foundation which method proposed on this thesis is built upon.

A number of space syntax units must be explained before introducing the formula for integration;

- Step Depth: Depth of a space indicate the number of spatial transitions -steps- required to access to other spaces within that system, higher step depth value indicates more spaces to overcome where lower values indicate easier accessibility.

- Mean Depth (MD): It indicates the mean distance of every other axial line within the configuration from a single axial line.

- Relative Asymmetry (RA): Relative asymmetry is a comparison value that indicates the depth of the system from a particular point in relation to minimum and maximum depth that point can potentially have with rest of the configuration. The least depth is when all spaces are directly connected to the original space, and the most when all spaces are arranged in a unilinear sequence away from the original space. RA equation produces a value between (or equal) 0 and 1, lower values indicate high integration where higher values indicate lower. RA is the unit of measurement for integration, but to describe higher integration with higher and lower integration with lower values, it is inversed in to produce integration value.

- Real Relative Asymmetry (RRA): Real relative asymmetry compares the RA value of a particular space with the RA value for the designated root space - the space that is chosen to be the starting point which all the other spaces are connected. RRA value is only needed when comparing different sized systems within the same scale.

The mathematical formula for integration is calculated by dividing RA value with 1, k value indicates the number of spaces in the system.

$$RA = \frac{2(MD-2)}{(k-2)} \qquad Integration = \frac{1}{RA}$$

Axial integration maps are prepared using Depthmap software (Turner, 2001b) through syntactic calculation of integration value -using Hillier & Hanson formula- of each axial line in the system, and then graphically representing the outcome by colorization of every single axial line according to their value, the most integrated lines being red while the least integrated -segregated- lines being blue. Another type of integration map is segment angular analysis; every aspect of this analysis is the same with axial integration except that the angular changes between each axis are also taken into consideration while calculating values. Segment angular integration is documented to mirror human activity more accurately than axial integration (Hillier & Vaughan, 2007) but the differences are only marginal and only when there are drastic angular changes between axis. Both analyses are used within this thesis; axial integration is preferred while analyzing smaller maps where segment angular integration is used in large scale analysis, the reason for this is even with angular integration's ability to better reflect human foot movement- and that is a notion more important in smaller urban spaces- the cases of smaller maps used in this thesis are of self contained walled cities which users expect to have angularity when moving within them. The second reason is that the methodology proposed here will ultimately suggest modification on the urban texture and while the angularity embedded within the axis of larger urban grids are difficult to adjust, smaller grids have less of that constraint which makes more sense disregarding a parameter that has potential to change.

It should be noted that the dimensional differences between urban grids does not change or influence the results of integration analysis as the numbers are acquired through formulation of spatial relationships, not dimensional. The formula and application of space syntax integration analysis remains unchanged even in building scale visibility graph analysis -VGA. Instead of axial lines, VGA analysis use isovists as spatial elements which are basically graphic representations of fields of view covering 360 degrees (Meilinger et al. 2006); they show the visible areas from a particular standpoint and are drawn by eliminating obstacles in the field of vision in that space (Figure 10).

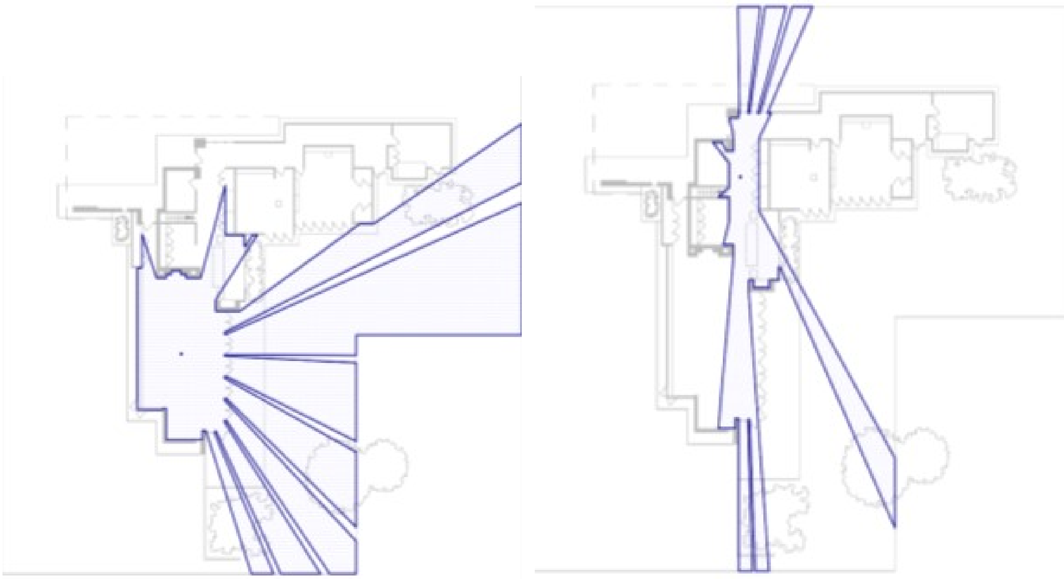


Figure 10: Representation of the isovists in an architectural plan (Frank Lloyd Wright's Jacobs House)

For VGA, the space syntax software produces the integration measure by placing thousands of isovists in the given space and calculating their visibility relationships using same formula of integration as other analyses (Turner & Penn, 1999) and paints the interior space with the same space syntax colour spectrum in accordance with the values (Figure 11).

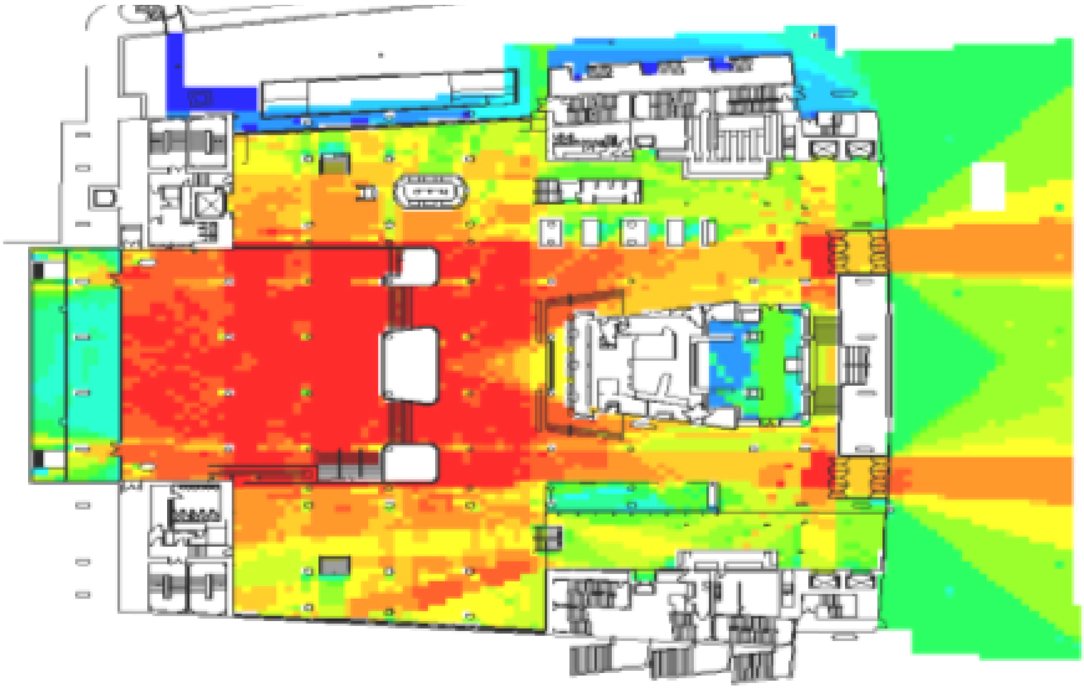


Figure 11: Visibility graph analysis of Royal Festival Hall, London
© Space Syntax Limited

The main objective of this chapter was to evaluate different analytical approaches on urban grids to choose the most suitable analytical tool for the development of the proposed methodology. Analytical theory of choice was Space Syntax for its well documented success in describing urban space with numbers that produce graphs which correlate with real life situations. Space syntax' technical literature was reviewed extensively, providing detailed descriptions on the working structure of space syntax methodologies and focusing specifically on urban scale analytical applications as it relates to the main research focus of this study.

Chapter 3

UNDERSTANDING URBAN SEGREGATION

In searching for the 'Cure', we must first look into the roots of the 'sickness'. There may be many perceptions to segregation, for instance Nightingale (2012) considers landmarks, religious and governmental buildings as the earliest forms of segregation which first cities saw. While they may very well be used as tools of segregation, this thesis' perception of urban segregation requires a break, a division on urban grid in either spatial or social sense. It is this kind of segregation which has importance in the sense of historical review.

Historians argue that earliest signs of urban grid planning were visible on ancient Chinese cities, built during the Shang Dynasty period around 2500 BC (DeMatte, 1999), which the most famous is Chengziyai. Archeological artifacts suggest that Chengziyai had a square-in-square plan which the inner square, enclosed with fortifications, accommodated royalty and upper class where the remaining parts within the limits of larger square accommodated the middle and lower class. Considering this is true, Chengziyai is not only the earliest example of urban grid planning but also one of urban segregation. Of course this was from a time which the land ownership was to way to demonstrate power, rather than currency; with this in mind it is possible to say that segregation was a tool instead of an urban consequence.

Moving forward almost 3000 years, the practice of urban segregation gained its first name in history in 1516, used by the Venetians to segregate city's Jews into a forced space; "ghetto" (Nightingale, 2012). Power was no longer defined by the amount of land but with the amount of people in that land, so is how religions work. But of course as more land meant more people, managing urban space was more important than it had ever been. The following sections of this chapter deal with the effects segregation on different cities' urban grids around the globe, the spatial conditions under it developed and consequent effects it has on the social space. The main focus is on divided cities as they demonstrate most severe forms of urban segregation both with their divided and unified states.

3.1 Cities of Urban Segregation

The city that comes into mind when speaking about urban segregation based on religious conflict is most undoubtedly Jerusalem. Considered holy land by all major religions, the conflict between Muslim and Jew inhabitants never extinguished for almost 100 years. Major impact leading to segregation was the separation of the city between two communities following the departure of controlling British mandate after World War 2. Following separation, Muslim Palestinian section -which also contained the Old City- only left with the outskirts of the city in the form of a disfigured crescent (Calame & Charlesworth, 2012). This destruction of urban grid is probably one of the reasons why Palestinian section was never able to develop neither economically nor socially. Even though following decades saw the political re-unification of the city, social barriers between two communities never ceased to exist, preserving the spatial segregation, without boundaries. Conflicts between two sides started again in 2000's, Jerusalem is not only divided but a war zone now. Looking at the map of the old city of Jerusalem (Figure 12), years of unresolved conflict comes hardly as a surprise. If urban space can influence these matters as discussed, then this is one of those cases where the influence clearly visible. The old city is divided into four sections by two main axes crossing the city in the middle both horizontally and vertically, these axes form the boundary lines between the equally -spatially- divided four sections (Rokem, 2011). If we do not consider the sections and only look at the axial structure of the city, it is instantly obvious the axes that are used as boundaries are in fact the most integrated lines of the city which means they must be used to forms centers of integration not tools of segregation as it is used in real life. Failing to form an integrated main core, the city's urban sprawl outside the old city's walls was inevitably irregular, decided by the population density. If the old city provided an integrated and hospitable environment for all the religious quarters, would the city be in the same situation that it is today? It is impossible to answer that question, but also it is safe to say that urban grid was on the negative side of things that influenced the city.

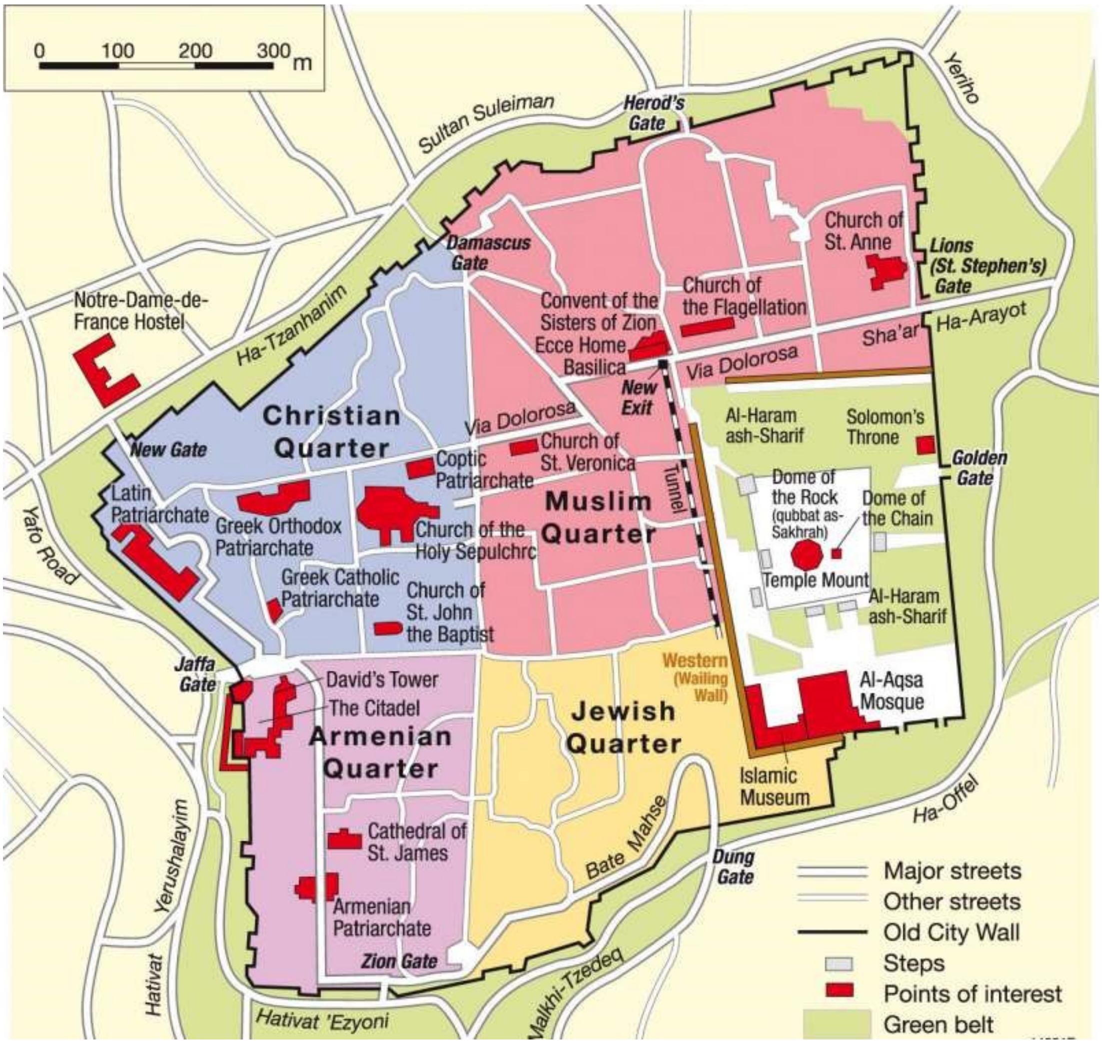


Figure 12: Old City of Jerusalem © Diercke International Atlas

Not too dissimilar from Jerusalem, Beirut, another city of middle-east, also suffered a form of religious segregation. Albeit the physical division lasted 15 years from 1975 to 1990, segregation existed long before that. Calame and Charlesworth (2012) states the east - west religious grouping in the city was prominent since the end of World War I. Slicing the city and its core right in the middle, the dividing line ran for around 10 kilometers from north coastline to south city limits (Figure 13). Since the physical reunification, Solidere (a semi-private development company tasked with urban redevelopment) assumed the responsibility to repair and modernize the urban texture of the city, receiving harsh criticism (Hockel, 2007) with claims that they gave little to no consideration to the historic core and character of the city.

Figure 13: Map of central Beirut showing divided sides

'Character' is the keyword here as most of the important buildings are preserved yet the swift transition from old urban landscape of Beirut -which was prominent since early twentieth century (Figure 14)- to ultra modern public buildings (Figure 15) in a matter of years alienated a large portion of the population while modernizing the city for twenty first century (Elsheshtawy, 2008). Changing locations to the point they are not recognizable destroys the sense of 'belonging' people feel for that particular place, ultimately leading to a decrease in social interaction in that particular space or transference of it; original users abandon the space because they don't feel their previous connection, new users adopt the place to eventually form a new social network, ultimately city is modernized but for its new inhabitants not original Beiruthians.

Figure 14: Old Beirut city centre, early twentieth century

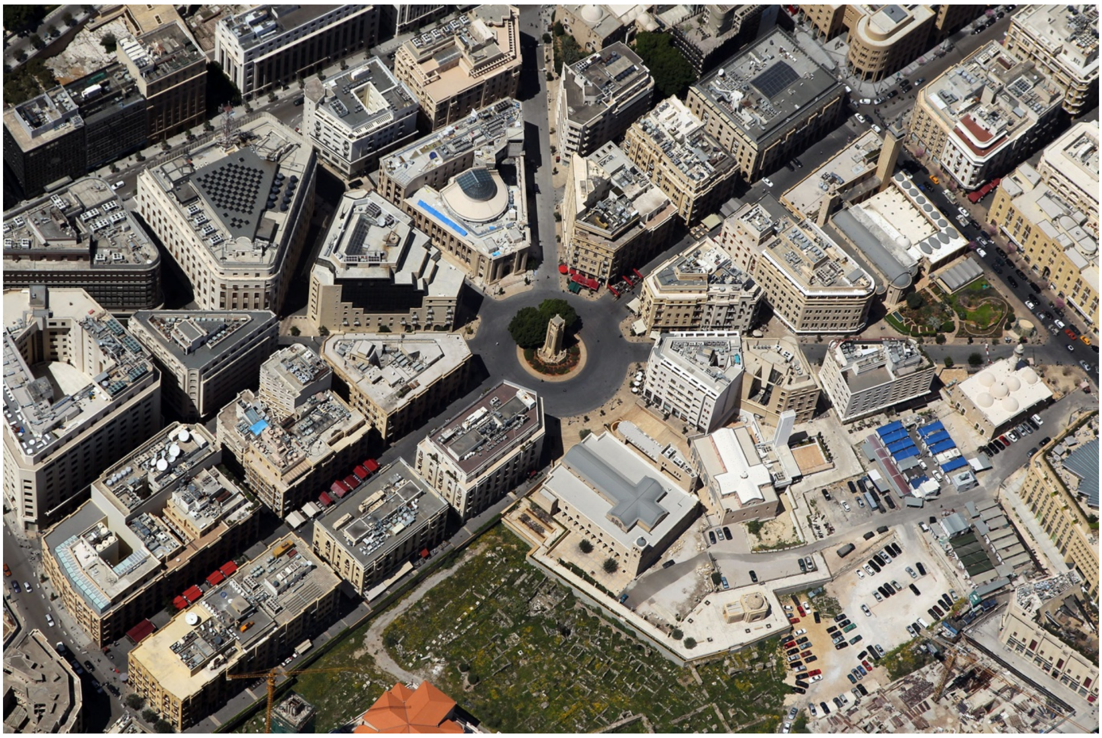


Figure 15: Modern Beirut city centre, 2012 © Solidere

The most famous execution of deliberate urban segregation is probably the case of Berlin. The city was cut in half as a result of failed power distribution between Western Alliance and Soviet Union at the end of World War 2. The division shaped the city for decades and its marks are still visible today. The existence of Berlin Wall between the years 1961-1990 coincided with important decades of technological advancements in human history, inventions stemming from the western world found its way to West Berlin where East Berlin kept its introverted structure under Soviet control (Loeb, 2006). When the cold war ended and the wall was demolished in 1990, the east side was -and still is- visibly less developed technologically, this is observable visually even today, as the two sides used different lighting infrastructure (Figure 16).

Figure 16: Difference in city lights between two sides of Berlin © ESA/NASA

We rarely get to see the reunification behavior of urban space in a formerly divided city, in his PhD thesis; Desyllas (2000) made space syntax integration analysis of the city's divided and reunified states. Having an already developed axial structure long before the division, axial lines were only disrupted by the dividing wall, not demolished. Along with macro scale urban regeneration projects, axially speaking the city's only requirement was to reconnect the existing axes. Even with such a relatively 'easy to fix' urban grid, the effects of unification on the city's overall integration is immensely visible. In Figure 17 the two sides of the city has parts closest to the natural centre of integration act as the centre. Lacking the natural properties of a successful urban core like intensified grid and accessibility, the integration is shared among the remaining parts of the city and with the help of dimensional constraints, the edges and non-central areas on the two parts of divided Berlin is much more integrated than the unified one. Of course central integration is much more prominent in the united Berlin as it has a natural integration core (Figure 18). So as a result of reunification, Berlin has a better working and more integrated central core yet considerably segregated at the other parts, especially outer edges. It is the aim of the Cure to help fix urban situations like these.

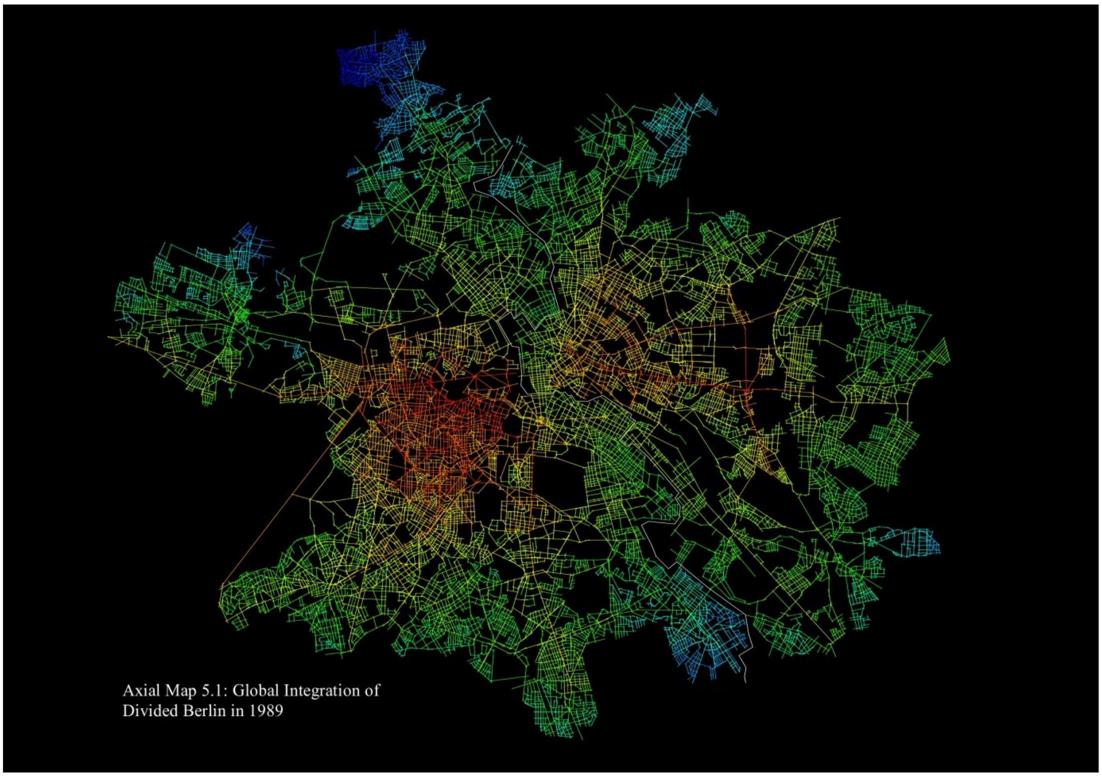


Figure 17: Integration map of divided Berlin © Jake Desyllas' PhD, 2000

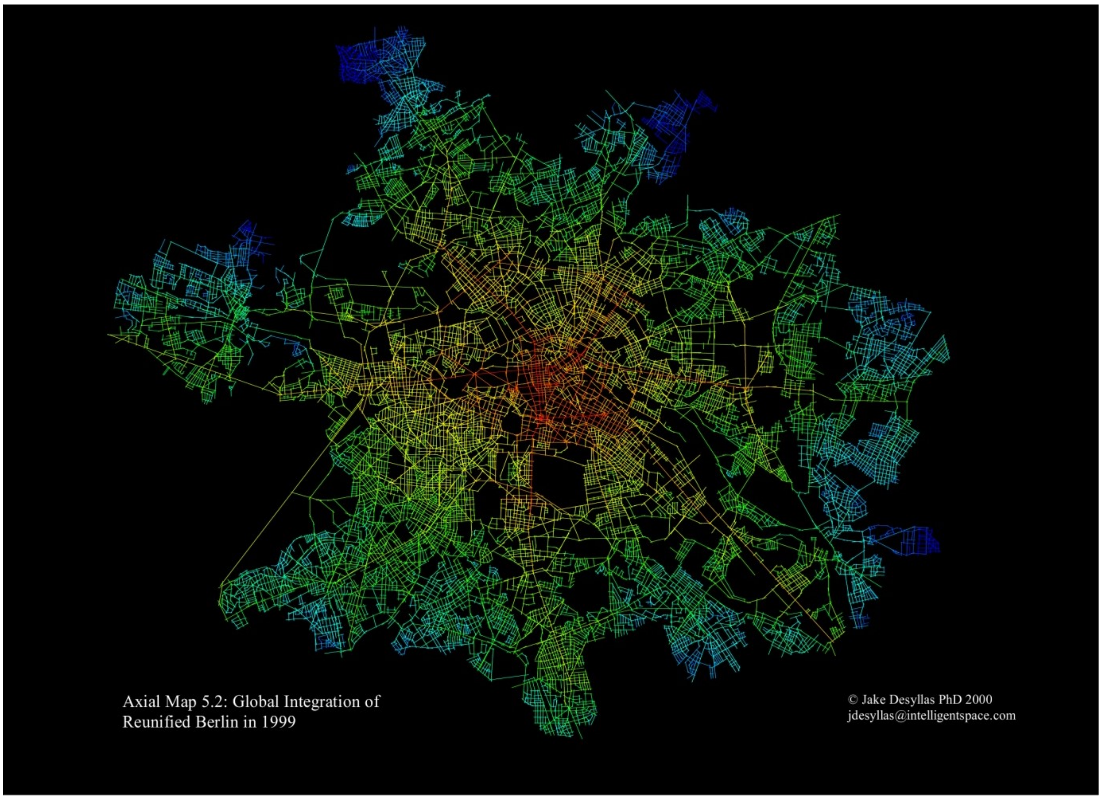


Figure 18: Integration map of united Berlin © Jake Desyllas' PhD, 2000

Belfast saw perhaps the most destructive type of spatial segregation which was both political and religious. Catholic Christian group adopted the identity of Republican Nationalists which supported the formation of a United Ireland separate from United Kingdom, whereas Protestant Christian group named Unionists supported the political union of Northern Ireland with the United Kingdom. Aptly named 'Troubles' lasted from 1969 to 2001 and were brought to an uneasy end by a peace process that imposed the declaration of ceasefires by most paramilitary organizations with police support, and the corresponding withdrawal of the British Army from the streets and sensitive areas. Conflicts left a different kind of damage on the urban texture; partitions called 'Peace Walls' were erected in different parts of the city with no visible pattern (Calame & Charlesworth, 2012) to separate conflicting groups. Where most of them are removed, the areas surrounding the walls remained segregated possibly since the memory of the Troubles are still fresh (Boal, 2002). Some of the walls that are still standing have been painted by graffiti artists to both create a tourist attraction and change the way the people perceive them in a positive way. Some argue that this process only helps keep the past pain that was associated with them fresh (Brand, 2009). Many also argue that Belfast is a prime example of unplanned urban reunion (Mark, 2013), 'the Troubles' left the city without a vision, an urban roadmap and while there are developments on the local scale like Libeskind's Peace Building, the lack of confidence in a united city both during and post conflict only allowed architects and urban planners to concentrate their efforts on small scale projects. A map prepared by Forum for Alternative Belfast (Figure 19) shows the empty spaces in and around the central core of the city, they point out that combined, these spaces take up an area much larger than core itself.

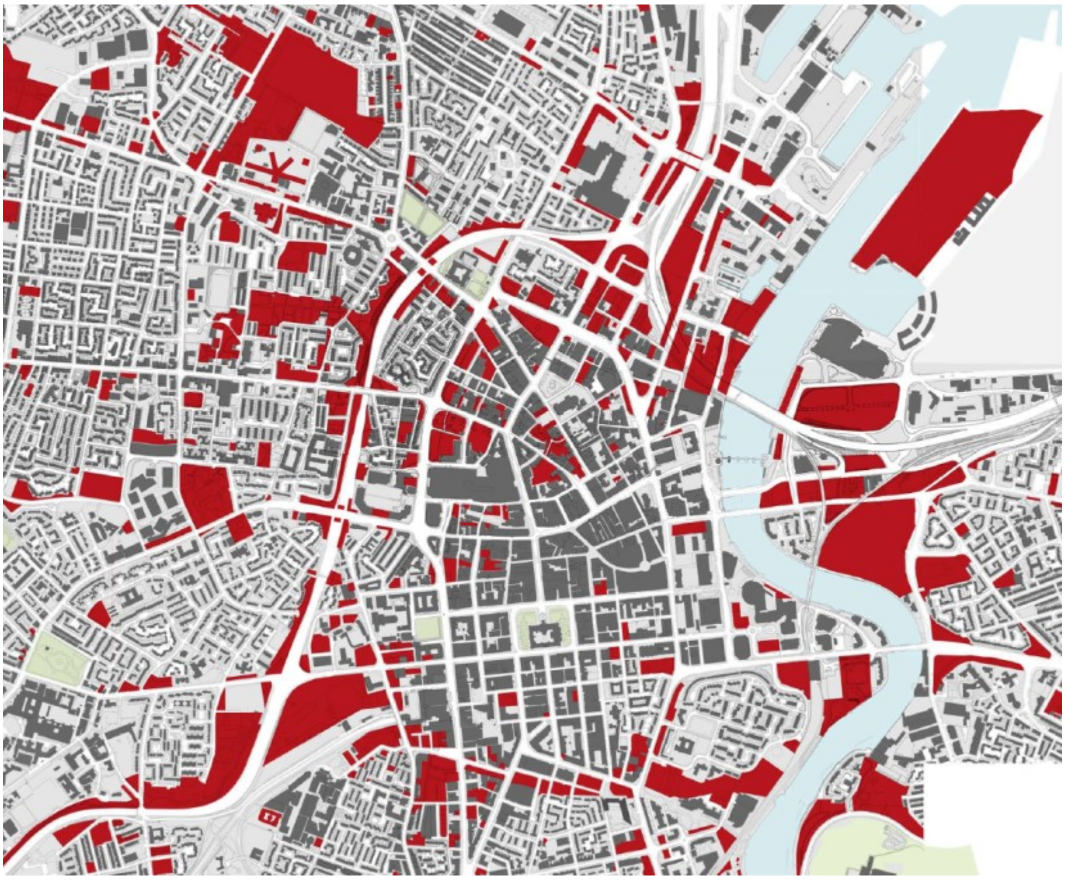


Figure 19: Empty urban blocks in and around the core of Belfast
the Missing City map © Forum For Alternative Belfast

Looking at the map it is clearly visible that the core has a 'Spiky Potato' shape (Hillier, 1999) which means it started as a linear axis and assumed the shape of a potato with the increase in the number of other integrator axis which makes this a well integrated city centre. But the 'spikes' that come out of the potato and form a connected city lead nowhere, not in the sense that they are not there; the spikes -the axes reaching from core to the outside- are there but there are numerous empty and unplanned areas and blocks around them which are a result of lacking urban plan. This of course cuts the integration of the core to the rest of the city which can be an explanation for why the city still deals with the segregation of two sides (Mulholland et al. 2014) even though there are no actual barriers any more.

The aim of this chapter was to define the sickness which we propose to cure; the sickness itself obviously being the problem of urban segregation. Literature on different forms of segregation as they manifest in various cities' urban grids was reviewed; in almost all of the cases; spatial aspect of segregation remained constant among numerous variables like political, religious and economical factors. Where global dynamics determine most of those factors and they do indeed influence urban texture eventually, urban grids' physical ability to support viable social structure remains the base requirement for a more integrated and less segregated urban form.

Chapter 4

CASE STUDIES OF URBAN SEGREGATION

4.1 Case Cities: Criteria of Choice

As the aim of the research is to help overcome segregation as informed by space syntax maps and measures, the case cities of choice must undoubtedly have a certain degree of segregation related issues. The city of Nicosia was chosen for its severe form of segregation; actual physical division of urban space and its unavoidable effects like socio-cultural separation of the communities inhabiting the city. Spatial analysis indicated the segregation levels of the city would dramatically improve if the two halves of the urban grid are reunited, though there is still room for considerable improvement both with the city's united state, but most importantly with the 'halves' as they are today.

The secondary case for the application of proposed Cure is the city of Famagusta with its significantly different form of segregation. A portion of this city too is physically divided but the divided part is located at the edge of the city. Famagusta formed five distinct self contained areas during its development; it is argued that all the districts developed their own separate urban identity; syntactic analysis will undoubtedly confirm this deduction with the visible patchwork distribution of segregated areas throughout the urban grid. Patchwork axial groupings on space syntax maps signify introverted, local urban characteristics for those areas at the expense of their relationship with the rest of the larger urban grid (Hillier et al.

2010). This represents inconsistency in the urban growth of the city, rather than the conventional definition of urban segregation this thesis proposes to overcome. The reason why city of Famagusta is also chosen for the application of proposed methodology is to demonstrate its range of use and underline its practical limitations.

4.2 Evolution of Segregation in the Case Cities

Historical background regarding the formation process of the segregation which we aim to cure on the case cities is unique, both when compared with each other but also in respect to all the other cities' discussed previously, especially Nicosia; being physically segregated still. Housing many civilizations throughout its existence, Nicosia suffered almost every type of segregation; physical, cultural, social and spatial. The city of Nicosia will be dealt with a more detailed approach as it will be the main case of this study to apply the proposed methodology of urban grid future predictions.

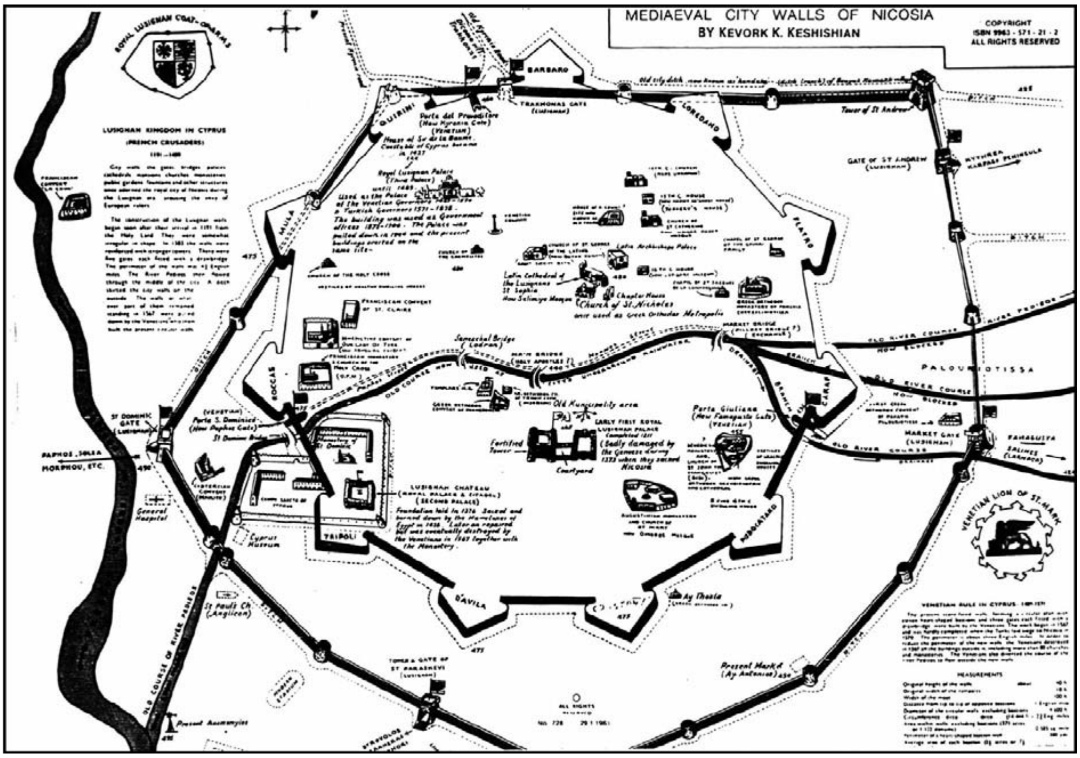


Figure 20: Map comparing Lusignan and Venetian walls of Nicosia
© Kevork Keshishian

Physical segregation of Nicosia came in the form of city walls built in 1567 by Venetians to defend the city against an impending Ottoman attack, with total disregard to the existing city which had larger boundaries than the walls suggested, urban grid was cut off and isolated at the centre. Looking at the comparison map of the both walls (Figure 20), it is possible to see the how much of the existing city was sacrificed in order to build the new ones. Many houses, churches and palaces were destroyed; the river that flowed inside the city was diverted to its present location. Cobham (1908) implied that the construction of the walls brought destruction to the city like no war ever did.

Doxiadis (1968) and Hillier (2009) explain that cities that do not have geographical constraints have a tendency to grow organically from a centre point, expanding like the branches of a tree. Relating this observation to the case of Nicosia with the penultimate boundaries, it is possible to say that Nicosia's growth was cut in the middle by the construction of the Venetian walls. So it is possible to say that the development of the urban grid was obstructed before it reached its maturity, resulting in segregation of the streets closer to the edge of the city (Aknar, 2008). Socio-spatial segregation of the city occurred in the form of religious division during Ottoman rule. As a result of World War 1, Ottoman Empire forced to give up a great portion of its lands which led to the Turkish War of Independence. During this war, the conflicts between Turkey and Greece caused Turkish and Greek Cypriot communities inhabiting Cyprus to take different sides. After almost 50 years of various conflicts, Turkey intervened in 1974. After the ceasefire the island divided into two with the establishment of a border line and thus began the story of division in Nicosia, the longest running spatial division in a city.

During the years of conflict, the city continued its expansion (Figure 21), even though its boundaries were well beyond the city walls now, the Walled City was still the central core, the heart of the city. Doxiadis (1968) explains that cities that do not have geographical constraints have a tendency to grow organically from a centre point, expanding like the branches of a tree.

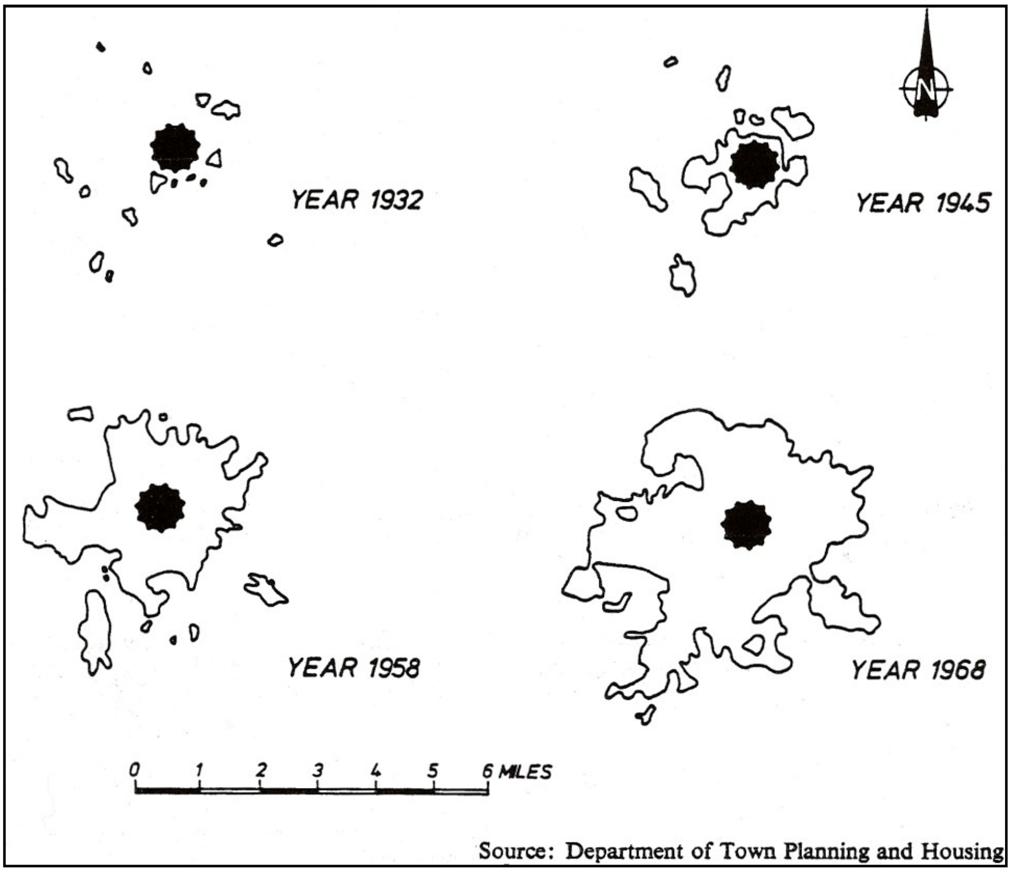


Figure 21: The growth of Nicosia between the years 1932 - 1968

Urban grid of Nicosia, now divided in two, lost half of their physical expansion paths; this forced the grids to have a linear expansion, not in the sense of physical linearity but a social one. By definition, linear designs lack a central core to encourage social interaction, arrangement of spaces force users to interact only with the users of adjacent spaces. This constraint of physical dimensions led to the formation of two spatially segregated cities, especially more on the north side; as a result of division the portion of the Walled City that remained at the North side lost its main connecting axis with the rest of the larger city as it was located on the dividing axis. As spatial segregation led to social division, the much more segregated walled city of the north side started to be used less and less except a few common routes, this led to it being a choice of place for illegal immigrants. This added another cultural dimension to a city that already had the effects of six different cultures on it.

Kliot and Mansfield (1997) argue, the Nicosia's and the whole Cyprus' division may very well be the same reason that gives the island its multicultural socio-spatial identity. In the study, the spatial and political history of Cyprus is reviewed along with the maps showing the settlement points of different communities inhabiting the island throughout its history. It is argued; the Cypriots never really adopted the sense of belonging, ownership and being a nation for the land they live on, as a result of its constant change of hands throughout history. This led for two main communities - Greek and Turkish- to socio-culturally attach themselves to their motherlands which obviously led to the conflicts the history made us memorize. Teerling and King (2011) argue the lack of 'belonging' sense is the reason why Cyprus is one of the countries with the highest numbers of migration concentration. Even if the 'lack of belonging sense' phenomenon was present between two communities historically, that may not be the case in recent years. A study by Charalambous (2001) looked into and compared the socio-spatial components of Greek, Turkish and mixed villages throughout the island. The result implied even though Turkish communities' social structure is more introverted from a cultural standpoint, all the other social or spatial elements are shared between two communities. This suggests the historical nationalist diversification of Cyprus identity between two communities is not -at least socio-spatially- present any more, implying the sense of co-existence might not be as problematic as politicians argue in case of a union of the island.

A study by Margaritova (2013) deals with the concept of the boundary by comparing Nicosia Buffer Zone and Berlin Wall. Where study looks for common characteristics in city-dividing boundaries, along with the de-facto characteristics like general segregation around the boundary, only common denominator between two cases is found to be their institualization throughout the course of time; their ability to reflect the history and the perception of division. An interesting observation is made with the physical state of the walls on the both sides; on the south side, the boundary is usually camouflaged with plants and greenery whereas on the north, the walls are just solid walls of division. Margaritova argues this is a direct result of difference in perception of two communities; where for Greek Cypriots the wall implies a division, an invasion of their own space and camouflaging it is to reduce its cruelty, to hide the pain. For Turkish Cypriots it is just the end of their domain, they do not see it as a partition on their space but more of a border of someone else's space. Such a generalization on general psyche of two communities is too broad to analyze and detect, yet is still points out the fact that there is a difference in perception of land ownership which in itself is another definition for the Cyprus conflict.

The form of segregation in the secondary case city Famagusta is also significantly different than any other aforementioned exemplary cities. Even though a portion of this city too is physically divided in 1974 as a result of Cyprus conflict, the segregation was not as destructive on the urban grid of Famagusta as it was in

Nicosia, since the divided part Maras is located at the edge of the city; its physical rupture from the rest of the city - social consequences painful as they may be- only prompted the urban grid of Famagusta to re-adjust its boundaries. Part of the dividing military zone now, Maras is rightfully addressed as a 'ghost town', the rest of Famagusta's urban grid continued its expansion and development since then. Although not an explicitly segregated city like the other cases. it is argued that during its development Famagusta formed four distinct self contained areas within the city; naturally self contained Walled City, lower Maras (part of the grid adjoining the ghost town), Maras itself and newly developed quarters expanding the city to further North (Onal et al. 1999). On site observation implies that since then two more districts were formed within the urban grid; Eastern Mediterranean University Campus which started within the 'new quarters' but grew to form its own district (Guley & Abbasoglu, 2005) and industrial zone in between the new quarters and lower Maras as well as next to the university (Figure 22). It is argued that all five districts -excluding Maras- developed their own separate urban identity with different grid characteristics so Famagusta is in fact not 'one' city but an urban entity formed by the collage of five small boroughs. None of these five regions have direct links with the sea, only seaside region is the 'new quarter' yet its whole coastline is either military controlled and sealed off or government controlled and semi-public. Famagusta is perhaps the only coast city in the world with so few public relationships with the sea; two are so separate, if one were to build a wall along the whole coastline of the city, none of the residents would notice it was there. All these issues imply imbalanced urban sprawl which is more in line with urban growth problems rather than the socio-spatial problem of urban segregation this study aims to rehabilitate. This highlights the reason for the inclusion of city of Famagusta as a case for the application of proposed methodology; to point out its practical limitations and demonstrate more clearly what can and what cannot be achieved by using the 'Cure'.

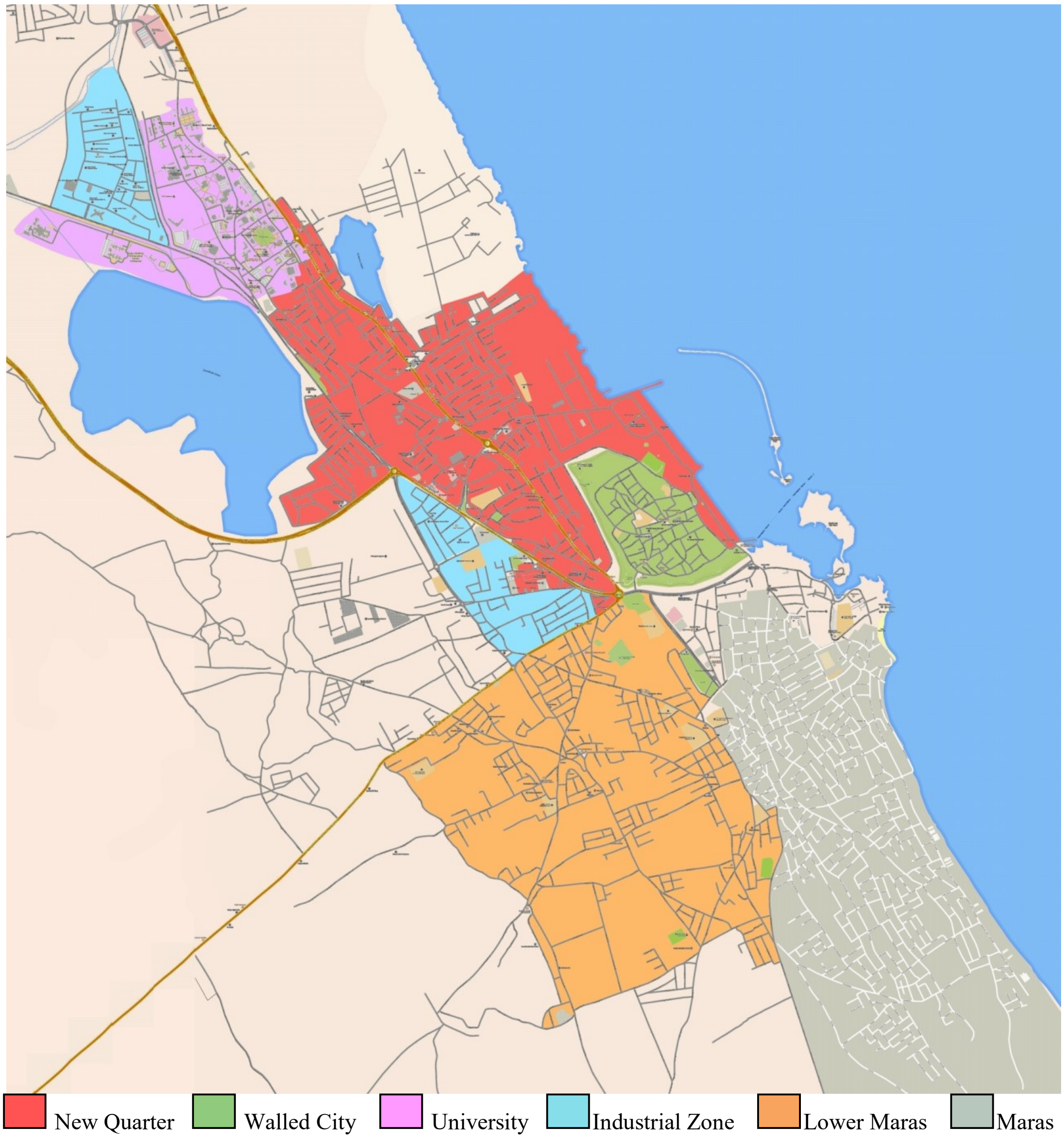


Figure 22: Map of Famagusta showing different districts of urban character

4.3 Urban Scale Integration Maps of the Case Cities

Space syntax axial and segment angular integration analysis maps will be exemplified in detail for the case cities for the application of the Cure; Nicosia, in order to grasp the nature and the character of the city as well as to support the claim why this particular city is the one which desperately requires the Cure and Famagusta -a significantly different urban grid of segregation- in order to clarify the uses of the Cure in different situations.

4.3.1 Nicosia

In its current state, there are four different cities within Nicosia. Four. How is that possible? For one thing, its divided, so that makes two. But Nicosia's historic core, the walled city, is actually one of the few old cities in the world that kept its separate 'city' identity from the rest of the city evolving around it. This is surely a result of Savorgnano's city walls that physically broke the walled city from the larger Nicosia (UNIFCYP, 2005). And of course, the walled city is divided in two halves as well, just like the rest of the city. So; we have a whole north Nicosia (which includes the north half of the walled city), we have the north half of the walled city which has a separate character from the rest of the larger Nicosia, we have the whole south Nicosia (which includes the south half of the walled city) and we have the south half of the walled city which again, has a separate character from the rest of the larger Nicosia. Where it is possible to argue the buffer zone itself as a possible fifth part, due to its inanimate socio-spatial existence and irregular physical dimensions, this study does not recognize it as an entity other than to address physical axial disruptions on the borders between four cities.

The following space syntax maps will analyze the city within the aforementioned four categories as well as the hypothetical 'unified' Nicosia, the analyses used here are axial and segment angular integration maps; they both take the axial structure of the urban grid and analyze the mathematical closeness of each line in the urban configuration in relation to the other lines but angular maps calculate with added parameter of angular changes between axis. Segment angular integration is used in analyzing larger grids where smaller grids use axial integration measure.

Although when considered spatially, the walled city is the only area that has a dense, intensified urban grid - comparing to the rest of the city - which should support generative use of urban space, but it still is the one of the most segregated spaces within the whole city while looking at the integration map. This segregation can be best explained by the obstruction of the urban block (marked on the map; Figure 23) in front of the main entrance of the walled city, since if that block was not there, the most integrated axial line of the walled city would have extended and connected to the main integrator axial lines of the rest of the city. This can be one explanation to the overall segregation of the walled city. Overall segregation areas are distributed in a patchwork structure in between axis with higher integration.


Figure 23: Global segment angular integration graph of the North Nicosia

Looking at the segment angular integration axial map of the south section of Nicosia we can see that the integration core of the city is located just near to the walled city and it has direct and strong links to it, making the walled city one of the most integrated spaces in city scale (Figure 24). At the integration core and the walled city, the urban grid is more intense and generative whereas, as we move towards the outskirts of the city the urban block size increases as they are mainly reserved for residential areas, which also are the most segregated spaces within the city. Segregation towards the edges of the city happens gradually instead of the patchwork structure seen on the North section map.

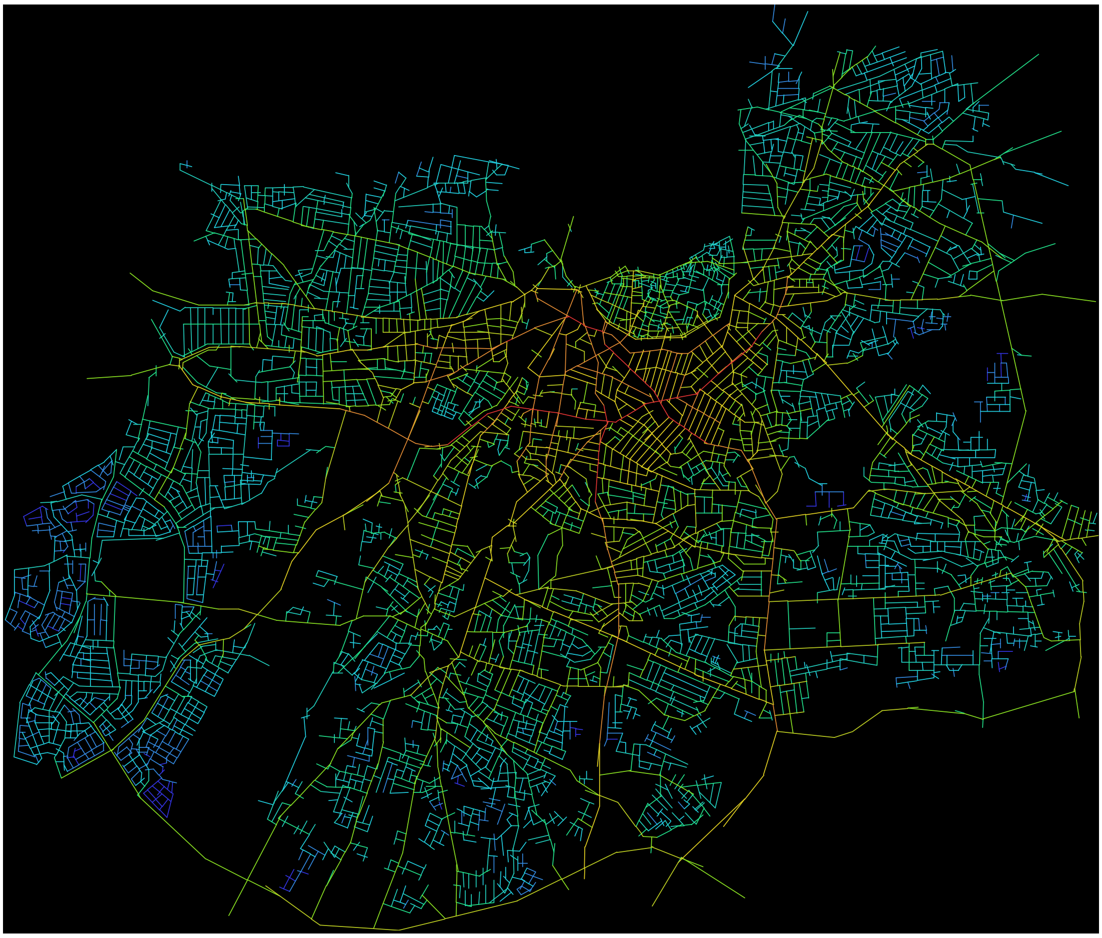


Figure 24: Global segment angular integration graph of the South Nicosia

The segment angular integration map (Figure 25) of the unified Nicosia seem to help improve the patchwork segregation issues in the north without disrupting the south of the grid. The integration core seen in the axial map of south side is slightly elevated further up the grid onto the buffer zone that divides the cities today, with the union of the urban grids the overall grid on the north side is much more integrated unlike the integration of only the main axes as seen on the integration map of north side. Also the walled city displays the properties of a real 'live' city centre (Hillier, 2001). Overall the integration values are much higher on both sides of the city than their separate analyses.

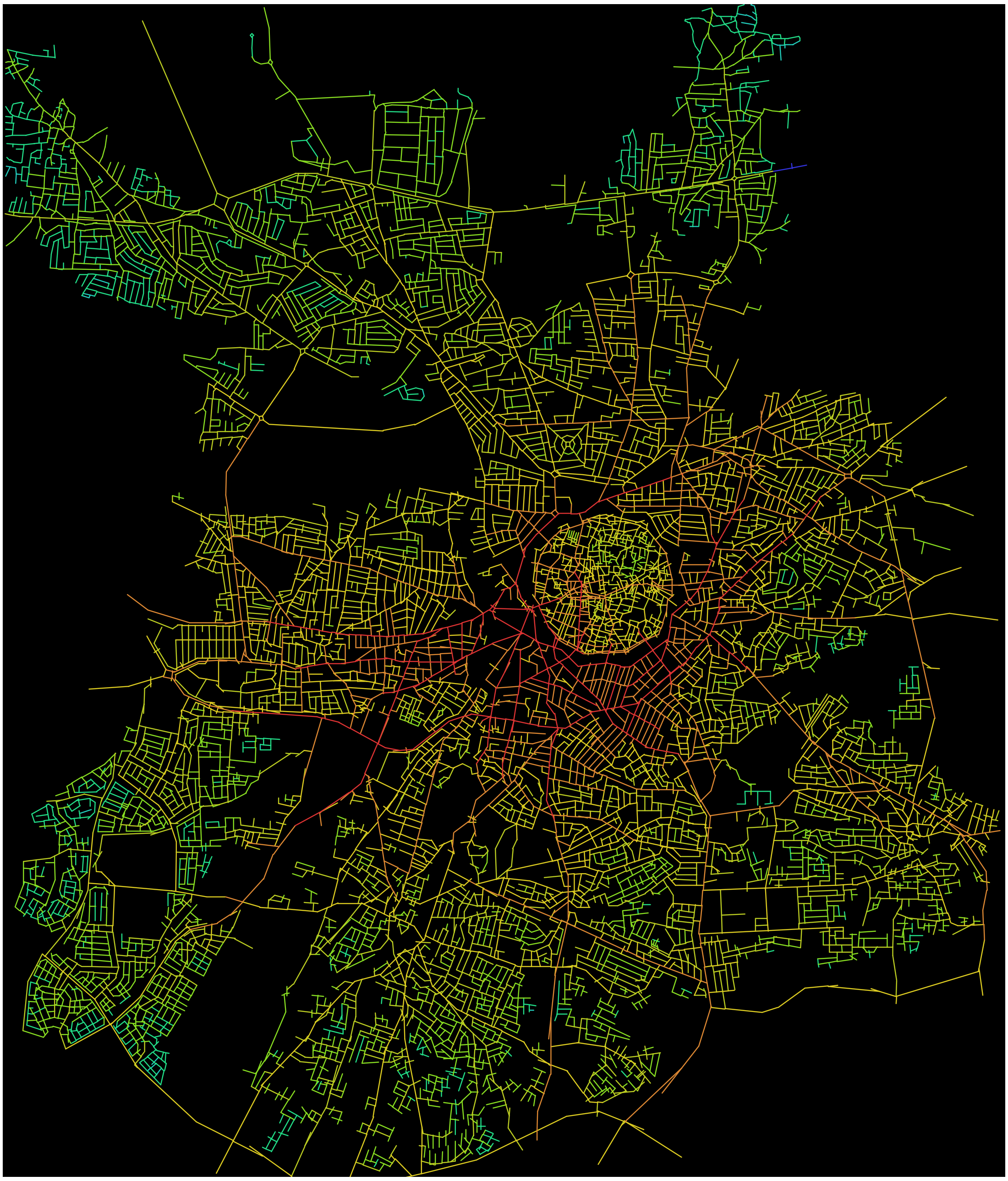


Figure 25: Global segment angular integration graph of the whole Nicosia

The global axial integration map of the walled city of north side (Figure 26) once again shows the most integrated axis as the Kyrenia Gate axis which also functions as the main entrance for the walled city; the overall integration is distributed around the same axis. The spatial layout of the grid demonstrates an organic yet irregular distribution; although the grid is a little bit more intensified around the integrator lines it's still not intensified enough to be considered a 'generative' space.

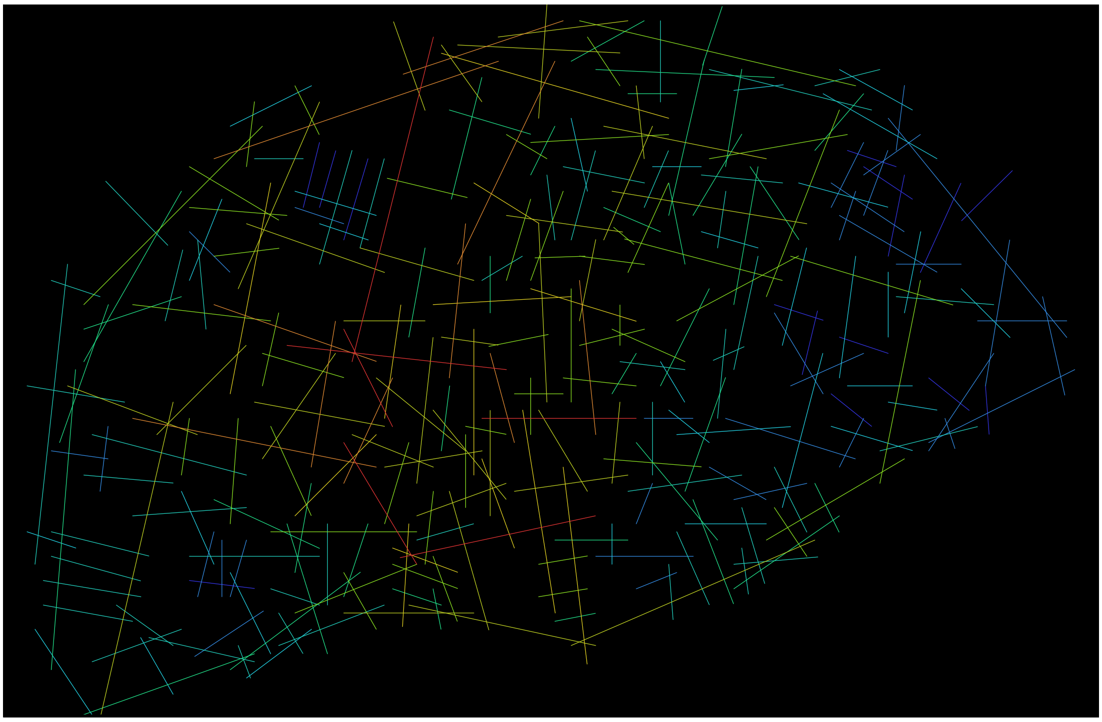


Figure 26: Global axial integration graph of the north side of the Walled City

The global axial integration map of the walled city of south side (Figure 27) shows the two lines near the buffer zone and another vertical axis leading to them as the most integrated axial lines, unfortunately, as said before the built environment near the buffer zones at both sides are mainly composed of vacant buildings and debris, after those two axial lines, the most integrated line is the Ledra Street which is the main shopping area of the walled city. The overall spatial layout is different from the north side; especially in the west part of the city the urban grid is more orderly with denser axial lines and smaller urban blocks.

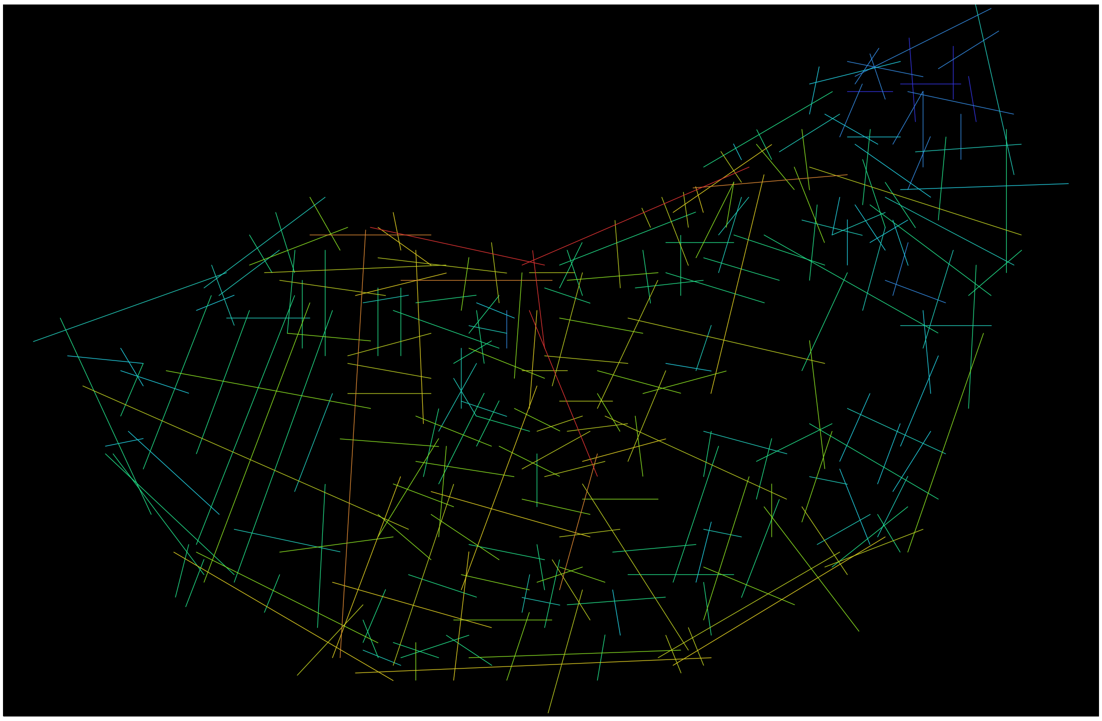


Figure 27: Global axial integration graph of the south side of the Walled City

Looking at the global axial integration map (Figure 28) of the unified walled city the integration core is located at the middle of the deformed wheel pattern which unfortunately falls into the ruined buffer zone. The only axial line with a high value that reaches completely outside the buffer zone is Ledra Street (marked on map) which reaches from the middle to the end of the walled city and can reach to the other important end on north side in the city's unified state. Hadjichristos (2006) has proposed that this connection could not only unify the most important core of the city but also could help the north side of the walled city to have an important place in the city scale again.

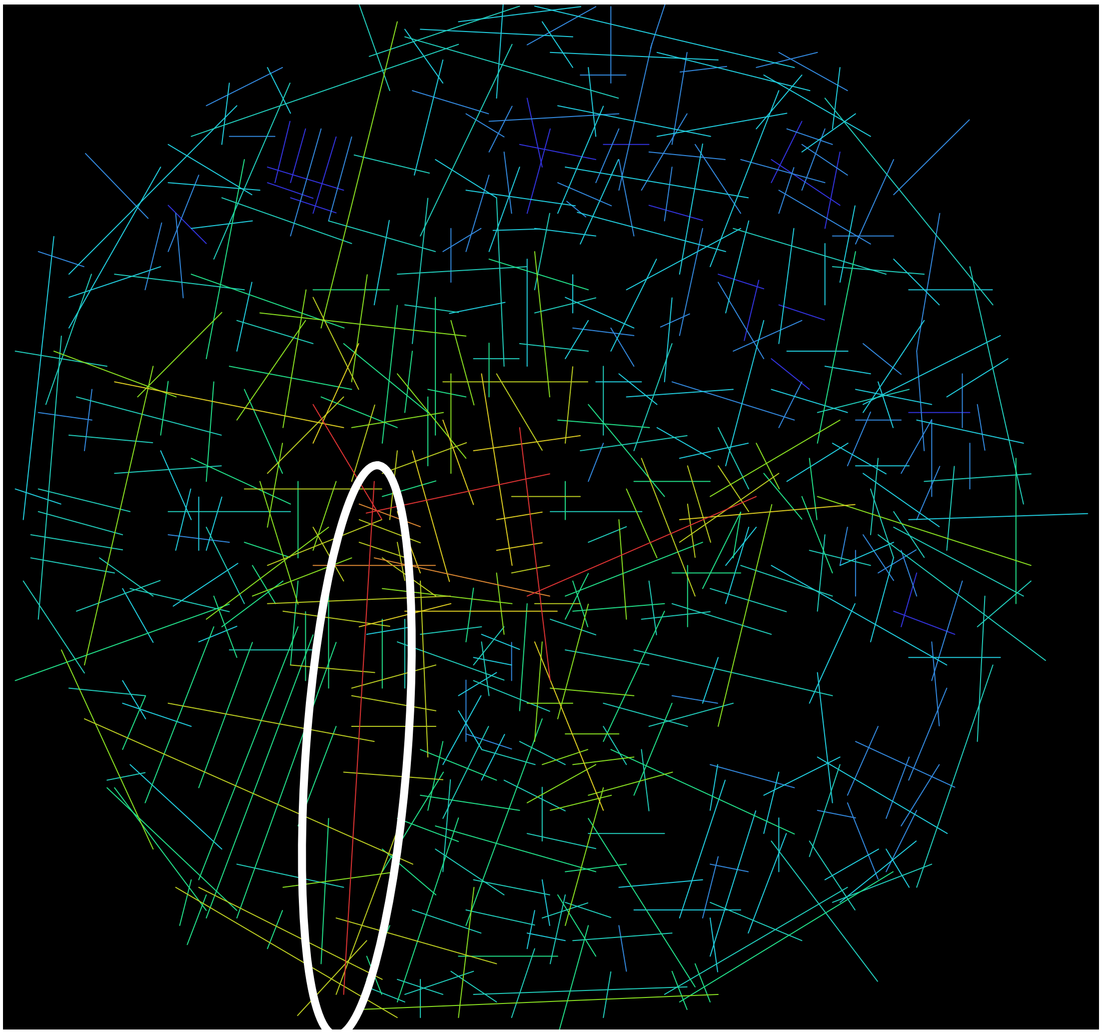


Figure 28: Global axial integration graph of the whole Walled City as if it is unified

4.3.2 Famagusta

The following space syntax maps will analyze the case of Famagusta in four categories; the urban grid of the city itself, the historic walled city, the urban grid of city if Maras district was not separated and the urban grid of Maras region. Once again, the analyses used here are axial and segment angular integration maps; they both take the axial structure of the urban grid and analyze the mathematical closeness of each line in the urban configuration in relation to the other lines but angular maps calculate with added parameter of angular changes between axes. Segment angular integration is used in city wide analysis where the smaller grid of walled city is analyzed with axial integration measure.

Famagusta is a considerably smaller urban grid when compared to Nicosia. Smaller urban grids tend to have a more compact and dense axial structure (Hillier, 1996) which suggests higher integration. That is not the case here with segment angular integration analysis of Famagusta. Segregated patchwork structure seen on Nicosia map is present and more advanced here, showing much higher degrees of city wide segregation.

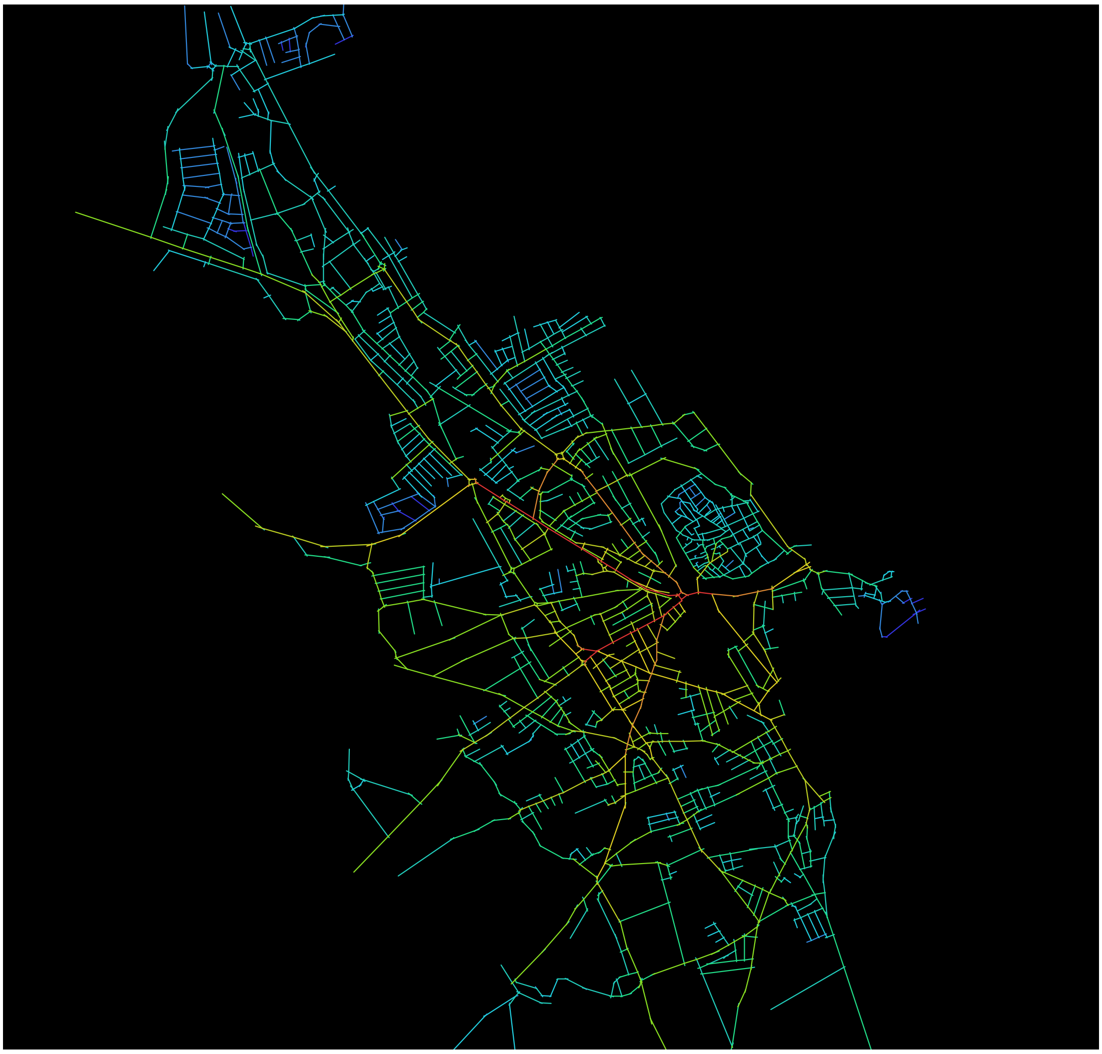


Figure 29: Segment angular integration graph of Famagusta

Only well integrated parts are the main transport axes which provide accessibility between previously mentioned 'districts' of the city. The districts themselves are segregated from within, with a few integrated lines which are connected to transport axes. The location that can be recognized as the integration core of the city is the point all the integrated transport axes meet, where there is the largest -mainly unused- urban block next to them. Also with immediate proximity to the walled city, if utilized, said urban block would form highly competent city centre which would unite and revitalize a great portion of the city. In simpler words, there is a hole on the urban grid of Famagusta where a city centre should be.

Figure 30: Segment angular integration graph of Famagusta with Maras

The angular integration map of the city with Maras (the military controlled, separated portion of the city) added within the grid does not paint a different picture (Figure 30). One of the axes surrounding the integrated 'hole' gets even more integrated towards the newly added part of the grid as it provides more connectivity toward the area. Maras itself joins the other 'districts' with its segregation value and its edges show to be the most segregated parts of the whole city. This implies that even if the Maras region was reunited with the rest of the Famagusta's urban grid in its current state, its 'ghost town' profile would continue no matter what amount of building scale revitalization works are conducted. Looking at the historic core of Famagusta, the walled city (Figure 31), most integrated axis is also where the physical core, the central square of the old city is located. All the other axes of integration throughout the city are the ones which have direct connection to the central core. If we disregard the outer urban blocks located at the north and south ends of the city, it is also possible to see the characteristics of a deformed wheel structure; (Hillier, 2001) centralized core at the middle with integrated spokes leading to the east and west edges of the city, segregated sections between said axes are mainly composed of residential spaces.

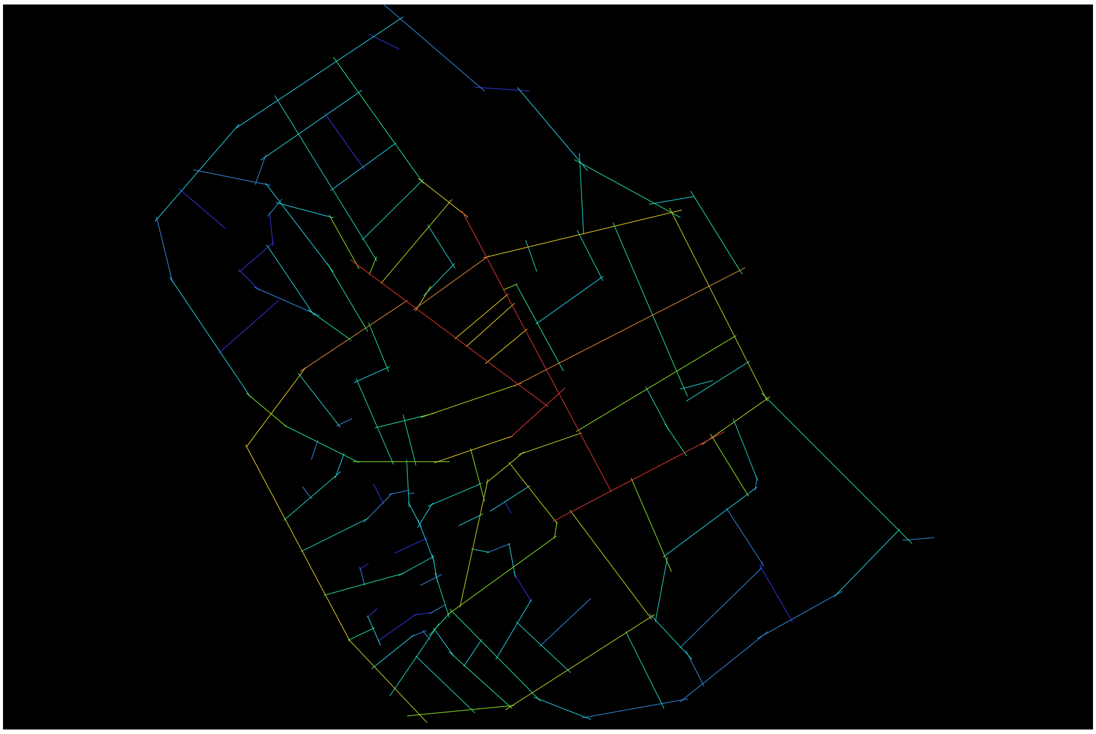


Figure 31: Global axial integration graph of the Walled City of Famagusta

Maras region is explained to be the most important part of Famagusta before division (Doratli et al,. 1999) accommodating major socio-economic functions like retail and tourism. Integration map of the urban grid of the region by itself (Figure 32) supports this; even with severed links at the west part of the grid, the overall integration is much prominent on the overall grid compared to any other map of Famagusta. Unfortunately, even with its integrated structure, if re-connected with Famagusta today, Maras would become a zone of segregation due to the malformation observed on the overall grid of the city.

Figure 32: Global axial integration graph of Maras

The main objective of this chapter was to evaluate the case cities Nicosia and Famagusta, both in terms of reviewing the historical formation process of their respective cases of segregation and also to analyze their urban grids with the chosen analytical approach; Space Syntax. Historic and current maps of the case cities, as well as different maps of the cities showing their divided and united states were analyzed using space syntax software and the reasons for choosing these two particular cities were explained in detail.

Chapter 5

CURE METHODOLOGY

5.1 Need for a New Methodological Tool

The concepts of integration and segregation existed since the beginnings of urbanism as a field of study; they might have had different terms but as long as there were urban systems they were there. It is the nature of things, some parts are dominant, and some are simply not. Thousands of research made on the subjects of urban morphology during the modern times as well; Caniggian (Caniggia et al., 1986) school of thought was that urban landscape had an inherent logic to its structure and political and economic conditions continually shape that structure organically. Conzen (1969) stressed, the way to understand urban form in its entirety was to observe the development process of the town plan, building form patterns and land use patterns. Conzenian and Caniggian schools of thought on comprehending urban landscape were prominent in 1970's and 1980's. Then came space syntax theory by Hillier & Hanson (1984) backing its view on space with mathematical certainties; its theoretical arguments gained more prominence in 1990's when user oriented space syntax software Depthmap was developed to analyze architectural and urban space (Turner, 2001a). In Fractal Cities (Batty, 1994) growth patterns of urban grids were observed, along with changes occurred in form and function during the process, and used fractal geometry in defining said patterns to provide a mathematical description for urban reality, not dissimilar from space syntax. These are all powerful theories which look for common descriptions of urban morphology in cities, and they are all analysis oriented. There are also recent works in defining different aspects of urban processes such as Culture Unbound (Hyler, 2013). Hyler (2013) deals with the process of Cultural Mapping, which is basically highlighting places (landmarks, historical streets etc.) with certain cultural values on the map. Then it is argued, it is possible to translate anthropological knowledge by using cultural maps and it should be integrated within city planning processes.

5.2 The Role of the Cure as a Methodological Approach

Aforementioned theories all aim to describe us what it is we are dealing with when we make urban decisions that impact our cities. They all help by demonstrating the situation in hand, to aid us make informed decisions. It is argued here, by using one of those theories -space syntax- in conjunction with another mathematical theory -Fibonacci series- it is possible to advance those informed decisions, by backing them up with mathematical certainty. Of course, mathematical certainty does not mean 'correct' yet even space syntax itself gained international recognition when its -mathematically consistent- theories correlated with real life data (Penn, 2001).

Obviously, the Cure is a theory that hypothesizes the outcome of certain applications on an urban grid. The main analytical method of the Cure, space syntax, is a mathematical theory itself that already has its own tools of predicting certain outcomes, at this point a question may arise; "If space syntax can be used, why Fibonacci?" yet space syntax can only inform us the amount of integration on any given axis. The amount of integration that is required for the artificial cores of the Cure should neither be the maximum or the minimum but must be something in between, in order to balance the integration throughout the whole map, this is what Cure is all about, balancing the integration. Now that 'sweet spot', space syntax has no mathematical means of finding, nor does it have a tool that can make temporal assumptions on the analyzed urban grid. Before coming to the choice on using Fibonacci retracement, the more important thing to understand is the golden ratio, the number 1.618. Perhaps the most famous number throughout history with its 500 year existence (Livio, 2002) the golden ratio has been subject of controversy numerous times, it is argued that such a thing does not exist and it is forced upon to support its myth of being found in everything in nature (Padovan, 1999) this may very well be but there is also the undeniable fact that it is only that number, that can be found in everything if you choose to look for it, in any case, further examination of the golden ratio is probably the subject of another, preferably much more mathematical thesis. So, we needed a solid number prediction tool that is Fibonacci retracement calculator -which uses golden ratio in its equation- because it is the only documented tool that has actual proof of succeeding in predicting highly complex number systems (Lakshminarayanan, 2005) rivaling space syntax maps' numerical value systems in complexity.

The theory of 'Cure' proposes to bring the aspect of 'commonality' which can be observed in other disciplines, to interventional approaches on urban grids which lack that aspect. Works regarding urban reintegration issues like master plans, all focus on their case of choice naturally. What is proposed with the 'Cure' is to form a model to use on every urban revitalization project, a tool to make best possible decision for future integrity of the urban grid.

Of course 'future integrity' does not equal 'total integration'; integration and segregation are relative concepts therefore total integration would actually not be much different than total segregation. The aim is to Cure the grid of any urban ruptures, to form a better integrated city as a whole without segregated portions which in their eventuality; stop being a part of the city. While not a definitive example as the 'Cure' aims for a much higher integration, the city of Amsterdam can symbolize the concept of a suitably integrated urban grid, because looking at the axial integration map of the city (Figure 33), there aren't any visible blue colored axes, meaning there are no spaces that are totally segregated, it has a well integrated core and albeit patchy, it has external smaller cores which are connected to the centre with most integrated lines. The city in general is not very well integrated yet the amount of segregation can only be observed in neighborhood scale areas that are located in between well integrated axes.

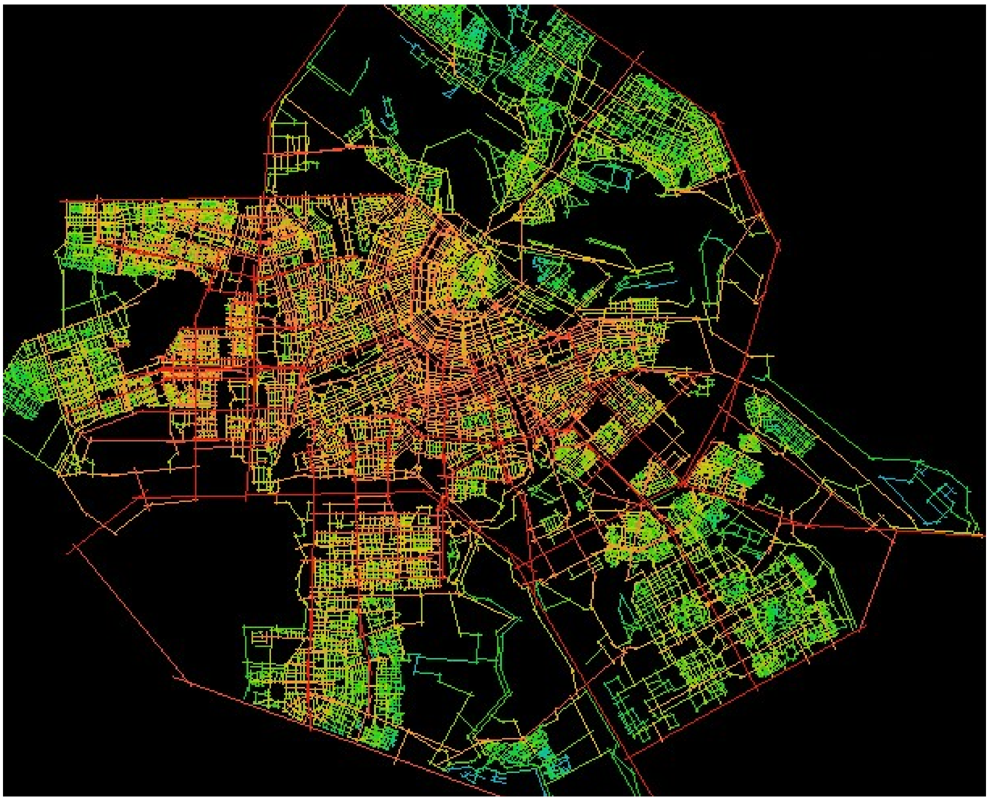


Figure 33: Integration map of Amsterdam © Stephen Read, 1997

There is always room for improvement, yet with its high values of integration both at the central core and at the very edges of the urban grid and even higher integration on the circulatory axes that unite the two areas; Amsterdam demonstrates a good balance between integration and segregation levels, making it a 'complete' city which functions as one single organism in spatial context, that is what the Cure is all about.

The proposed urban cure has a two-step original methodology; in the first step Fibonacci method is used to pinpoint locations on the map and in the second step specifically designed artificial cores are placed on those locations in applying the cure.

5.3 The Role of Fibonacci Numbers in the New Methodology

Why Fibonacci? We established the spatial analysis and 'number prediction' portions of the study are the main components, Space Syntax' established academic success in its field and the ability of integration analysis in producing actual verifiable numbers to indicate spatial relationships made it the primary choice of spatial analysis method to be used on this study. But, in the field of mathematics, there are numerous mathematical applications used for number prediction; first one that comes to mind is no doubt 'Mathematical Probability' without going into mathematical detail, the process is rather self explanatory, the calculation provides us with possible scenarios with their probability rankings on any case that can be described with numbers, but all the numbers to be used on probability calculations are static, it is impossible to consider numbers as part of a greater number series in probability calculations, and while it is possible to pull numbers out of space syntax maps and perform probability calculations on those numbers, it would have no relation to the rest of the numbers and it is more important to get the relations between those numbers rather than numbers itself because that is how cities work; as a whole of interconnected spatial structures, and it is imperative to remember that while analyzing cities in the form of numbers.

However, this still wouldn't answer 'Why Fibonacci?' but merely points out that we need a mathematical sequence -where each number has a relation to the other- for predictions. Yet amongst well known mathematical series and sequences, Fibonacci is the only one that has practical interdisciplinary identity that can be observed in different situations having practical implications in real life; many algorithms used in software programming involve Fibonacci numbers (Knuth, 1997), as well as economic model Brock-Mirman Growth Model (Brasch, T., Byström, J.,Lystad, L.P., 2012), Amiga computers used it for audio coding (Amiga, 1991), Golden Ratio -which is the primary Fibonacci ratio- is found on works of art from artistic geniuses like Da Vinci and Michelangelo (Bouleau, 1963), on Neoclassical buildings like Parthenon (Van Mersbergen, 1998), Le Corbusier also used it in development of Modulor -a proportional model for human body- (Ostwald, 2001), even the dimensions of molecules that make up DNA are composed of Fibonacci numbers which produce Golden Ratio (Fett, 2006).

The only other mathematical -more accurately, geometrical- sequence that provides real life application is Lazy Caterers Sequence (Moore, 1991); it is performed to find out maximum number of parts a circular shape can be divided into by using straight lines cutting across the circle. While this may very well provide a layout in designing cities, most it can possibly be translated into urban field is that; a design tool. Amongst all its favorable features, perhaps the most important feature of Fibonacci numbers is its relationship with golden ratio which can be acquired by dividing two successive numbers in the sequence. Considering the organic analogies drawn on urban systems over the years (Mata; 1892, Howard; 1904, Mumford; 1938, Lynch; 1981, Kostof; 1991, Marshall; 2009), Nature-Golden Ratio relationship should prove enough validation for Fibonacci numbers to use it on one.

5.3.1 Fibonacci Retracement

The mathematical equation 'Fibonacci retracement' naturally stems from the Fibonacci sequence. Fibonacci retracement is a method of analysis used in finance to determine support and resistance levels of a stock in the stock market (Brown, 2008). Identified by mathematician Leonardo Fibonacci in 13th century, Fibonacci sequence of numbers are formed by summing the two preceding numbers in the sequence; 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144. The important point to understand in this is not the numbers themselves but the rational relationships between them, there are quite a few Fibonacci ratios, but the one concerning us is the 'main' one that also provides the Golden ratio of 1.628. The ratio is derived by dividing one number in the sequence by the number next to it. Golden ratio, as it is used in the stock value retracements; 61.8%, is what will help us understand the level of integration urban grid is likely to have in the future. But firstly, we need to understand its usage in stock market to predict values (Douglas, 2001). There are two types of stock movements in the market, the uptrend and the downtrend. As our spatial aim is to find out the locations that are likely to develop and increase in integration, we will use the uptrend example here. When a stock value goes up, it does so irregularly, that is why when we look at those complicated charts, all we see are zigzags. The high and low points that we see on those zigzags are the support and resistance levels; when the value of the stock goes up to a level which it stops and lowers, that is the resistance level, when the value of the stock goes down to the lowest point and all it can do from that point forward is to go up, that is the support level (Figure 34). When we input these two important numbers to the Fibonacci retracement calculators, by using 61.8% ratio, they give us what the highest and the lowest values of the stock can be on its next movement.

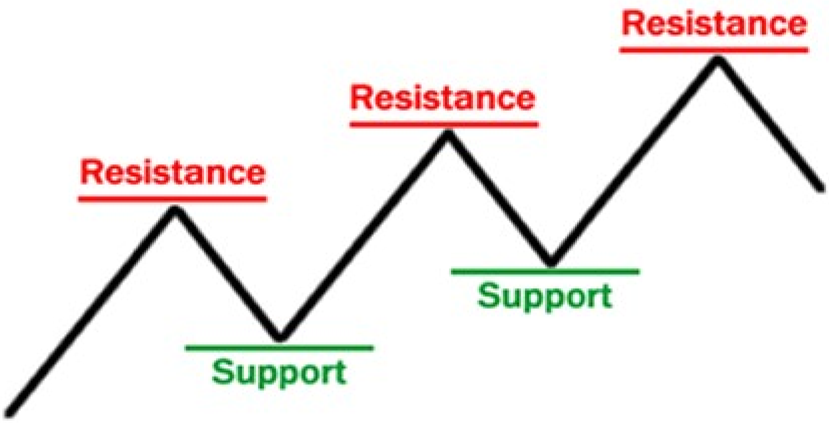


Figure 34: Support and resistance levels in stock market © investing.com

5.3.2 How Fibonacci Works?

Time and time again, Fibonacci numbers have proven mathematically (Basir & Hoggatt; 1963, Honsberger; 1973) its proof of connection to the golden ratio is also simply proven as the ratio 0.6 is acquired by simply dividing any number on the sequence by the number next to it, occurrences of Fibonacci in nature is also documented numerous times; various tree branches, fruit texture and flower head arrangements all follow Fibonacci numbers (Douady & Couder, 1996).

Performance of Fibonacci retracement at stock level predictions stemmed a heap of research on understanding its working mechanism. Instead of developing an absolute formula, almost all research is dedicated to proving the usefulness of the method by correlating retracement values with real time stock movements. In accordance with the inquiries gathered from relevant research on topic (see; Glaister, P. 1995, Fibonacci Power Series, Ball, K. M. 2003, 8: Fibonacci's Rabbits Revisited and

Stevens, L. 2002, Essential Technical Analysis: Tools And Techniques To Spot Market Trends) it is mathematically plausible to address that Fibonacci numbers do exist and that they work on predicting stock values.

How exactly it is performed on a stock chart is rather simple; a vertical line is drawn from the highest and lowest points on the chart (dotted line in Figure 35), then the Fibonacci ratios that are placed on the graph are used to divide the vertical distance of said line. Resulting number shows the ideal number the value will be before moving up (Stevens, 2002). Fibonacci calculators are widely used and every investment website provides their own calculator, any of these calculators can be used to perform the retracement operation directly and provide us the necessary values instead of drawing a chart to acquire them.

Figure 35: Fibonacci retracement chart on USD - CAD stock movement
©investing.com

5.3.3 Why Fibonacci Should Work With Space Syntax?

Although never attempted before, it is possible to draw many analogies to highlight the similarities between a stock and an urban system. Both are affected by the external socio economic factors, both have certain periods of time where they are in demand, both have a phase of initial development and unfortunately a phase of descension, yet what interests us here is both can be represented by numbers. A stock is directly formed of numbers, but Space Syntax shows us that cities can also be viewed as a series of numbers in a configurational relationship. The main difference between them is that a stock has different values of the same thing through time and the charts are drawn to represent that. A city or an urban grid, on the other hand, has different values (integration ratios) on different components (axes) of a whole and where a chart (Figure 36) can also be drawn to represent those, it does lack the time aspect.

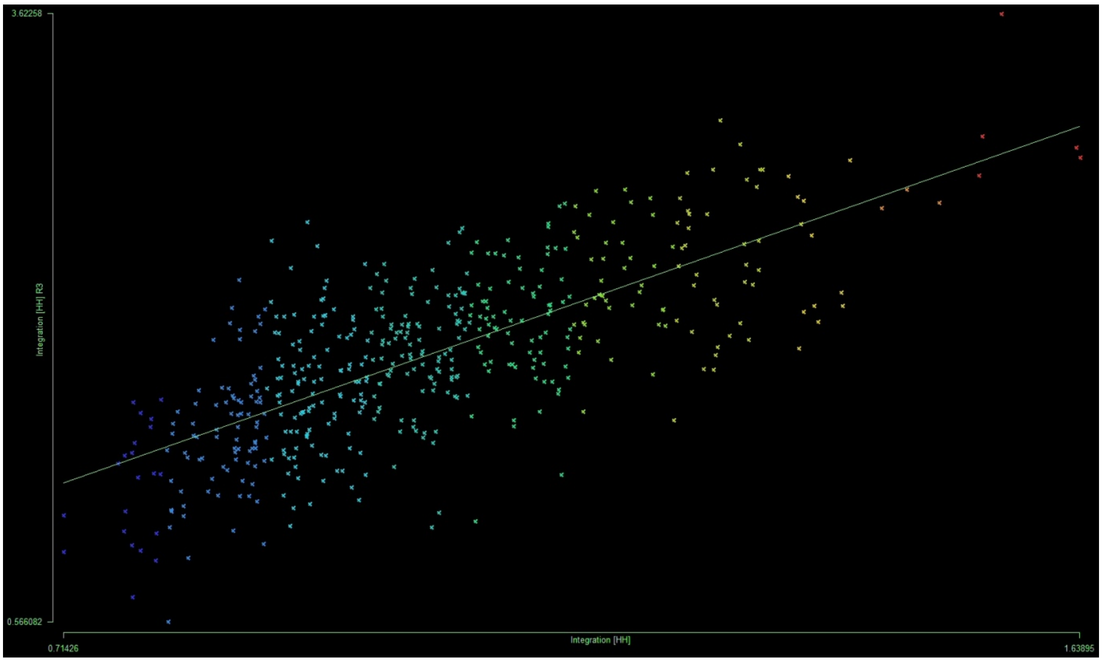


Figure 36: Overall to local integration scattergram of the Walled City of Nicosia

It can be argued that the Fibonacci predictions are based on time and it would not possible to apply the method where time doesn't exist as a variable. This argument is misleading; Fibonacci retracements do not account for time, they take static numbers on a chart (Kamath, 2012) and -in layman terms- point out the ideal number. True, the outcome is a prediction yet it is the researcher's interpretation that turns it into one. From Fibonacci's perspective, they are both a series of interrelated numbers with patterns in them that are not visible to the naked eye and if it is possible to have an ideal value that indicates increase in prices, then it is possible to have an ideal value that can indicate increase in integration.

At this point it is important to understand how Fibonacci calculator handles those numbers, in order to simplify mathematical description we can look at the shape patterns up close, both on stock charts and space syntax scattergrams; Figure 37 shows a portion of the stock chart on Figure 35 and a portion of the space syntax scattergram on Figure 36 respectively.

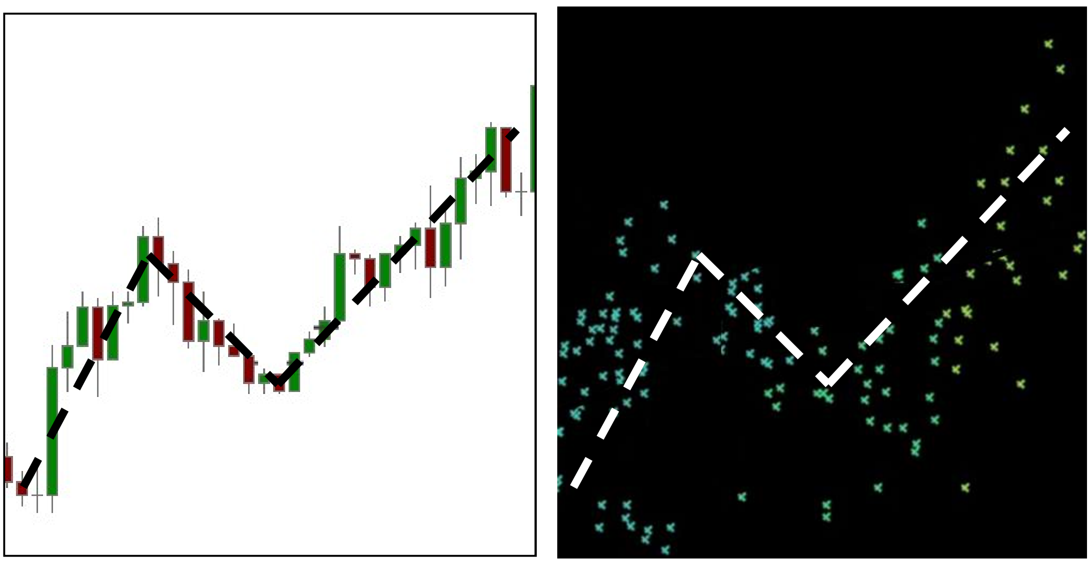


Figure 37: Parts of a stock chart and a space syntax scattergram showing zigzag pattern

Figure 38 shows the same exact shape extracted from Figures 37 which is a simple zigzag pattern that represents the geometrical nature of all charts alike. This particular zigzag has four specific points named A, B, C and D. Within this context, point A represents the lowest value on the chart, point B represents the highest value on the chart, point C represents the last value the chart has before the graph adopts an uptrend movement; a constant increase in values, represented with an arrow on the chart.

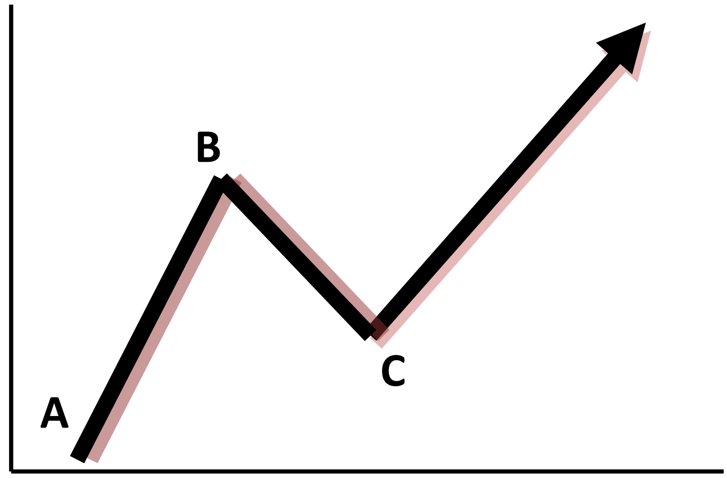


Figure 38: Zigzag pattern representing three key points used in Fibonacci calculator

It is this "C" point that is proposed to be a possible indicator of integration increase on space syntax maps. Where the C point is evident on Figure 38, on any other chart it would be lost among millions of values, but the values represented by points A and B are always visible as they are simply the highest and lowest values respectively, it is those two values we input on Fibonacci calculator and get the third value -C. The mathematical formula the calculator software uses to achieve this is formed by extracting the A and B values' difference that is multiplied by the golden ratio of 0.618, from B value: C= B- ([B-A]*0.618).

It is possible to test this whole process of Fibonacci calculations' use on space syntax maps by comparing older maps of a city with its current state. Figure 39 is the axial integration map of the Walled City of Nicosia, this map is derived from an old 1914 map of the city (Baedeker, 1914). On this map, the integration numbers are; min integration: 0.570, max integration: 1.105, average integration: 0.810. When we input these numbers in Fibonacci calculator, using the % 61.8 (golden ratio) calculation, we get an integration value of 0.774. The three areas found with the approximate integration numbers (0.750-0.800 range) are marked on the 1914 integration map within the diagram showing the whole process (Figure 37). Integration values are; Area 1: 0.77, Area 2: 0.79, Area 3: 0.75.

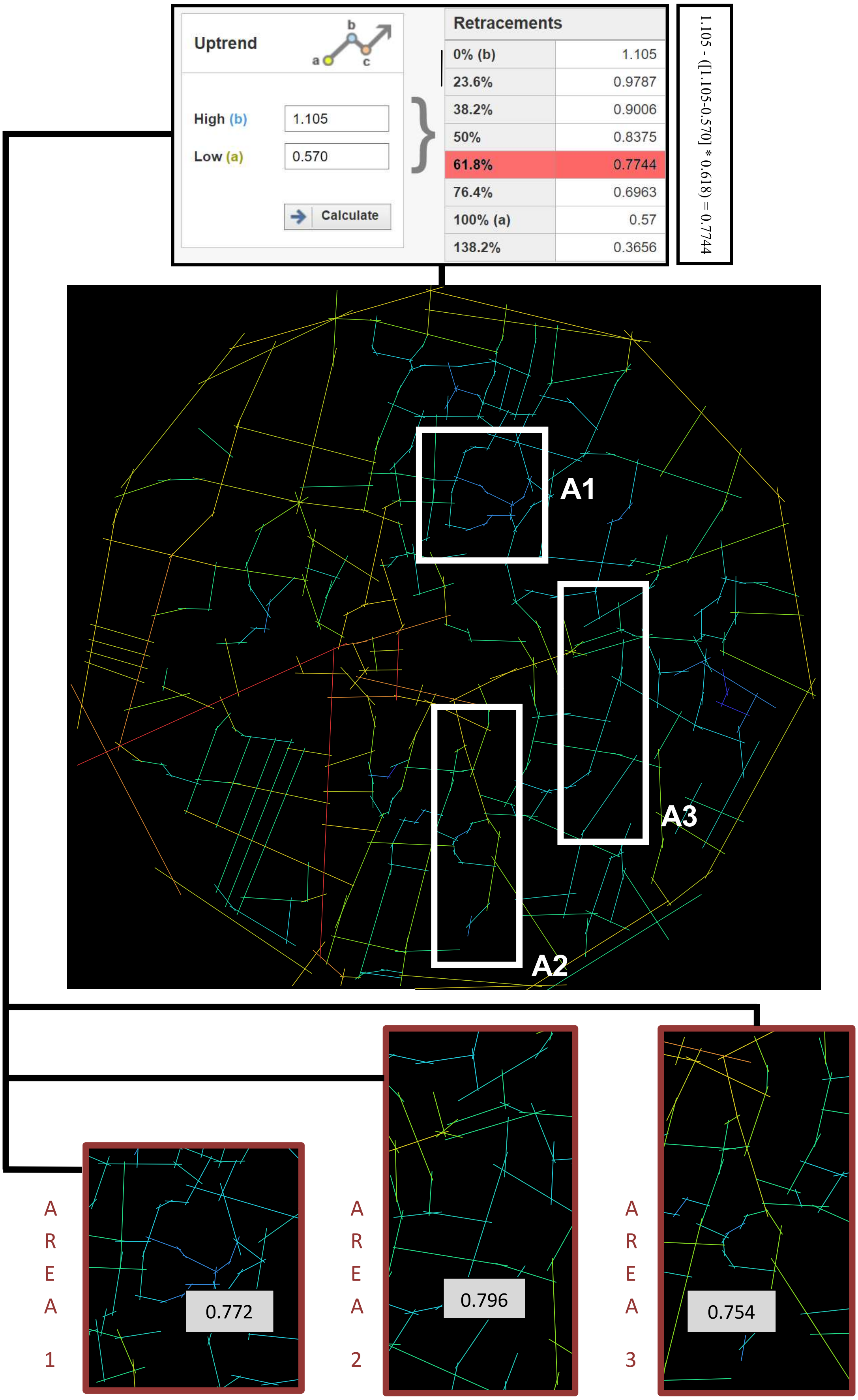


Figure 39: Fibonacci - Space Syntax process and prediction sites on 1914 axial integration map of the Walled City of Nicosia

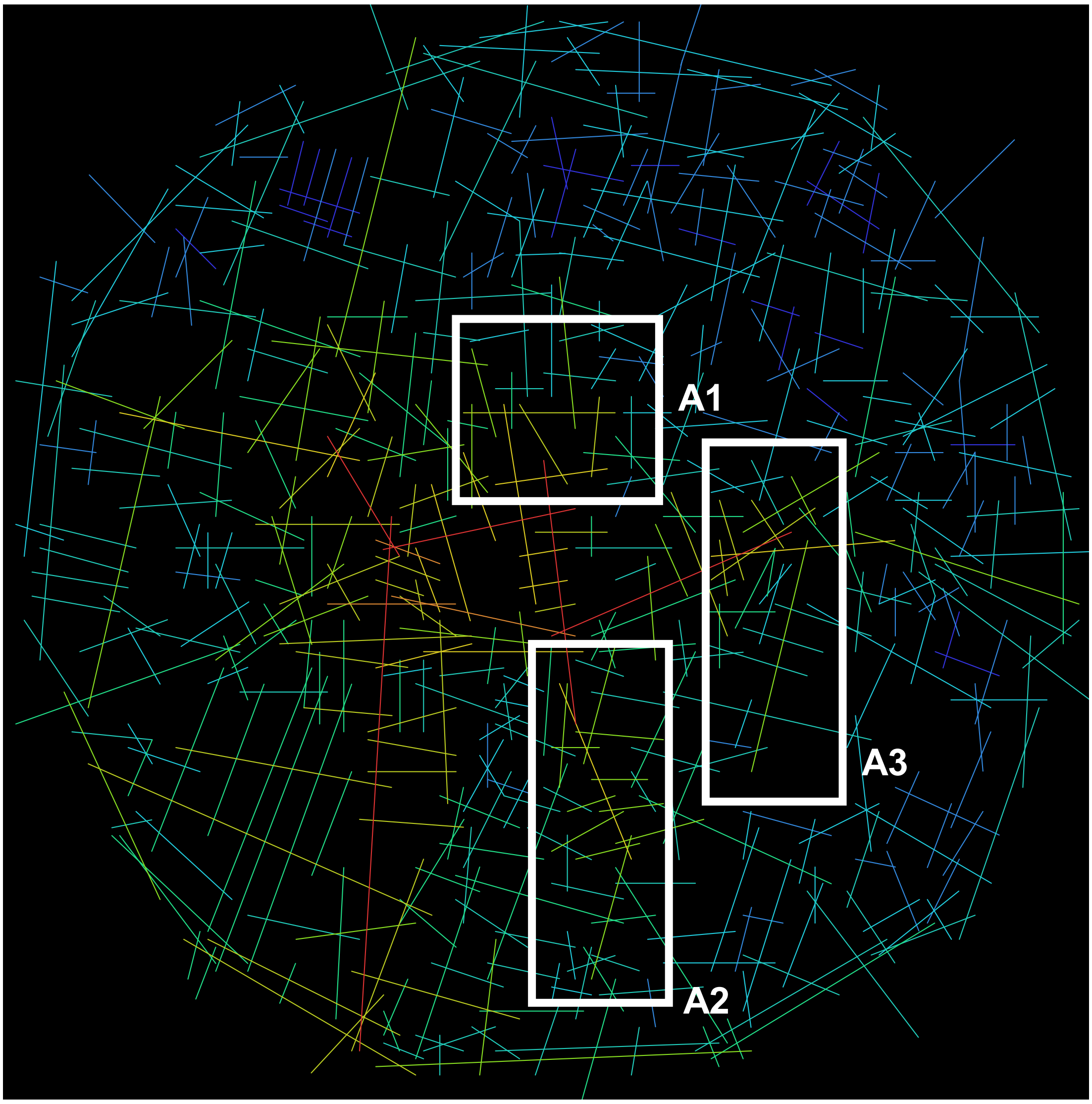


Figure 40: Prediction sites on recent axial integration map of the Walled City of Nicosia

Figure 40 shows the integration map of the current state of the walled city, it is possible to see the increase in integration on the predicted areas from 1914 map, the new integration values are; Area 1: 1.33, Area 2: 1.43, Area 3: 1.20. It should also be noted, the increase of integration on these areas are significantly higher than the increase percentages suggested by minimum, maximum and average integration values of the two maps (Table 1). It is important to understand what this points out; on the new map, the integrated spaces did remain integrated, whereas among the segregated spaces seen on the previous map, the ones with the predicted integration values saw the most drastic increase in integration. So this prediction does not mean the values predict the future integration centers but they accurately point out the locations that are likely to see increased integration and development in foreseeable future.

Table 1: Integration values and integration increase percentages of the past and present states of the Walled City of Nicosia and sites of Fibonacci prediction

	Walled City of Nicosia (1914)	Walled City of Nicosia (Current)	Integration Increase Percentage
Maximum Integration	1.10	1.63	% 48
Minimum Integration	0.57	0.71	% 24
Average Integration	0.81	1.04	% 28
Area 1 Integration	0.77	1.33	% 72
Area 2 Integration	0.78	1.43	% 83
Area 3 Integration	0.75	1.20	% 60

It is also possible to correlate the prediction with real-life land use data (Figure 41) as the mentioned locations evolved to have more socio-economic functions such as retail and leisure, even though they are primarily located at the residential quarters.

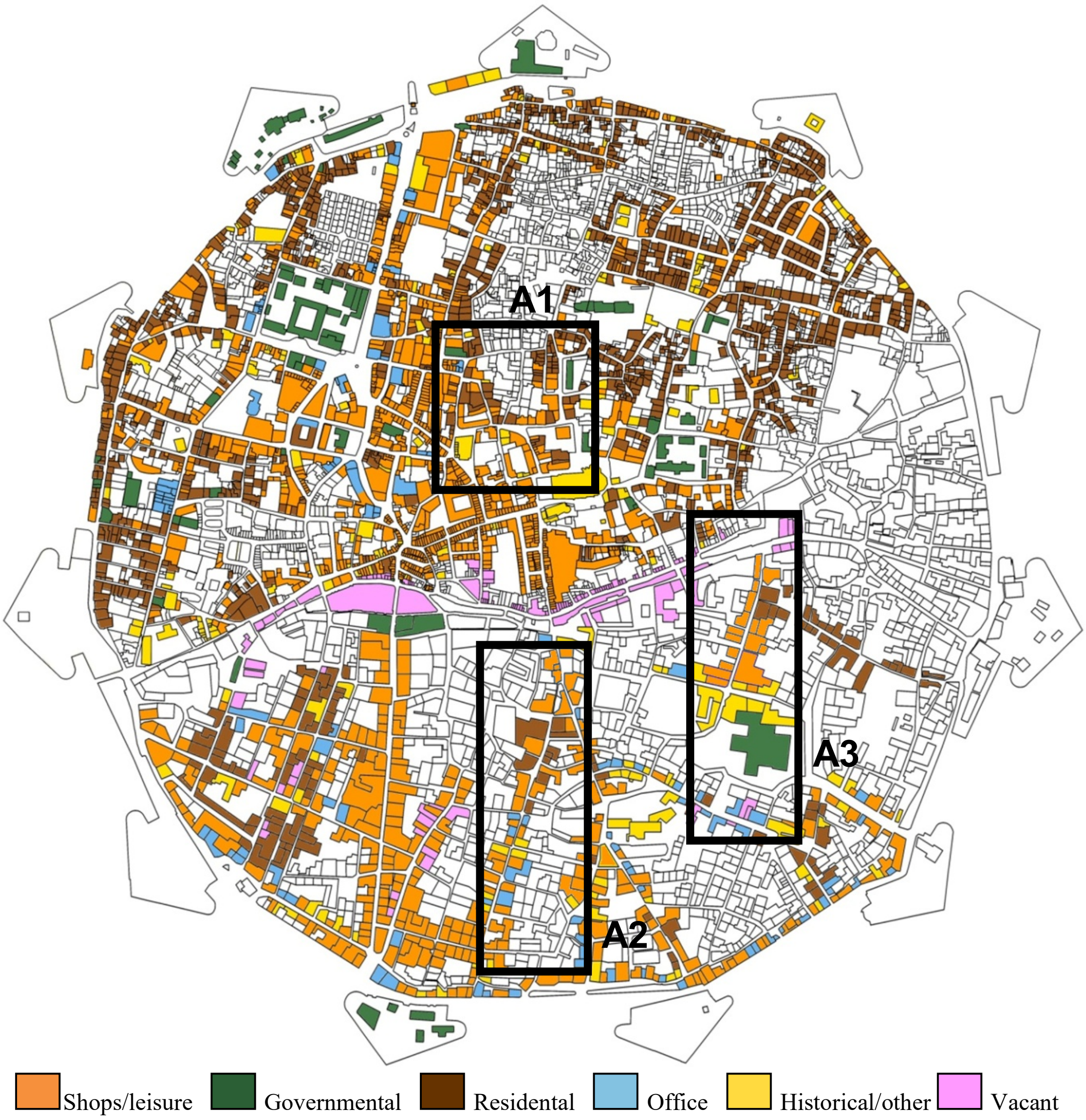


Figure 41: Land use map of the walled city showing prediction sites

Performing the same process on another city with historical and recent maps also provides similarly predictive results, even though the overall integration of the city seems less than its previous state. The city in question if the Walled City of Famagusta, it should be noted, the fact that both exemplary cities are walled cities is immaterial, having nothing to do with the method. The deciding factor in choosing them was the availability of the older maps. Figure 42 is the axial integration map of the Walled City of Famagusta, derived from an old 1899 map of the city (Enlart, 1899). On this map, the integration numbers are; min integration: 0.356, max integration: 1.045, average integration 0.734. When we input these numbers in Fibonacci calculator, using the % 61.8 (golden ratio) calculation, we get an integration value of 0.619. The three areas found with the approximate integration numbers (0.600-0.650 range) are marked on the 1899 integration map (Figure 42). Integration values are; Area 1: 0.64, Area 2: 0.62, Area 3: 0.65.

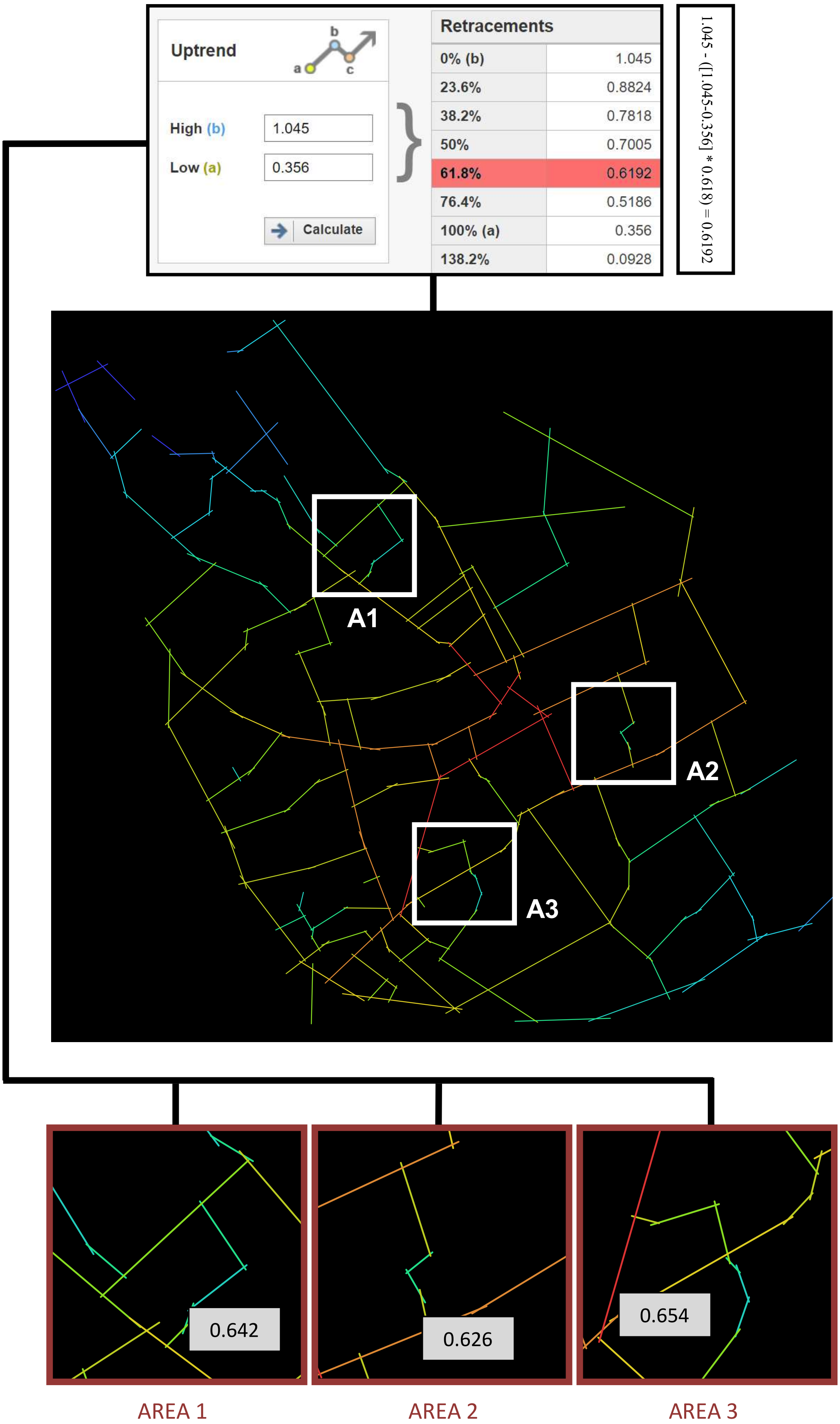


Figure 42: Fibonacci - Space Syntax process and prediction sites on 1899 axial integration map of the Walled City of Famagusta

Figure 43 shows the integration map of the current state of the walled city, it is possible to see the increase in integration on the predicted areas from 1914 map, the new integration values are; Area 1: 1.25, Area 2: 1.14, Area 3: 1.20. It should also be noted, the increase of integration on these areas are significantly higher than the increase percentages suggested by integration values of the two maps (Table 2). Like the previous comparisons of Walled City of Nicosia, the integrated spaces did remain integrated, whereas among the segregated spaces seen on the historic map, the ones with the predicted integration values saw the most drastic increase in integration. Once again, the predictions do not mean the values predict the future integration centers but they accurately point out the locations that are likely to see increased integration and development.

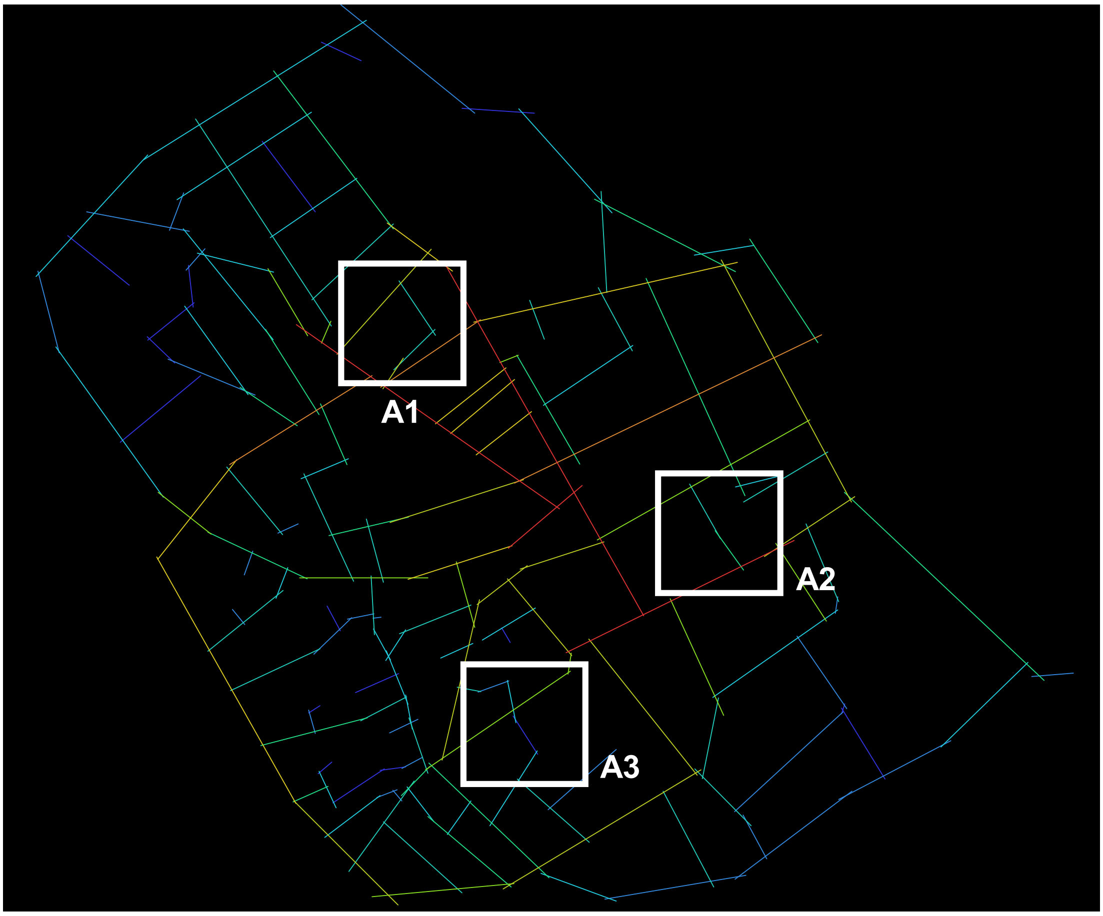


Figure 43: Prediction sites on recent axial integration map of the Walled City of Famagusta

Table 2: Integration values and integration increase percentages of the past and present states of the Walled City of Famagusta and sites of Fibonacci prediction

	Walled City of Famagusta (1899)	Walled City of Famagusta (Current)	Integration Increase Percentage
Maximum Integration	1.04	1.56	% 50
Minimum Integration	0.35	0.75	% 114
Average Integration	0.73	1.04	% 42
Area 1 Integration	0.64	1.25	% 95
Area 2 Integration	0.62	1.14	% 83
Area 3 Integration	0.65	1.20	% 84

Correlating the prediction data with recent land use data (Figure 44) also suggest the mentioned areas evolved to have socio-economic functions such as retail and leisure.

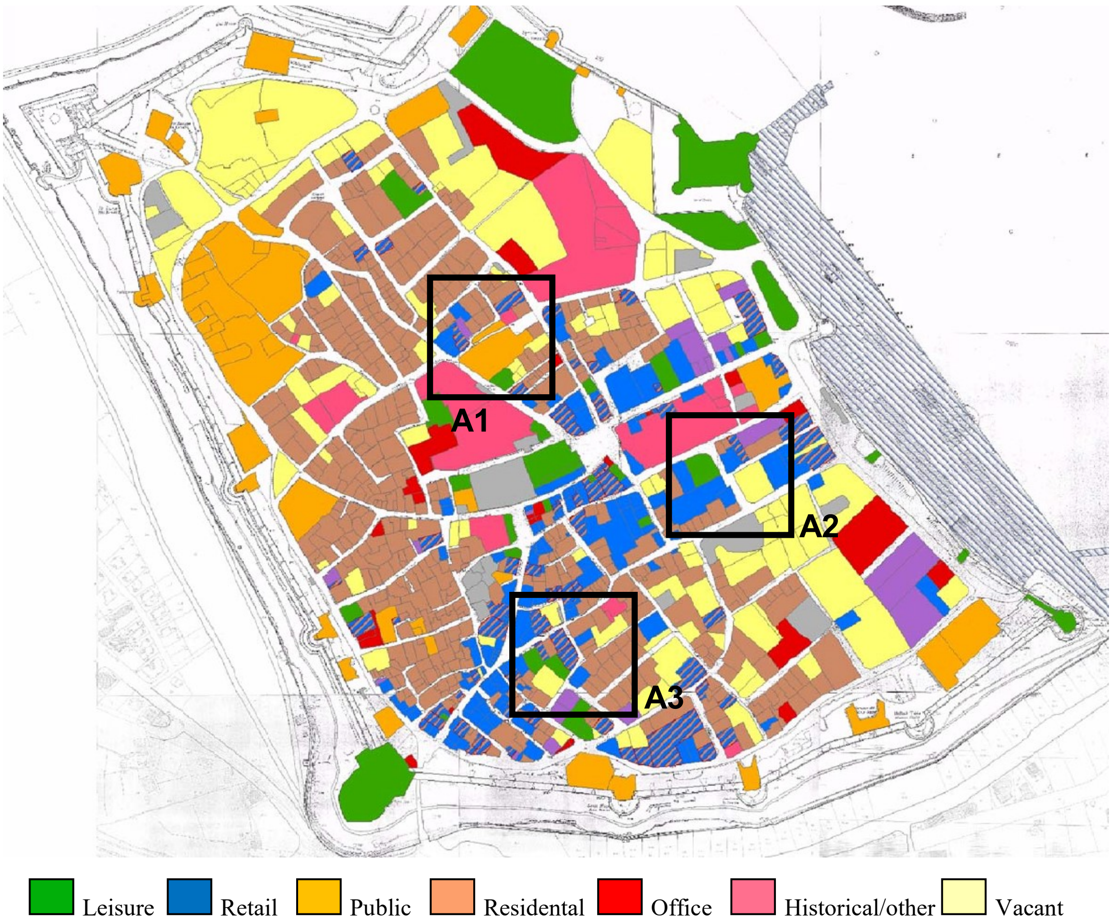


Figure 44: Land use map of the walled city showing prediction sites

Once again; the values we get from the Fibonacci calculator when we input integration numbers, indicate an area on the map that is likely to have increased socio-economic activity (integration) in the future.

This is an important outcome, one that informs on the method's universal applicability; comparing the two urban grids, they have very little in common. Morphologically, walled cities have fundamentally different designs -strictly circular for Nicosia vs. loosely rectangular for Famagusta- with different axial density; although smaller, Walled City of Famagusta's axes are much more spaced out than Nicosia's, which suggests low integration yet looking at the integration values, both have the same average integration of 1.04, indicating a more intelligible design for Famagusta. Famagusta also has a more diverse functional range against Nicosia's residential dominated urban texture apart from the main axes.

Detailed comparison between the urban characters of both walled cities can possibly be the subject of another research but at this point, it is possible to say that their similarities have nothing to do why Fibonacci predictions worked on both cases.

5.4 Artificial Cores

One of the most important parts of the cure is without a doubt the proposed artificial cores. With considering numerous analytical approaches on urban grids reviewed within previous chapters, we have a general idea as to the properties of the cores; they must have tightly packed small grid structures that allow integration and interaction. It is also of utmost performance that the cores must have a universal identity, not resembling or appropriated to existing cities as the aim is to make this 'Cure' work on any city or settlement -of a certain scale- anywhere on the world. As no two settlements are alike, the proposed artificial cores will have three different types based on their size. The term 'size' is used here for lack of a better term to define the differences between cores, as depending on the dimensions, functional and structural features of the cores also differ. It must be noted that the cores suggested here are merely conceptual approaches on city centre design, where the functions and properties presented here are required for the cores to be able to act as secondary city centers, it is at the Cure implementer's -of a specific case- discretion to alter design choices within the bounds of suggested core parameters.

5.4.1 Core Influences

Hillier (2009) argues it is in sustainable cities' genetic code that wherever one is in the city, he or she is close to a small centre, if not the city centre itself, this closely mirrors the Cure's resolve on placing sub-centers -the artificial cores- on the urban grid as needed, to act as secondary to the main city centre overcoming any possible segregation in between. So the artificial cores are basically city centers in different scales, with their functional, spatial and socio-economical responsibilities to act as centers, there are crucial design elements which they should incorporate. Howard's Garden City (1902) is an obvious influence on artificial cores, with their self contained structure, and use of green zones to both create spatial categorization and social public spaces, of course, a notable difference from Garden City concept is the dependency of artificial cores' to external arteries that lead to the rest of the city and other centers, this however, does not affect the self-sufficiency of the cores' as they accommodate enough functions to contain a small community. Also influenced from Garden City concept, New Urbanism movement's (Duany, 2011) focus on creating "walkable" public spaces which encourage socialization on foot is also a design element shared with the artificial cores; apart from the two main axes, core center axes are designed for pedestrian use in mind. The main axes that cut through all of the artificial cores provide links to the other cores as well as the main centre. Given the importance of these axes the grids of the cores that shape around them have a linear structure, not literally but with spatial arrangements of functional needs.

Hillier (1999) argues that urban grids evolve from a linear central core and expand around it and form axes as part of that expansion which sub-centers eventually emerge on, all characteristics used on the creation of artificial cores, yet the aforementioned evolution is sped up and the end product is applied directly on the existing urban grid here. Functional preferences of the core designs are aimed to be economically viable, embedded attractors -such as artificial cores here- always have economic purposes (Hillier, 2009) yet this time, economic success is not for its own sake but for the sustainability of the cores. The need for a strong economy is of utmost importance as it shapes social activity. Hillier (2009) argues, well integrated urban systems has a foreground network that us formed of linked centers with an accompanying background network of residential grid (Figure 45), where the Cure proposes to set up said foreground network, the artificial cores themselves also have an internal residential network, while it may seem as 'too many functions' it is the overlap of all those functions that would make the cores real attractors. Alexander (1977) argues the node points that define any social system are always where different functions overlap.

Figure 45: Axial integration map of Atlanta showing sub-centre formations
© Bill Hillier, 2009

In all urban revitalization proposals there is great importance given in defining public areas that can have retail functions. Pullan (2012) argues the public spaces that can successfully overcome the segregation difficulties with co-existence of two different communities, and support in sharing space are shopping areas with global character. It was observed that the inclusion of global brands in a retail environment neutralizes the social differences as the 'global' vibe brought by said brands eliminate any 'local' character no matter the user. It is important in regenerated urban grids to create a hospitable spatial configuration for such retail functions to flourish. Of course, the political constraints need to be overcome first in any scenario. Smyth and McKnight (2010) dealt with the 'neutral' character brought by similar functions in the Belfast City Centre, where they agree on most aspects, it is pointed out that forming an area with a hundred percent neutral character and not supporting that character within proximate urban spaces, further alienates people outside of the 'neutral' zone. This can possibly make users prone to territorial behavior that can lead to socio-spatial urban segregation if the grid is unable to support social behavior. Proposed artificial cores of this study aim to represent the same type of 'neutrality' with accommodation of socio-economic functions such as retail as discussed here.

As denser grids tend to be more integrated and that density is provided by the proximity of certain axes, it is possible to say that more compact the urban grid's dimensions are the more integrated it will be, this makes it important to consider the limitations of city boundaries. McEldowny (2004) deals with Murray's (1991) 'stop-line' concept of preventing urban sprawl in Belfast and its consequent transformation to 'green-belt' by the Department of Regional Development as eco-sustainability started to gain more importance in urban design. It is noted that, the green-belt can not only prevent meaningless urban sprawl but also form a live-centre in containing the urban grid, essentially forcing it to grow denser from centre to city limits. The denser grid in centre helps vitalize economic activity as any live-centre can, it is pointed out that this characteristic of the green-belt makes it suitable to be used on cities lacking tourist activity to rely their economy on. Green belt concept will be used on all of the proposed artificial cores to help preserve their form in terms of spatial boundary.

5.4.2 Designing the Cores

The design language employed in forming the cores suggestions consist of pure geometric allocations, various arguments can be made in influencing this design choice; Batty (1994) argued urban design morphology can be described by underlying fractal geometry on urban grid formation, Le Corbusier considered geometry to be "hierarchy of reason" on urban design (Crow, 1989), geometric structures of ideal city forms of Renaissance was used because of their mathematical consistency (it was believed mathematical perfection represented the perfection of God; Gelernter, 1995), but the main reason for using pure geometry in core design is that it provides objectivity. Any process of design is subjective and reflects the predispositions of the designer (Casanova & Hernandez, 2013), in a study which aims create a common global model; it is not surprising that the most suitable design form would be the most universal one, which are geometric proportions. Although the grid designs proposed here are mainly conceptual to define parameters and proportions, they can also be used with their current, proposed state.

There are three different grid designs that are suggested as artificial cores, while their functions are primarily same; their difference is due to their size. The reason for the creation of three variations of cores is to be able to fulfill the requirements of every urban grid as appropriately as possible; even though any of the proposed cores would do the same job, depending on the city size and grid morphology, some are more suited than others. Nonetheless, all three of the proposed grid suggestions share the most important characteristics:

- A core of integration; that will act as the centre of the core and unite functions and movement.
- A main axis cutting through the grid; a sizeable axis as a way of delivering movement in and out of the core.
- Green belt; allocated green zones spreading from the core to the surrounding of the grid, providing natural surroundings as well as spatial limitations to prevent sprawl.

5.4.3 Core Form and Functionality

We know by now how these cores are supposed serve a city in urban scale but how will they serve themselves in local scale? These cores are essentially city centers, and as with all city centers, they contain the sum of the functions that are found in the whole city but in a smaller and compact scale; so it is possible to say that these cores are in fact small cities themselves, so functionally speaking they should contain leisure, office and residential spaces. Each core has a different distribution of said functions depending on grid size and spatial allocation. Another design mark that can be found in the suggestions is the use of landscaping and greenery, aside from the green belts at the edges -to prevent unnecessary sprawl- there are also allocated green spaces within the cores themselves. With the use of green belt, and a number of green spaces within the cores themselves the Garden City (Howard, 1902) influence on the designs is undeniable yet it is only utilized in developing design principles -like the use of greenery- for the cores as their primary functions were to be self-contained, self-sufficient cities unlike the cores here which are supposed to serve a greater -and already existing- whole. Another design influence can be Le

Corbusier's Ville Radieuse with the separation of leisure and residential functions and the general geometric design attitude, but that's where the similarities end as Corbusier's 'Cities of Tomorrow' were mainly designed with vehicular movement in mind and were actually heavily criticized for it (Kunstler, 1993), whereas the cores' size along with their roads, sidewalks and pathways are all planned for human scale. Although not intended, it is also possible to see the similarities with ideal renaissance cities with the use of central hubs and radial geometric distribution of functions.

Apart from borrowing useful features from emphasized influences, the core suggestions are designed to be purely objective geometric forms, resulting from this approach, one conspicuous design element is the heavy use of symmetry on all three of the cores, along with its practical advantages in design it is also used in order to discourage the formation of clan systems which a hierarchical design can harbor.

5.4.4 Dimensional Specifications

As explained before, the reason why there are three cores is the dimensional requirements of different grids, although the cores themselves are ultimately suggestions, it is important to elaborate on different urban scenarios which grid size forms an important aspect. Overall dimensions and capacity of each core was determined by investigating dimensional specification values of several different cities, primarily the cases studied in Chapter 3. It should be noted that these numbers are suggestions; not prerequisites for the cores to function, also, the values presented here are not utilized from another urban grid but approximated to match the size and functional criteria that the cores need to meet in order to present a viable support mechanism or an overall alternative to existing city centers. While the general capacity and area coverage is dictated by overall size, this is not the case for the detailed dimensions such as lane or sidewalk width.

Hall (1966) argues the personal buffer zone for pedestrian contact should be at least an 'arms reach' distance which equates to approximately 80 centimeters radial distance from the individual. In their observational study of human movement behavior in urban spaces, Willis et al. (2004) also confirm this dimension and demonstrate the varied distinction of interpersonal space when moving as pairs or triples; where the distance is almost non-existent within the pair, the outside buffer is increased as the footprint of the moving unit of two individuals is also increased. The sidewalk widths of the artificial cores are suggested to be significantly more than those of vehicular lanes to account for the interpersonal space; to accommodate as much foot movement as possible to encourage social activity.

Dimensions such as block size and building heights are designated to serve the integration measure; more compact and dense urban grids lead to higher integration, artificial cores' axial density is a direct result of this, which influences the dimensions of the building blocks which are located between those axes. Depending on the axial length and the overall size of the core, the building heights are also limited to provide as less obstruction within the isovists -fields of vision- as possible, as more visual reach also adds up to more integration with axial lines being lines of sight essentially (Penn, 2003). All of the relevant dimensional specifications for the artificial cores are summarized in Table 3, as well as within the following core descriptions.

Table 3: Suggested dimensional specifications for artificial cores

	Artificial Core Type A	Artificial Core Type B	Artificial Core Type C
General Capacity	1.5km^2 surface area, suggested capacity of 10,000 inhabitants, 250 shops & offices. Suggested lane size 3 meters; sidewalk size 5 meters; island size 2 meters	1km^2 surface area, suggested capacity of 6,000 inhabitants, 150 shops & offices. Suggested lane size 3 meters; sidewalk size 5 meters; island size 2 meters	0.75 km^2 surface area, suggested capacity of 3,500 inhabitants, 80 shops & offices. Suggested lane size 3 meters; sidewalk size 5 meters; island size 2 meters
Leisure Hub	250,000m^2 open, 80,000m^2 closed spaces. Maximum height suggestion is 10 storeys Central square is around 10,000m^2.	55,000m^2 open, 40,000m^2 closed spaces. Maximum height suggestion is 10 storeys. Central square is around 6,400m^2.	14,000m^2 open, 18,000m^2 closed spaces. Maximum height suggestion is 8 storeys. Central square is around 5,000m^2.
Residential Area	Block size 240x80 meters. Plot size 800m^2. Maximum suggested height for apartment buildings is 6 storeys.	Block size 240x80 meters. Plot size 800m^2. Maximum suggested height for apartment buildings is 6 storeys.	Block size 240x80 meters. Plot size 800m^2. Maximum suggested height for apartment buildings is 4 storeys.
Means of Circulation	Two main axes through the core; 4 lane and 2 lane. One 2 lane beltway connecting the residential area with the hub as well as main axes. 10 meter openings for circulation or possible 2 lane vehicle roads between residential blocks.	Two main axes through the core; 4 lane and 2 lane. One 2 lane beltway circulating around central hub and providing connection to the main axes. 10 meter openings for circulation or possible 2 lane vehicle roads between residential blocks.	One 4 lane main axis cutting through the core. One 2 lane beltway circulating around central hub and the whole core, providing connection to the main axis. 10 meter openings for circulation or possible 2 lane vehicle roads between residential blocks.

5.4.5 Core Type A

First core is the largest of all three, it is approximately 1.5 km^2 in size and at its maximum, is spatially equipped to contain over 250 shops and 10,000 inhabitants in residential quarters. Two axes cut through it; the larger one contains a four lane vehicle road and 10 meters wide sidewalks around it, its primary function is to become the main axis that connects the core to the rest of the city and its centre, the smaller axis has the same sidewalk width but has a two lane vehicle road which cuts through the central hub that contains leisure functions, the function of this axis is to provide a secondary artery that connects the core with the nearby settlements. There is also a two lane rectangular beltway that circulates through all the four sections of the core that contains all vehicular movement within the core as well as providing four connections -with roundabouts- to the arteries that lead outside the core. The centre of the core has the leisure hub, designed as a rectangle within rectangle, the space between the outer and inner layer contain green spaces that also separates the central hub from residential quarters, inner layer contains all the leisure and office functions distributed around the main square in the middle, spatial allocation allows to establish to the amount of 250 shops and corresponding office spaces in upper storeys.

Residential spaces are divided in two; one part that remains between the beltway and the green zone that is connected to the hub, are mainly designed to be high-end and maximum two storey residential spaces, yet their high-end-ness is not due to the plot size or typology but because of the proximity to the leisure hub.

The other main part is distributed outside the beltway, all the four residential quarters contain a green central park that connects the green zone in the middle of the core to the green belt at the edge of the core, at the sides of the central park are residential blocks that are sized at 240x80 meters which contain 12 plots, the maximum planned height for these plots is six storey's and that is limited to only half of the plots to prevent congestion in core population. There is 10 meter distance between the residential blocks, these spaces are proposed to be used for foot movement only, to encourage neighborly social interaction but the 10m distance is adequate for conversion into two lane vehicular roads if demand arises.

Figure 46 shows the spatial distribution of the suggested core along with possible functional distribution showing different functions. The regularity of the suggestion is clearly visible, where this might pose issues of design compatibility, as most cities are organic entities, yet subjective design is of secondary concern at this point and it is the functions that are important; both within the cores but more importantly in terms of city scale impact. Of course a flawed design can hinder the expected functionality, but integration analysis of the suggested axial structure of the core (Figure 47) demonstrates the core works the way it is planned to; with well integrated central core (orange) and circulating axes (red) along with less integrated (green) but well connected residential areas.

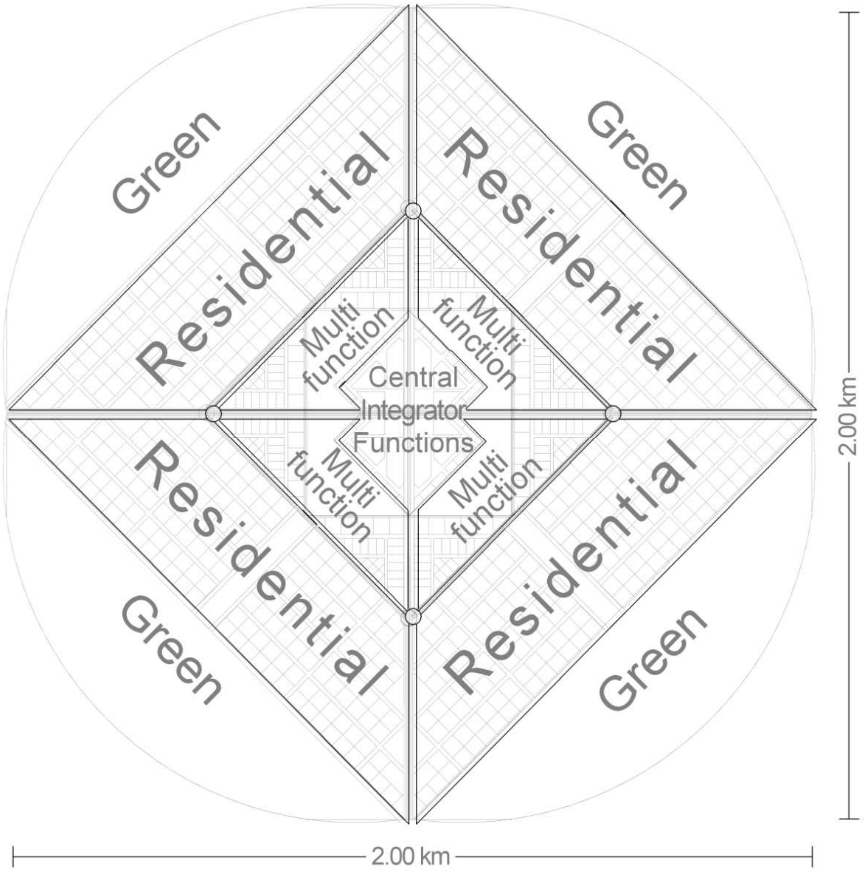


Figure 46: Spatial distribution of the artificial Core Type A

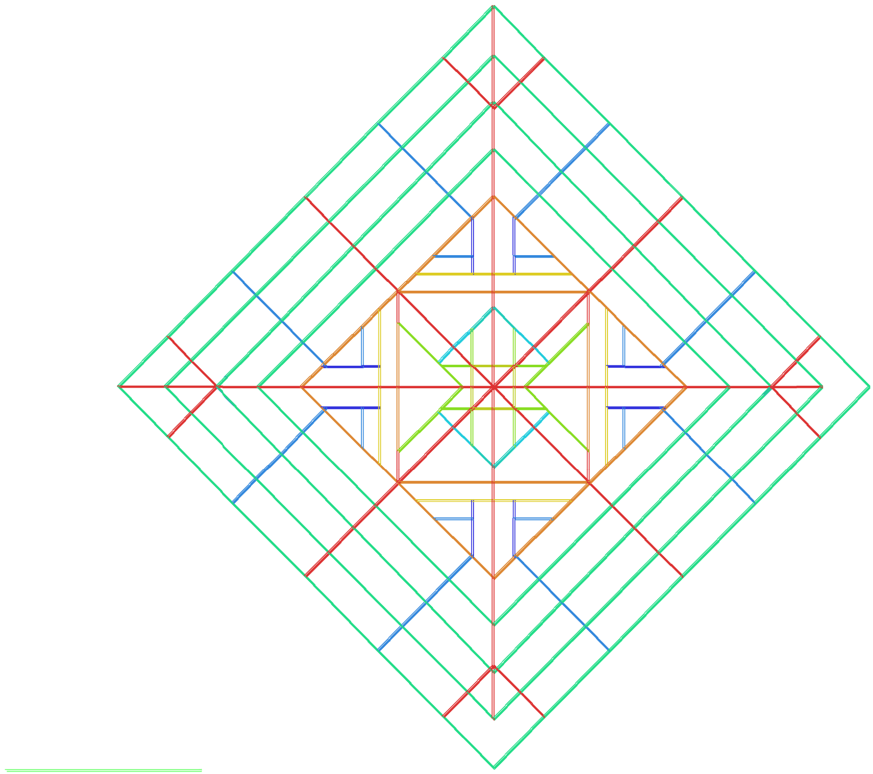


Figure 47: Integration analysis of the suggested axial structure of Core Type A

5.4.6 Core Type B

The second core suggestion is approximately 1 km^2 in size and it has the capacity to house 150 shops and 6,000 inhabitants in its residential sections. The form of this core is rather simplistic with its perfect square shape; used with its current form it would be more suitable for cities that have a formal urban grid structure like US cities like Atlanta or New York. Two axes carrying the same characteristics of the Core Type A axes cut through this suggestion as well; larger one contains a four lane vehicle road and 10 meters wide sidewalks around it, its primary function is to become the main axis that connects the core to the rest of the city and its centre, the smaller axis has the same sidewalk width but has a two lane vehicle road which cuts through the central hub that contains leisure functions, the function of this axis is to provide a secondary artery that connects the core with the nearby settlements.

This core is basically comprised of four square shapes within each other, the outer square is the green belt obviously, and the next layer of square is the residential quarters, the layer after that is the central park that separates the residential quarters from the final square layer which contains the integrator functions like leisure and offices. This suggestion too, has a two lane rectangular beltway which provides circulation around the central portion of the core and is located at the intersection of surrounding square shaped central park with the centre. The central hub at the centre of the core is formed by square in square shopping streets with a main public square at the middle of them. Spatial allocation allows establishing to the amount of 150 shops and corresponding office spaces in upper storeys.

Residential spaces of the core are divided in four with the two main axes crossing through them, and are located between two green spaces; the outer green belt and the central park. Residential blocks are sized at 240x80 meters which contain 12 plots, the maximum planned height for these plots is six storeys and that is limited to only half of the plots to prevent congestion in core population. There is 10 meter distance between the residential blocks, these spaces are proposed to be used for foot movement only, to encourage neighborly social interaction but the 10m distance is adequate for conversion into two lane vehicular roads if demand arises.

Figure 48 shows spatial distribution of the suggested core along with possible functional distribution showing different functions. Even a more regular suggestion than Core Type A, the design of this core is a little more suitable to be used on planned cities of a certain scale. Nonetheless, functionally it can serve in any urban grid the way it is expected to, this of course is checked and correlated with space syntax analysis of the suggested axial structure (Figure 49).

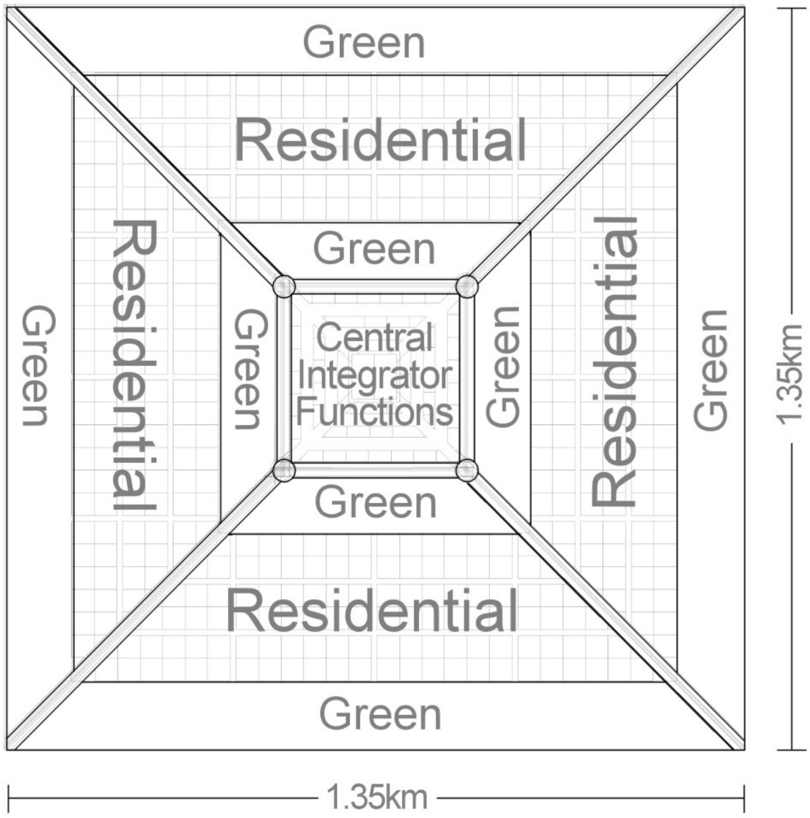


Figure 48: Spatial distribution of the artificial Core Type B

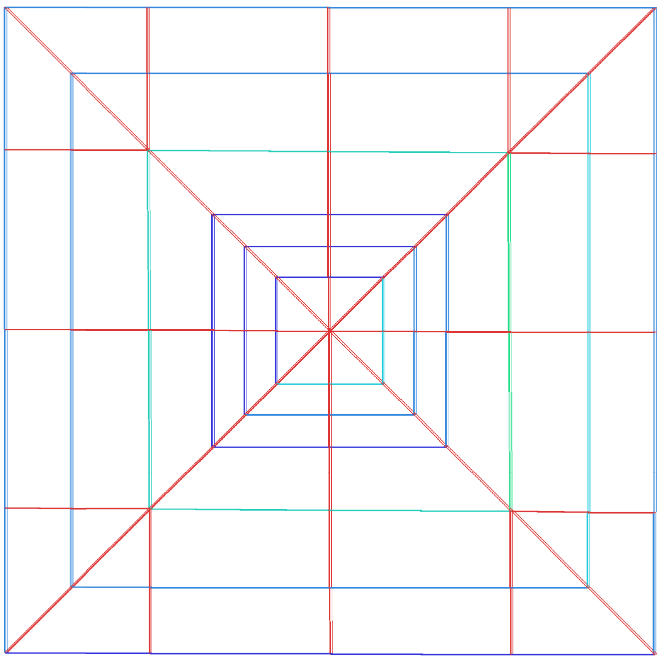


Figure 49: Space syntax integration analysis of the suggested axial structure of Core Type B

5.4.7 Core Type C

The smallest core suggestion is approximately 0.75 km^2 in size with the capacity to house 80 shops and 3,500 inhabitants in its residential portions. The form is linear and with being the smallest core, has only one -the major- axis cutting through it; the four lane wide main axis which provides the connection with the city. Similarly this core too has a beltway that circulates around the main hub but also branches out to circulate the whole core itself. The main axis divides the core in two parts; the upper part contains the north half of the central hub and close by residential area with green belt at the edge of it, the lower part contains the south part of the central hub that is directly connected -with the beltway- to the central park below it which itself has the residential sections on both sides.

The central hub at the centre of the core is formed by square in square shopping streets with a main public square at the middle of them which the main artery crosses by. Spatial allocation allows establishing the amount of 80 shops and corresponding office spaces in upper storeys.

Residential spaces of the core suggestion are divided in four with two different symmetrical sections; the two parts that remain at the north portion of the core are closer to the leisure hub thus can be categorized as high end -and maximum two storey residential spaces- due to this proximity to integrator functions. The two parts that remain at the south side of the core face the central park, they provide a calmer, almost suburb-like living environment.

Again, the residential blocks are sized at 240x80 meters which may contain 12 plots, the maximum suggested height for these plots is four storey's and that is suggested to be limited to only half of the plots to prevent congestion in core population. There is 10 meter distance between the residential blocks, these spaces are proposed to be used for foot movement only, to encourage neighborly social interaction but the 10m distance is adequate for conversion into two lane vehicular roads if demand arises.

Figure 50 spatial distribution of the suggested core along with possible functional distribution showing different functions; the smallest and least regular of the artificial cores with only one main axis cutting through it, this core would be most suitable for more organic, small scale cities such as historical towns. Integration analysis of the suggested axial structure of the core (Figure 51) shows the spatial suitability of the design with functional requirements with a well integrated central core and less integrated but well connected residential and green areas.

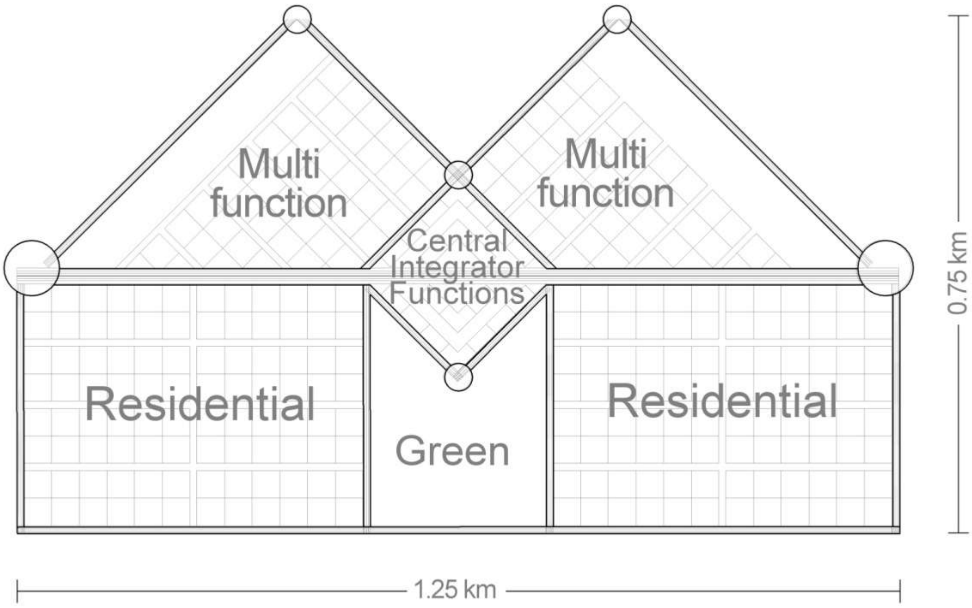


Figure 50: Spatial distribution of the artificial Core Type C

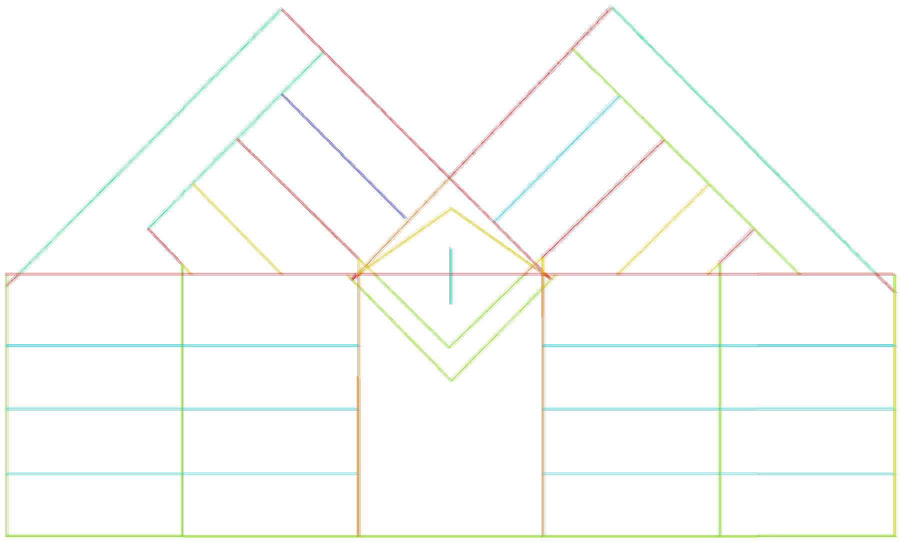


Figure 51: Space syntax integration analysis of the suggested axial structure of Core Type C

5.4.8 Interfacing Core Forms

If decided to be used with their suggested -objective- urban configuration, the formal geometric design language of the cores might prove incompatible with cities which have organic features in their urban fabric, even with different core types with different functional configurations. In that case, it is possible to adjust the axial structure of the cores slightly -interfacing- so that they better embody the identity of the urban grid they are placed in, and sustain the visual continuity within the city. Of course disrupting the axial structure of these cores too much would lead to different spatial results, same with changing functions or planning suggestions. The following guidelines are designed to show the limitations which core adjustments would not affect functionality of all three presented core types.

1. Axis number or locations cannot be changed, no additions or subtractions.
2. It is possible to make angular changes on edge axes up to 30 degrees.
3. It is possible to make angular changes on internal axes up to 10 degrees.
4. It is not possible to make angular changes on two main axes of the cores.
5. Functional distribution cannot be changed.
6. It is possible to convert some streets into vehicular roads as dimensions support but core center axes should always remain pedestrian.
7. Two main axes should maintain direct connections with the rest of the city.
8. It is possible to add more connections to the artificial cores from external axes but on the condition they do not sever proposed connections.

Interfacing suggestions in accordance with above guidelines will be further exemplified using axial maps following cure results.

5.5 Three Step Process of the Cure

This section summarizes the step by step chronological working structure in application process of the Cure (Figure 52).

Step 1 - Space Syntax Angular Integration Analysis

Segment angular analysis of the urban grid shows the problematic and segregated areas of the grid, where achieving a wholly integrated urban grid is mathematically impossible. The re-integration of segregated areas will leave us as integrated a city can ever be. The results of the analysis will provide the highest and lowest values of integration on the grid which we will process with Fibonacci method.

Step 2 - Fibonacci Retracement On Angular Integration Map

The highest and lowest numerical values of the urban grid that is derived from the space syntax analysis will be inputted to the Fibonacci calculator, from the high and low (support and resistance) value interval we get, we will find out the levels of integration which will point out the locations on the map. When the cores are placed on the urban grid suitability of different sizes on the used grid will also be decided upon space syntax analysis.

Step 3 - The Placement of the Artificial Cores

When the final locations of the artificial cores are decided, they will be drawn into the map with the necessary adjustments in respect to the existing urban fabric and analyzed once again to verify the urban grid's increased level of integration. This process obviously considers the proposed artificial core plans as material, not conceptual. One might argue that any other subjectively designed core might not work here (not counting 'interfacing' adjustments on original cores); even if the cores suggested here are only used as conceptual references, the parametric requirements of their form and functions ensure the 'artificial core' features of any other design are maintained. Abiding by those parameters, any other subjective grid form would at least produce as much integration as the artificial cores presented here; 'at least' because any subjectively designed core would be designed to conform to the dedicated urban grid's original features. So it is possible to say the cure application maps only represent the worst case scenario.

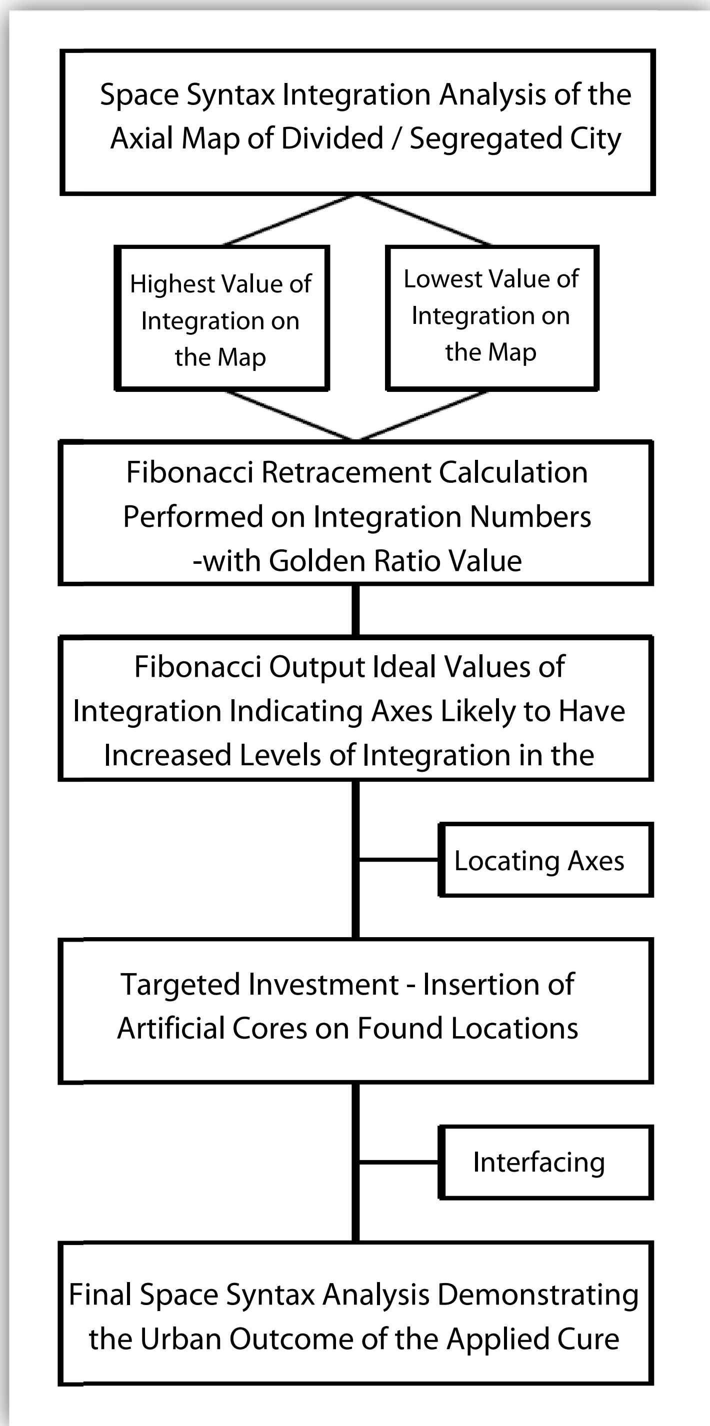


Figure 52: The working structure of the Cure

5.6 Range of Application

Where it is possible to say the Cure should work with any urban grid, it is important to define what constitutes an urban grid in terms of size. What is meant by 'size' is not the dimensional aspect of an urban grid but its grid density; for instance, large urban entities such as airports are formed of a certain number of axes where smaller urban grids like Walled Cities of Nicosia and Famagusta (Figures 39 and 42) are formed of a clearly dense axial structure. So proposing certain dimensional ranges and say 'the Cure works between this and that dimension' would not be a correct classification. It is possible to say the Cure works only on urban grids of settlements upwards of a certain size. Where there is not a universal definition of dimensional requirements of an urban structure to be considered as an urban grid, for the Cure, Walled City of Famagusta (Figure 43) is a perfect example in signifying the lower limitations of Cure application with its approximately 0.5 km^2 surface area and its minimally sufficient grid density with only 40 axial lines, any grid formation with lower parameters would be too local an entity to be counted as 'urban'.

The Cure is designed to work primarily on cities, not small towns, so when used on smaller grids like the aforementioned walled cities, only the first two steps of three step Cure process would be operational as proposed artificial cores would encapsulate any smaller urban grid than a city. But the reasoning remains the same; instead of artificial core implementation on larger grids, smaller grids would benefit from local scale implementation of integrator functions on the targeted street, turning it into a form of 'high street' which can be observed as main integration centres in small suburban towns (Griffiths et al., 2008).

Chapter 6

CURE APPLICATION

In this chapter the Cure will finally be applied on the segregated case cities of choice; Nicosia and Famagusta. The application of the method will be undertaken in six steps; first data tables will be introduced containing the relevant syntactic data derived from the space syntax analysis, then the Fibonacci retracement will be applied on the relevant minimum and maximums we get from the data tables, the values that we get are compiled under another table called 'Cure Values', the third step discusses the urban morphology of cities in deciding which or how many of the artificial cores must be used, then the artificial cores are placed on the axial map and analyzed once again with the space syntax software; this analysis will be done with five different maps to illustrate the effectiveness of the Cure; North Nicosia by itself, South Nicosia by itself, the Unified Nicosia, Famagusta by itself and Famagusta with Maras. The fifth and final step evaluates and discusses the results and finalizes the Cure application.

6.1 Syntactic Data

The following data tables contain all the relevant values derived from the space syntax analyses, namely; axial and segment angular integration values with their respective radii. As mentioned before space syntax' maps color grading ranges from warm to cold colors and these colors are determined according to the numerical values that we get from the analysis; warmest color red has the maximum integration and the highest numerical value where the coolest color dark blue has the minimum integration -segregation- and lowest numerical value. For instance; the n (the whole map) radius maximum segment angular integration value of South Nicosia is 2761.1, this -most integrated- axis is marked on the map (Figure 53) to further clarify how the values are graded.

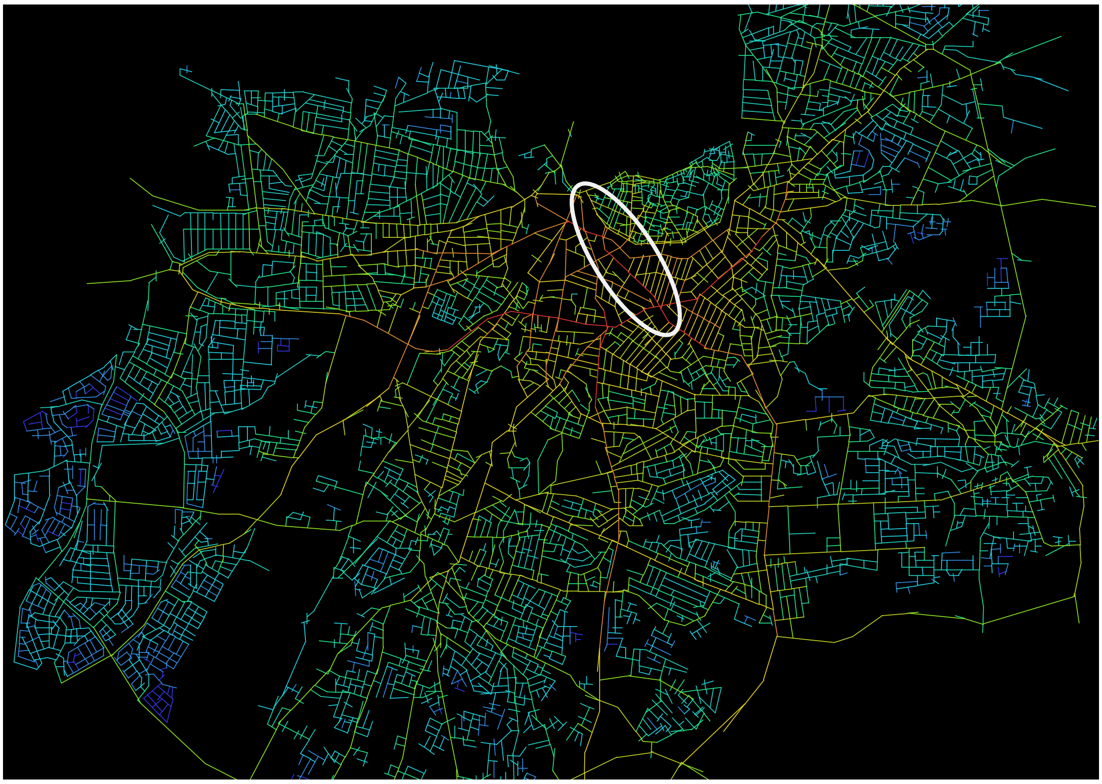


Figure 53: Global Segment Angular Integration Map of South Nicosia, most integrated axis marked

The values that are highlighted with red in the tables are the minimum and maximum integration values of the case cities of Nicosia and Famagusta which we will input on the Fibonacci calculator to get the ideal integration values for the cores that will be placed on the map.

Table 4: Syntactic Data of Nicosia

Measure	Value / Radius (Analysed Space)	Nicosia North	Nicosia South	Unified Nicosia
	Radius	n	n	n
Segment Angular Integration	Average	**763.44**	**1750.69**	**2160.17**
	Maximum	**1232.47**	**2761.12**	**3220.38**
	Minimum	**378.09**	**969.91**	**4.5**
Axial Integration	*Radius*	n	n	n
	Average	0.57	0.56	0.49
	Maximum	0.85	0.80	0.71
	Minimum	0.28	0.34	0.24

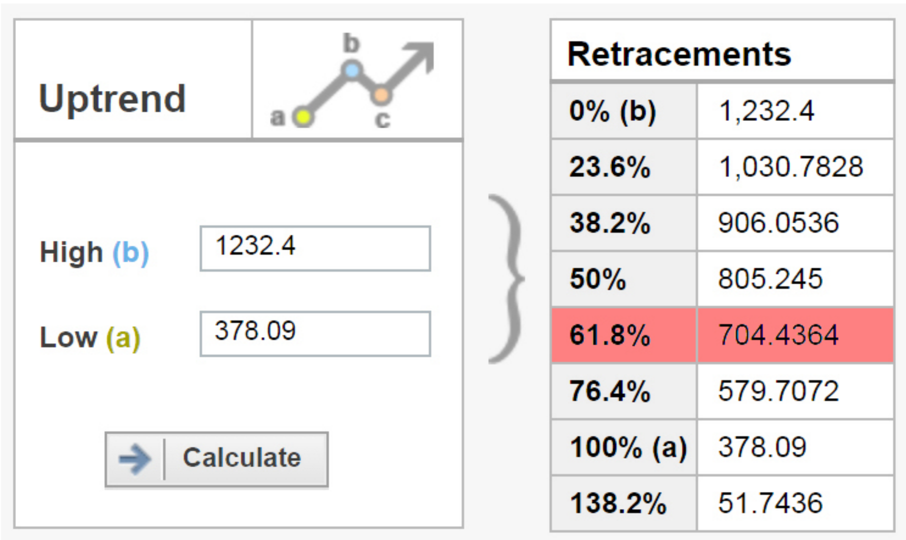
Table 5: Syntactic Data of Famagusta

Measure	Value / Radius (Analysed Space)	Famagusta	Famagusta with Maras
	Radius	n	n
Segment Angular Integration	Average	**769.77**	**560.42**
	Maximum	**1210.08**	**865.87**
	Minimum	**441.48**	**329.90**
Axial Integration	*Radius*	n	n
	Average	0.53	0.51
	Maximum	0.82	0.78
	Minimum	0.30	0.29

6.2 Fibonacci Retracement and Cure Values

In this step we will input the minimum and maximum integration numbers on the Fibonacci calculator. The Fibonacci analysis has two prediction categories; uptrend and downtrend, as it is our aim to increase overall integration, the calculator that will be used here will be uptrend and the retracement value which we will adopt is the original golden ratio 61.8%.

As it is a commonly used tool in finance, there are many Fibonacci retracement calculators online; once again, the one that will be used here is courtesy of 'investing.com'. Figures 54, 55 and 56 highlights the Fibonacci retracement values calculated using golden ratio for North, South and Unified respectively where Figures 57 and 58 shows values for Famagusta and Famagusta with Maras added to its urban grid. Table 6 compiles the integration values the calculator provided that proposed artificial core locations needs to have -the Cure Values.



Retracements	
0% (b)	1,232.4
23.6%	1,030.7828
38.2%	906.0536
50%	805.245
61.8%	704.4364
76.4%	579.7072
100% (a)	378.09
138.2%	51.7436

Figure 54: Fibonacci retracement value for North Nicosia

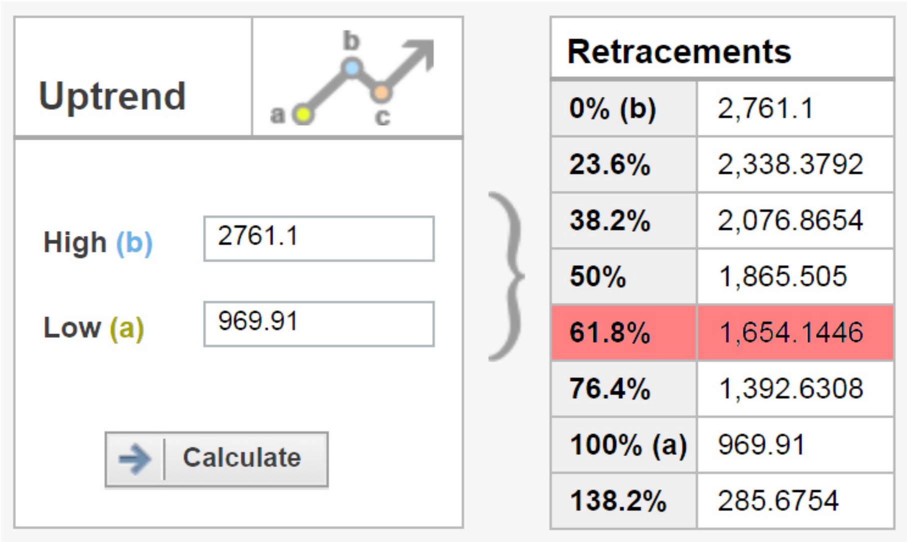


Figure 55: Fibonacci retracement value for South Nicosia

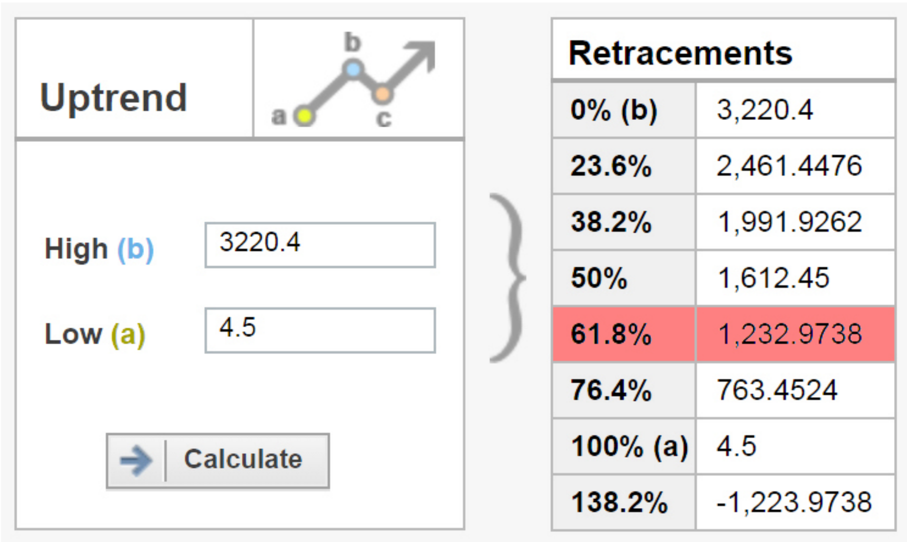


Figure 56: Fibonacci retracement value for Unified Nicosia

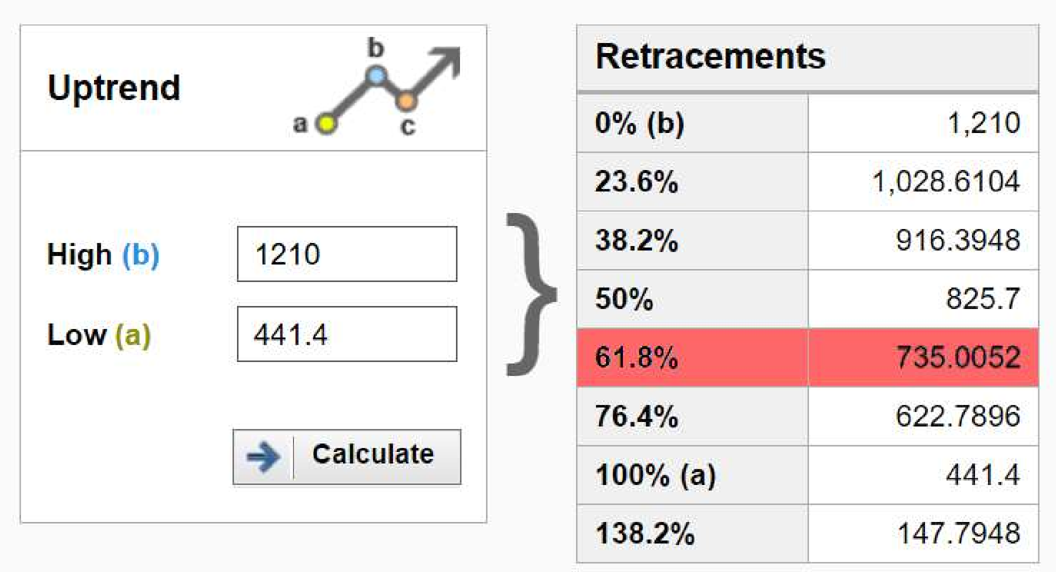


Figure 57: Fibonacci retracement value for Famagusta

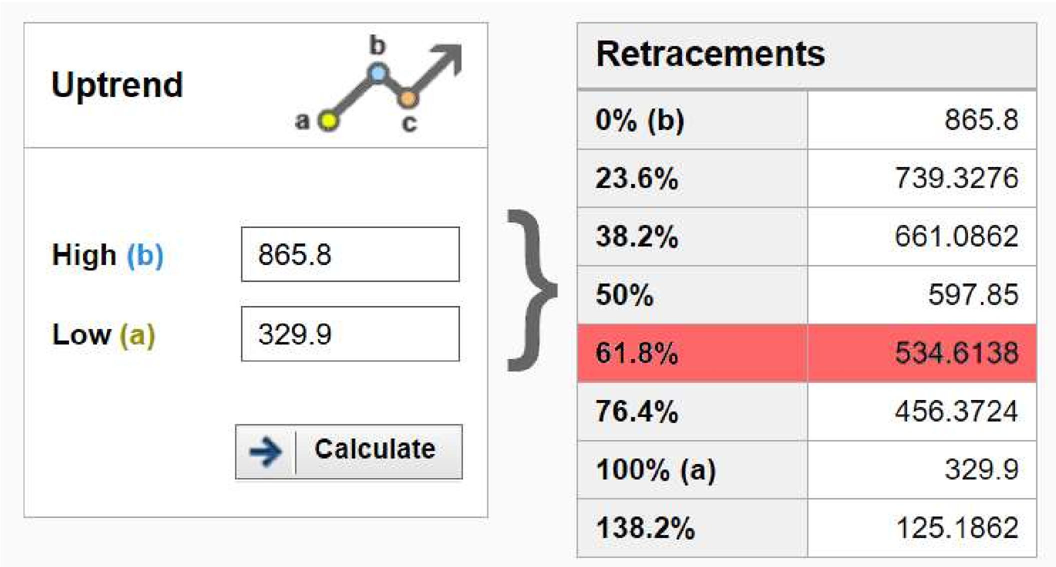


Figure 58: Fibonacci retracement value for Famagusta with Maras

Table 6: The Cure Values

Cure Values The ideal values of integration for the placement of artificial cores in each respective map.	
North Nicosia	704.4364
South Nicosia	1.654.1446
Unified Nicosia	1.232.9738
Famagusta	735.0052
Famagusta with Maras	534.6138

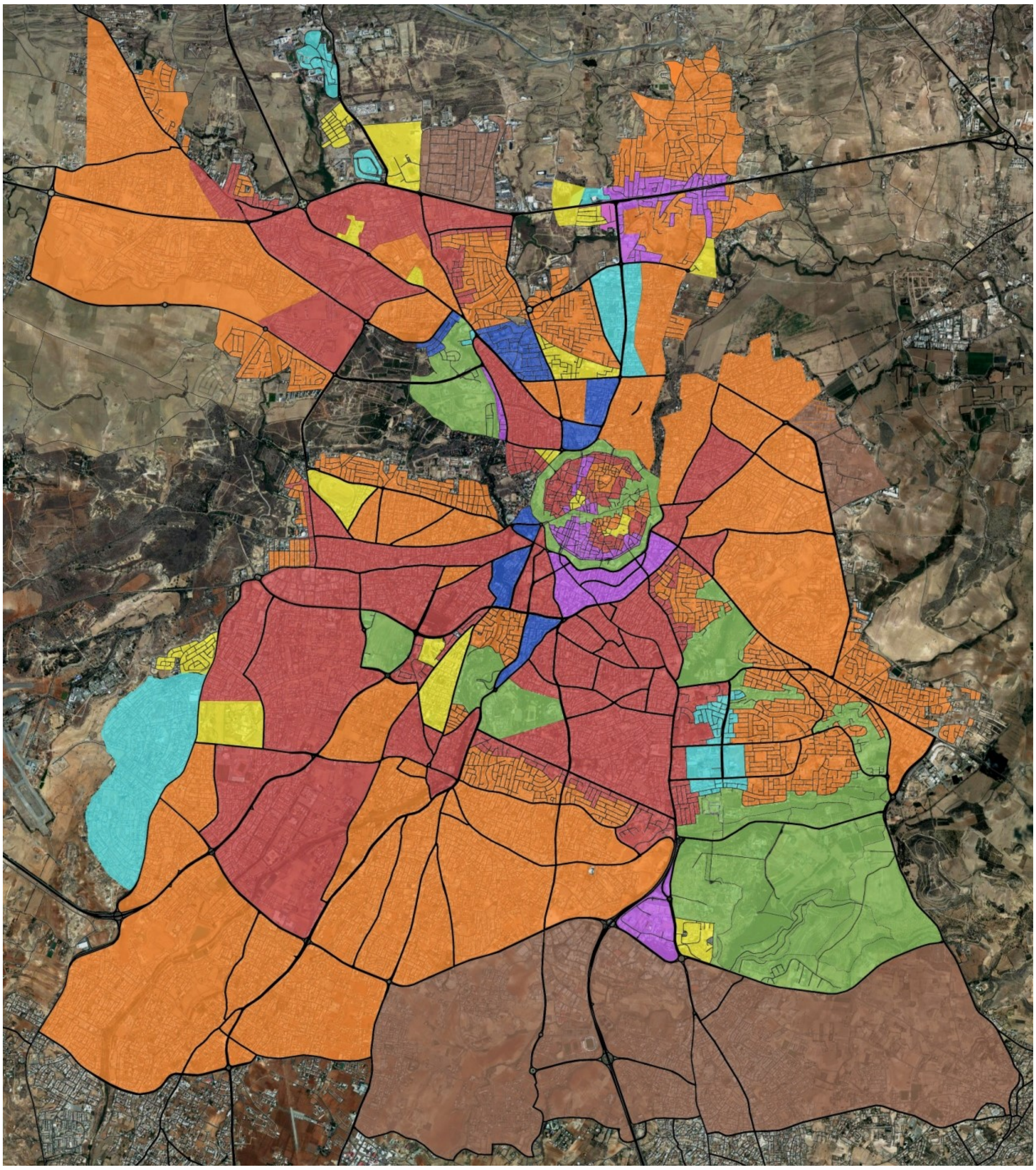
6.3 What Numbers Really Mean?

Space syntax gains a larger role at this point. As the numbers acquired from Fibonacci retracements are purely space syntax values, in detail; they are ideal space syntax integration values of a future state of an urban graph. This means, in future incarnation of the given city, the location(s) with approximate integration numbers would be ideal locations for socio-economic activity. It is important to understand that these numbers are not the 'future' integration numbers, these numbers indicate approximate locations on the existing map, and those locations that match with Fibonacci numbers, those are the ones that are argued for their future state.

6.4 Choosing and Locating the Right Core

Even though all three artificial cores have similar morphological characters, containing same functions, their differing sizes and spatial distribution make one more suitable than the other depending on the city. As the analyses will be conducted using five different maps (North Nicosia, South Nicosia, Unified Nicosia, Famagusta and Famagusta with Maras) each will be considered for core compatibility separately. Looking at the proportion and dimensions of the each map, Core Type C would be best suited to be used on North Nicosia where both Core Type C or Core Type B can be used for South as the grid is considerably larger, all three of them can possibly be used on the Unified Nicosia map as its gigantic size compared to others can accommodate even the largest of the cores; Core Type A. But next to their size, obviously their location is of greater importance.

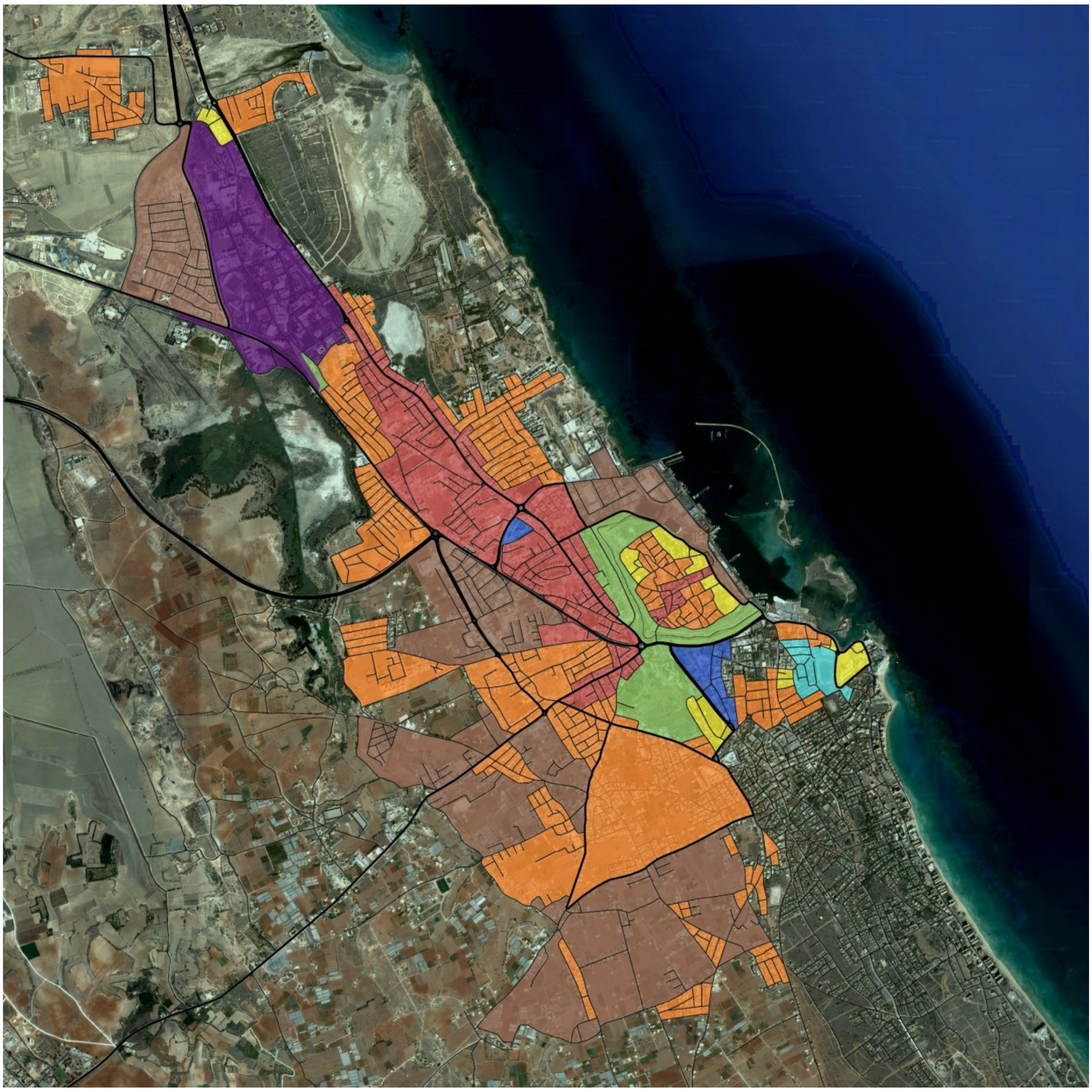
It should be remembered that even though 'Cure Values' we get from Fibonacci retracement point out several locations with the ideal integration numbers for the artificial cores, deciding on the exact location is dependent on local factors like local morphology and functional distribution; for instance, if there are two places with the same cure value where one is located in the middle of the walled city and other the outskirts of town, obvious choice is to place an artificial core at the outskirts and leave walled city's heritage intact. Maps of Nicosia (Figure 59) and Famagusta (Figure 60) showing different zones of land use are employed to make aforementioned functional distinctions within the decision making process for the locations suggested by the cure values. An important parameter is that where certain functional distributions and topographical constraints will be taken into account in suggesting core locations, spatial influences of non-spatial external political factors like military or buffer zones will be ignored, these spaces are also not represented (uncolored) on the land use maps and are regarded same as the empty parts of the urban grid.



Residential-commercial mixed use | Residential | Commercial (retail)

Commercial (service) | Public | Government | Industrial | Green

Figure 59: Map of Nicosia showing different zones of land use



Residential-commercial mixed use | Residential | Commercial (service)

Public | Government | EMU | Industrial | Green

Figure 60: Map of Famagusta showing different zones of land use

6.4.1 Cure Locations

It can be argued that it is already possible to locate and fix the segregated portions of the urban grid with only space syntax analysis, without the complicated task of finding cure values. Effective as they are, space syntax maps cannot perceive cultural importance of specific locations. Cure values suggest several locations, providing us a chance to choose a location that would reduce the severity of the impact the urban grid has to go through.

Looking at the segment angular integration map of North Nicosia integration values may suggest Yenikent region (Figure 61), Walled City itself or the industrial zone for possible core locations due to their segregated nature. All of these regions would be incorrect, as the industrial zone should in fact be segregated due to its functional nature, readjusting Walled City with an artificial core would truly be disrespecting and ignoring historical heritage and as important as it is, locating a core very near the Yenikent region would increase sprawl and take the integration further from the centre of the city.

Of course the mentioned segregation in these areas should also be eliminated but not by directly editing their grid but by supporting it with clear lines to artificial core locations. Figure 62 shows the cure value suggestions for the placement of artificial cores, these locations are military controlled, empty spaces. Suggestion 1 would work in uniting disparate and broken off functional distribution along the city and help with the core integration by bringing connectivity within the central region of the map. Suggestion 2 would unite both the main shopping street -Dereboyu- and the Walled City with the Yenikent region which currently is in the stage of evolution into another city due to its weak links with the rest of the grid.

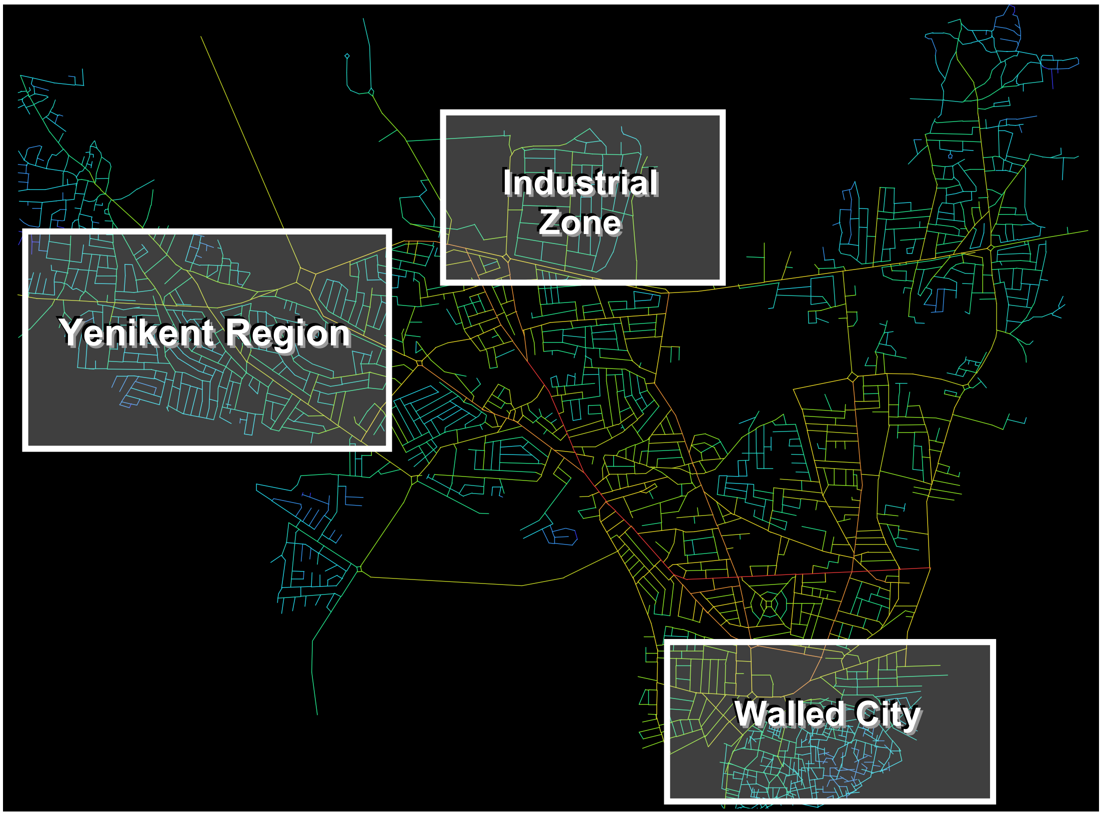


Figure 61: North Nicosia segregated parts

Figure 62: North Nicosia artificial core location suggestions by cure values

Map of South Nicosia shows an overall segregation in the city apart from the central region and circulation axis around the city. The segregation towards the further south is expected due to its industrial and suburbia nature and even the outermost axis that defines city limits is not segregated. What could be improved is the mid sections of the grid (marked on Figure 63) because where the segregation is controlled and contained towards the south end of the city, there are no defining axes that helps west and east ends, connecting both ends would help the integration align with the centre and possibly eliminate the segregation that can be observed in the mid section, this is considered in choosing between several locations with cure values (Figure 64).

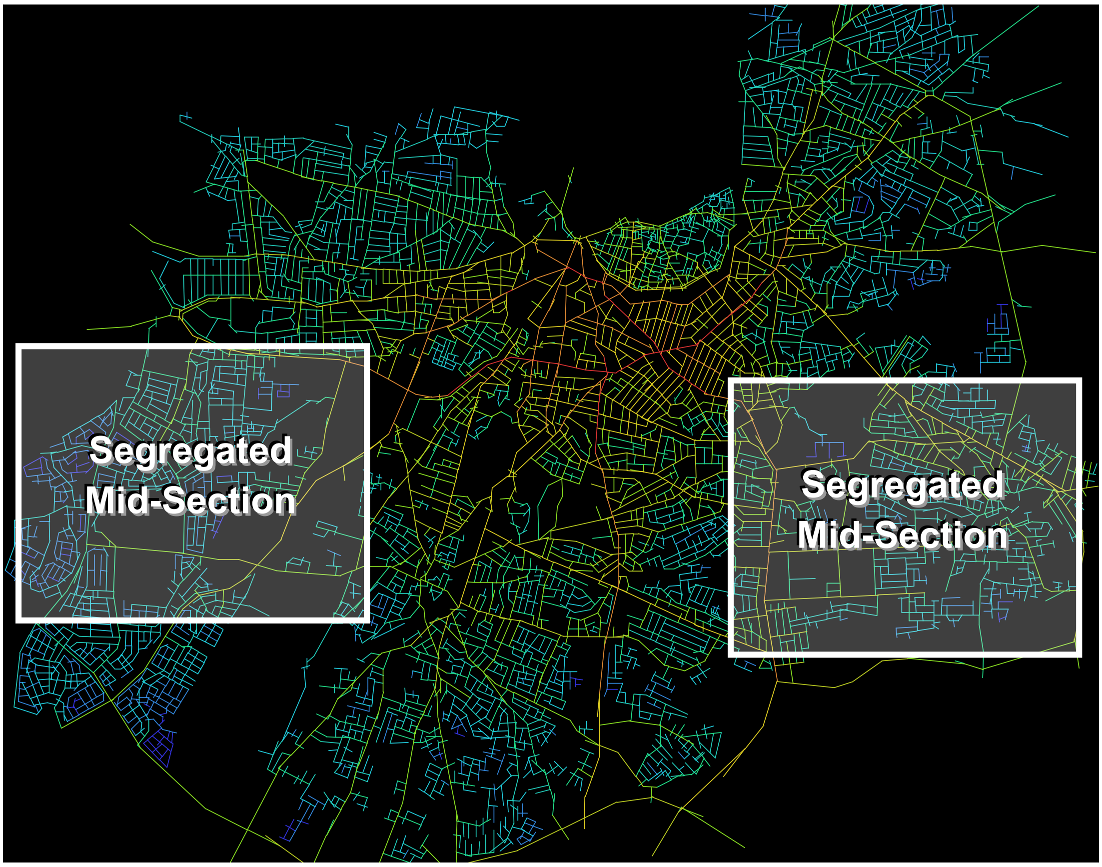


Figure 63: South Nicosia segregated parts

Figure 64: South Nicosia artificial core location suggestions

Looking at the most important map, the Unified Nicosia paints a different picture. (It should be noted that the 5 km radius map is used in this case to suggest a more accurate comparison with the rest of the maps.) Where the union of core, Walled City, brings much higher levels of integration at the city centre the segregation also increases along the edges. The suggestion sites would be bookending the city, similar to the South Nicosia map but at different places; Core Type A could be placed at the same suggestion site from North Nicosia map, where Core Type C could be placed at the same suggestion site from South Nicosia map. Placing the larger core where the grid is smaller (North) and the smaller core where the grid is denser (South) would help fix the proportion problems between the two sides and the locations would create an axis that aligns all three cores (natural core Walled City being the third one in the middle) on the same axis that spans from north to south;

leaving no chance of perceiving two different halves on the city again. Figure 65 shows the locations suggested by cure values and decided with aforementioned spatial considerations.

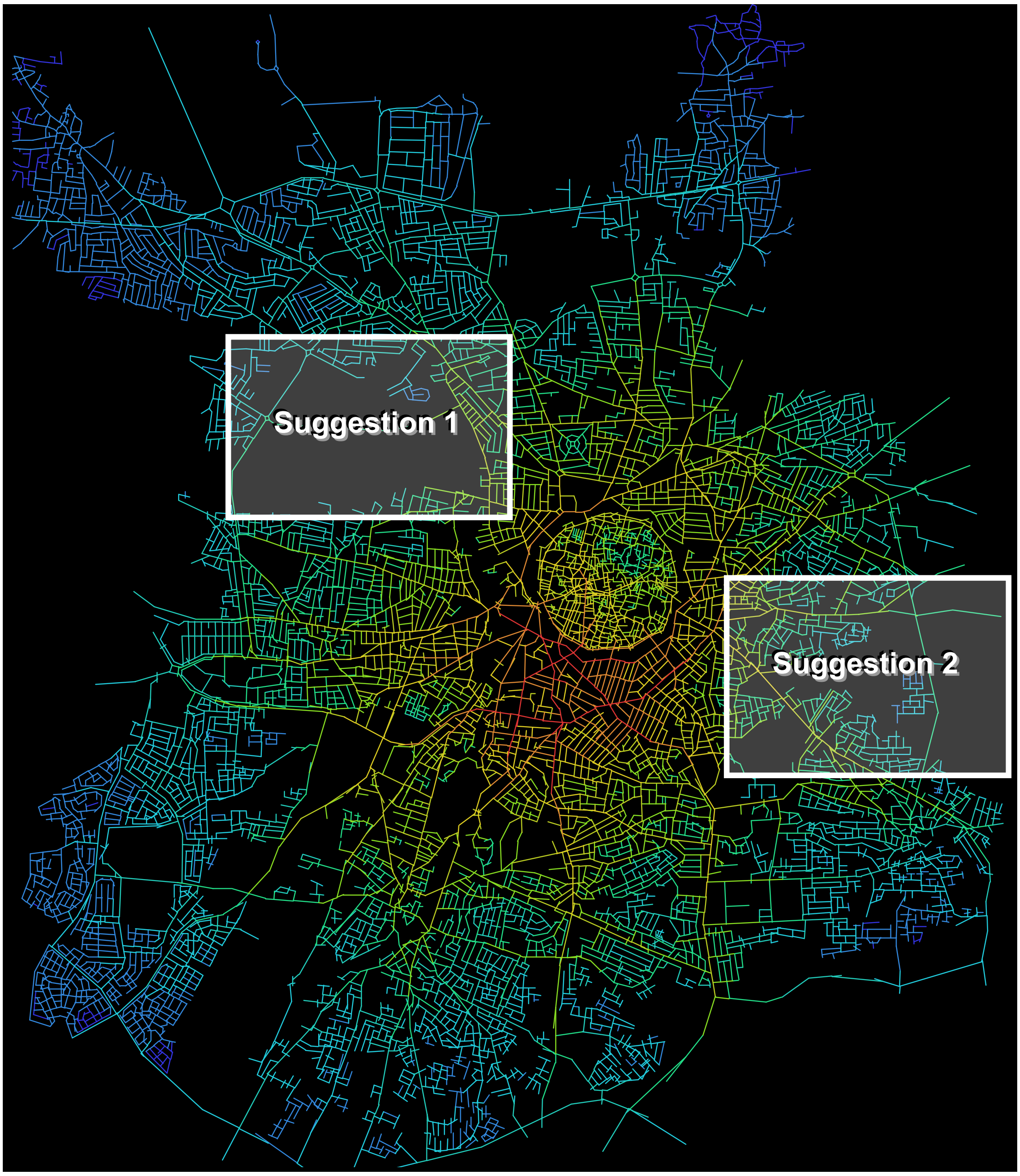


Figure 65: Unified Nicosia artificial core location suggestions

Even though these suggestions appear to be regional and non-specific, they are not. Locations are decided upon by singling out the axis with the desired cure value and the regions marked on the maps all have the said axis in the centre.

The effectiveness of the cure can be better understood by looking at the angular maps of Famagusta, there are no specific locations with accumulated segregation centers which one may argue for intervention locations. Apart from a few integrated axis, the whole grid is full of segregated areas therefore making specific suggestions based on plain logic would just mean choosing random location among segregated axes; this is by no means underestimating the effectiveness of correlating local data such as functional land use, movement patterns etc. with space syntax data and making an informed decision, to the contrary, cure values would increase the effectiveness of such choices by providing scientific, quantitative data.

Locations that correlate Cure values are marked on the integration map of Famagusta (Figure 66). Suggestion 1 area is located right next to the university at the other side of the road, it is an empty -military controlled- area stretching as far as the sea. Suggestion 2 is in the middle of the government controlled free trading port. Suggestion 3 is located at the edge of the city in the lower Maras region. As Famagusta is a city with a very small urban grid, even the placement of two artificial cores would be too much but given the amount of segregation observed on the map, it is suggested here that suggestion site 1 and suggestion site 3 would benefit the insertion of artificial cores. Suggestion site 2 is discarded due to its spatial proximity with suggestion site 1 and also because it already contains a function where site 1 is empty.

It should be noted that neither space syntax software nor cure methodology has any parameters that suggest the existence of the sea boundary next to the urban grid and their lack of relationship, the fact that suggestion site locations coincide with seashore is another indicator of cure capabilities which real life land use verifies.

Figure 66: Integration map of Famagusta with artificial core suggestions

Cure values indicate different suggestion site locations for the integration map of Famagusta with Maras (Figure 67). Where one of the suggestion sites from the previous map -trading port- is present again (suggestion site 1 here) suggestion site 2 resides at the industrial zone right next to the entry point of the city. Suggestion site 3 is located at the far south edge of the Maras region which is among the most segregated locations of the whole grid. Once again, considering the size of the urban grid, only two artificial cores will be used. Suggestion sites 1 and 2 are spatially proximate, the discarded one will be site 2 as placing an artificial core to the opposing part of the city with the sea would further sever the relationship of the grid with its coastline.

Figure 67: Integration map of Famagusta with Maras with artificial core suggestions

6.5 Applying the Cores and Integration Analysis

In this step, the artificial cores are finally placed on the maps. The following figures show the results of the Cure. Compared to their previous states, the change in integration is visible throughout all maps.

6.5.1 The Cure of North Nicosia

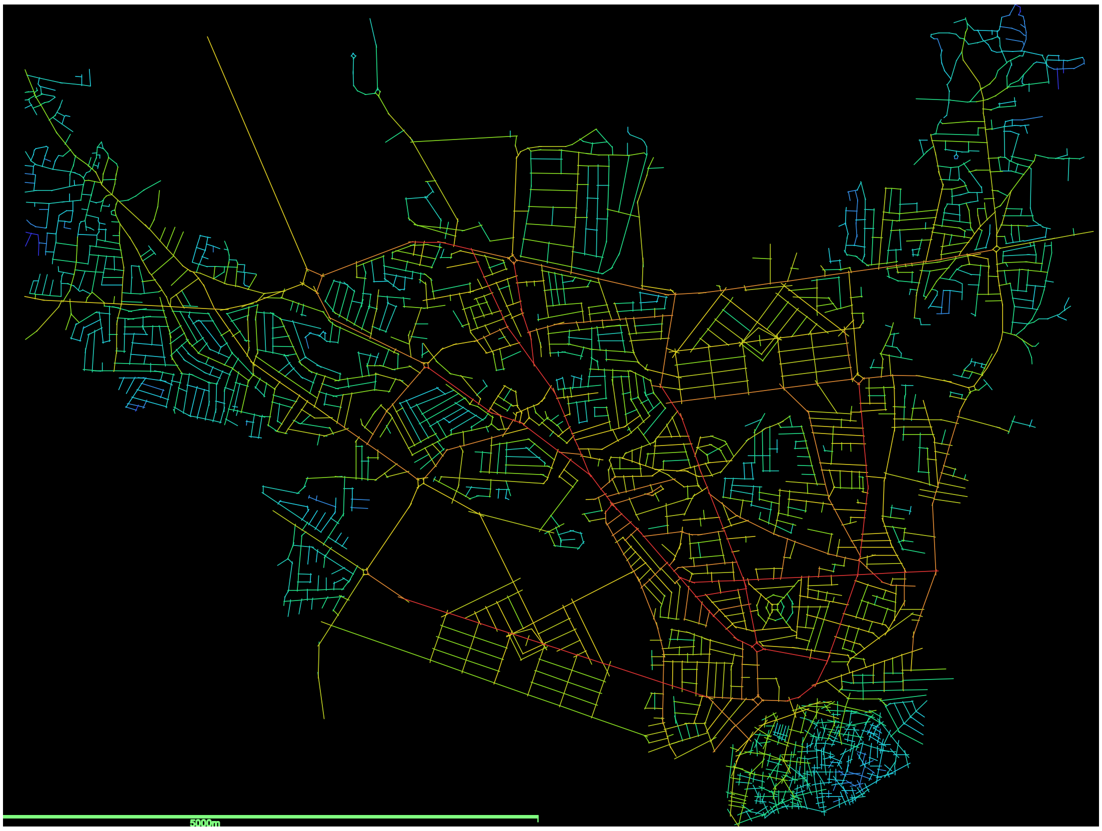


Figure 68: North Nicosia, the Cure applied

Angular integration analysis of the North Nicosia with the Cure applied shows an overall increase in integration throughout the city, albeit still having segregated portions, the left part of the walled city is much more integrated than its previous state. Two of the same smallest scale artificial cores are used in this map; the Core Type C. One of them acts as a connecting core; it unites the rest of Nicosia with the newly developed Yenikent area of the city. One being the central, 6 arteries in total are branched out from the core that attaches it to the urban grid. The central axis that cuts through the centre of the core is also the most integrated axis and it is the main one that connects with the other 'naturally' integrated axis of the urban grid. The second artificial core is placed at a more compact and central location in the city. Accessible from the main highway that leads outside the city, the second core is placed at Kucuk Kaymakli region which space syntax analysis suggest it to be integrated yet real life use is hindered by the lack of a central core that can define the region. Transforming to be a part of an existing grid, this core uses 10 arteries in total to connect itself with the grid. Even though the value of integration is different from the first core, the centre of this core too is well integrated.

6.5.2 The Cure of South Nicosia

Angular integration analysis of the South Nicosia with the Cure applied too shows an overall increase in integration throughout the city. The already well integrated central region in and around the walled city has more integration even in the side streets of that part of the grid. The main integration increase however stretches horizontally from the west to the east of the city. One mid-sized and one small artificial core are used on both ends of the city; Core Type B and Core Type C respectively. They bookend and define two ends of the grid and act in containing the integration at the central area, thus eliminating the segregated clusters that can be seen on the previous map of the urban grid. Being used as boundary defining integrator cores, the values of integration are lower, nonetheless they are still high considering they are located at the edges of the city where seeing integration levels represented by any other color than blue is very rare. Core Type B at the west end of the city branches out 9 axes from its grid to connect to the natural urban grid where the Core Type C at the east end branches out with 8 axes.

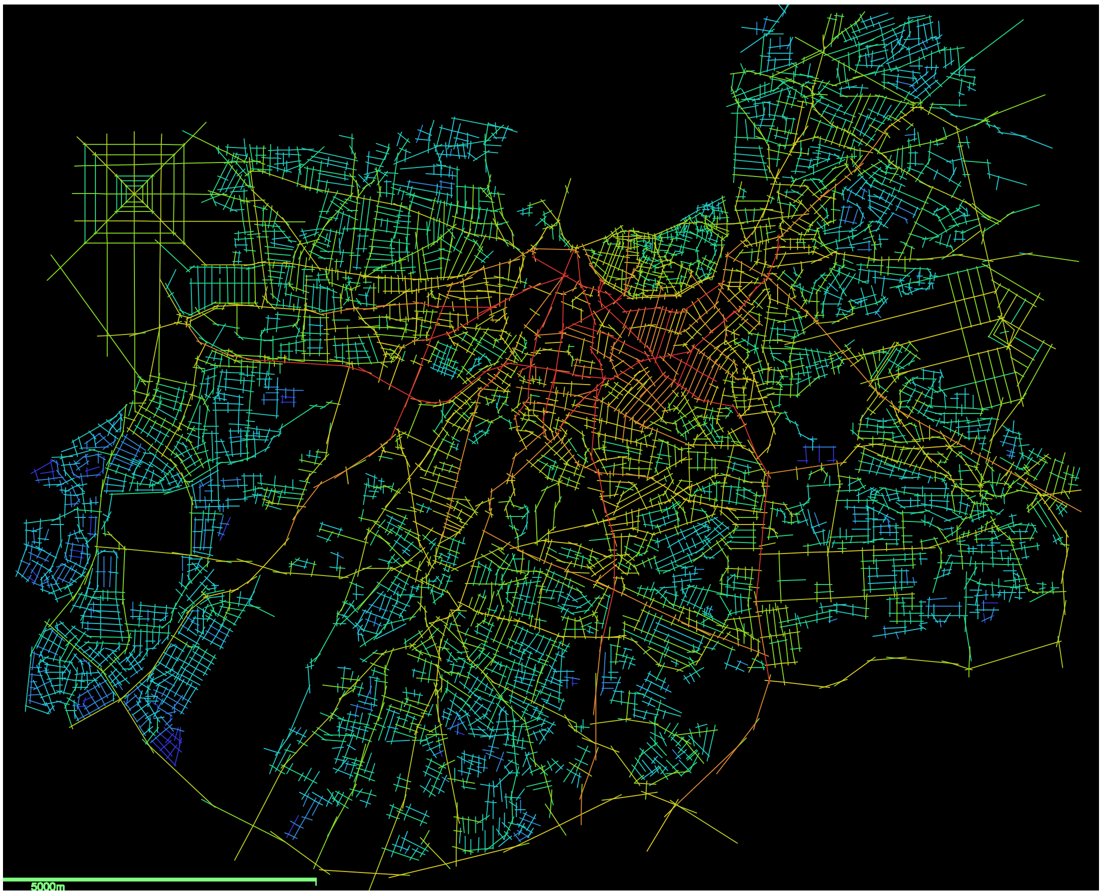


Figure 69: South Nicosia, the Cure applied

6.5.3 The Cure of Unified Nicosia

Angular integration analysis of the Unified Nicosia with the Cure applied shows highly improved results compared with any other previous analysis of the unified state of the city and even compared with any other previous analysis of any city; the outcoming integration results of the map are very high; there is no visible segregation, at any point throughout the city. Granted, the unified state of the city without the cure applied also had very little segregation but in this map, there is -with all certainty- none. No segregation.

Using the artificial core sites from both North and South's cure maps, two cores are used in curing Nicosia; the largest artificial core, Core Type A at the west and the smallest, Core Type C, at the east end of the city. With the walled city reclaiming its central core stature with the union of the city, there are three cores in total, including the artificial ones. All three of them align perfectly on a single axis that goes from one to another, holding the city together. Core Type A uses 12 axes that branch throughout the city where Core Type C uses the same 8 axes from the South Nicosia cure.

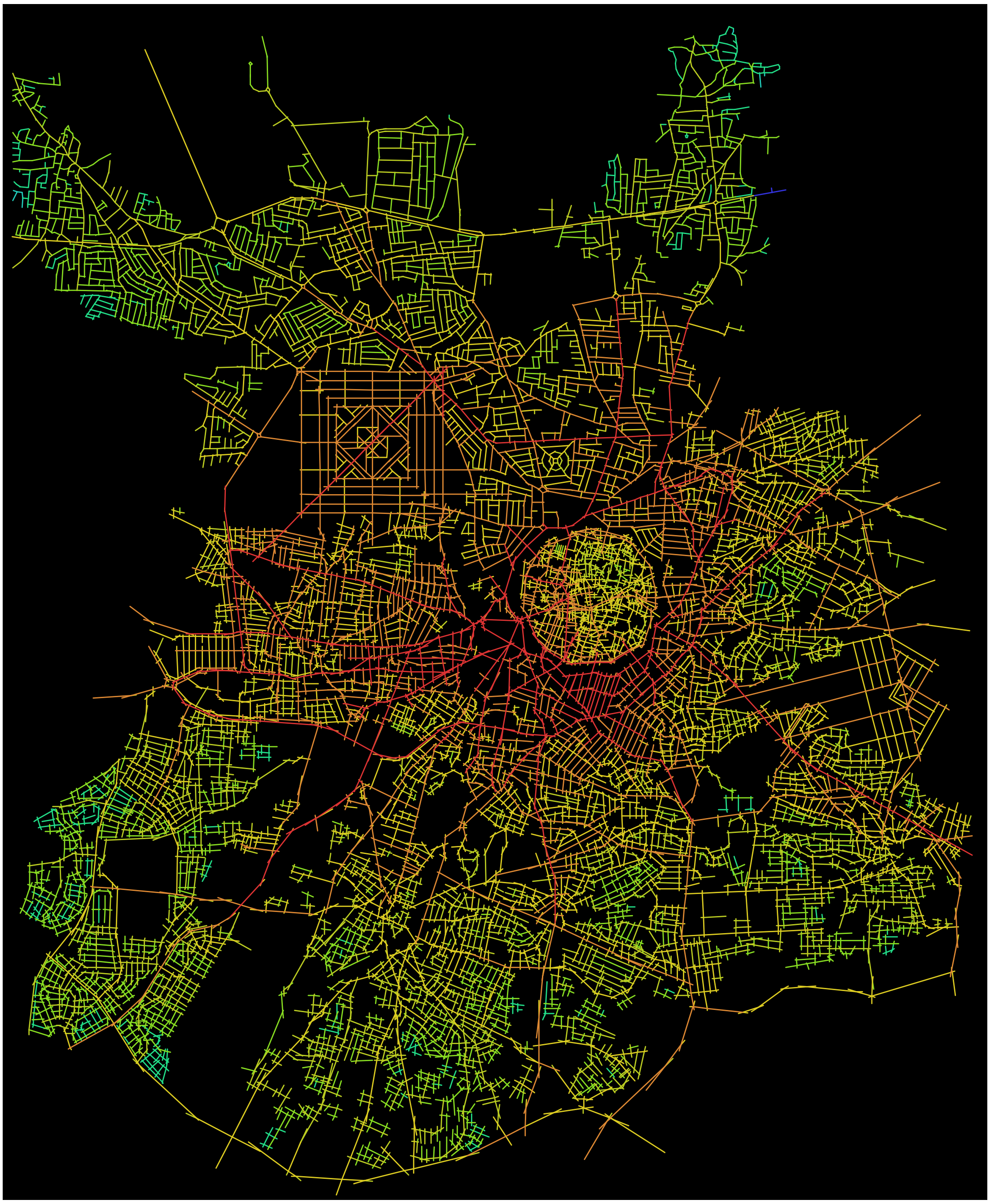


Figure 70: Unified Nicosia, the Cure applied

6.5.4 The Cure of Famagusta

Figure 71: Famagusta, the Cure applied

Due to the smaller size of Famagusta, the smallest of the artificial cores are used on the suggestion sites. Overall integration of the city with the cure applied is significantly increased, where the core located at the south is integrated itself too. Where there are still patchy areas of segregation around the city, the integration has a central core this time, number of integrator axes increased from 3 to 5 of which one of them directly connects with the artificial core at the south of the city.

6.5.5 The Cure of Famagusta with Maras

Figure 72: Famagusta with Maras, the Cure Applied

Integration map of Famagusta with Maras with the cure applied shows even more improvement than the previous map and much more than the original map. Integration core is moved slightly towards the sea, there are 7 main integrator axes instead of 3 in the original. Most important change is; where Maras was the most segregated portion that lowered the overall integration of the grid, here it serves as an integration centre located just adjacent to central core with 2 of the 7 main integrator lines passing through it.

6.6 Cure Results

As the Cure itself is a theoretical entity for now, drawing conclusions following the analyses and saying it works would be a hasty judgment but it is possible to say it works 'on paper'; space syntax data does show significant integration increase following Cure application, where it is possible to argue any development plan could increase integration, the question is if they could increase it this much and that is exactly why the Cure exists; to choose the best scenario, either by implementing the suggested artificial cores or any other development plan which conforms to the requirements suggested by the cores but invariably, applying them on the Cure locations suggested by Fibonacci calculations.

Surely, Cure works differently on some maps than other but the results did prove the outcome is an improved grid compared to the previous state of it in every scenario. The situations it worked most effectively is in the case of a union of a divided parts of cities, which is the highest form of segregation -physical- and that was the main aim; to Cure urban rupture. Looking at the cases particularly, in the Cure of Unified Nicosia, the segregation is almost totally eliminated, at least spatially. Cure of Famagusta with Maras transformed the previously segregated city with one with an integration core with well integrated areas connected to that core. Of course it is clear that the Cure did not work as definitively here as Unified Nicosia Cure, but it should not have been expected to do so in any case. It is important to clarify what Cure does here; it is not Cure's objective to fix urban planning mistakes, or any other flaws observed on the urban grid. Cure's aim is to produce accurate predictions on the urban grid as it is, and making interventions -with artificial core suggestions- on these locations with 'future integration potential' to overcome segregation and in a sense future-proof the urban grid. Therefore, no, the Cure does not fix urban flaws of Famagusta but even with its numerous flaws, it can help it reach its maximum integration potential, even if doesn't, space syntax data proved that -theoretically- the city would be better off with Cure than without. So it is possible to say that even within a city with a flawed urban grid, Cure works, not as well as in cities with more consistent urban grids, but it does and increase integration at the expense of segregation. What this means is the urban space becomes as enabling as it can be in providing sociable space for the society and encourages a more social, more successful community and way of life.

Chapter 7

REAL LIFE IMPLEMENTATION

This chapter of the thesis addresses the real life conditions and possible socio-spatial arguments to ensure a harmonious process in a possible concrete implementation of the Cure.

7.1 Post Cure Interface: Physical Suggestions of Application

The cure is designed to develop a generalized solution to urban segregation, its components like artificial cores aim to fix urban rupture in the urban grid they are placed in, this is obviously achieved by directly interfering with the urban grids of cities; encouraging urban evolution by unnatural means, thus, it does not deal with the aesthetical continuity of the urban fabric if they are employed the way they are originally designed.

In no way this means they can cause further segregation by introducing a grid structure different than the original grids own, space syntax analysis results show the case is quite the opposite. Nonetheless, image of the axial structure; the structural shift in urban grid continuity might leave something to be desired. Even though the Cure works -theoretically- on every level it was designed to work, preservation of visual continuity of the urban texture is obviously lacking.

Axial interface maps are prepared for all the cases the Cure methodology is applied on, showing possible adaptation of the axial structure of the artificial cores to accommodate a possible scenario where a decision can be made to construct the cores in real life with their current forms. All the suggestions below are prepared abiding to the essential guidelines of the Cure methodology introduced in Chapter 5.

It should be noted that this section of the study is not a part of the Cure, it explores what can be done after the Cure in case of mismatched visual urban continuity. As guidelines already ensure the space syntax analysis would not give any different results with limitations, following suggestions are axial maps only to demonstrate the difference 'interfacing' brings without the distraction of analytical color grading. It should be noted that, where increasing number of connections cannot lower the degree of core integration, the more they are implemented means the more destruction brought upon the existing grid. Caution must be taken to not disrupt the urban environment too much in attempts to make artificial cores fit in more naturally. Three images are used on the figures showing interface maps, emphasizing their differences compared to the original cure maps; first image on the left shows untouched, original cure map of the case city, next image on the right highlights the artificial cores and the edited axes throughout the urban grid during the interfacing process, larger map below the first two images show the resulting 'Cure Interface' map without any distracting colorization on the axial structure.

Looking at the axial map of North Nicosia (Figure 73), the urban grid already has disjointed visual continuity and the addition of the artificial cores does little to change that. Interfacing process here is employed by increasing axial density around the areas the artificial cores are placed in, this not only brings a more comprehensive and aesthetically pleasing visual bonding of artificial cores with the rest of the city but also gives the grid a more continuous urban network by completing the urban voids located on those areas.


Figure 73: North Nicosia, Cure Interface

Interfacing works well on the South Nicosia axial map of Nicosia (Figure 74). Where it is easy to spot artificial cores at the first map, looking at the interface map only, there are very little signs of unnatural grid alteration. This is due to the more integrated structure of the urban grid; higher the integration, higher the grid intensity is, therefore the grid structure of the artificial cores sits in better than a looser urban grid like North Nicosia requiring a lesser amount of additional axes during the interfacing process. It is still possible to pick out a few axes of the artificial cores as they are located at the very edges of the city but otherwise the interface map displays an urban grid without external interference.

Figure 74: South Nicosia, Cure Interface

The axial map of Unified Nicosia was already the most visually complete urban grid among other cure maps and also the most accommodating one in terms of artificial cores. Similar to the maps of North and South Nicosia, additional axes are inserted onto the areas around the artificial cores for seamless urban continuity. Looking at the resulting interface map (Figure 75) it is nearly impossible to tell where the artificial cores were added, a first time onlooker would definitely not locate them; the most stand-out part is clearly the walled city.

It should also be noted that the artificial cores and existing core -the walled city- are all aligned on a straight line with clear axial connectivity, supportive of each other. With the interfacing process, the link between the two artificial cores were also supported with the extension of north-east axis (visible on the highlighted part of Figure 75) which is essentially a direct artery leading from the larger artificial core on the west to the smaller one on the east of the city, inclusion of this axis was impossible on the previous maps as they represented separate versions of the urban grid, leaving the axis location outside the boundaries.

Figure 75: Unified Nicosia, Cure Interface

Unfortunately, there is no amount of axial additions that can improve the continuity of the urban texture of Famagusta; where the densifications of axial networks around the artificial cores are successful in blending them on the existing urban continuity, the patchwork grid structure of the overall urban network prevents the interface map from displaying a collective integrity (Figure 76).

This situation is somewhat improved in the interface map of Famagusta with Maras (Figure 77); while blending in the artificial cores themselves, the densification of surrounding areas helped the overall grid density and gave the urban grid a more continuous structure mainly on its east part which forms the coastline. Where the rest of the city is still disjointed, the three main parts that actually define the city -Eastern Mediterranean University area, the Walled City and Maras- have improved axial structure, supporting better integration and they also have preexisting direct physical connectivity as a result of them being aligned next each other, forming the coastline.

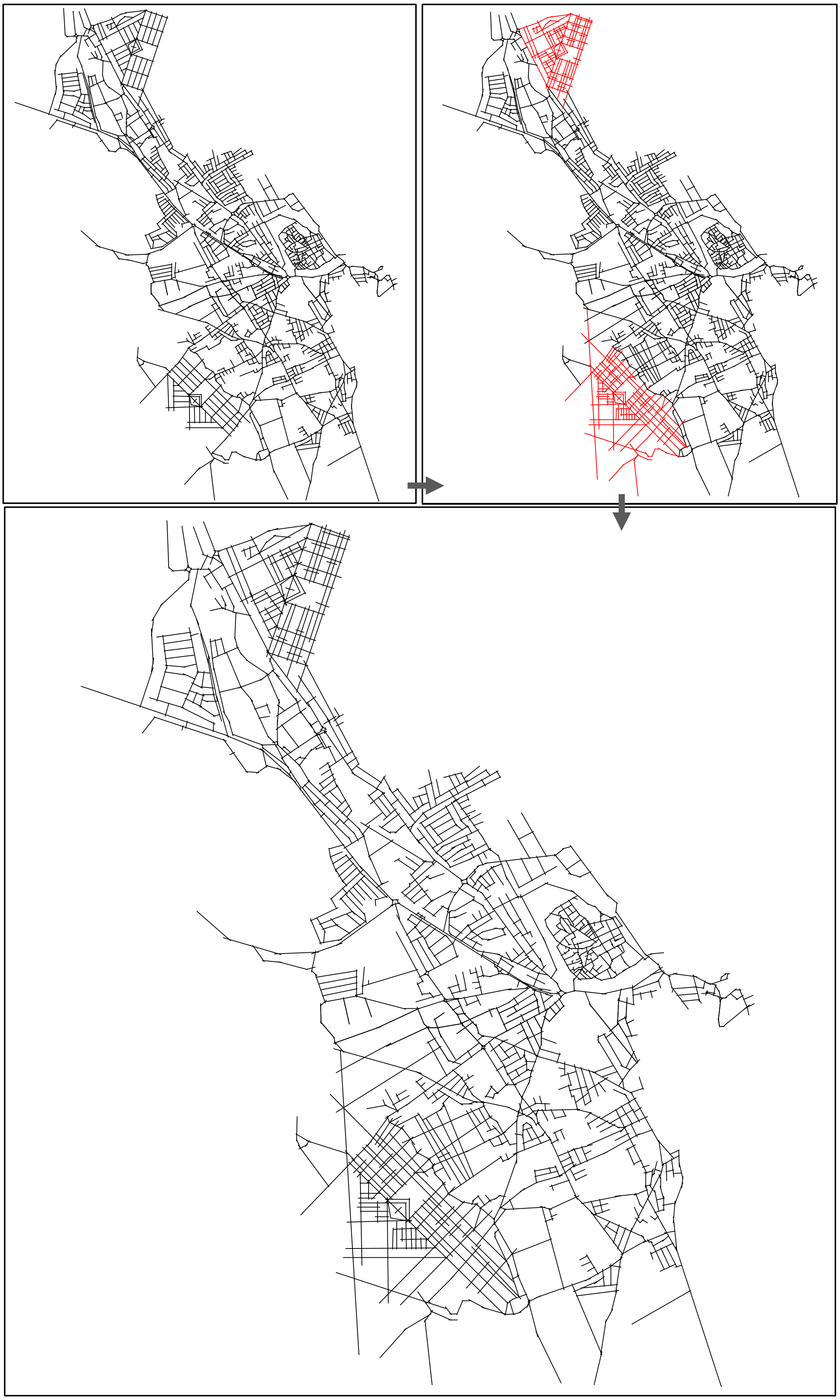


Figure 76: Famagusta, Cure Interface

Figure 77: Famagusta with Maras, Cure Interface

7.2 Socio-cultural Implementation

Like Doxiadis (1968) many architects and urban planners believe cities are naturally evolving organic structures and the changes that occur upon them are just a part of their natural evolution. Implementation of the artificial cores and 'the Cure' has very little to do with natural evolution though; it is possible to argue the Cure is a consequence of spatial malaise and it is in fact a part of the evolution but from a spatial standpoint, it still is bringing major changes to urban grid that took centuries even millennia to evolve and mature.

Younger cities with formal and regular urban grids can accommodate the cure implementations more easily than cities with historic roots; doing alterations in newly urban grids may matter little as they are still in the preliminary stages of their evolution, yet apart from a number of US cities most of the cities are already matured with historic roots. This then turns into more of a cultural discussion, should we be allowed to do such drastic changes to our cities all at once? How will that affect the character of the city and the way of life? Many scientists today argue that the global warming and resource shortage our planet is predicted to endure is a result of our evolving too fast as a species; our speed in technological evolution hindered our ability to consider our planet before our advancements and as a result we consumed so much fossil fuel, damaged the ozone etc. Is it possible then, to apply this analogy to the application of the Cure? Is 'the Cure' taking things too far? What if the collective mind (social consciousness of the people) and the character (spatial configuration) of the city reject the artificial cores, even though every precaution is taken to adapt them successfully?

From an ethical standpoint, the construction of artificial cores is no different than building a shopping mall. They are both entities of newly emerging needs, where shopping mall is primarily a result of consumerism, the artificial core is a result of socio-spatial rupture within our cities. Possible issues that can arise as a result of adaptation to a new situation are clearly addressed by Space syntax where it is explained why the spatial features like integration do correlate and encourage social behavior, and as the whole spatial proposal is built upon space syntax principles, the possibility of social rejection is miniscule at best.

Another important matter of adaptation is the historical aspect. Cure is an urban scale process; the micro scale architectural design of the buildings that can possibly be introduced within artificial cores would obviously have to consider the architectural texture of the built environment that they would co-exist with. Urban scale historical circumstances can only relate if external agents of past segregation like political conflicts still has physical bearing on the current grid, as it is in the case cities of Nicosia and Famagusta. If the Cure is to be realized in those cities, the most ideal spatial state for the implementation would be when the two halves of the urban grids are reunited. Where it was demonstrated the Cure also works in their divided state, the results for united grids had much higher values than any other instance. The socio-cultural aspect of Cure implementation in reunited Cyprus would be much more practical as well; the Cure applications would be integrated within the inevitable physical reunion process which both communities already expect and are prepared for.

While it is argued within the context of the Cure that a social and well integrated urban system would solve the alienation problems between co-habiting communities through the social encouragement the new urban configuration would bring, admittedly it has no application on political influences international diplomacy may force on people. But it was also never claimed of the Cure to have such an application, it is designed to fix urban segregation in cities; to fix spatial problems that urban grid has and also help fix the social problems that spatial problems may cause but obviously it cannot control or enforce the will of international politics on urban space.

7.3 Local Scale Implementation

If the real-life application of the proposed method materializes at some point in the future and its validity is proven not only theoretically but tangibly. It is possible to adapt this analytical framework of integration-Fibonacci analysis to different scale spatial arrangements such as architectural plans, as space syntax' measure of integration is universal among analyses of different scale; the produced numbers are acquired using the same formula. Architectural scale analytical tool that calculates integration is VGA (visibility graph analysis) can be used to extract the necessary values to input on Fibonacci calculator and -much like axial maps- then it can be used to locate the spaces which are pointed out by the resulting numbers. Of course, it would not be foreseeable for this method to be used on custom-designed spaces where functions are strictly allocated into specific spaces such as residential designs; it would have no point as the method proposes to detect increase in social activity among seemingly mediocre spaces. This limits the use of the methodology to mainly public buildings where social activity has the primary importance like exhibition spaces, shops, restaurants etc.

Figure 78 shows the VGA integration analysis performed on the architectural plan of a restaurant located in Nicosia, circled spaces show the 'Cure' locations we get when we input the integration numbers acquired from VGA analysis on Fibonacci calculator. The spaces are located on seemingly segregated locations yet a quick interview with the maitre'd who provided the plan for analysis explains at least three of the four indicated spaces housed preferred tables. Of course further user interviews, economic data and more cases are needed to test the applicability of the Cure methodology on building scale spatial formations, yet the indication is positive for this particular example.

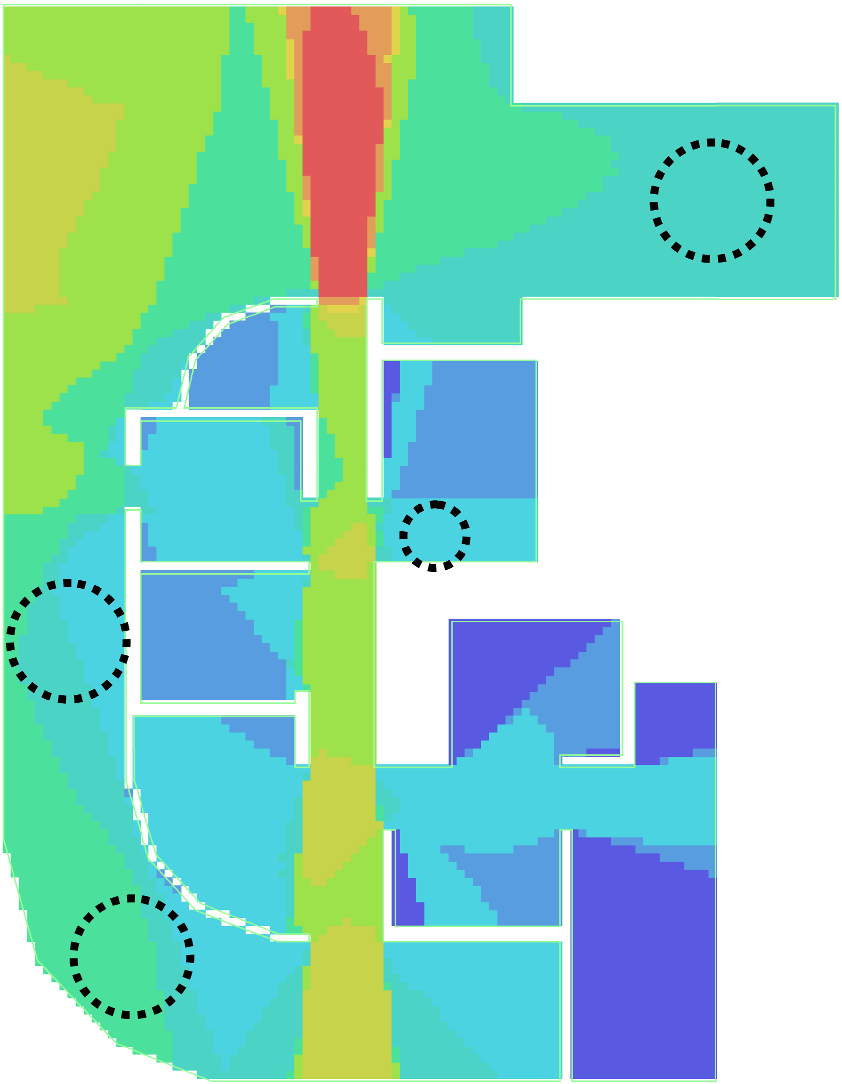


Figure 78: VGA plan showing the possible sub-integration locations

Chapter 8

CONCLUSION

This PhD thesis intended to introduce a new method, a new approach to urban segregation problem. It is argued that even though every city and urban network is different, it is still possible to bring about a generalized model to be applied when dealing with cases of spatial segregation as it manifests on the structure of the urban grids.

In looking for common segregation behavior among different examples, issues of urban segregation on several cities around the world were observed, focusing on the historical formation process of urban segregation and its consequent socio-spatial effects on the urban morphology of the cities. Analytical methodologies used in identifying segregation problems were extensively reviewed to construct an analytical framework for the proposed -new- approach. Space Syntax Theory was chosen above others for its documented analytical accuracy in informing on socio-spatial processes of urban grids.

As the parent theory of the proposed methodology, Space Syntax' theoretical background was adopted in forming the approach to evaluate segregation in urban grids, in particular, the analytical tools; axial and angular integration analyses were used in analyzing the grid structure of the case cities of choice to be employed in development of proposed method; the Cure. The Cure is formed of several synergetic elements. It was argued, using the numerical values acquired through space syntax integration analyses along with a number prediction tool could possibly inform on locations regarding sustainability of the urban texture.

Space syntax' integration values inform on socio-spatial viability of every axis of the urban grid, it is proposed that a particular method of mathematical prediction, Fibonacci analysis, can be applied on integration values and the resulting values can be used to pinpoint 'key' locations on space syntax integration maps. Where space syntax maps by themselves are also extensively used for detecting locations that are potentially problematic as informed by segregation measure, they lack a temporal aspect that can elaborate on specific areas on the analyzed urban grid and make predictive assumptions on their potential future transformations. Fibonacci analysis tool employed for the process of detecting key locations uses the golden ratio of 1.618 in calculating the equations because among other ratios, the golden ratio is the only documented tool having actual proof of succeeding in predicting highly complex number systems (Lakshminarayanan, 2005) rivaling space syntax maps' numerical value systems in complexity.

It was argued; the specific 'key' locations -provided by the process of matching the set of numbers produced with Fibonacci analysis on space syntax integration map - would point out parts of the urban system that would have the highest potential to have increased socio-spatial and economic activity in the future. These spaces were named 'Cure locations'. It was then suggested to insert specifically designed 'artificial cores' on the Cure locations to increase socio-spatial activity along the whole grid, to act as secondary -or tertiary- city centers with clear connections within the system and also to have all the spatial requirements of a self contained area that could function as an integration attractor.

Two existing urban grids with different degrees of segregation were used for application of developed methodology; the cities of Nicosia and Famagusta in Cyprus. As the aim of the research was to help overcome segregation as informed by space syntax maps and measures, the case cities were consequently chosen for their segregated nature but also for their specific differences when it comes to the manifestation of segregation. The city of Nicosia was chosen for its severe form of segregation; actual physical division of urban space and its unavoidable effects like socio-cultural separation of the communities inhabiting the city. Spatial analysis indicated the segregation levels of the city would dramatically improve if the two halves of the urban grid are reunited, though that alone would not resolve segregation problems of the city.

The secondary case for the application of proposed Cure, the city of Famagusta was chosen for its significantly different form of segregation to better demonstrate the range of use of the Cure. A portion of this city too is physically divided but the divided part is located at the edge of the city. Famagusta formed five distinct self contained areas during its development; it is argued that all the districts developed their own separate urban identity, this was also indicated by syntactic analysis with the visible patchwork distribution of segregated areas throughout the urban grid, signifying introverted, local urban characteristics for those areas at the expense of their relationship with the rest of the larger urban grid (Hillier et al. 2010).

Several different axial maps were employed representing different scenarios for the urban grids of the cities; as both cities have divided portions of their urban grid, their partial and unified states were handled separately.

Following the analytical process, the Cure methodology was applied; Fibonacci analysis was performed using the numerical data acquired from space syntax maps in order to identify the key 'Cure locations' on the axial maps of Nicosia and Famagusta and the artificial cores were inserted on the urban grids of both cities on selected locations. The maps of both cities with the Cure applied were analyzed once again using space syntax tools. Resulting space syntax maps showed major increases in the levels of integration and even total elimination of drastically segregated areas on some cases.

Although successful in theory, the practical realization of the Cure would require a process of adaptation which would involve both the existing urban grids by themselves and the specific axial arrangements of the artificial cores' insertion points. To accommodate for this possibility of real life implementation of the Cure, interface axial maps were prepared for every case which the Cure was applied; axial additions were made which provided continuity on the maps where the artificial cores were involved. The produced results demonstrated successful physical integration of the artificial cores on the existing urban grids; the cores did not look artificial any longer but were blended into the existing natural urban texture of the cities.

In terms of real life usage, the process of the Cure itself can also be adapted and reconfigured into a software which would accommodate its three main components -

Fibonacci retracement, space syntax analysis and artificial cores- all at once for a more practical and user friendly application. Also, it could potentially be introduced on the newer versions of the existing space syntax software, contributing a new parameter among other analytical measures.

Regardless of how the methodology is eventually translated into real world usage, conclusive evidence this research provided showed it is in fact possible to form a new approach on how to handle cases of spatial division and segregation in cities or other types of urban grids of a certain size. That it is, in fact, possible to cure urban rupture.

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