From compact colonial villages to sparse metropolis:
Investigating grid integration, compactness and form of the integration core in Brazilian cities

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Abstract

This paper explores three variables – grid integration, compactness, and form of the integration core – to investigate the spatial configuration of Natal, Brazil, focusing on its old town centre. Results are compared to the data resulting from the analysis of Brazilian urban settlements by the DIMPU/UnB and the MUsA/UFRN research teams. Syntactic modelling and GIS techniques are used to investigate the urban expansion of Natal, and new procedures are proposed for calculating integration cores and compactness values. It was found that the city's integration core "shifted" southwards, away from its original settlement, "stabilised" around the 70's, and expanded from then on, re-incorporating the old centre in its periphery and contributing to the maintenance there of a robust commercial "sub centre". The diachronic analysis of compactness values suggests a pattern of cyclic growth in which expansion waves leave intermediary patches of low density that are, eventually occupied. It also demonstrates that the "modern" city is a great deal sparser than the "traditional" old centre thus confirming findings from the study of other Brazilian towns. It has been seen that the highest compactness is to be found in colonial settlements, and old city centres. On the opposite end of the scale, less compact, sparser grids occur in those designed under modernist guidelines and in metropolitan neighbourhoods scattered amidst unoccupied urban land. The study thus confirms hypotheses often presented in the literature but seldom demonstrated empirically, such as that of a positive correlation between measurements of "topologic" and "geometric" nature, and contributes to clarify nuances associated with cyclic stages of decay and/or vitality in Brazilian old town centres.

Keywords
Spatial configuration, grid integration, compactness, form of the integration core, Brazilian old town centres

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1. Foreword

This paper presents a descriptive and exploratory study of three variables in configurational analysis – (1) grid integration, (2) compactness, and (3) form of the integration core – aiming to illustrate its applicability to the investigation of old town centres in Brazil. The study was also motivated by the observation that these attributes, although recurrently utilized in morphological studies, lack a more practical applicability approach for real rather than theoretical cases.

The investigated area is the city of Natal with a special focus on its old centre, part of today's neighbourhoods of Cidade Alta and Ribeira. Analyses were based on existing axial maps that have been studied elsewhere (Medeiros, 2002; Medeiros et al, 2002; Trigueiro, Medeiros, 2000), which represent Natal's spatial expansion in a diachronic perspective, according to the available cartographical data: 1599 (Natal´s foundation year), 1777, 1864, 1924, 1955, the 70's the 90's and 2002.

In synthesis, this paper aims to (1) verify the spatial variables referred above, from a historiographic perspective (2) ascertain whether and how these attributes vary in Natal, through an essentially descriptive approach focused on the old town centre, and (3) compare resulting values and rates to those found for other Brazilian cities, previously investigated by the DIMPU/UnB ("Base de Pesquisa em Dimensões Morfológicas do Processo de Urbanização, Universidade de Brasília") research team and available in its data base. Grid modelling techniques, as recommended by Hillier (1996) and Holanda (2002), were utilized for the study.

2. On Natal and its old centre

Natal, capital city of the state of Rio Grande do Norte, part of the Northeast region of Brazil, now has over one million inhabitants within its metropolitan area. Officially founded in 1599 on the orders of King Felipe II of Portugal, to strengthen the colonial defence system, Natal remained little more than a hamlet until the last years of the18th century – when the urban area extended a little farther beyond the quadrilateral that shaped the foundation square and spread out over the plateau upon which it had been established, named "Cidade Alta" (Upper Town) by Portuguese first settlers.

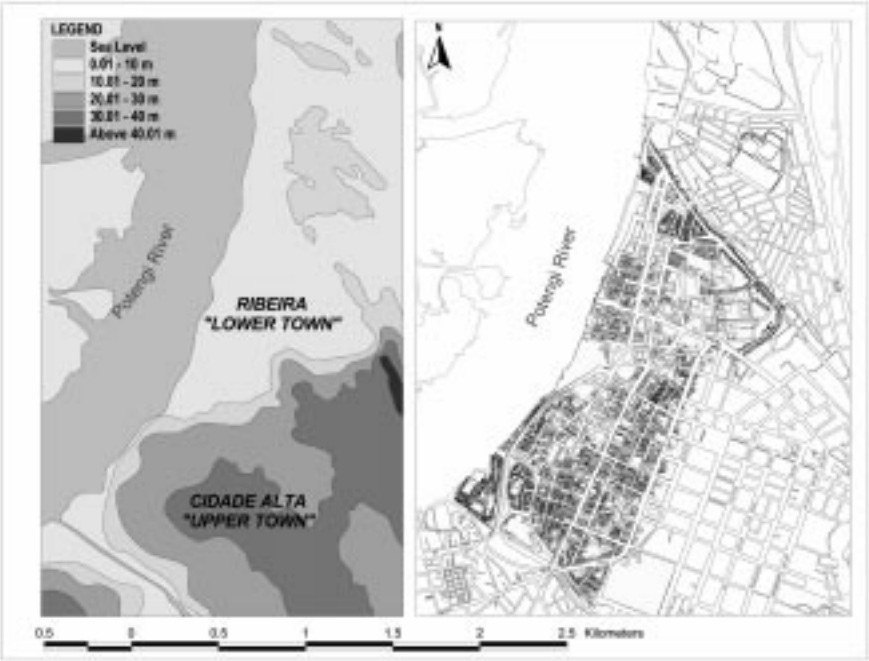

Figure 1: Foundation site of the city of Natal with Cidade Alta and Ribeira sites highlighted

A slight but continuous growth along the 19th century, was enhanced by the harbour activities and by the occupation of Ribeira – meaning "riverside", also referred to as "lower town", ("Cidade Baixa" in Portuguese), in opposition to the earlier "upper town" site. (Figure 1) This was followed by a series of growth booms during the 20th century: in the 1940's, during World War II, when Natal served as an important base for Brazilian and American troops, and in the 1960's and 1970's following the intense urbanization process that seems to have then reached its peak in Brazil (Trigueiro et al., 2001).

As Natal is still growing to consolidate its metropolitan status and the increment of tourism is becoming a main goal for local development, the idea of a "cultural tourism" has become one of the items recurrently associated with an immediate need for the preservation and increase in real estate value within the old urban centre, which has been officially considered a Special Historic Preservation Zone ("Zona Especial de Interesse Histórico, ZEPH") since 1984.

In spite of its official status, of the natural beauty of the site, and of an increase in architecturally distinguished buildings (Figure 2), many of these artefacts are being lost due to abandonment, replacement, demolition and/or modifications – causing the area to be addressed as one of decay and loss of vitality (Figure 3).

Figure 2: General view of the foundation site of Natal, from the Old Church tower ("Velha Catedral")

Figure 3. Present stage of some buildings in Cidade Alta

3. Integration

The first spatial attribute to be examined is the global grid integration ("radius n" in terms of mathematical calculation, here normalized in order to enable comparison), taking into account the whole urban complex at each period of time. The aim here is to assess whether and how integration values varied and the integration core changed over time and how such features associate with urban and historic phenomena in Natal. Attention is also directed to the position and transformation of the old town centre in the light of the notion of a main urban "active centre".

Although axial maps may be visually compared through the chromatic scale, itself a relativising artifice, numerical results are more difficult to perceive due to the fact that the interval of the obtained integration values (between maximum and minimum) vary from system to system, from map to map. In order to make this comparison somewhat more intelligible, the tactic of transforming the figures into a common scale has been adopted in this study.

A scale from zero (0) to one hundred (100) has been established to translate actual results so that the minimum value is considered as 0 and the maximum value is considered as 100. For instance, for the year 2002, the highest global integration value found was 1.017, which was then expressed as a 100, and consequently the minimum value, 0.243 was reduced to 0. All intermediate integration values resulting from the analysis of the urban configuration in the same period were distributed, by way of mathematical calculations, along this scale.

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In accordance with the purposes of this investigation, the explored measurements were: (1) mean integration values for Natal's old town centre; and (2) mean integration values for Natal's whole complex at each period (from 1599 to the present day) (Figure 4).

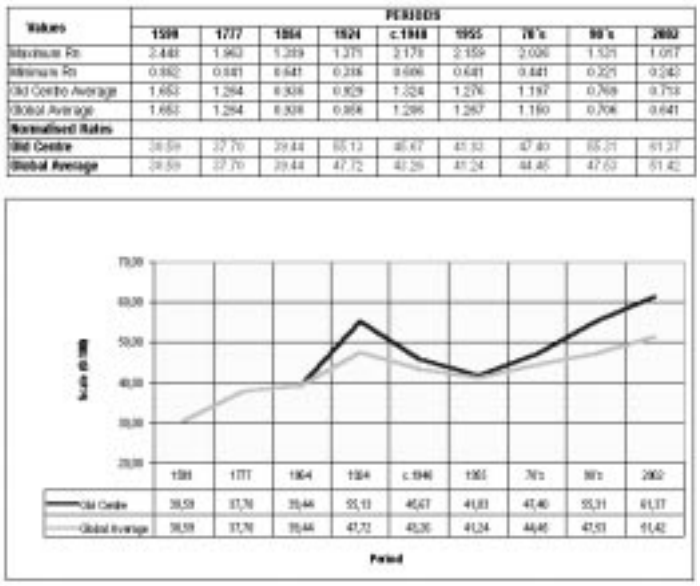

Figure 4: Normalized average integration rates from (1) Natal´s old centre, and (2) the city as a whole

It is necessary to clarify that the area here designated as the old town centre corresponds to that occupied by Natal until the mid-19th century. Therefore, the mean integration values for both the old town centre and the whole complex coincide in the modelling of Natal's grid between 1599 and 1864 (Figure 5). These are shown to be quite high in terms of global integration, thus demonstrating a high level of permeability in the grid structure as a whole.

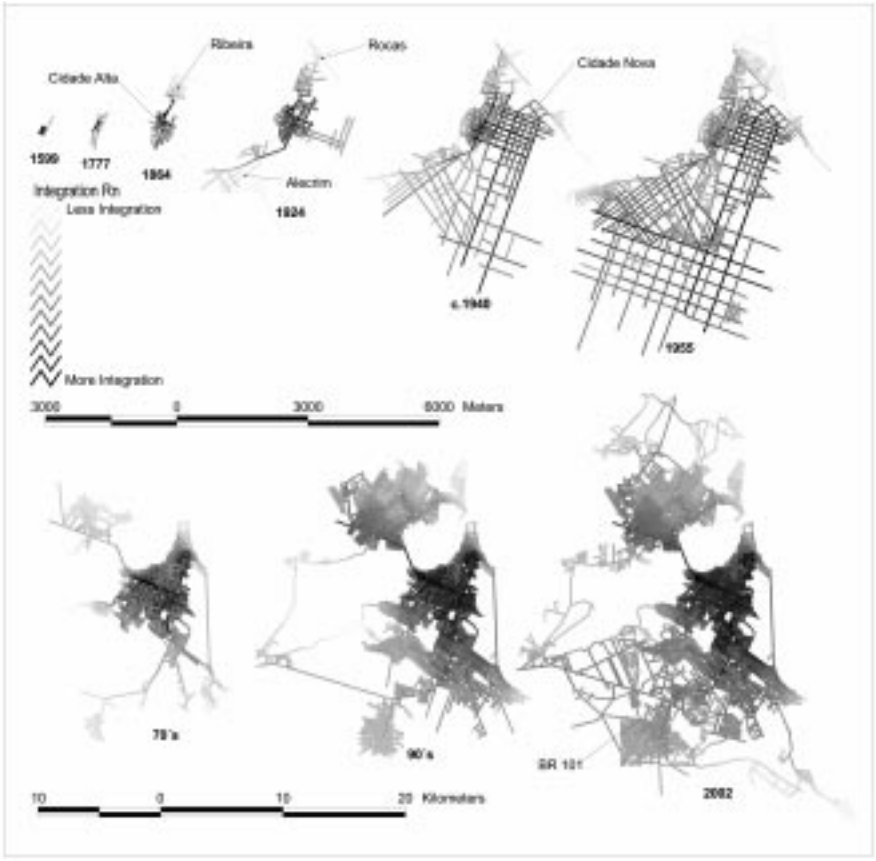

Figure 5: Axial Maps from 1599 to present day

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From 1864 on, boosted by the growth of commercial activities, Cidade Alta and Ribeira are alternatively described as active centres, especially after the consolidation of the harbour at "Cidade Baixa", on the Potengi River. A direct consequence of this process is the urban expansion resulting from the sprouting of new neighbourhoods around the earlier contours of the town.

In 1924 the grid hierarchy is consolidated in "bairros" (neighbourhoods) or "zones": whereas Cidade Alta and Ribeira acquire a highly integrated configuration, thus becoming movement magnets, Alecrim and Rocas, lower-class settlements situated beyond the borders of each "bairro", respectively, are extremely segregated. Mean integration for the whole complex is 47.72 and that for the town centre is 55.13.

From 1924 through to 1940, the consolidation of the grid structure resulting from the development of "Cidade Nova" (present day neighbourhoods of Petropolis and Tirol), boosted the displacement of the integration core from its initial location, the old centre, towards the southeast. Mean integration in the old centre dropped from 55.13 in 1924 to 45.67 in 1940, almost equalling the then mean global integration (43.26), a trend which appears to have reached its peak in the post war period (1955), when mean integration values for both compounds are around

41.50. This seems to have been directly affected by the consolidation of roads built during the Second World War to connect the military bases to the town's centre and the harbour, into regular thoroughfares.

It should be clarified, however, that despite the above mentioned shifting of the integration core south-eastwards onto the "chess" grid of Cidade Nova, various factors and magnets have contributed to the maintenance of an active centre in the old town, specifically, in Ribeira, due to the port activities in the area, to the existence there of a seaplane dating from the early times of aviation and to the development brought by the presence of Brazilian and foreign troops during war time – when the bulk of Natal's business, service and entertainment centres, were located there.

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Little by little, from the 1960's on, in consonance with the town's expansion southwards – and the consequent displacement of the integration core – Cidade Alta surpassed Ribeira as the active centre, becoming the site where the best shops and service outlets were located, while a certain decadent and nostalgic atmosphere began to pervade the neighbouring Ribeira.

In the 1970's, however, a new situation started to emerge. As massive housing developments, supported by the public funding of the government housing policy, sprawled around the urban area, the integration core seems to have reached its maximum displacement point, then stabilised and modified in shape, as can be verified in the axial maps that represents Natal in the 1970's and the 1990's.

From the 1970's through to the present day, the integration core expanded and engulfed the axes in the old centre, its borders at first, then most of Cidade Alta, and now reaches the limits of Ribeira. Numerical results show a growing gap between the old centre's mean integration and that of the whole complex. That gap that was a mere three points in the 1970's (47.40 to 44.45) is now higher than ever since 1599, reaching 10 points.

These results support the empirical evidence, represented in the land-use data, of a robust commercial centre in the area. This has, however, been acquiring a secondary rank in relation to the new centralities emerging along the BR 101/avenida Salgado Filho, the main access strip into town, where shopping centres, large chain supermarkets and a vast mix of facilities cater for a high-income population.

4. Compactness

Compactness measurements may take into account diverse variables and are usually expressed, as far as space syntax analysis techniques go, by the relation between the area of a specific space and another attribute associated with low or high density.

Two mathematical procedures were specifically developed in this study, both relating the area of a convex polygon (in 10 hectares) to: (1) the number of axes within the polygon (from now on referred as "Compactness A"); and (2) the length of all axes in kilometres, (or "Compactness B"). These measurements will be compared here to evaluate how they differ and to assess their applicability for exploring the present study object.

Figure 6 shows the compactness values – A and B – found for Natal from 1599 to the present day. The most relevant aspect appears to be their similarity.

PERIOD	Area (10ha)	Number of Lines	Comp. A	Normalized "A" Value (FD)	Total Length of Lines (Km)	Comp. B	Normalized "B" Value (FD)
1599	0.73	8	10.96	14.23	1.61	2.21	9.19
1777	1.36	19	13.97	18.14	3.44	2.53	10.54
1864	3.57	54	15.13	19.64	12.33	3.45	14.39
1924	21.05	109	5.18	6.72	27.66	1.31	5.48
1940c	24.71	146	5.91	7.67	36.76	1.49	6.20
1955	26.78	224	8.36	10.86	49.97	1.87	7.77
70´s	27.9	394	14.12	18.34	65.97	2.36	9.85
90´s	28.8	432	15.00	19.48	67.14	2.33	9.71
2002	29.21	429	14.69	19.07	68.34	2.34	9.75

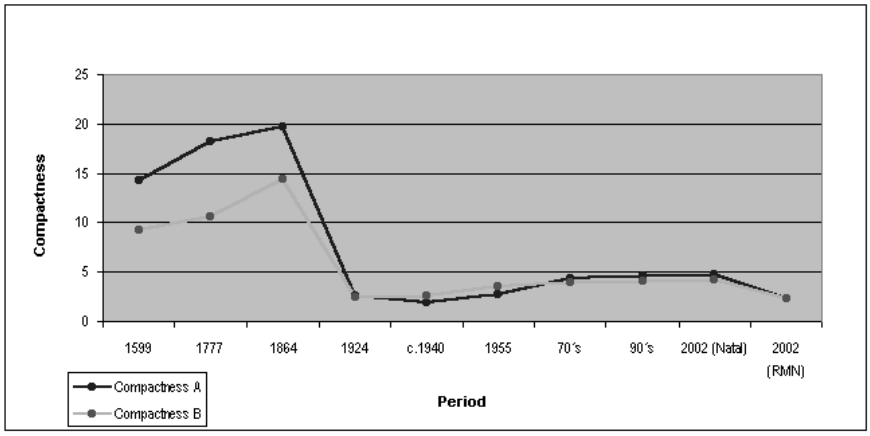

Figure 6: Compactness A and B values to Natal, from 1599 to present day

Results show the colonial town (1599 through 1864) to be a much more compact system than the 20th century city developed after 1924. The maximum compactness value found for the colonial town is four times that of the 20th century city. This seems to be associated with the fact that Natal's urban boundary was almost the same between 1599 and 1777 (i. e. the convex polygon had the same area despite an increase in the number of axes).

In 1864, when the settlement in Ribeira, which started in the late 18th century, was fully consolidated, the increase in the quantity of axes is superior to the increase in the area of the amplified convex polygon. This explains the highest compactness value found for all periods analysed here – be that of type A or B.

The 20th century broke slow pace of Natal's urban expansion during the three previous centuries. In 1924 the first ground plots in Cidade Nova area were occupied, signalling the appearance of a new residential neighbourhood for the local elite. This brought about a considerable increase in the urban area though not accompanied by a relative growth of new axes. These were scattered at considerable distance from one another, implying a substantial decrease in compactness values for that period. This trend continued into the war period, during the 1940's.

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Once the axes connecting the military bases reminiscent from the wartime are absorbed into Natal's grid structure from 1955 on, there is an increase in the urban area density. This coincides with an increase in the town's population due to the remnant of people who had moved to Natal during the war, attracted by the offer of jobs and financial opportunities generated by the presence of a huge military contingent (Ribeiro, 2001: 54-55).

The most important aspect of the urban growth during the 1960's and 1970's, are the appearance of a new building type, a series of far-stretching housing estates that are at first located in the town's periphery. Later on, intermediate areas, which had benefited from infrastructure facilities built to reach the new housing estates, start to be occupied, thus filling the remaining empty grounds. This resulted in increasing compactness rates, both in the 1970's and in the 1990's. This trend has been maintained to this day as verified by the modelling of Natal in 2002 (the town's official boundaries, considered).

This "suburbanisation" or "peripheralization" process occurred in parallel with the consolidation of Natal as the centre of an urban compound that includes five other neighbouring municipalities. This led to the creation of the "Região Metropolitana de Natal"(Natal Metropolitan Region), RMN, in 1997. If the configuration of the Metropolitan Region is considered, the compactness rate is considerably reduced, reaching values that are lower than those found for the axial map of 1924.

Findings thus reveal a pattern of cyclic growth, in which expansion waves and the consequent formation of empty spaces is followed by periods when those intermediate and interstitial areas are developed and occupied. This fact is easily demonstrated by the current occupation tendency around the border area between Natal and Parnamirim, now the main urban development spot in the state.

In summary, findings demonstrate that the configuration of the "modern" city, here understood as that shaped and built from the 20th century on, is much more discontinuous and sparser than that of the "traditional", colonial town.

4.1 Comparative Compactness

Compactness results, from the examination of the various modelling procedures of Natal at successive periods of time, were then compared to those found for a sample of other Brazilian settlements. The figures have been normalized in accordance to values found for the Federal District ("Distrito Federal", where Brasília, is located), the least compact system within the analysed group.

The examined sample, from a database provided by DIMPU/UnB, includes small colonial towns (such as "Goiás Velho", inscribed in the World Heritage List, "Pirenópolis" and the "Traditional Sector of Planaltina", a town situated in the surroundings of Brasília), metropolitan regions ("Belém", "Manaus"), middle size cities (Maceió, Santo André) and settlements planned along the 20th century ("Goiânia", "Anápolis" and the "Federal District" as a whole – including all "satellite cities").

Three analytical levels were worked for Natal: (1) the official limits of the municipality; (2) the RMN, which includes Natal and conurbation municipalities; and finally (3) the old centre only, comprising the present day neighbourhoods of Cidade Alta and Ribeira.

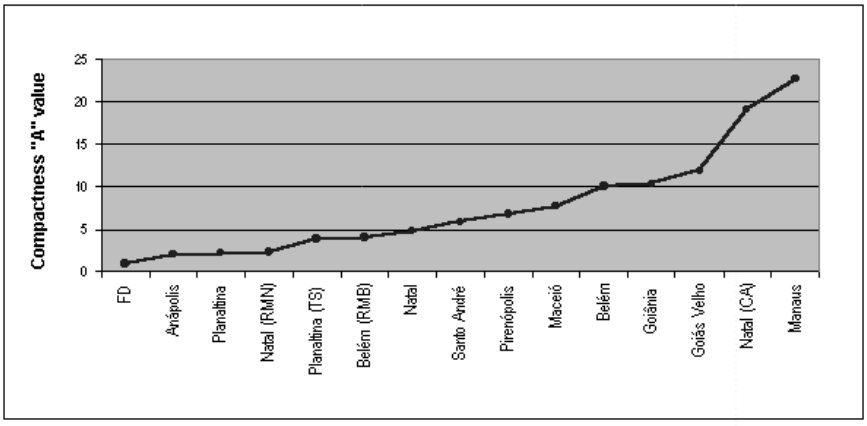
The analyses of the available data demonstrated that the most compact settlements were those dating from colonial times (Goiás Velho, for instance), in addition to the old centres of some capital cities (Manaus, Belém and Natal; Figure 7).

On the opposite end of the scale, less compact and/or disperse areas are to be found in urban fractions designed under conspicuous modernist guidelines (i.e. Federal District) as well as in metropolitan neighbourhoods scattered amidst unoccupied urban land, especially when many empty land patches are located in-between the main complex and neighbouring settlements, as is the case in Natal and Belém.

In Natal, this tendency is particularly intensified by the presence of various "natural" sites such as continuous dune formations, and a wide river estuary partially fringed by swamplands. A similar situation occurs in Belém whose metropolitan complex is formed by a series of detached disperse settlements.

Figure 7: Comparative compactness A of Brazilian urban settlements

Brazilian settlements	Area (10ha)	n° of lines	Comp. A	Normalized Value (FD)
FD	24785.44	19156	0.77	1.00
Anápolis	1954.95	3079	1.57	2.05
Planaltina	555.01	920	1.66	2.15
Natal (RMN)	5883.21	10707	1.82	2.36
Planaltina (TS)	23.16	70	3.02	3.93
Belém	661.59	2044	3.09	4.01
Natal	2299.84	8343	3.63	4.71
Santo André	510.22	2296	4.50	5.84
Pirenópolis	17.8	94	5.28	6.86
Maceió	290	1740	6.00	7.79
Belém	164.27	1271	7.74	10.05
Goiânia	116.1	931	8.02	10.41
Goiás Velho	28.37	261	9.20	11.95
Natal (Old Centre)	29.21	429	14.69	19.07
Manaus	9.24	161	17.42	22.63



The above mentioned tendency was confirmed when "compactness B" was considered (Figure 8), by examining data available only for some of the investigated settlements: old centres in the so-called "traditional" towns tend to be denser, more compact than the so-called "formal" settlements that often sprawl over vast metropolitan areas.

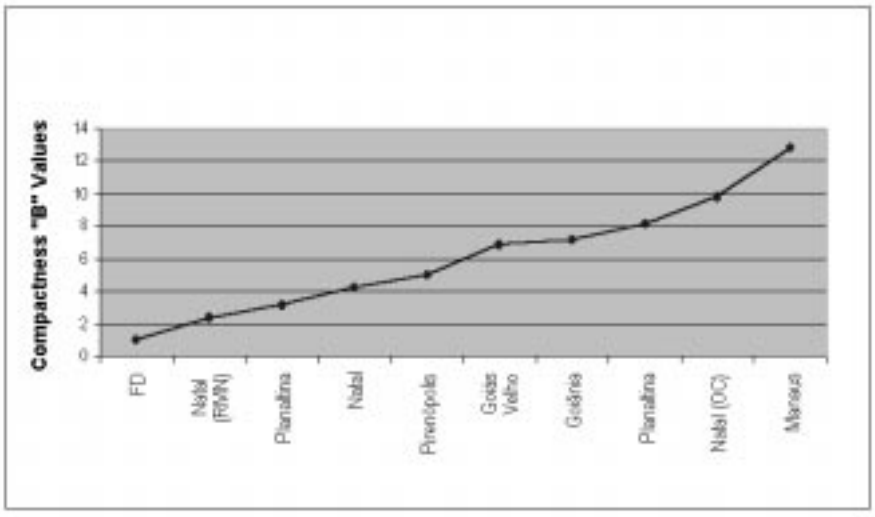


Figure 8: Comparative compactness B of Brazilian urban settlements

As a final consideration on the matter, it seems important to emphasise the similarities concerning the lines resulting from compactness levels A and B. This supports the assumption that either measurement can be worked out to similar results, an assumption that is further reinforced by the positive correlation between the two values (97% maximum r2).

Such procedures also help demonstrate that a purely topological analysis can reveal important configuration attributes regardless of the examination of geometrical factors.

5. Form of the Integration Core

The study of the form of the integration core is useful for understanding transformation processes affecting a city's active centre over time and to ascertain whether this city's global integration core coincides with the urban idea of centrality. In this kind of analysis, various historical aspects interface with and help clarify factors underpinning the transformation of the spatial structure.

There seems to be no consensus about the number of lines to be considered in determining the size of the integration core. A brief review of the literature reveals the adoption of diverse calculation procedures according to specific study purposes. Holanda (2002: 94) reports references ranging from 10% to 25% of most integrated lines for large (over 100 axes) to small settlements, respectively, as well as cases in which the researcher chose to adopt a 10% rate throughout the study, regardless of the object's size. In a recent study, Hillier (2001: 02.8) refers the "integration core" as a set of "red, orange and yellow lines", thus taking into account the chromatic scale resulting from the electronic handling of numerical segments rather than some specific percentage of most integrated axes.

As an attempt to explore the issue, two sets of calculations were developed to determine the percentage of axes to be considered for defining Natal's integration core: (A) that suggested by Holanda (2001:94), resulting from the equation F(x) = 108,6615*(x**(-0,4486), developed for the Federal District´s settlements; and (B) that derived from a simple arithmetic interpolation, for which the smallest complex herein analysed (Natal in 1599, with 8 lines) was considered as a 25% rate integration core, and the largest complex (RMN 2002, with 10707 lines) as a 10% rate integration core. All intermediate values were then determined by the linear function F(x) = 0.0999x + 1.2009.

Figure 9 displays the number of lines being considered, as explained above, for defining Natal's integration core at each time period. From 1599 to 1940c., the number of lines for functions A and B do not differ significantly. This ceases to occur, however, in the subsequent time periods – when Natal starts to expand towards a metropolitan state. In 2002, for instance, 181 axes belong in the integration core for compactness A, against 1071 axes according for function B, thus showing an increase of over 500%.

Figure 9: Number of lines being considered (functions A and B) for defining Natal's integration core at each time period

PERIOD	AMOUNT OF LINES	FUNCTION A		FUNCTION B
		% Lines (Core)	Number of Lines (Integration Core)	Number of Lines (Integration Core)
1599	8	42.75 %	3	2
1777	19	29.00 %	6	3
1864	54	18.15 %	10	7
1924	135	12.03 %	16	15
1940c.	238	9.33 %	22	25
1955	551	6.40 %	35	56
70´s	2991	3.00 %	90	300
90´s	8833	1.84 %	163	884
2002	10707	1.69 %	181	1071

The idea of an integration core for systems as small as those of Natal in 1599 and 1777 do not seem to make sense. The adoption of function A or B is, of course, indifferent. The most integrated axes – where the church (Old Cathedral, "Velha Catedral" in Portuguese) and the town hall ("Casa de Câmara e Cadeia") are sited – surround the Portuguese foundation square. Almost two centuries later, these axes stretch up, north and south of the original square, towards the two landmarks (North Cross and South Cross) that demarcated the limits of the "town" at the time of its foundation.

In 1864, Ribeira is being occupied and the polygon forming the integration core, though remaining around the foundation square, spreads north-eastwards, following the formation of the new grid. The only thoroughfare joining the two urban nuclei becomes the most integrated axis.

The form of the integration core, when function A is considered appears to derive from the three axes that seem to propel the urban growth – towards northeast, southeast and southwest, as later defined and clearly perceived in the map of 1924 – and connect the central nucleus to the edges of the settlement. When function B is considered that nucleus becomes more compact, more restricted within a centralised position.

In 1924 the situation is identical for A and B. The polygon that outlines the integration core again embodies the streets around the square, and the road that links the square to Ribeira but also spreads towards the new regular grid of Cidade Nova, the residential suburb planned in 1901. The core shows signs of being about to spread towards the three expansion directions although it does not reach the settlement fringe – a pattern that seems to associate to its compactness value, the lowest found for all the investigated configurations.

The situation that begins to be outlined in the 1920's, consolidates around 1940 when the regular grid of Cidade Nova is fully developed, thus establishing a design pattern of orthogonal axes that is to be reproduced throughout future developments. The integration core sprawled from Cidade Alta – now occupying its border – towards Cidade Nova. The regular grid of the new neighbourhood then contained a large portion of most integrated axes. The resulting configuration resembles that referred to as a "deformed spiky wheel" (Hillier, 2001: 02.8) in which the polygon forms the central wheel attached to long axial roads (Hermes da Fonseca Avenue, Prudente de Morais Avenue, Coronel Estevão Street) that make up the spikes, thus connecting the central nucleus to the settlement fringes. An integration core that propagates through extended orthogonal axes is then configured.

This configuration was further reinforced in 1955 when new roads were constructed and old roads – including the ones that connected the town centre to the American air base in the wartime – were engulfed by the urban complex. The integration core spread throughout most of the city, from the geometrical centre to the extreme southern border, the longest possible distance, considering the town's natural limits – the ocean to the north and east, the river to the west. Its shape almost coincided with that of Natal's global complex.

The configuration analysis revealed that in the 1970s there were three important trends: the continuing expansion southwards; a new expansion north-westwards, across the river; and the initial symptoms of a metropolitan scaling. A radical and quick shift seems to have occurred then, sending the integration core to a position as far away from the old town centre as it ever had been before or would be hence. Whereas in the 1950's the core covered the whole of Natal's urban complex, in the 1970's it appears to have become encapsulated within that complex, firmly tied up by the long orthogonal axes whose roots sprouted from the regular grid of Cidade Nova. The shape referred to as "Natal's integration cross"[2] (crossroads connecting Hermes da Fonseca and Bernardo Vieira Avenues; Figure 10) is thus configured.

Figure 10: Comparative integration core considering functions A and B in the 1990s

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Another aspect that calls for attention is that, at this moment, a polynucleated centrality seemed to emerge: a small compact square integration core remained anchored upon the grid of Cidade Nova whereas a larger cruciform irregular core sprawled around the "integration cross", pointing towards the new occupation of the so-called "Zona Norte" (North Zone) in the north bank of the Potengi.

When function A is considered for the analysis of Natal's configuration in the 1990's, the patterns referred to as "integration cross" and "spiky wheel" are emphasised in a complementary mutual relationship. When function B is considered, the polynucleated cores that have emerged in the 1970's amalgamate as their intervening grid fabric increases in density and a new huge core sprawled engulfing various neighbourhoods. In this case, function A seems better fit for a clearer perception of the micro-centralities. From this huge core, long axes extended and linked the central areas to the borders of the global grid system, among which the BR-101[1]

(main access route to/from Natal), Engenheiro Roberto Freire Avenue (main access route to Ponta Negra, the busiest tourism seaside compound) and Tomaz Landin Avenue (busiest commercial area in the "Zona Norte").

The configuration of greater Natal (2002), now a metropolitan region, strengthened the formal attributes originated in the previous decade thus confirming the "spiked wheel" pattern. However some alteration in the shape of the polygon that outlined the integration core is worth mentioning, as one of its vertices advanced southwards covering an area situated along the BR-101 and Eng. Roberto Freire Avenue. This area is now becoming a major shopping magnet, at a metropolitan scale, and contains six of the largest shopping units in town – three large chain supermarkets and three shopping centres, one being the largest in town.

6. Final considerations

The findings resulting from this essentially exploratory study indicate that the three spatial variables explored here may be useful for the diachronic investigation of old town centres.

The analysis of how the grid integration and the form of the integration core altered over time revealed the traces of evolving urban phenomenon imprinted on the spatial fabric: (a) the two-century near stagnation of Natal's original settlement; (b) the to-and-fro shifting of the active centre between Cidade Alta and Ribeira and its eventual dislocation southwards; (c) the expansion and rarefaction of a new active centre over various neighbourhoods and its fragmentation into several sub-centres; (d) the transformation of the once principal town centre (Cidade Alta) into one of these sub-centres.

Results from the analysis of compactness values reflected the several expansion waves – that would push the town limits in all possible directions – which alternated with densifying periods when urban voids were occupied. It also revealed the configuration the "modern" 20th century city to be a sparse and discontinuous structure whereas that of the "traditional" colonial town was dense and continuous.

These findings confirmed those resulting from other studies when similar data from diverse Brazilian settlements were compared. Colonial towns and old town cores within large and middle-size cities were found to be a great deal more compact than those developed under modernist guidelines as well as the ones which are part of a metropolitan compound. Although this issue requires further investigation, such findings suggest that traditional settlements may be regarded as structures

better fit for fostering "urbanity", insofar as their denser, continuous grids seem more likely to induce higher co-presence rates than their sparser modern and contemporary counterparts.

The exploratory study of the three morphological attributes – integration grid, compactness, and form of the integration core – has, also, proved useful for a better understanding of how some socio-economic processes recorded in the historiography are deeply related to (and imprinted on) the spatial configuration. It has also contributed to shed light on specific issues regarding the relationship between contemporary urban settlements and their so-called "decayed" old centres by exposing nuances associated with cyclic stages of change in status and vitality patterns.

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Such findings also help to reinforce the assumption that the investigation of spatial relations linking old town centres and their surrounding urban fabric may contribute to comprehension of the nature and development of Brazilian old town centres and to underpin guidelines for architectural heritage conservation policies.

Notes

[1] The BR-101 is also the longest road in Brazil stretching for over 8,000 kilometers, from the state of Rio Grande do Norte to the state of Rio Grande do Sul. It is, therefore, an impressive movement generator for both incoming and passing-through visitors.

[2] Trigueiro, E. Oral communication.

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