

#93

PIPA BEYOND THE RING:

Exploring possible effects of a road grid expansion on the centrality of a coastal resort

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ABSTRACT

The proposed paper addresses relations between space configuration and centrality in a coastal resort, in diachronic perspective (2006 and 2013), in order to evaluate the interference of addition of new road stretches, outlining a ringy conformation, in the accessibility of the resort's main thoroughfare, a point of convergence of pedestrian movement, function diversity and sociocultural animation.

The focus in this paper is to present the spatial properties defining and supporting that centrality, to discuss how such properties appear to have been only minimally affected by the recent road development, and to forward some conjectures about its possible after-effects, concerning the formation of new centralities, stemming from the ideas of centrality as a process (Hillier, 1999).

Pipa is a trendy holiday destination, is the hearth of a coastal resort situated in the Northeast Region of Brazil, which grew from a fishing village, developing into a deformed grid that conforms to its sloped natural site. Its main thoroughfare, Avenida Baia dos Golfinhos, is partly pedestrianized, is seen as an iconic image of Pipa, sharing status with views of its many bays and cliffs, running parallel to the sea, some between 30m and 100m uphill, is the longest street, with a section that concentrates a mix of land uses and activities housed in narrow blocks.

The results show that the topological hierarchy is maintained after changes in the road grid, the strong linear centrality anchored in Avenida Baia dos Golfinhos is also sustained. The centrality continues its process, considering that the animation tends to concentrate in the shorter segments and shorter distance between blocks. On the other hand, the linear growth of the settlement southward is generating seems to anticipate the formation of centralities more likely to relate to vehicular movement.

The proposed paper research is part of an ongoing dissertation, whose aim is to investigate how and to what extent changes in the spatial structure of the coastal village of Pipa may affect urban qualities, which, together with privileged natural traits, confer identity to the place and render it unique.

KEYWORDS

Centrality, space configuration, Pipa village, coastal settlement

1. INTRODUCTION

The research reported here – part of an ongoing master dissertation – explores relations between space configuration and centrality, focusing on properties deemed indicative of movement, function diversity, and sociocultural animation, in diachronic perspective. Spatial properties vis-à-vis the presence of diverse land uses (and users) are examined within a seven-year temporal break (2006 and 2013) in a coastal resort renowned for its natural beauty that combined to the cultural flavours related to its long-term residents, and to a certain cosmopolitan air brought in by newcomers and visitors, confer the place unique qualities of urbanity. The study was motivated by the worry that the addition of new road stretches, outlining a ringy conformation that encompasses and encircles the area where most diversity and liveliness is concentrated, would impact the settlement's hierarchy of topological accessibility and dilute the vitality of that area. The focus in this paper is, therefore, to present the spatial properties that we believe to have been crucial for defining and supporting that centrality, to discuss how such properties appear to have been only minimally affected by the recent road development, and to forward some conjectures about its possible after-effects, concerning the formation of new centralities.

Pipa, originally a fishing village, is the heart of a large coastal resort extent situated in the state of Rio Grande do Norte, Northeast Region of Brazil. There are references to fishing activity there since round 1800 (Simonetti, 2015). It was also a viable stop for vessels transporting merchandise to and from harbours in Rio Grande do Norte and Pernambuco. Besides Pipa, the districts of Piau, Cabeceiras and other minor settlements are part of Tibau do Sul the present seat of a municipality, which grew independent from the town of Goianinha in the 1960s. South of Pipa and closely linked to its tourism and leisure compound is the district of Sibauma, part of the municipality of Canguaretama, which together with that of Goianinha comprise the southernmost coastal border of the state of Rio Grande do Norte, whose beaches are sought for as leisure resorts all year round.

Until recently, Pipa was connected by roads to the settlements of Tibau do Sul (north), Piau (west) and Sibauma (south). The road work built from 2008 through 2010, created a new link, to the settlement of Cabeceiras (figure 1), offering a shortcut to the road from Goianinha to Tibau do Sul, improved the route to Sibauma, by paving a third of the length of a difficult sandy track, and generated a circular circuit round Pipa's urban centre, of which the main thoroughfare is the Avenida Baia dos Golfinhos running parallel to the sea, about 30m to 100m uphill from the water line. It is the longest street in Pipa, and it was the first land connection to Goianinha and to Tibau do Sul. The busy Avenida Baia dos Golfinhos is a well-known tourist destination and an icon of the "village" (a term often used to refer to Pipa that we shall adopt here), as it concentrates a variety of uses, mainly retail shops and restaurants that remain open till late, attracting hordes of passers-by, especially from late afternoon onward. This street can be considered the functional centre within the village's street grid, which has grown from it, branching into paths and alleyways that define a deformed grid whose assemblage of connected lines compacts into a convex shape with lines that connect out into the surrounding area in the like of Hillier's (1999, p. 118) "spiky potato" (figure 1).

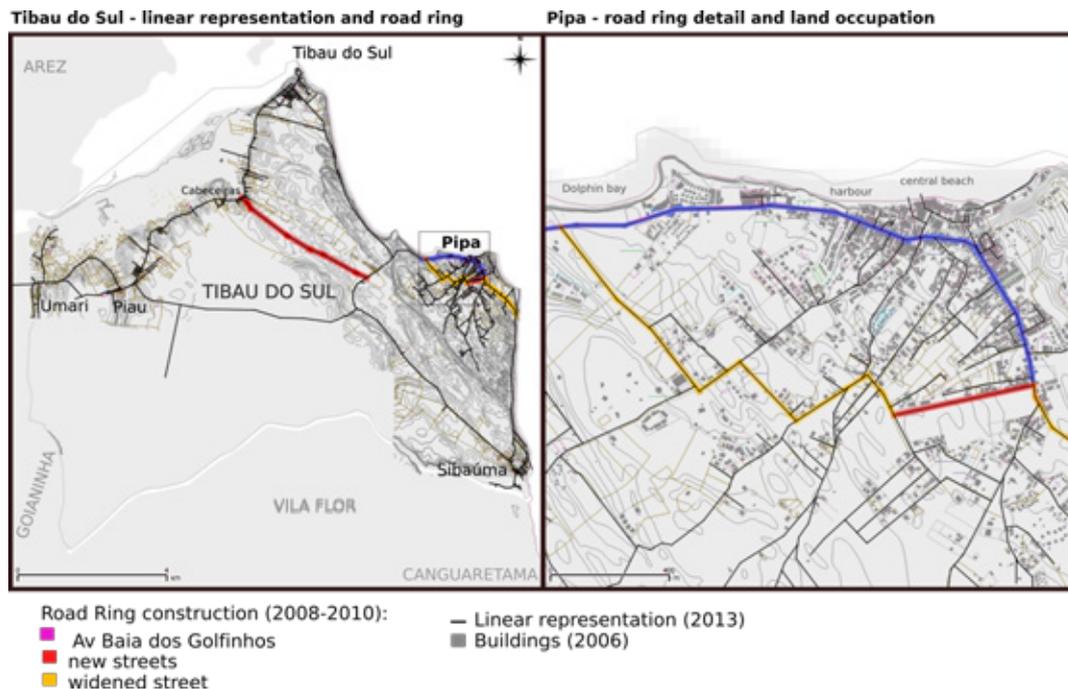


Figure 1 - 'Spiky' Pipa connecting another settlements of Tibau do Sul into a deformed grid that conform to its sloped natural site. New and widened roads which form a circular circuit (road ring) with Avenida Baia dos Golfinhos. Datasets: IDEMA (2006), Google Maps (satellite image, 2013).

The new road construction widens some existing thoroughfares and creates broad road stretches connecting them, so that a ring is formed, linking the two ends of Avenida Baia dos Golfinhos (figure 1). As part of the road works, the access from Pipa to the beaches in the south was duplicated and paved and a short-cut was created connecting the southeast end of the Avenida to the zig-zagging way that leads to the entrance to the village. The ring is at present used as a round one-way circuit, running clockwise in and out of Pipa. The shortcut has greatly reduced the in and out distance for vehicular movement, especially that of touring coaches that take visitors around the area.

This road development induced our initial hypothesis that the ring could weaken the linear centrality of the village by diluting the movement concentrated in the Avenida, besides favouring land occupation to the South of Pipa that could lead to the formation of new centralities. In Figure 1, it is possible to note the dense building concentration in Avenida Baia dos Golfinhos (North part of the ringy route), as well as the two shortcut routes, one linking the Northwest and Southeast ends of the village main street (that includes the Avenida), the other connecting the entrance road to Pipa and the settlement of Cabeceiras.

The configuration analysis suggests, however, that the access hierarchy, both as concerns Pipa's inner space structure and that of Pipa in relation to the other settlements is maintained after the insertion of the ring. The strong linear centrality anchored in Avenida Baia dos Golfinhos is also sustained. On the other hand, the linear growth of the settlement southward is generating newly occupied thoroughfares, some of which already highly accessible, that seems to anticipate the formation of centralities more likely to relate to vehicular movement. Some recent constructions these new roads – such as large gated condominiums, petrol stations / garages and building material warehouses – reinforces this conjecture.

2. MEASURING CHANGE AND CONTINUITY IN SPACE AND USE

In the current investigation of properties, which have been associated to sociocultural animation we have considered the idea of networks of linked centres that favour the establishment of movement-driven activities, which, in turn, may anchor the formation of "active centres", as

suggested by Hillier (1999) and Vaughan, Jones, Griffiths & Haklay (2009). The variety of the activities as well as the relative position they occupy in the street grid are also considered in combination with the spatial hierarchy. Within a less “objective” approach, the investigated physical and functional datasets were checked against the empirical knowledge of the researchers (one of them former resident in Pipa, to this day a frequent visitor), photographic surveys of Pipa’s central spaces and complementary source from the literature and narratives.

The temporal dimension is given by comparing physical attributes before (2006) and after (2013) the road development of 2008-10, which motivated the hypotheses about a possible “rupture” concerning the qualities of urbanity that have turned Pipa into a national and international holiday destination, a sought-for place for a second or even permanent residence. It is obvious, though, that these temporal milestones serve mainly our epistemological purposes since space transformation is a continuous process and centrality the “outcome of a long-term historical process of the formation and location of centres” (Hillier, 1999, p.107). The idea of “rupture” would, in our view, be sustained by a substantial change in the hierarchy of accessibility, potential movement and land use, what did not take place.

Granted that the block size is a physical attribute thought to affect potential movement (Jacobs, 1961), attractiveness and the “mixture of uses along them”, as verified in numerous empiric studies (see compilation by Netto, 2016), these aspects were examined by calculating segment length and number of segments per kilometer, although the researchers understood that these parameters are not precise, since in Pipa, segment length does not correspond to block size due to the sinuous shape of various streets that generate segments which do not necessarily correspond to street intersections. Long blocks can, therefore, be formed by various small segments. Therefore, we chose to count activities both per segment, as proposed by Vaughan (2009, p7-8) and per block, presenting the average size of the measured segments and blocks.

The linear representation of Tibau do Sul was drawn with QGIS (QGIS Development Team, 2016) over tiles from Google Earth 2013 satellite images. After that, the linear representation was fitted to an aerial photograph (Tibau do Sul, 2006) due to its higher precision to detail pedestrian ways as compared to Google Earth. Some lines were erased from the 2013 map to model Tibau do Sul before the road ring construction.

The narrow pedestrian pathways were updated in another layer based on a GPS survey made with a GPS-logging application (OSMTracker, 2017), including the sand stretches walkable at low to medium tide. This layer was joined to the main layer to gauge the possible effect of footpaths on local measures.

The linear representation of footpaths was constructed for Pipa only. The 2006 representation was drawn from the memories of Martins, author of this paper, who lived in Pipa from 2004 through 2009. Some existing beach paths were not represented as they are limited by tides other than very low ones as well as by the formation of salt ponds – the maceios – after high tides in certain months.

The representation was checked and analysed with Space Syntax Toolkit (Gil, J., Varoudis, T., Karimi, K., & Penn, A., 2015). Axial integration (IntHH) and axial choice (CH) were analysed with radii $r=3, n$. Normalized Segment Angular Integration (NAIN) and Normalized Segment Angular Choice were explored with 17 radii from 200m to 12000m.

The land use records and the built area representation for the municipality of Tibau do Sul in 2006, was obtained from an official document (Tibau do Sul, 2008), a raster image granted by Instituto de Defesa do Meio Ambiente (IDEMA, 2006). Land use categories were labelled as: “residential”, “commercial”, “institutional and services”, “hotels and hostels”, “condominiums”, “vacationers”, according to which use predominated in each polygon that corresponded to the built area projection. Each polygon may represent more than one building or premises as, for instance, a dwelling or dwellings and hostels in different floors or galleries with diverse retail or service outlets.

As concerns land use categories, “commercial” refers to retail in general, including restaurants, pubs and private services such as travel agencies, currency exchange etc; “Institutional and

services" refer to public or to what is expected to be predominantly non-lucrative service, such as health centres, police stations, schools. "Residencial" refers to dwellings in general; however, two other labels were added to specify habitation schemes that are numerous in the studied case and relate to different communities, thus bearing important sociocultural implications. "Vacationers" are dwellings occasionally inhabited by people who reside elsewhere for most of the time and keep a second (third or whatever) residence, usually for leisure purposes; "condominiums", referring to multiple dwelling units sharing the same land plot may also serve as second residences, but are often unofficially used as hostels or boarding houses

There is no land use official record for 2013. This problem was partially overcome by constructing one, based on local surveys and photographic images gathered in September 2016. In contrast to the analysis of space configuration, the land use comparison across time relies more on a qualitative evaluation than on a quantitative examination, since the 2006 record displays little information about non-residential uses and what is being served as a proxy to a 2013 record is a in loco survey carried out three years on, which although much more detailed, focus on Pipa's central areas and their surroundings plus some selected spots. However, we trust that despite these limitations, the examined data and analysis procedures are robust enough to anchor findings, thus contributing a case study to the knowledge about centrality formation or 'centrality as a process' (Hillier, 1999).

3. AND THE SPACE HIERARCHY CARRIES THE PROCESS ON...?

There is no substantial difference concerning the topological measures before and after the construction of the road ring in terms of integration and choice (segment [NACH/NAIN] $r=n$ and 200 to 12000m and axial [intHH/choice] $r=n,3$), except for some footpaths.

Figure 2 compares the spatial configuration before (2006) and after (2013) the road works, showing that the hierarchy of topological accessibility remains the same, regardless of the representation procedure or measure explored. These were integration [INT] for axial analysis and normalised integration [NAIN] for angular segment analysis, choice [CH] for axial analysis and normalised choice [NACH] for angular segment analysis, both for the global and local scales ($r = 3, [R_3]$). Similar findings resulted from the calibration of the segment maps for 17 different metric radii, ranging from 200m to 12000m, based on the two maps (2006 + 2013), that added up to 37 representations.

Most of the accessibility core for the global scale comprising the spatial configuration that includes Tibau do Sul, Pipa, Cabeceiras, Piau and Sibauma is formed by Pipa's urban network. Only locally [R_3] is the street grid of Tibau do Sul more integrated. High through-accessibility [CH] is found, not surprisingly, on the roads connecting Pipa to Tibau do Sul and to Piau. The new road link Pipa-Cabeceiras will share (and dilute) accessibility with those roads.

The 2013 map of Pipa's street grid was reworked to include the representation of pedestrian only routes – alleyways, open air stairways (connecting lower and upper towns), and the walkable stretches along the waterfront in low tide. No substantial change in the hierarchy of accessibility, locally and globally, was noted when the representations before and after the road works were compared.

Figure 2 shows that part of Avenida Baia dos Golfinhos's northern and southern sides are highly accessible and that the accessibility core shows a tendency of expansion towards south even before the road ring. The axial global integration [INT] for 2013 highlights the circular contour of the road ring, outlined from highly integrated lines since at least 2006. At the southern end of the integration core the Avenida splits into two ways, forming an inverted Y-shaped whose accessibility values are on the upper side of the scale before and after the road ring in all measures [INT, CH, NAIN, NACH].

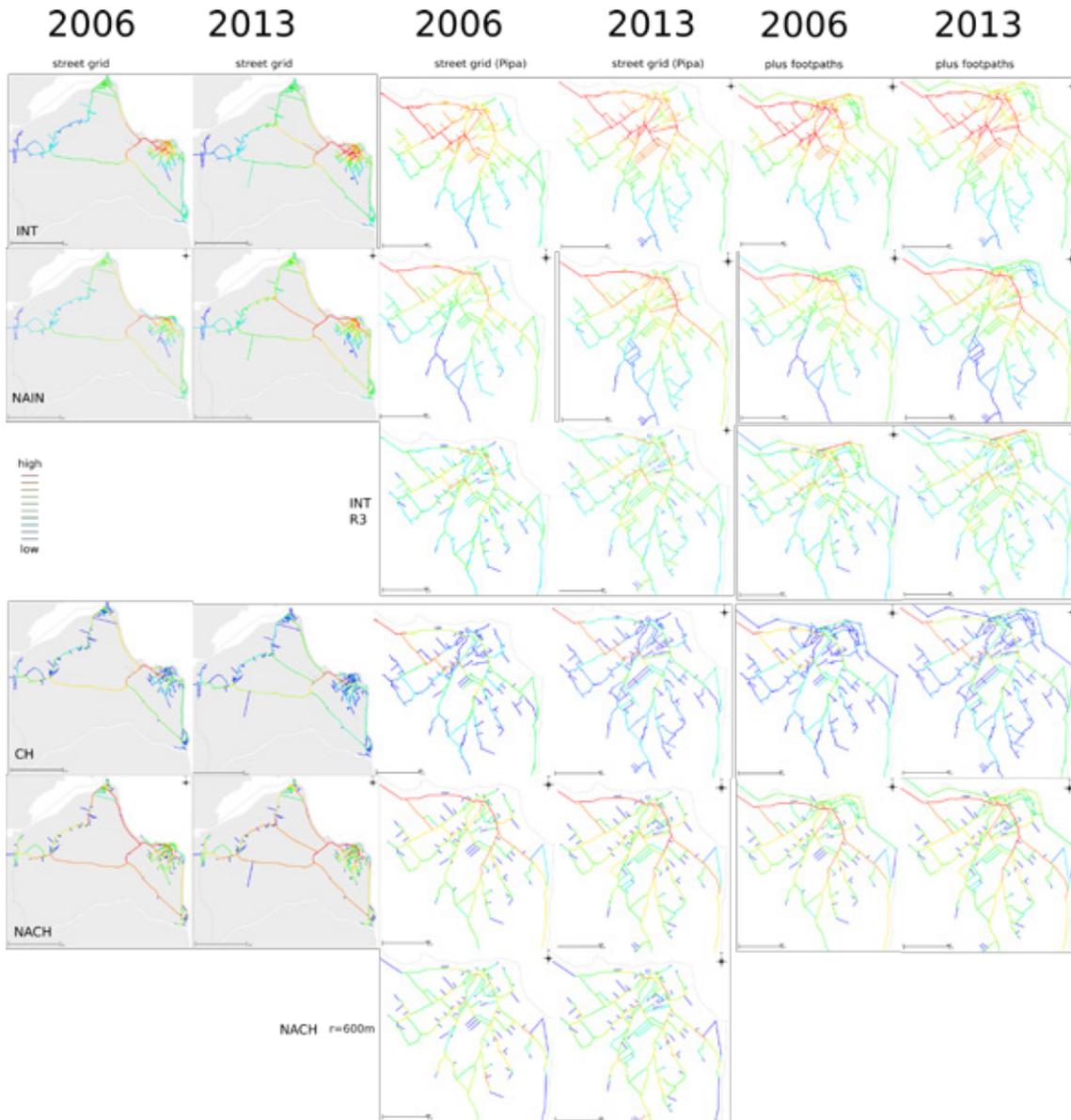


Figure 2 - Topological hierarchy INT, NAIN, INT-R3, CH, NACH, NACH=r600m 2006 and 2013, street grid and streets plus footpath (only in Pipa)

The addition of footpaths shows a tendency for the formation of highly to-accessible [INT] circular routes in 2006 that fades slightly in 2013 (from red to orange) and falls some points in the hierarchy scale as compared to the new road stretches. Through-accessibility [CH] is however strengthened, as some red segments stretch towards the inverted Y-shaped compound, what does not come as a surprise considering that the measure picks up the grid skeleton. With footpaths considered for local integration [INT $r=3$] the axis running along and offering access to various second homes or season houses (labelled here as “vacationer” houses rather than “residential”), below Avenida Baía dos Golfinhos is even more accessible than the Avenida’s average. This highly accessible path highlights the importance of the central beach – the only beach included in the perimeter of Pipa due to the discontinuity of the cliff line, a key site for the original fishing trade, now the heart of Pipa in daylight.

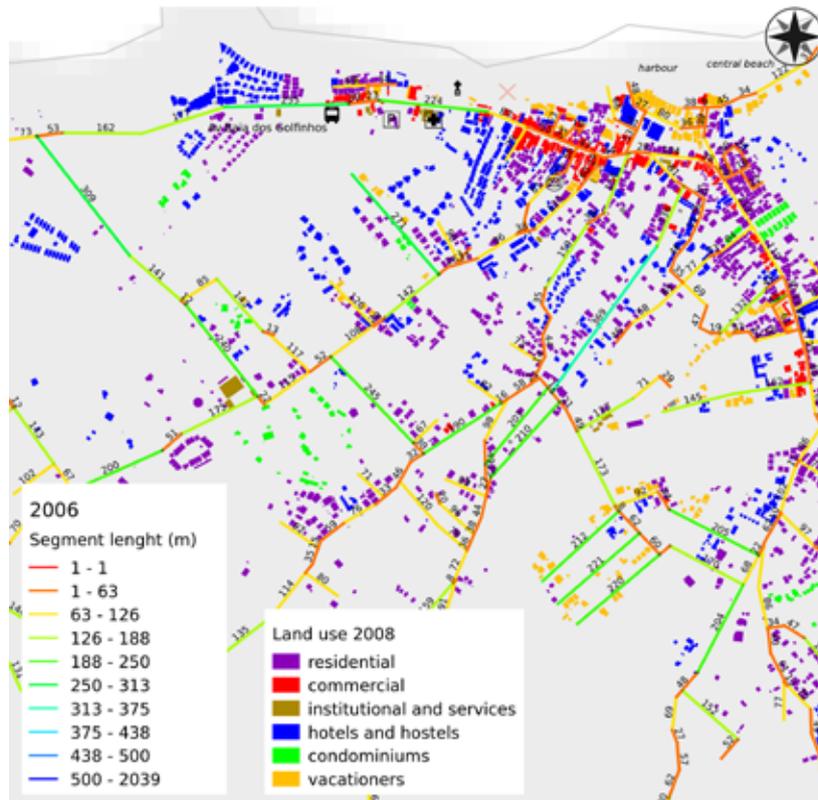


Figure 3 - Segment length, projection of buildings and land use . Dataset: aerial photograph (IDEMA, 2006), Plano Diretor (Tibau do Sul, 2008).

| Street grid and block attributes | Avenida Baia dos Golfinhos | New and widened street |
|------------------------------------|---|--|
| Segment length, mean | 64.6 | 104.7 |
| Block size, mean | 102.0 | 157.4 |
| Segments per kilometre | 15.5 | 9.8 |
| Length (m) | 1938.3 | 2014.6 |
| Land use (2016, photograph survey) | Restaurants / bars, hotels / hostels, chemistries, residential condominiums, one-family dwellings, summer homes ('vacationers') groceries, bakery, beauty parlours / hairdressers, automated teller machines (ATM) / bureaux de change, worship places, car rental, nightclubs, parking, bus terminal, space for concerts and outdoor events, school, health centre, square, car service (tyre repair). | Hotels / hostels, residential condominiums, one-family dwellings, school, warehouses (buildings material and timber), beauty parlours / hairdressers, worship places, groceries. |

Table 1 - Segmentation and land use

4. CONCLUSIONS

Pipa has the largest street structure amongst all settlements in the municipality, including that of its seat - Tibau do Sul. Half of all segment lines (487 segments of 977 total segments in 2013, 429 segments of 911 total segments in 2006) are there (Figure 3). High global to-accessibility coincides exemplarily with variety in land use, whereas high through-accessibility tends to reinforce uses related to local centralities, although this is hardly a rule as some of them – especially longer segments – are not sided by non-residential uses, a finding that makes us recall Jacob’s (1961) defense of small blocks as generators of street animation.

Avenida Baia dos Golfinhos, Pipa’s main street, connects other settlements along the road to the neighbour town of Goianinha. The links spreading out of the Avenida, formed by the segments with the densest occupation, recalls Hillier’s (1999) spiky potato, each spike becoming a potential generator of other centres as they connect to the segments belonging to those destinations, which, in turn, help to increase the movement potential, mostly northwest and west of Pipa. As the village cannot expand towards north and east – limited by the sea line – the Southern spikes conduct the road network expansion.

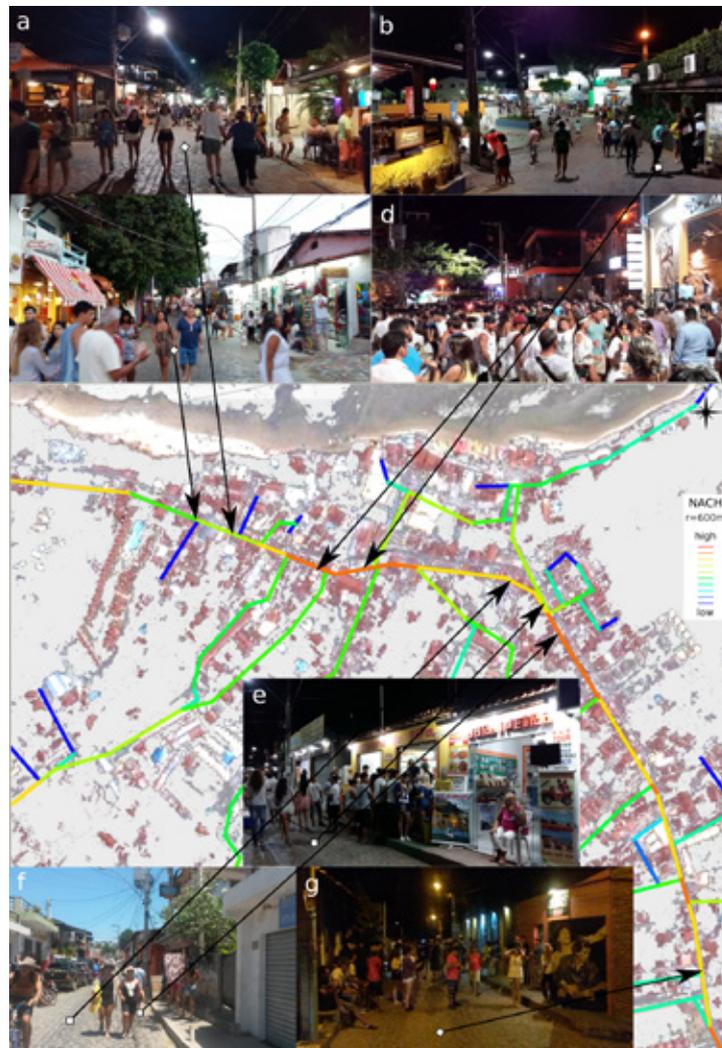


Figure 4 - Local through-accessibility [NACH, r=600m] and diversity of activities and users in the new and widened roads. Dataset: Google Maps (tiles of satellite , 2013); SST-QGIS; photography survey (2016-2017)

The road from Pipa to Sibaúma is mostly an earth track mainly trod by vehicles related to tourism. The recent road ring increased the paved stretch up to a third of its total length, adding a shortcut that allows vehicles to avoid Avenida Baía dos Golfinhos and, therefore, Pipa's live centre on the way back from Sibaúma to all other settlements within the municipality, to Goianinha and to the BR101, the main federal road connecting the capital cities of the Northeast region. The former two-way movement along the Avenida is now reduced by half. Although this could theoretically reduce animation in the area, it should be taken into consideration that accessibility properties are not sensibly affected by the new roadworks and that return routes across a busy and densely occupied area may contribute more to bring congestion than to boost animation. This idea is strengthened by the fact that, on occasion, the busiest street segments in the Avenida were closed to motor vehicles after seven in the evening and residents and shop owners often argued in defense of the creation of a pedestrian-only stretch in the Avenida, now also freed of heavy service traffic, and cargo vehicles such as the frequent lorries loaded with building material that feed the expansion of resorts and holiday homes south of Pipa.

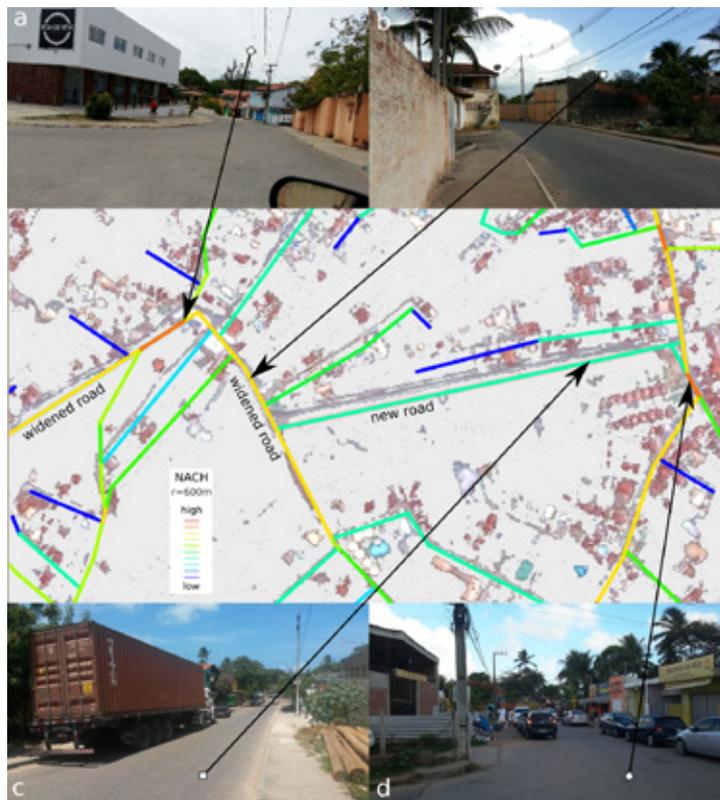


Figure 5 - Local through-accessibility [NACH, $r=600m$] and diversity of activities and users in the new and widened roads. Dataset: Google Maps (tiles of satellite, 2013); SST-QGIS; photography survey (2016-2017)

The sand stretch belonging to Pipa's central beach is even more highly accessible (in the local scale – INT $r=3$) than Avenida Baía dos Golfinhos. This is the only beach within the village borders in which a break in the cliff chain allows for pedestrian (and vehicle) access along the shore and between Pipa's lower and upper settlement. It is a diversified busy spot that has always been very important to sustain the village economy, especially related to fishing. Fishermen dwellings once occupying the beach were gradually substituted by summer houses and uses related to leisure and tourism. This diversity is not fully picked out in the land use map since various facilities are not represented as a polygon. Playing and recreational equipment, a garage for fishing and leisure boats, huts in which an ample variety of goods, especially food and drink, are sold and the numerous table-plus-umbrella spread, besides the appealing rock

topped by the statue of Saint Sebastian (Pipa's patron saint) are such examples. These share space with restaurants, hostels, a chapel that lost its former view of the sea, screened from it by the many summer homes.

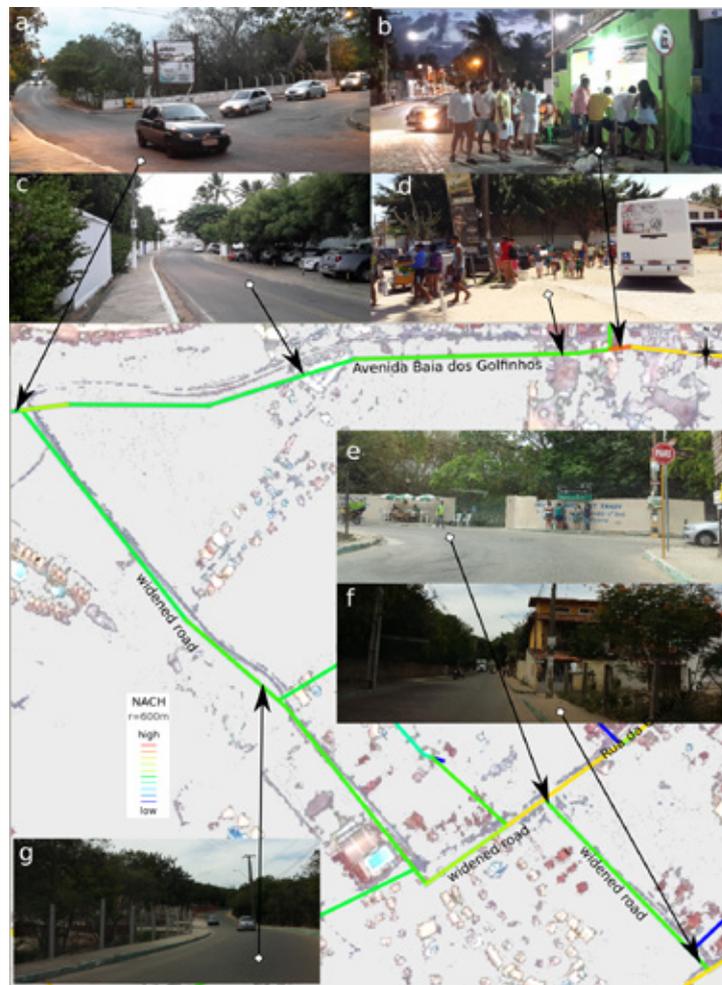


Figure 6 - Local through-accessibility [NACH, $r=600m$] and diversity of activities and users in the Avenida Baia dos Golfinhos and the widened streets. Dataset: Google Maps (tiles of satellite, 2013); SST-QGIS; photograph survey (2016-2017).

The highest accessible line in the grid runs along summer residences, this being a good reason to distinguish “vacationer” (or “non-residential”) from “residential” in the 2006 plan, thus emphasizing the contours of an active space in the light of Vaughan et al. (2009). Intense pedestrian movement coincides with high local accessibility there. As has been mentioned earlier, the occupation by holidaymakers dates, at least, from the early 20th century, when the dam that separated the Lagoa de Guarairás from the sea burst and flooded Tibau do Sul’s urban settlement so that sugar mill farmers from Goianinha that used to spend their summers there, opened tracks in the woods between Piau and Pipa, and initiated the beach as a vacationers’ destiny. The accessibility measures relating to pedestrian footpaths along the beach appear to capture the memory of this occupation.

The diachronic segment representation shows that the road ring reduces some of this high local accessibility. However, this should be taken cautiously as it was impossible to ascertain the moment in time (from 2006 to 2013) when segments were broken due to the enclosure of farms and plots. Part of the difficulty to represent footpaths diachronically has to do with the fact that many such paths cut through private property formerly not enclosed. Occupation was then

more permeable to pedestrians and may have been reduced by walls and fences that affected the richness of potential encounter. This could have interfered with the configuration analysis before and after the road ring.

On the other hand, the increase in accessibility in the ways running south of the village reinforces a tendency already outlined in the 2006 spatial configuration. The inverted “Y-shaped roads that fork southeast and southwest from the Avenida, which is already part of the integration core in the 2006 representation, with or without footpaths, is strengthened after the road works signaling what seems to be the route towards the formation of new linear centralities.

However, although reinforcing a configuration tendency which has been outlined a decade ago, this probable linear centrality on the make is unlike to replicate the kind of linear centrality that has helped make Pipa a lively, mixed, diverse, 24-hour magnet as it lacks the ingredients small blocks and many corners as observed by Jacobs (1961), about the conditions for city diversity, and Hillier (1999) about the process of centrality formation. Even if the sinuosity of some streets renders segment length unreliable to measure block size, the contrast within the central area is striking. The average segment length north of the Avenida is much shorter than that south of it (64.6m against 104.7m), as is the distance between blocks, considering the number of segments per kilometre (15.5 against 9.8 segments per kilometre).

The land use representation shows that routes with greater activity and variety of uses are associated to shorter segments and shorter distance between blocks as displayed in table 1 and figure 3. Animation, therefore, tends to concentrate there. A sensible difference between the north and the south ends concerning the presence of people on the street is noted as one walks along Avenida dos Golfinhos and its intersecting ways, which is illustrated by the photograph survey presented in figures 4, 5 and 6. Whereas the street images support the idea that the physical attributes in the southern end constitutes a scenario less conducive to pedestrian movement and encounter, the list of non-residential land use found there reinforces the idea that we are witnessing the formation of a linear centrality that favours large developments and functions, whose movement nexus is that of the automobile.

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