

# GIS-ASSISTED IDENTIFICATION OF HISTORIC DISTRICTS: A CONCEPTUAL MODEL CASE STUDY IN PLANALTINA, BRAZIL

PEDRO PAULO PALAZZO

---

**ABSTRACT** — Georeferencing and digital databases are being used increasingly as tools for the identification, visualization, and management of cultural heritage sites. Likewise, typological models are useful for classifying buildings and structuring knowledge about historic urban districts. The merging of these two approaches provides increased spatial awareness of the built fabric, especially when studying entire neighborhoods whose character is yet to be formally defined. The historic preservation survey of the historic center of Planaltina, a nineteenth-century town in central Brazil, provided a test case for this combination. The site boundary as well as the defining character of the site had to be derived from the survey itself. To achieve this, the survey team recorded on a relational database each building lot as an assemblage of morphological features. Each database record was then linked to the lot's spatial location using a Geographic Information System. This setup delivers dynamic maps providing direct visual assistance for the team in defining the limits and dominant character of areas of historic interest within the site. In turn, the results assist in the definition of values to be preserved as well as design regulations to be enacted for interventions and infill projects in each area.

---

## INTRODUCTION <sup>1</sup>

**T**he identification and management of heritage sites is, ideally, supported by extensive historical data collected from written and graphical documents, oral sources, and archaeological evidence (Cohen 1999, 99). In a conventional workflow, this data is provided directly to historic preservation scholars, managers, and practitioners, who will then draw conclusions from direct

analysis of the material. Often in such a process, the general perimeter and character of the historic site are assumed beforehand—as given by prior historiographical interpretations or put forward by the preservationist movements themselves (Fiori 2012, 288). The historic preservationist's role thus focuses on determining specific criteria for preservation of a well-known set of objects.



Fig. 1. Geographic situation of Planaltina within Brazil. (Author's drawing.)

The gradual transformation of historic preservation practice from the conservation of “monuments” to the safeguarding of “social values” and nonelite living cultures, however, increasingly brings up the need to work out both the spatial reach and the defining character of a heritage site as part of the process of identifying the site. The uncertainties brought about by a wider understanding of heritage (Araoz 2008, 36) have had particular bearing upon the Americas. The determinations

of “The Venice Charter” (ICOMOS 1964) and “The Nara Document on Authenticity” (ICOMOS 1994) were quickly tempered by continental responses in Quito (OAS 1967) and San Antonio (ICOMOS 1996), highlighting the specific situation of sites in the Western hemisphere. In particular, the intensity of informal urban growth at the margin or in contempt of regulations, the prevalence of culturally and politically disenfranchised groups in many historic districts, and the lesser accumulation of

historical and archaeological records pose greater challenges to identification, enactment, and enforcement of heritage preservation in the Americas (Adams 2004, 1–2).

Nevertheless, in Brazil, the same voices that raise awareness of these issues are eager to consider legislation and charters, especially the Venice Charter, as godsend and gospel (Adams 2004, 4, as opposed to Kühn 2010, 293–298). This simplistic view hinders an accurate observation of multilayered urban sites and, consequently, the development of analytical tools suited to their complexity—particularly with an insistence on stylistic unity as a major criterion for listing, inherited from the totalitarian “patrimonial canon” at the root of Brazil’s national heritage service in the 1930s (Williams 2001, 103).

To counter this oversimplification, the National Historic and Artistic Heritage Institute (IPHAN) of Brazil has developed since 2006 a methodology known as the Integrated System of Knowledge and Management (*Sistema Integrado de Conhecimento e Gestão*, or SICG) (Martins and Rossignolo 2013, 63). The system’s dual nature aims to promote, as its name suggests, integration between the gathering of information and its use for the management of cultural sites, properties, and objects while standardizing data structure and content for every item that is listed or identified by IPHAN.

Under the aegis of this system, IPHAN contracted in 2012 for an inventory of the historic core of Planaltina, a town in Brazil’s Central Highlands then under consideration for heritage status (Figure 1). Confronted with a large, highly altered, and diverse site, the contracted team developed a typo-morphological approach to defining architectural character. Survey data was spatialized with a geographic information system (GIS) to analyze the existing fabric and suggest an outline for various historic sectors within the district, each with preservation criteria fine-tuned to its particular character. This methodology can assist in managing historic districts that are heterogeneous or in poor condition, due to its ability to process large amounts of information and present historic preservationists with easily grasped interpretations regarding the spatial distribution of architectural features and building integrity.

Spatial analysis has come to be widely employed in historic preservation research and management as a result of its use in urban morphological research and design, economics, demographics, and other disciplines that have benefited from the quantitative manipulation of qualitative data (Abeyaselera 2017). Most applications of georeferencing in historic preservation, however, have so

far focused on mapping objects or features that are otherwise known and interpreted prior to their spatialization (Bryan 2010; Gilbert 1991; Lo 2007; Skarneas 2010).

The research and development outlined in this article, on the other hand, consists of a proof of concept that GIS can be used not only to visualize information but also to automate preliminary analysis of large amounts of data from urban areas more effectively in combination with a database of morphological features. This was achieved by, first, entering simple bits of architectural form into a morphological tree. Each building’s database record was then associated with these architectural elements and linked to the plan location of its corresponding lot. Combinations of certain architectural features were used to define *building types* or *styles*. Finally, the researchers ran queries on the database for these combinations, resulting in maps that showed the spatial distribution of the different types, styles, and conservation states. These combinations and the maps resulting from them allowed the team to define morphological sectors and establish each sector’s character-defining features from the predominant architectural element combinations in their respective area.

## HISTORY AND GROWTH OF PLANALTINA

The Portuguese conquered the South American hinterland now comprising the State of Goiás during the first half of the eighteenth century. A gold rush resulted in a string of villages settled mostly along the highways—mere mule paths with tolls—connecting the Western frontier to the Atlantic Ocean, typically along ridges (Barbo 2010, 175; Magalhães and Eleutério 2008, 102).

The gold rush in Goiás was followed by a long economic slump and urban decline lasting from the 1770s until the 1880s (Bertran 2011, 252; Furtado 1977, 107). The townsfolk could hardly be called “urban” by current standards; French botanist Auguste de Saint-Hilaire recorded that “a few menial workers and merchants excepted, all of the inhabitants of Santa Luzia work the land, and come to town only on Sundays and holidays; thus, during the week, no one is to be seen in the houses nor on the streets” (Saint-Hilaire 1848, 2:14).

Goiás experienced significant economic progress as its beef and leather exports rose in the late nineteenth century. In the early nineteenth century it was the least populous diocese in Brazil, with fewer than 120,000 people (Simonsen 1937, 2:328). Even at the time of the first national census, in 1872, Goiás barely exceeded 140,000 people, compared to the nation’s 9.9 million.

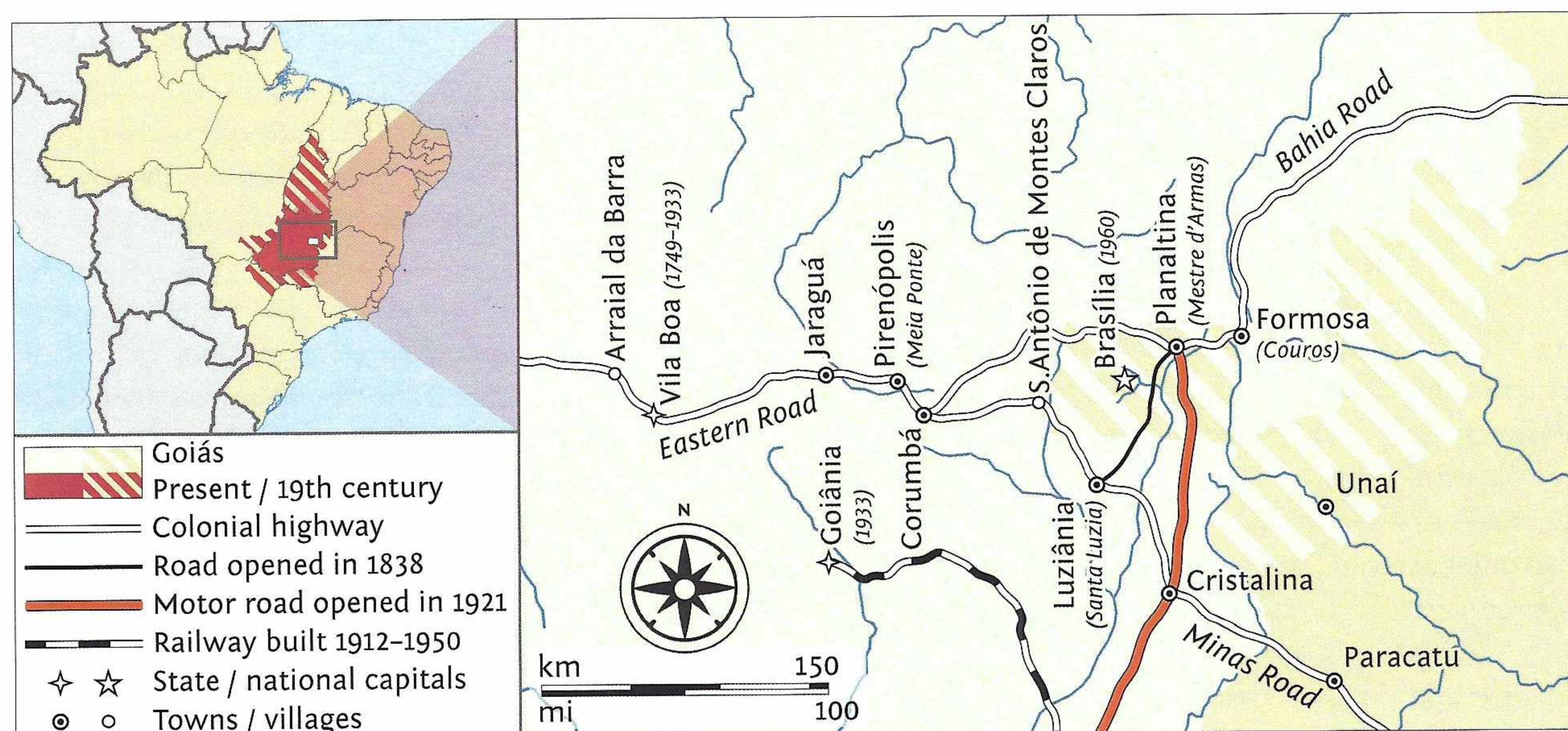


Fig. 2. Planaltina in relation to the road network in Brazil's Central Highlands before 1960. (Author's drawing.)

In 1900, the population of Goiás had reached 255,000 (SEPLAN 2003, 13), and over the first two decades of the twentieth century, its population growth was almost double the national average.

The present site of Planaltina, originally known as Mestre d'Armas, has since 1741 supported three cattle ranches in the form of *sesmarias*, or land grants by the crown (Bertran 2011, 307).<sup>2</sup> Its savanna pastures were irrigated by streams flowing from three lakes atop the highest plateaus of the Central Highlands. The future site of the town, at an altitude of 950 meters, commanded a ridge road between impassable river gorges to the north and a wide basin with south-flowing rivers (Bertran 2011, 49). One of the old colonial highways, the Bahia Road, ran just north of the site (Figure 2). The closest urban settlement, Couros (present-day Formosa), was founded in 1768, forty kilometers to the east (Silva 2011, 5).

In 1811, the holders of three *sesmarias* founded an expiatory chapel on their lands, dedicating for that purpose one league of land on the eastern bank of the Mestre d'Armas stream (Figure 3); the parcel extended half a league (approximately three kilometers) eastwards from the streambed, and had an area of about eighteen square kilometers (Castro 1986, 67; Silva 2011, 6). By 1838, the land deeded to the Catholic Church had been subdivided for urban dwellings (Figure 4), and in that same year a new road was opened, linking Couros to Santa Luzia through Mestre d'Armas (Castro 1986, 20–21). In 1859, Mestre d'Armas was erected a district of Couros, and in

1880, a new church was built to mark the establishment of a parish serving the district.

Regional economic prominence shifted from the former gold-mining town of Santa Luzia to the merchant town of Couros and its cattle-ranching surroundings during the late nineteenth century; Mestre d'Armas benefited from this change and saw its population and urban area grow. The incorporation of Mestre d'Armas as a town, in 1891, acknowledged its growing importance, so much so that it was beginning to overshadow Couros—now known as Formosa.

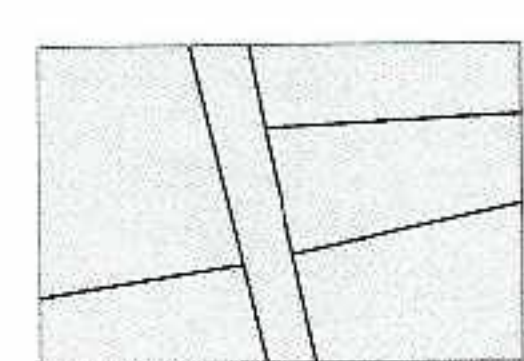
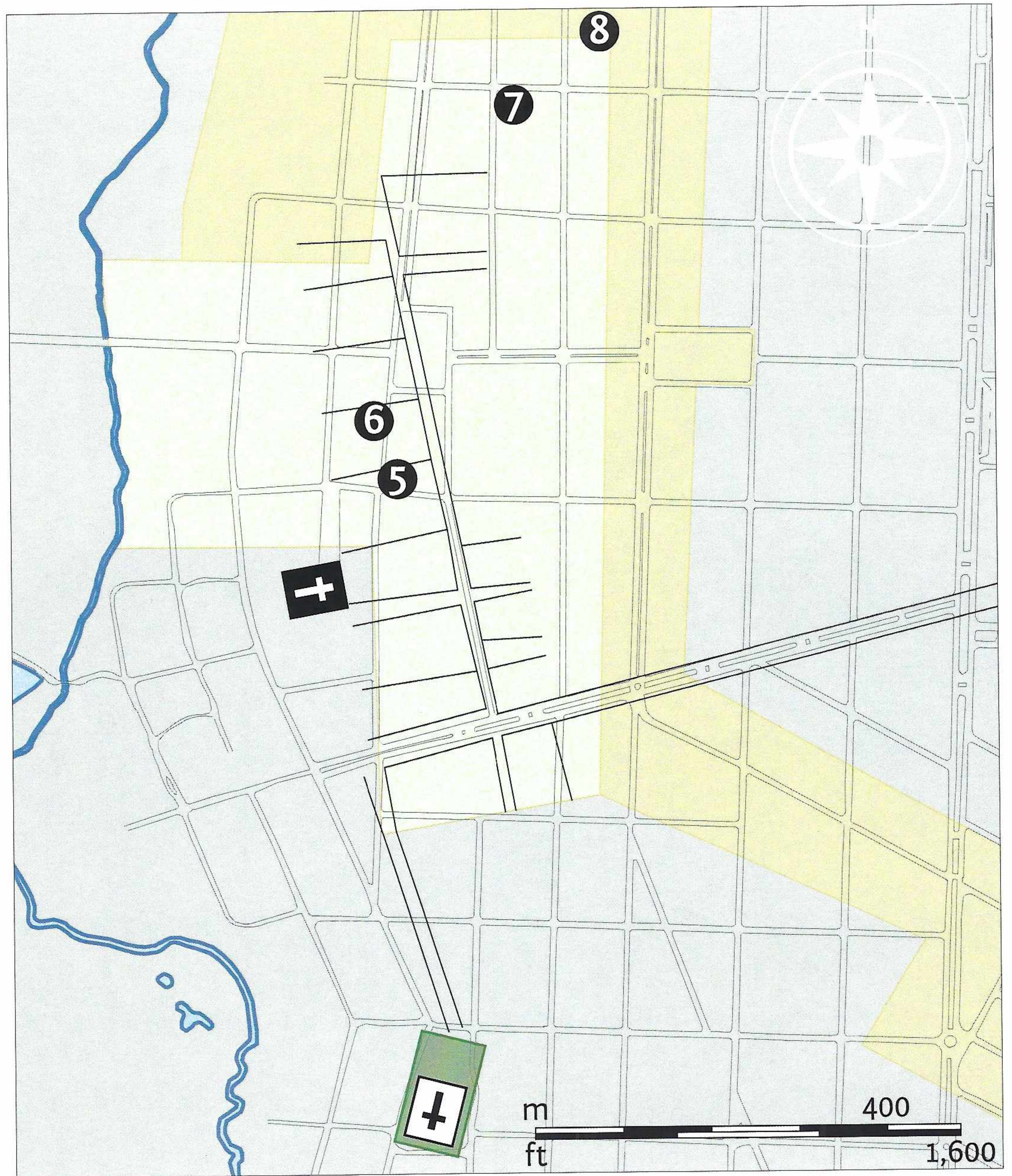
Indeed, the 1910 yearbook for Goiás had no entry for Formosa, but had one for Mestre d'Armas. The latter was described at length, having around 1,000 inhabitants in town and as many in its rural jurisdiction (Azevedo 1910, 171–72). This number was unusual in preindustrial Brazil, where 80 percent of the population lived in the countryside, and more characteristic of a thriving commercial hub. The entry described the town as having some one hundred houses built on five streets and two squares. This structure supported twelve craft shops and four stores.

Mestre d'Armas did not cease to grow during the first half of the twentieth century and was renamed Planaltina in 1917, in reference to the highlands (*planalto*) that had been earmarked for the construction of the new national capital. Throughout the 1920s and 1930s, the wealth and statewide prestige of Planaltina's landed elite brought technical and economic improvements: a

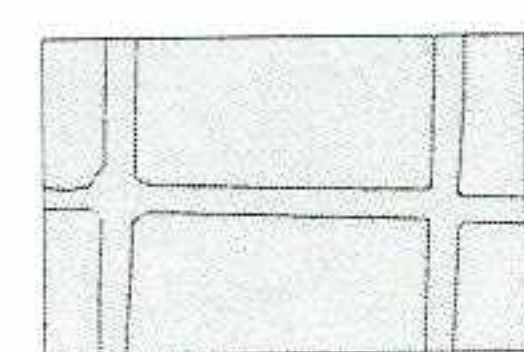


Fig. 3. Site plan showing the urban area of Planaltina, survey perimeter, and historic core with one-meter contour lines. (Author's drawing.)

Fig. 4.  
Reconstructed  
original subdivi-  
sion of  
Mestre d'Armas  
overlaid on  
the present-  
day street  
grid. (Author's  
drawing.)



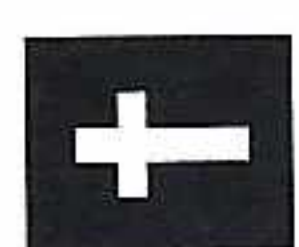
Reconstructed  
pre-1838 subdivision



Street grid developing  
1895-1966



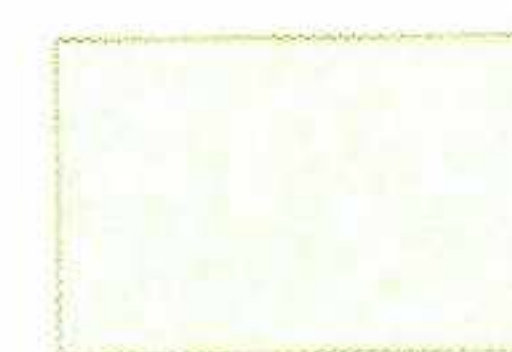
Buildings referenced in  
numbered figures



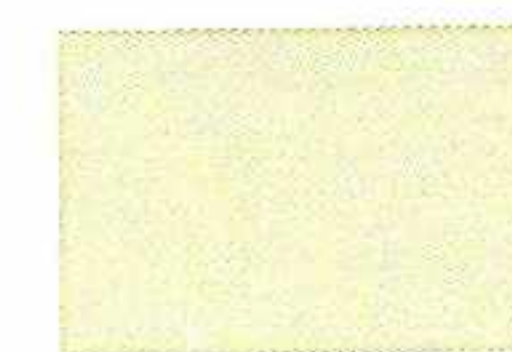
Parish church (1880) &  
likely site of 1811 chapel



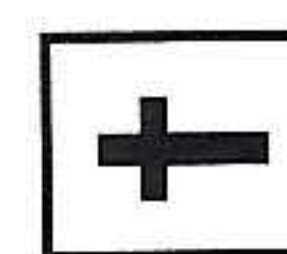
Cemetery (1811 or 1893?)



Urban area ca. 1925



Urban area ca. 1958



Other possible site  
of 1811 chapel

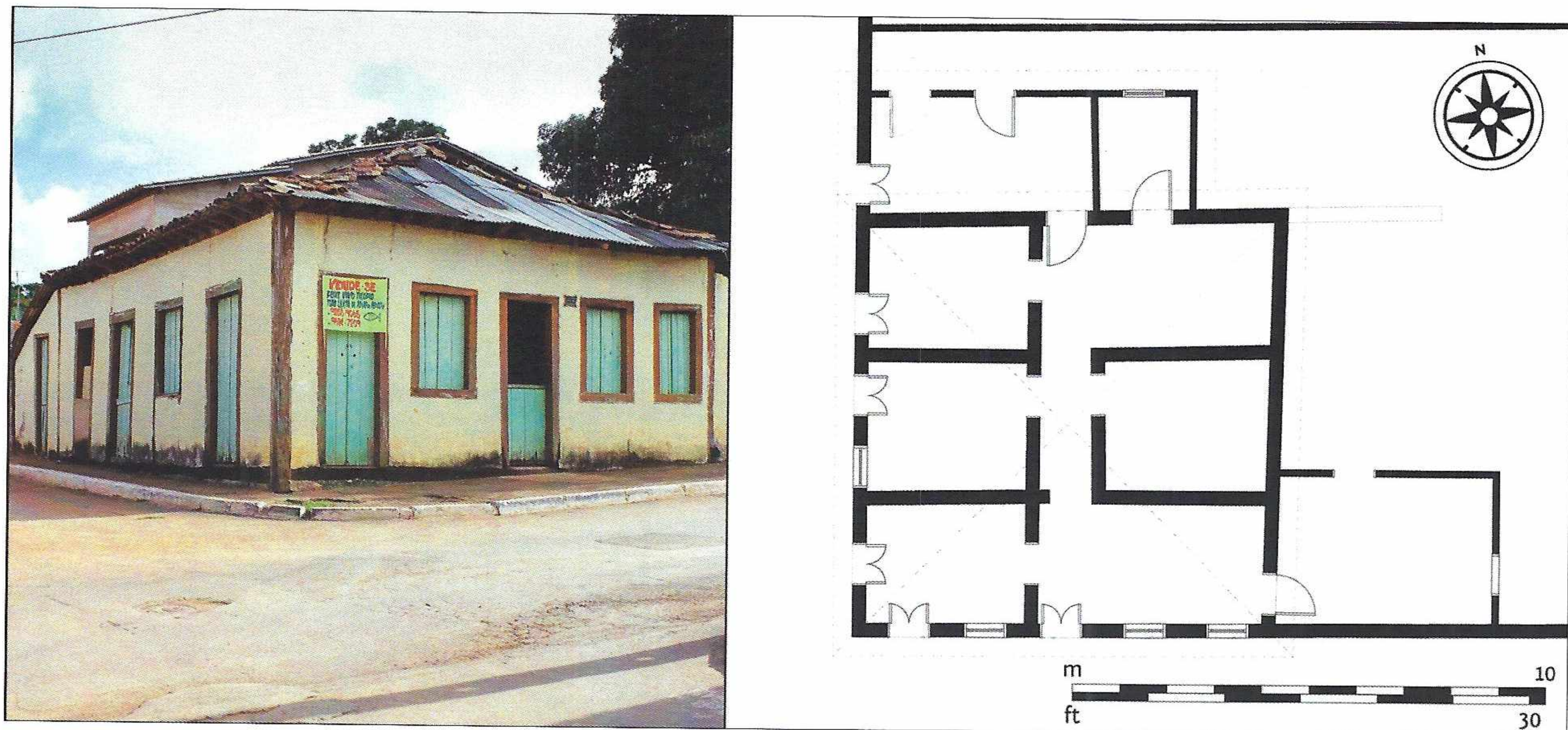


Fig. 5. House of Dona Negrinha, built 1896. (Photograph and plan by the author, as surveyed in 2010.)

power station and telephone link, two new motor roads, and an airfield (Castro 1986, 31–34).

The inauguration of Goiânia in 1933, however, signaled the increasing economic importance of rail links to the south at the expense of the old east–west road. Planaltina’s urban population peaked at that time, at 2,000 inhabitants, whereas formerly smaller villages farther south were surpassing 10,000. Construction of all of the public buildings in Planaltina was either completed or abandoned by 1942.<sup>3</sup> The development of the nation’s capital, Brasília, begun in 1956 and inaugurated in 1960, dealt the final blow to the prosperity of Planaltina (IPHAN 2012). Its urban area ended up within the borders of the new Federal District. The new paved highway, built in 1958, bypassed the town altogether. The attraction of Brasília stifled commercial and manufacturing growth, while migrant workers began to settle in large numbers in Planaltina, soon outnumbering the locals (Campos 1985, 12) The historic center of Planaltina is nowadays drowned in a dormitory satellite town of over 100,000 inhabitants, while the pressure of the real estate market and the enduring fascination with modernity threaten its architectural heritage.

### BUILDING TYPOLOGY

The urban house type that became dominant throughout central Brazil in the eighteenth century arose from an adaptation of rural housing in southern Portugal and its Atlantic islands. The plans of these houses had a main

room and kitchen separated by one or more alcoves.<sup>4</sup> All spaces were distributed around a central or lateral hallway that ran from the front, flush with the street frontage, to the back of the house (Moutinho 1995, 141–52). In Brazil, the kitchen was often relegated to a separate shed, and the main building developed between a common room at the front and the “veranda”—actually a family and dining room—at the back (Oliveira 2001, 165–66).<sup>5</sup> The late nineteenth century brought updates in the dwellings of Goiás.<sup>6</sup> Main entrances through side setbacks and suites of rooms started being added to existing houses as well as to new plans (Oliveira 2001, 179). This occurred in response to the recent hygienist ideals imported from larger cities such as Rio de Janeiro and São Paulo (Lemos 1999, 29).

Only a handful of nineteenth-century structures remain standing in Planaltina, the oldest reliable dates being 1880 for the rebuilding of the chapel and 1896 for a small house nearby (Figure 5).<sup>7</sup> This house shows all the standard features of the colonial dwelling type in Goiás, both in plan and structure. Atop a shallow, rough stone foundation, adobe walls are set within a wooden frame. The adobe and wood are painted in pastel colors—although whitewashing the walls was a more widespread practice. Its hipped roof is supported on posts and beams; proper trusses are seldom seen in these traditional houses, and gutters would come into common usage only in the twentieth century.

In 1926, Planaltina witnessed the construction of its earliest known example of a transitional type—a former clinic dubbed the “Blue House” (Figure 6)—along a newly



Fig. 6. Blue house, built 1926. (Photograph and plan by the author, as surveyed in 2009.)

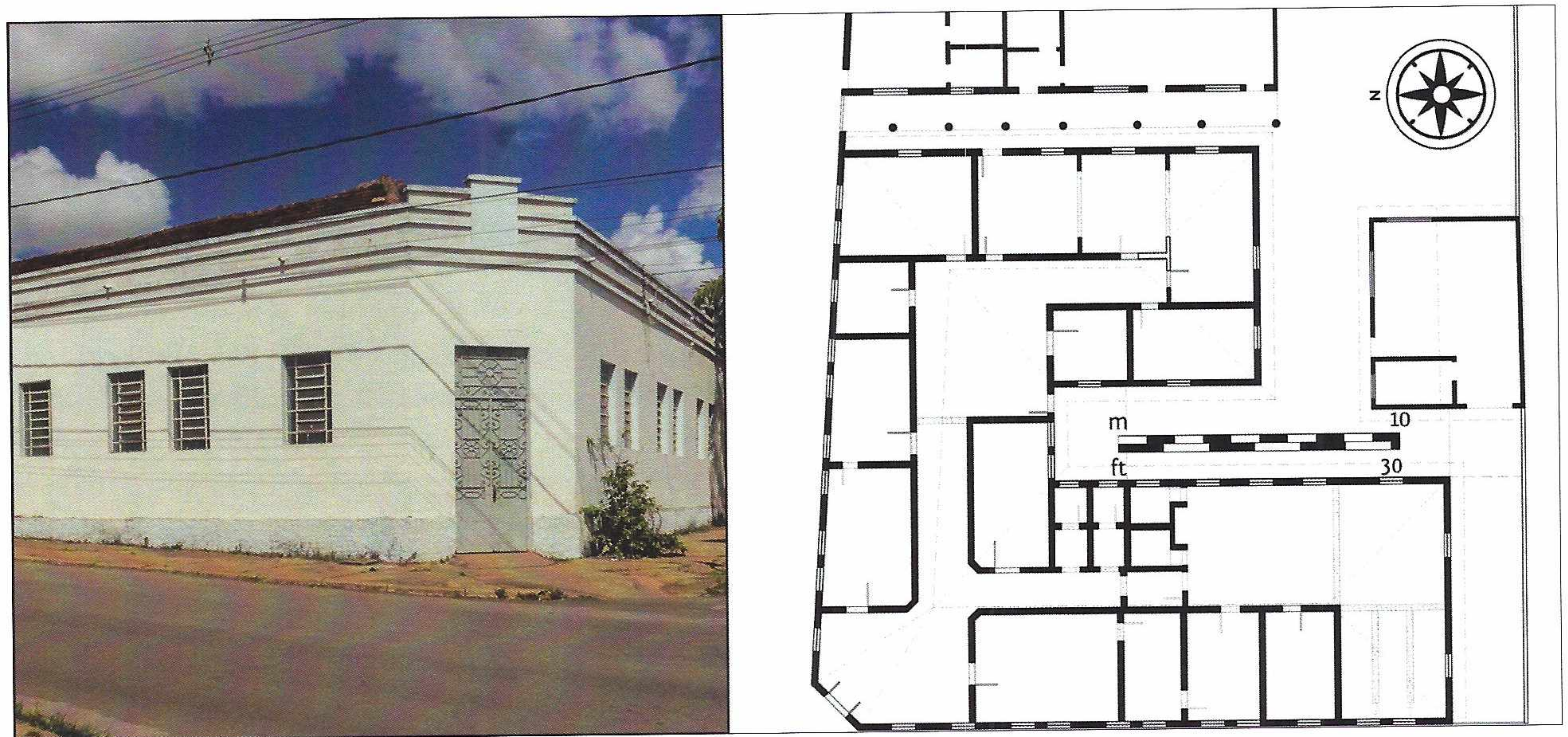


Fig. 7. Mayor's office, built 1942. (Photograph by the author, 2017, and plan surveyed by the Federal District Culture Department, 2011.)

opened avenue, which indicated a shift in the main axis of urban development. It consisted of a standard colonial layout, yet had two side porches leading directly to a much bigger and more dignified common room at the back. It was later enlarged with the addition of an indoor kitchen. That house was also innovative in that it displayed a neoclassical fired-brick facade, stuccoed and painted, topped with an attic hiding the roof.

This pattern echoes eclectic house plans and facades built in larger cities since the second half of the nineteenth century and attested in the state capital since the 1910s. From then on, eclectic and art deco features became common in new buildings. The most iconic examples are the eclectic town council building, completed by 1932, and the art deco mayor's office, inaugurated in 1942 (Figure 7).



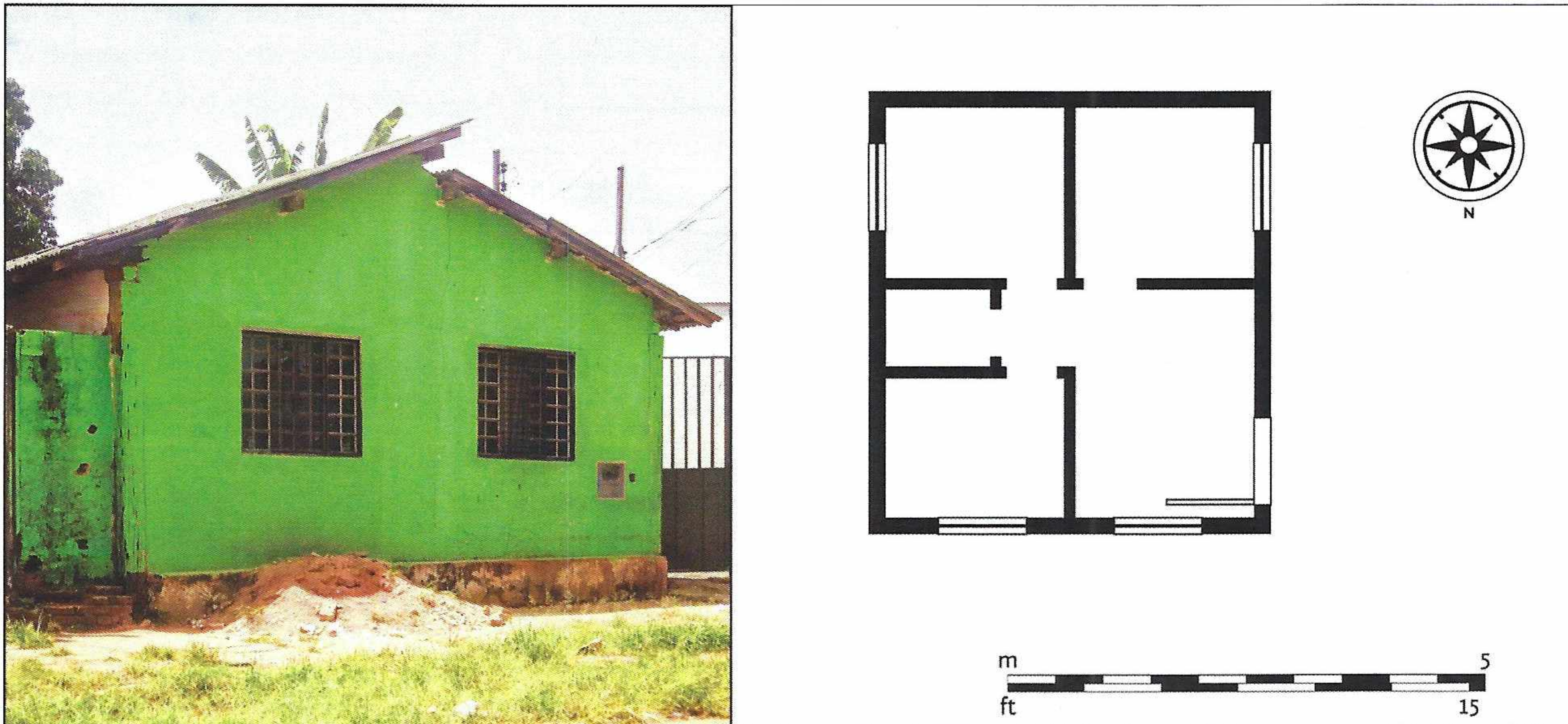


Fig. 8. Post-1969 social housing. (Photograph by Alessio Gallizio, 2012; plan after Labaki and Kowaltowski [1998, 66].)

The introduction of transitional housing types thus occurred at the time of the last two urban extensions. This was also the period in which modern infrastructure—in the form of a power station, telephone lines, and an unpaved motor road—came to Planaltina. This did not, however, mean the disappearance of the colonial type, which continued to be built as late as 1965, using a curious mix of traditional roofs and adobe walls with prefabricated steel doors and windows.

In 1969, a new housing type was introduced in conjunction with the development of a huge low-income subdivision to the east of the historic center, eventually spreading to the older center of Planaltina (Figure 8). It had a compact shape with gabled asbestos roofs over fired-brick walls, with or without a concrete frame. The free plan usually accommodated a living room at the front, kitchen and bathroom in the middle, and bedrooms at the back.

More recently, two-story contemporary houses, large commercial buildings, and flats have been transforming the skyline and density of the historic center of Planaltina. Despite the current prevalence of narrow lots as a result of recent subdivisions, contemporary single-family houses are detached whenever possible, even if this means leaving only the narrowest of passages on either side. They also have front setbacks, often used to accommodate grade changes, and garages at the front, as well as high walls secluding the front yards. Despite all these changes, it is remarkable that a few recent houses still retain the

traditional compactness of volume and hipped roof shape of their older counterparts.

This architectural landscape comprises folk and vernacular building traditions (Noble 2009, 8–9). The restricted range of techniques and forms employed attests to economic constrictions, geographic isolation, and social stability through time, at least up to the construction of Brasília. This context presents pitfalls to interpretation, not the least the risk of patronizing approaches to local knowledge (Glassie 1976, 8). The classification schema outlined below attempts to acknowledge Planaltina's built heritage on the basis of its intrinsic morphological aspects, to the extent that one may claim a certain neutrality with respect to the assessment of what constitutes architectural form.

The schema seeks to demonstrate both historical transformation and continuity in the architectural patterns, where each occurs. Indeed, single-family housing construction in Brazil—the dominant stock in Planaltina's historic core up to this day—is characterized by the informal market, ranging from the self-built to popular appropriations of historic or recent forms (Lara 2009). This production evidences shared cultural norms as well as dominant building processes (Rapoport 1969, 129) that change slowly through time and overlap one another. In this situation, few buildings can be named as canonical exemplars of each type. The most common situation, rather, is the combination of design and material features from two, or even three, different types in a single house.

## THEORETICAL FRAMEWORK

The study of large, heterogeneous urban areas for the purpose of historic preservation must be approached with a solid methodology to provide a sense of the global web (Cohen 1999, 85), but this must be done while striving for a consistent picture of the built fabric itself. Traditional approaches since the founding of the earliest preservation organizations have emphasized the identification of aesthetic and historical values in individual structures or well-delimited ensembles (Jokilehto 1999).

This approach succeeded in protecting exceptional masterworks as well as vernacular buildings and urban sites of regionalist or nationalistic relevance, particularly when they are perceived as homogeneous. Prime examples of such sites are Colonial Williamsburg (Murtagh 1997, 36) and, in Brazil, the city of Ouro Preto, a World Heritage site since 1980, widely—though mistakenly, according to Vieira (2016)—believed to be a pristine example of eighteenth-century urbanism and architecture.<sup>8</sup>

The individualized approach, even if explicitly articulated in a justified discourse, breaks down when confronted with large sites that cannot possibly be taken in intuitively as a whole. Empowering local communities to make this assessment does not necessarily lead to very different processes, but only to broadening the scope of historic sites to comprise those of previously marginalized groups (Johnston 1992). It often leads to a piecemeal approach toward large areas, such as in the process of listing sites in the “Old Paris” (Fiori 2012).

Incidentally, it was such a grassroots movement that gained momentum in Planaltina starting in 2009 (Paulino et al. 2012, 26), and this led, indirectly, to the IPHAN decision to contract for a survey of the town’s historic center in 2012. The aforementioned SICG procedure that is now IPHAN’s standard method of identifying and managing historic sites is more systematic than its predecessor, the National Inventory of Properties and Urban Sites (*Inventário Nacional de Bens Imóveis e Sítios Urbanos*, or INBISU), begun in 1989 and expanded to support the *Monumenta* program in the early 2000s (IPHAN 2007, 15–16). *Monumenta* was the first Brazilian attempt to integrate management of listing procedures and restoration work across entire historic centers, encompassing both public and private property.<sup>9</sup>

SICG inherited from the INBISU a threefold record format for collecting information on architectural features, state of conservation, and property management (IPHAN 2007; Mongelli and Schlee 2016, 335). The

INBISU approach to describing architectural form consisted of a checklist of morphological or constructive elements and their respective materials. SICG did away with much of this list in favor of descriptive text, thereby sacrificing standardization for adaptability to every conceivable historic site.

On the other hand, this change communicates the prevailing ideology among IPHAN’s officials over the years—the institute was founded by modernist intellectuals and architects in 1937.<sup>10</sup> Especially after the retirement of the older Beaux-Arts-trained architects of the institute, official design and construction guidelines have either strictly upheld Article 9 of the Venice Charter—the (in) famous “contemporary stamp” requirement—or been style-agnostic (at least formally).<sup>11</sup>

The series of manuals issued by IPHAN as technical guidance for cities taking part in the *Monumenta* program covers only material or procedural aspects and does not delve into the matter of design compatibility and contextualism. For instance, the “Project Planning Manual” issued in 2005 as part of the *Monumenta* program takes “typological analysis” to mean an assessment of existing style, historical authenticity, and the occurrence of “unarchitectural” additions (Gomide, Silva, and Braga 2005, 26). While the latter evidently implies value judgment, the manual is silent on what is to be made of the existing styles and building types—whether new design is to be compatible or distinct.

As to the issue of organizing data spatially, the SICG’s implementation of GIS is rudimentary. It merely pins whole records to geographic coordinates, but does not provide tools for analyzing specific information as spatial elements. Since GIS is rapidly becoming the standard method of visualization and follow-up for historic sites, this is a significant drawback. Established or experimental practices in historic preservation commonly involve plotting quantitative information from a database as points or areas on a map. This can be achieved at any scale, as there are examples of GIS used for locating features within single rooms (Banta, Diebolt, and Gilbert 2006).

Still, the interpretation of spatial data most often is a task entirely outside the scope of digital tools and, therefore, left to the practitioner’s intellectual skill, or even to his or her intuitive feel for the site at hand. What was required in the case of a site as large and as diverse as Planaltina, with over 400 buildings, was a method to automate preliminary pattern recognition. This would assist the survey team in making initial decisions about

the identification of discrete historic districts, as identified by means of architectural features.

Precisely such a technique predated the widespread adoption of GIS as a historic preservation tool, and it could be easily adapted to the digital resources of the present day. Between 1989 and 1992, a team led by Adriana Baculo Giusti from the University of Naples established a systematic procedure for recording the built fabric of Italy's third-largest city.<sup>12</sup> The product of the project, *Napoli in assonometria* (Axonometric Naples), was ostensibly a graphic exhibition of the city as a line drawing.

Behind this product, however, was a database of standard descriptions for all the architectural forms that could be assembled to represent every building conceptually as well as visually (Giusti et al. 1995, 74–78). The spatial representation itself was not georeferenced, but the concept could be easily implemented on GIS. The originality of this approach is that it distinguishes the identification and representation of morphological character both from the task of recording formal elements and from the direct cartographic visualization of simple data in space (Coppo 2010, 15).

To achieve this, *Napoli in assonometria* was built as a relational database—meaning that data was not only accessible in a two-dimensional spreadsheet but that several relationships could be established simultaneously between the “lines” of data and across a large number of tables. A relational database is composed of several tables, each with two-dimensional data, and any number of rule sets determining the ways in which records in one table relate to, or *join*, elements in one or more other tables.

In this case, architectural features were organized in a hierarchical tree. For example, facade elements comprise colonnades, rusticated bases, quoins, arcades, different types of windows, curtain walls, and so on. Roofs are subdivided into domes, pitched roofs, and flat roofs. In each of these groups, several particular forms are distinguished, such as cornice variations or projecting mechanical equipment (Giusti et al. 1995, 42–45).

This system is conceptually analogous to how Henry Glassie set about to record folk houses in Virginia by describing them as combinations of basic forms and rules for transforming them (Glassie 1976, 21–39). The general principle is that the database table provides an abstract representation of each building by referring its specific record to other tables' records defining constituent elements or processes. The database's records cannot fully reconstruct the exact appearance of each building, but they do give an accurate list of its architectural features.

When porting this concept to GIS, the records with information in a relational database could be linked to spatial features; some data processing can then be automated. In the same way that a building can be described by the combination of its elements, an entire urban district can be visualized as a set of specific building descriptions. If those descriptions are standardized to identify certain specific combinations as morphological *types* or *styles*, the resulting maps are much richer in interpretive value than output that merely presents the individual records. As a result, they not only become analytical tools but can also serve as the basis for management of historic sites.

Amoruso and Manti (2016), for instance, propose that management, not just visualization, can be made cost effective with spatial information model sets. The rationale is that digital tools can be configured to indicate clear, hierarchical relationships between semantic elements—be they parts of a structure or elements in an urban setting. These relationships, in turn, both assist the practitioner in making sense of large amounts of data and, at the same time, require her to maintain consistency in the interpretation. As long as this discipline stems from a clear vision of what sort of guidance the digital tool is expected to provide, decision making is supported and justified by strong empirical evidence, while management tasks themselves are streamlined.

### CONCEPTUAL MODEL AND TECHNICAL IMPLEMENTATION

The precedents of *Napoli in assonometria* and the related projects outlined above hint at even more powerful applications of digital tools to assist not only in the visualization but also in the interpretation of historic urban sites. In the case of the survey in Planaltina, harnessing this power was critical for the success of the project. The lack of historical documentation and of prior inventories meant that fieldwork would take up much of the manpower involved. At the same time, the analysis and drafting of preservation guidelines for the large data set to be produced—of about 2,000 buildings on the whole site, later thinned down to around 450 significant properties—required special attention to consistency and the ability to take in a great amount of information at one time.

A conventional approach to studying a historic urban site would have been to narrow down character districts from a preliminary study of background historical and cartographic records (Cohen 1999, 266ff). The team would then proceed to analyze contributing buildings in each district. In the absence of the supporting

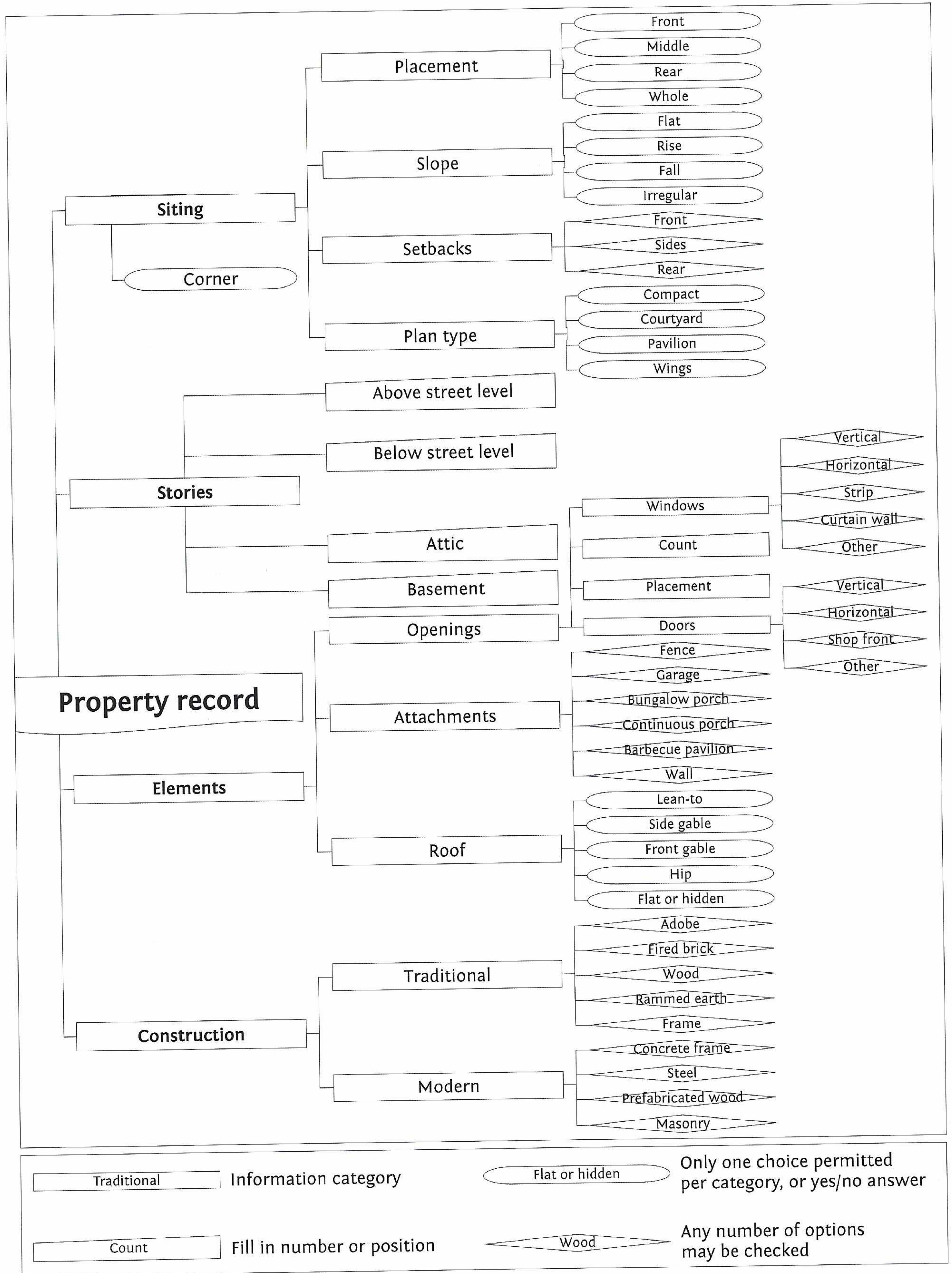


Fig. 9. Hierarchical model of architectural morphology in Planaltina. (Pedro P. Palazzo and Ana Laterza in IPHAN [2012].)

documentation required to do this, the team opted for a bottom-up approach in which the districts would emerge from the computerized processing of field survey data for each building.

The design of the system began with the construction of a morphological tree (Figure 9) based on the INBISU checklist and on the Naples hierarchy of architectural forms. These forms, as well as building materials employed, became keyword tags in a relational database, so that they could be easily attached to property records. The latter provided an identification number, geographic coordinates, and the property management information required by SICG, such as the street address and owner's contact information. The set of tags applied to each record made up a thorough, abstract description of the building.

The actual implementation of this concept owed as much to the conceptual model outlined above as to concerns for reliability and ease of use. To this end, Drupal, an open-source content management system (CMS), was used to provide an out-of-the-box, web-based interface to set up, fill out, manage, and output the database records.<sup>13</sup> A CMS database can be cumbersome to tie in to a GIS, since its tables are organized around the program's inner workings rather than readability. Nevertheless, the ease of implementation and use could not be matched by any other means—it took the author, no professional programmer and working alone, less than a week to set up its functionality and only half a day to train the five other team members to use it.

While it would have been possible to use smartphones or tablets to fill out the database directly during fieldwork (Banta, Diebolt, and Gilbert 2006), an initial test found that printed checklists would make the field survey faster—an important concern since we began work at the height of summer—and keep a secure paper trail of the data. Of the six survey team members, three were interns who did not take part in the creation of the morphological tree and were only summarily instructed in its principles before being sent into the field. We surveyed the historic core—the area known to have been developed by 1958, comprising about 600 properties—in ten working days, then made a cursory evaluation of the remaining 1,500 lots over one more week. Transcribing the checklists to database records took two of the interns another two weeks (Figure 10).

Meanwhile, a GIS was set up using the QGIS open-source program and the Federal District cadastral map.

Fig. 10. Flowchart of the survey process carried out in the inventory of Planaltina. (Author's drawing.)

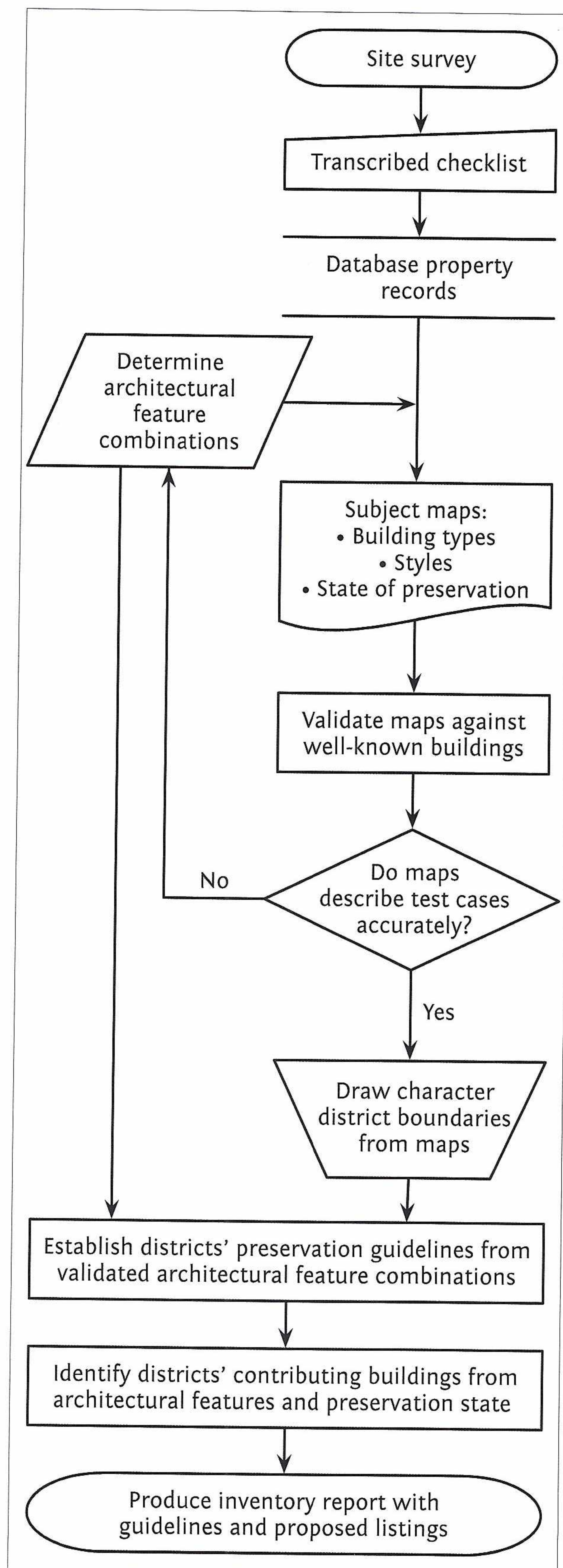


Table 1. Database query sets for types

Result	Construction	Roof	Parapet	Porch
Traditional	(Adobe) or (Frame)	Hip	No	Linear
Modern	(Adobe) or (Brick)	(Hip) or (Gable)	Yes	Entrance
Contemporary	(Brick) or (Concrete)	(Gable) or (Hidden)	Either	Entrance

Table 2. Database query sets for styles

Result	Openings	Pediment	Support	Footings
Colonial	Vertical	No	Poles	Visible
Neoclassical	Vertical	Yes	Columns	Ornamental
Art deco	(Vert) or (Hor)	Yes	Plain	Hidden
Social housing	Horizontal	No	Plain	Hidden
Postmodernist	(Vert) or (Hor)	Either	Columns	Ornamental

Each lot object in the digital map was attributed an identification number based on the respective database record, and the database itself was referenced in the QGIS project file so that it could be read on demand—though not edited, to avoid mistakes and data loss.<sup>14</sup> At this point, the program was able to output maps showing single kinds of information, such as number of stories or the occurrence of any one architectural feature on each lot.

Using the database as a tool for data interpretation, rather than mere visualization, was achieved through the development of special database queries. The distribution of the various building types and styles was to form the basis for the demarcation of preservation districts. These types and styles, in turn, were understood to be defined by specific combinations of architectural forms and materials, as shown in Tables 1 and 2.

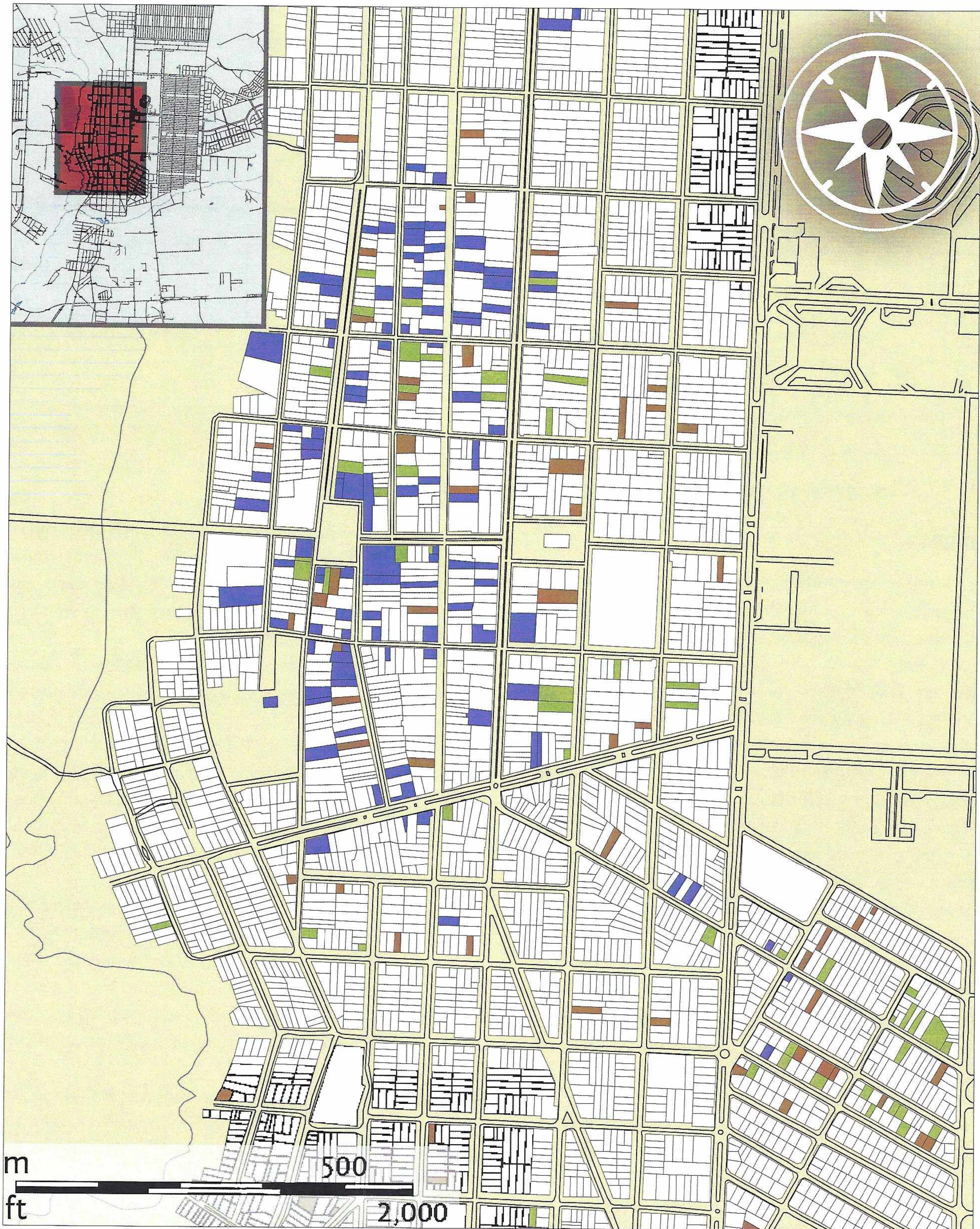
These combinations were programmed as database queries within QGIS, which was then able to render preprocessed maps—color-coded renderings of the database query results in space—of building types and styles (Figure 11). These maps generated semantic value much faster than a human sorting manually through the raw data could make sense of it. Moreover, it allowed the team members to quickly check the computed attribution of

types and styles against their own interpretations of a few chosen buildings, thereby refining the queries and weeding out errors.

The principle behind the type-versus-style matrix was taken from a Humboldtian analytical tool called the *transect*, as adapted to urban design by a founder of New Urbanism, Andrés Duany (Duany, Speck, and Lydon 2009). More specifically, the application of a two-dimensional transect table to building types was provided by New Urbanist and classicist architect Dino Marcantonio (2003), who proposed a generic classification based on two scales: rustic to monumental and rural to urban.

In the case of Planaltina, the team eventually settled on a matrix plotting types against styles. This schema accounted for the wide variety in how plan types and aesthetic features were mixed and matched by local builders. Each axis had four steps, which, put together, resulted in five categories of buildings contributing to the historic fabric; a summarized version of this matrix is shown in Figure 12.

Fig. 11. Planaltina historic district map showing architectural styles. (From IPHAN [2012].)



“Colonial”  
plan



Eclectic  
plan



Standard 1969  
social housing



Contemporary

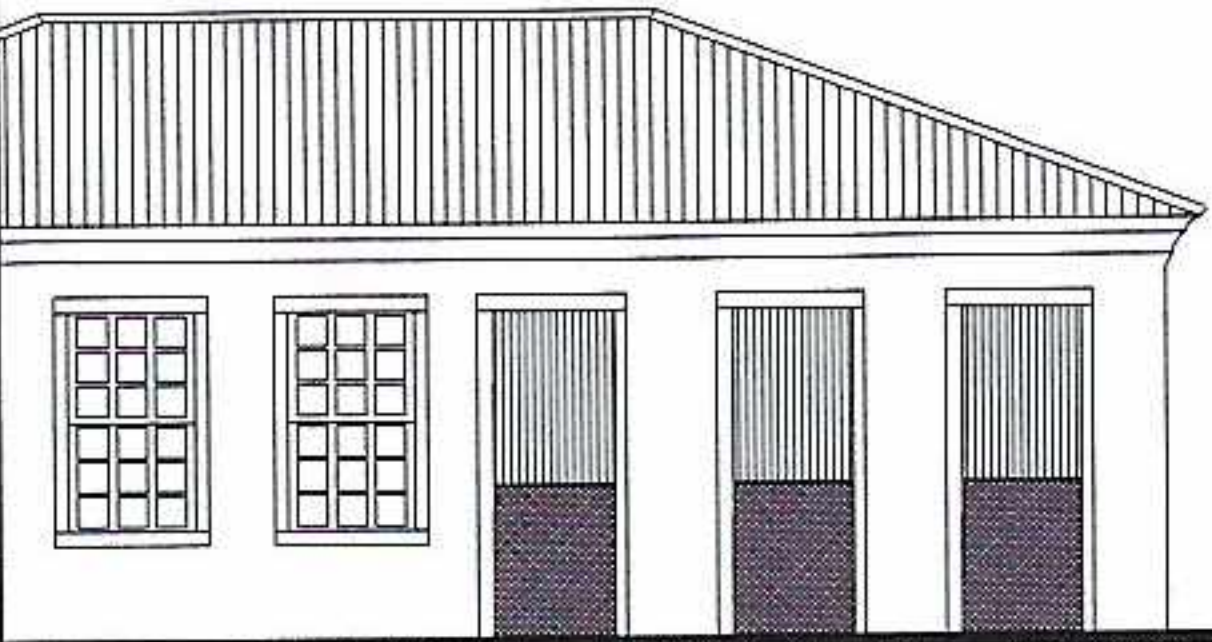

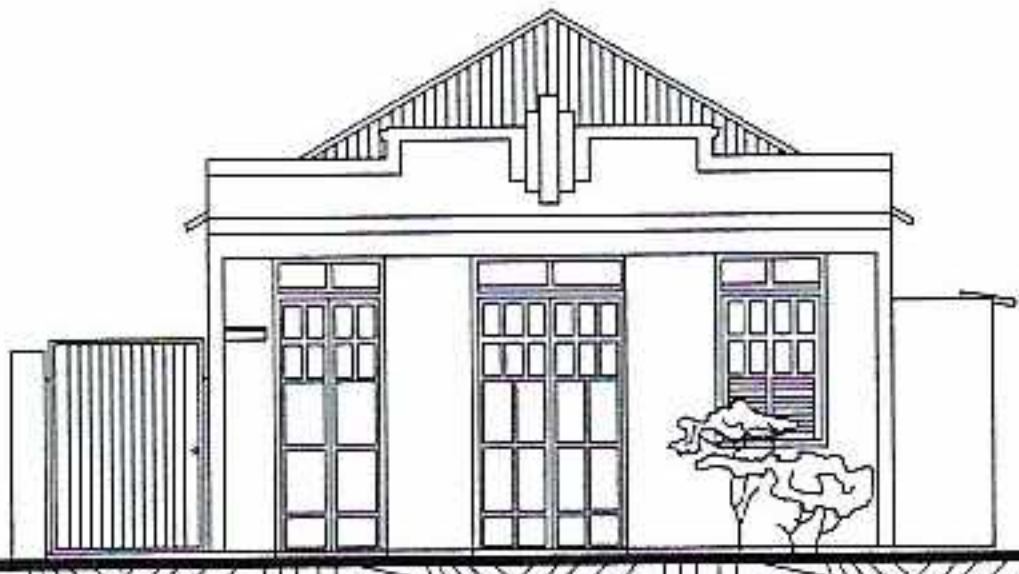
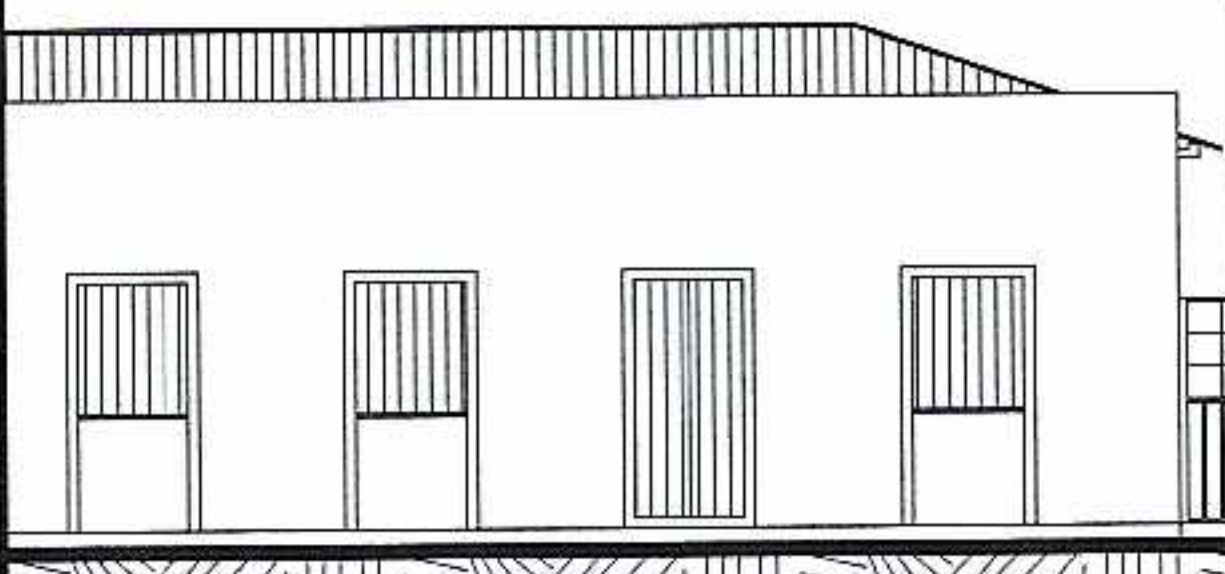
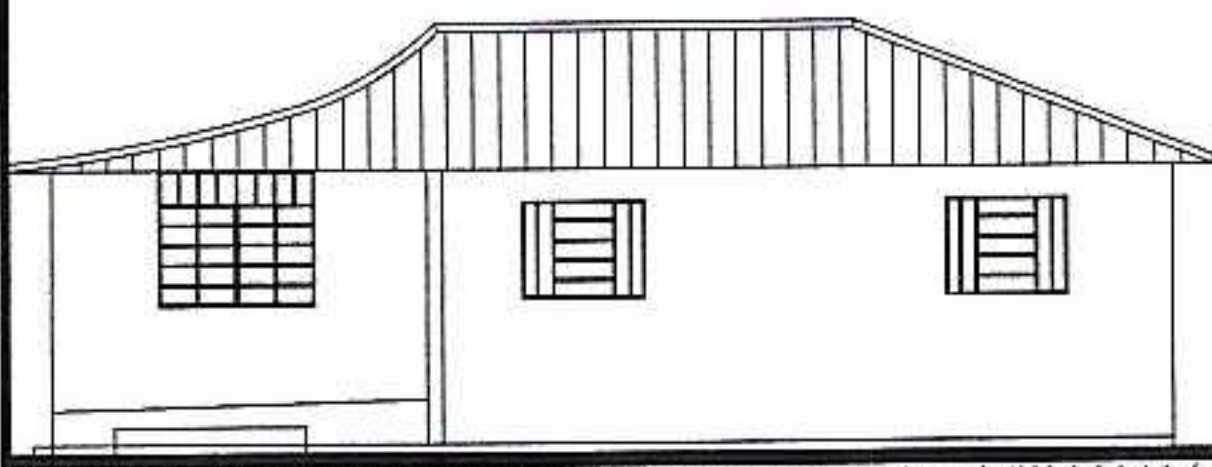
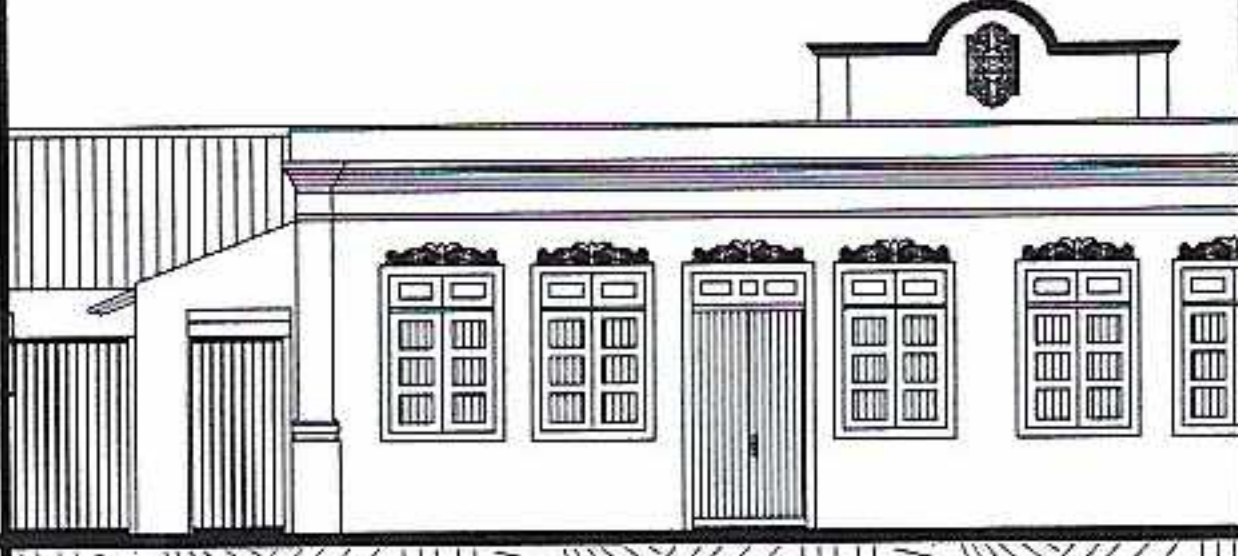
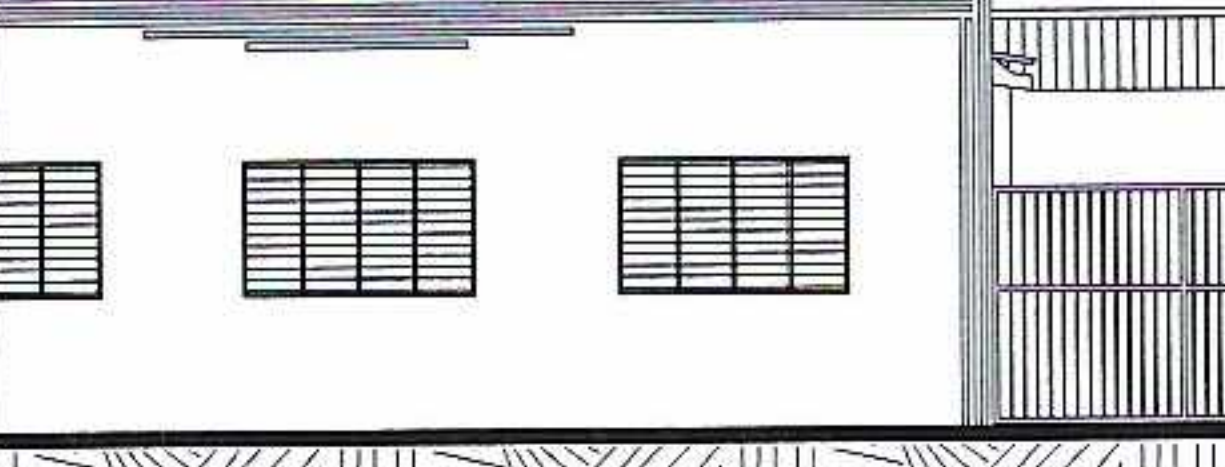
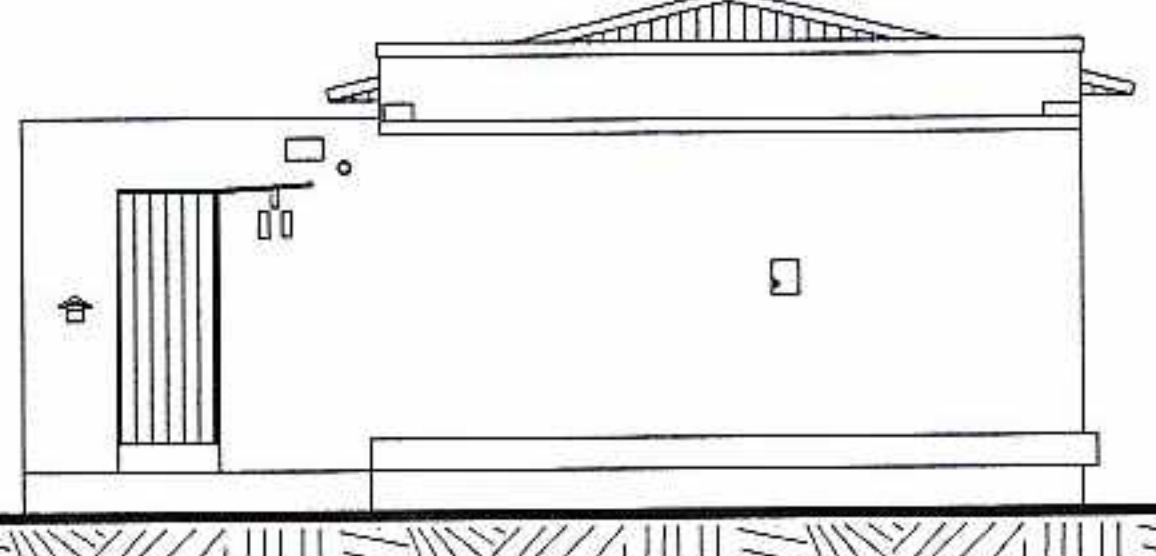
	“Colonial”	Neoclassical	Art deco	Modern
Traditional				
Eclectic-Modern				

Fig. 12. Matrix of building types and styles in Planaltina. (Author's drawing after IPHAN [2012].)

## RESULTS

From the interpretive maps, team members were able to make sense of a historic site heavily damaged by the introduction of recent buildings and alterations to older ones. Particularly, the distribution of colonial-type and art deco houses challenged a long-held assumption regarding the location of the original “main street” of Planaltina (an assumption recorded in, for instance, Martins and Pinto 1998, 22). This eventually led to a newly reconstructed history of the urban growth (see Figure 4; see also Palazzo [2014, 508]) and to the division of the site into four distinct character districts, one of which—Vila Vicentina—had been previously assumed to lie outside the historic area (Figure 13; see also Figure 11).

Because the team was able to identify both the historic district boundaries and the prevailing character in each district from the interpretive maps, establishing the criteria for preservation was relatively straightforward. After having settled that the rules should not concern style or materials, the team drew up tables for each sector (IPHAN 2012, 114–41). Building design guidelines simply mirrored the predominant architectural elements recorded in the database, such as number of stories, setbacks, roof types, porches, and parapets (Table 3).

Additionally, the maps also helped the team single out contributing buildings intended to be listed as an architectural ensemble (Figure 14). The guidelines suggested that the building envelopes and facades had to be preserved, to guarantee the historic character of the

district would remain rooted in actual surviving properties rather than abstract directives. Finally, the database was also used to extract building-by-building cadastral reports, a useful material in case any structures were deemed worthy of individual listing.

At the end of the project, the use of database-driven GIS as an interpretive tool significantly streamlined the process of identifying and characterizing specific districts within the larger historic center of Planaltina. It also ensured consistency in the treatment of each district and the contributing buildings within it, providing the decision-making process with firm empirical evidence regarding local character and significant morphological features.

Regarding information structure and management, the use of open-source tools ensures data will remain accessible even as the programs used to create or read them may change. Moreover, since information was recorded in small, elementary chunks, new and improved analyses can be designed in the future to take advantage of the existing data set.

On the downside, the use of a ready-made CMS to set up the database, while affording time and cost savings at the beginning, hindered the portability and ease of reusing data in future studies of the same site. The conceptual structure of the system was, furthermore, geared toward capturing a snapshot of the town as it looked in 2012. It did not provide for recording state changes over time, a critical matter given the real estate market pressures on the site.



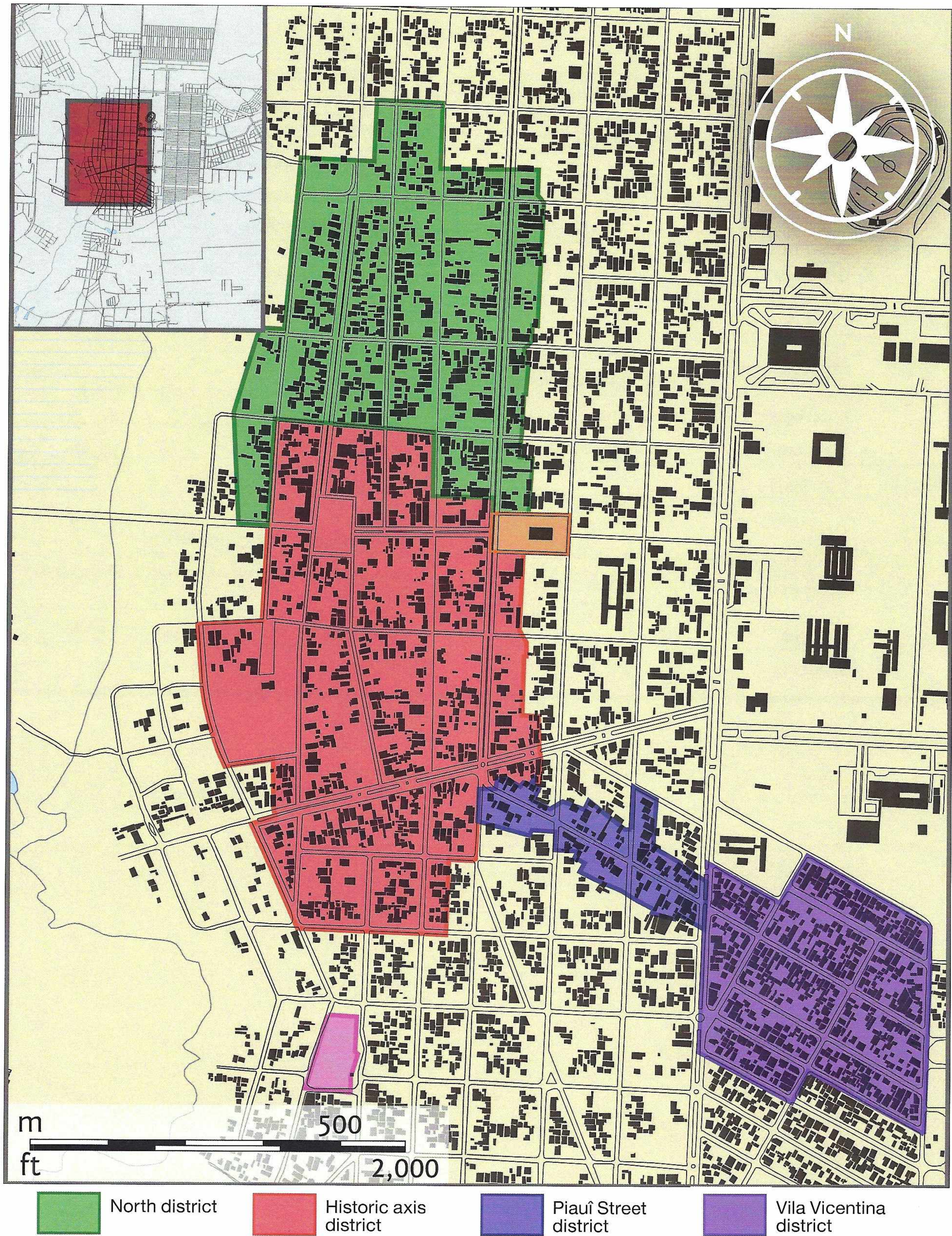


Fig. 13. Character districts identified for the historic core of Planaltina. (From IPHAN [2012].)

Table 3. Proposed regulations for the Historic Axis district in Planaltina

Scale	Elements	Guidelines for buffer area	Guidelines for strict area
Urban	Network	Promote accessibility and shared right of way	Carry out studies for pedestrianizing the avenue between the main squares
	Open space		<ul style="list-style-type: none"> <li>• Revitalise the museum square</li> <li>• Make walk paths accessible</li> <li>• Design urban furniture</li> </ul>
	Greenery	Landscaping design for avenue medians	Landscaping design for both squares
Lot	Consolidation		Discouraged
	Setbacks	<ul style="list-style-type: none"> <li>• Front: Discouraged</li> <li>• Side: No regulation</li> </ul>	<ul style="list-style-type: none"> <li>• Front: Discouraged</li> <li>• Side: Discouraged</li> </ul>
	Max. height	Two stories	One story
	Land use	Encourage mixed use	Encourage mixed use
Building	Openings		Max. 25 percent of facade area
	Roof		<ul style="list-style-type: none"> <li>• Hipped</li> <li>• Parapet flush with facade allowed</li> </ul>
	Build-to line		Continuous facade prolonged with 1.80-meter-tall wall
	Porches	Encouraged	Max. 25 percent of lot width when built on facade
	Cladding		Paint only

Source: IPHAN (2012).

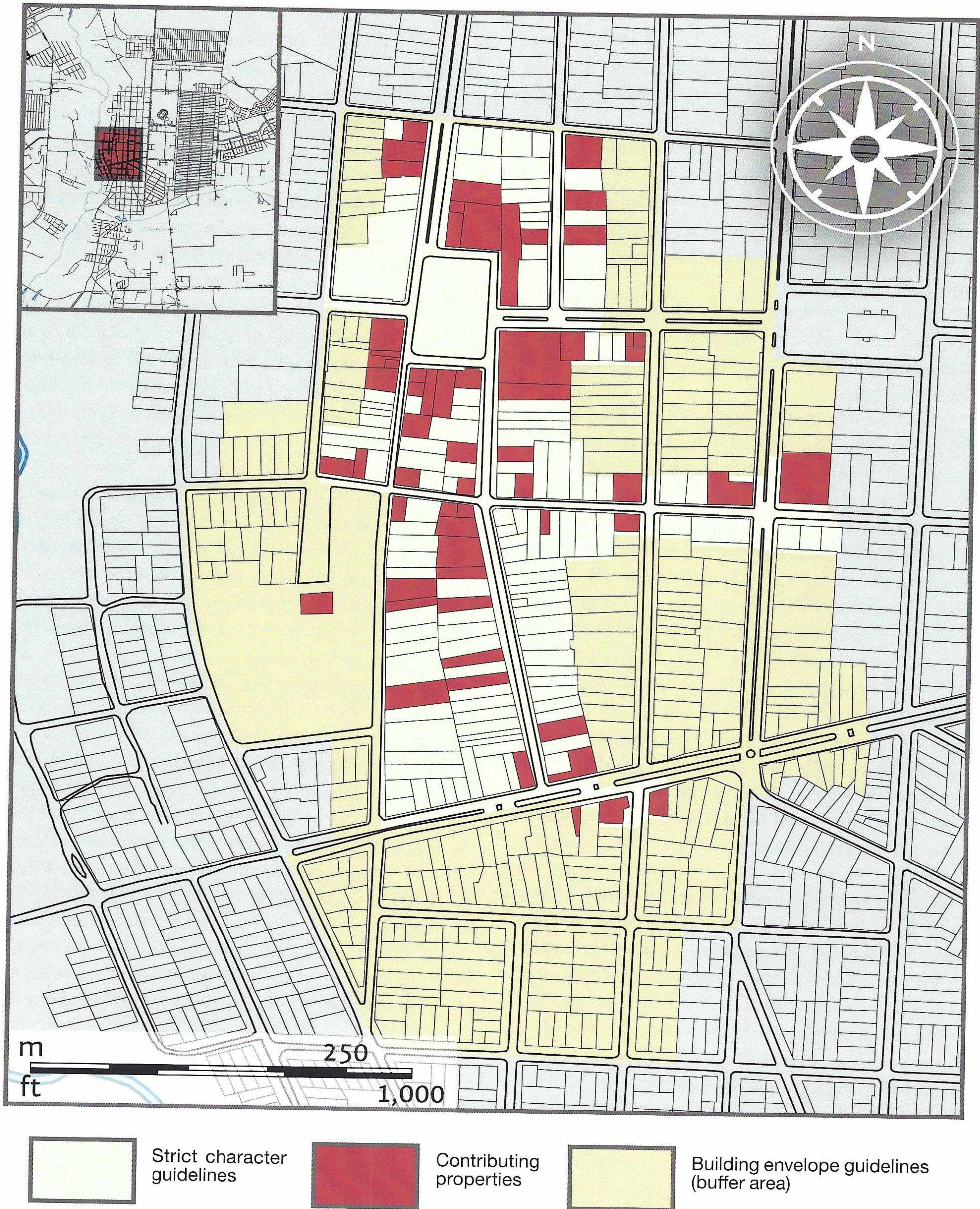


Fig. 14. Historic Axis district map showing contributing buildings and boundaries of strict and buffer regulation areas. (From IPHAN [2012].)

## CONCLUSIONS

The inventory of Planaltina provided a test case for a methodology employing database-driven GIS to automate part of the interpretive process involved in identifying character districts and contributing properties in a historic site. The conceptual and technical solution developed for this project provided an effective and economical way of building knowledge from a field survey, in the near absence of other historic and archaeological evidence. It is not claimed that the methodology obviated or subsumed social values going beyond the recognition of architectural form, but it achieved the goal of making sense of the existing built stock and exposing its diverse character.

Acknowledging these strengths and shortcomings is key to understanding how the methodology outlined in this article can be improved and extended to other cases and regions. The study of built heritage presents an extreme diversity of objects, precluding a one-size-fits-all model such as that provided by the British Spectrum standard for collections management or the Dublin Core Metadata Initiative for digital asset information hierarchy (Zhang and Gourley 2003). While addressing minimum standards for documentation, an open-ended tool must take into account that its objects, and even cultural norms on the practitioner's side, may impact data structure (Monteiro and Lara 2014, 826). Conversely, the nature of architecture itself means that at least some hierarchies should be enforced if semantic analyses are to be useful with respect to construction systems and the nature of materials and spaces (Saygi and Remondino 2013).

With respect to technical solutions, a useful tool to assist in the survey of historic sites might provide an abstract framework of *ontologies*—that is, data structures in which information can be presented hierarchically and related to one another, even before any meaning is attributed to these hierarchies—to support feature trees devised on a case-by-case basis. It would seem absurd to suggest that Naples and Planaltina, or Mesa Verde and Suzhou, should use the same morphological tree; on the other hand, any attempt at hard-coding formal elements comprehensive enough to account for all of these sites would turn out to be overly complex and unwieldy for field work. The resulting database structure should be transparent enough that it can be easily plugged into any GIS program using only basic knowledge of database connections and structured queries. While the

implementation of fuzzy computing is not within reach of the typical GIS or database user, future advances on this side could be useful in improving the identification of patterns from survey checklists.

This research implies that, even though written and oral records may be lacking, some information can be gathered regarding the stages and chief features of the urbanization from the distribution of character features made readily visible in GIS queries to a manageable database created from simple field survey checklists.

While the focus of this article is to show a proof of concept for constructing complex morphological sets through the combination of basic formal elements, the methodology can conceivably be ported to nonmorphological studies. For example, checklists of places, activities, or values could be extracted from large sets of interviews and documents to build up webs of socially shared interpretations regarding historic sites.

These possibilities notwithstanding, significant restrictions remain, due to the nature of such vernacular settlements of the preindustrial era. Assigning dates to the buildings and urban sectors cannot be done with morphology alone. Urban and architectural patterns are long lasting, and older practices often overlap with newer ones for long periods of time.

Likewise, it can be argued the lack of clear historicity in vernacular sites is a hint that both descriptive and prescriptive work could or should transcend chronology. A richer GIS implementation might be particularly useful in tuning fine-grained guidelines based not only on the general character of a delimited district but even on the morphological peculiarities of the immediate neighborhood of a proposed infill or alteration. Such a tool could be of use to architects and fine arts commissions in justifying design decisions based on readings of the surroundings. Even more so, it could simulate the impact infill would have on the overall balance of morphological features within a historic area, with a thoroughness well beyond present-day intuitive assessments of design sheets at public hearings.

When available, historical and archaeological information could be layered on top of the morphological data. This implementation would simply require a chronological data set for each record; models for digital recording of fuzzy dates already exist (Signore et al. 1997). Theoretical conundrums would inevitably arise, however, as in the problem of Theseus's ship—at what point has a property suffered so much change it must be considered a different one? Or might one conceive a

methodology that could do away with the very individuality of properties and buildings within a larger historic site entirely—a geographic point cloud of sorts? In the end, such innovative approaches would have to grow alongside new management practices for heritage sites, while taking into account structures of land tenancy and project permitting.

### PEDRO PAULO PALAZZO

University of Brasilia

Brasilia, Brazil

Pedro Paulo Palazzo is an architect, a historic preservationist, and an assistant professor at the University of Brasilia School of Architecture. His primary research fields include nineteenth- and early twentieth-century history and historiography of Brazilian art and architecture, interactions between the classical tradition and the modern movement in monumental and civic architecture, and urban history in the Brazilian Central Highlands.

### REFERENCES

- Abeyaselera, Savitri. 2017. "Quantitative Analysis Approaches to Qualitative Data: Why, When, and How." *University of Reading (website)*. Retrieved January 27, 2017 from <https://www.reading.ac.uk/ssc/resources/>
- Adams, Betina. 2004. "Challenges and Trends: The Trajectory of Urban Preservation in Florianópolis, Santa Catarina Island, Brazil." *City & Time* 1 (1): 1–16. Retrieved August 8, 2017 from <http://ceci-br.org/novo/revista/docs2004/C&T-2004-2.pdf>.
- Amoruso, Giuseppe, and Andrea Manti. 2016. "A BIM for the Identity of Historic Urban Landscapes. Integrated Applications of Survey for the Certosa Di Bologna Architectural Heritage." *Disegnare Con* 9 (16): 17.1–17.7. Retrieved January 29, 2017 from [https://www.researchgate.net/publication/308726163\\_A\\_BIM\\_for\\_the\\_identity\\_of\\_historic\\_urban\\_landscapes\\_Integrated\\_applications\\_of\\_survey\\_for\\_the\\_Certosa\\_di\\_Bologna\\_architectural\\_heritage](https://www.researchgate.net/publication/308726163_A_BIM_for_the_identity_of_historic_urban_landscapes_Integrated_applications_of_survey_for_the_Certosa_di_Bologna_architectural_heritage).
- Araoz, Gustavo F. 2008. "World-Heritage Historic Urban Landscapes: Defining and Protecting Authenticity." *APT Bulletin* 39 (2/3): 33–37. Retrieved August 27, 2017 from <http://www.jstor.org/stable/25433949>.
- Azevedo, Francisco Ferreira dos Santos. 1910. *Anuario historico, geographico e descriptivo do Estado de Goyaz*. Goiás: Aredio de Souza.
- Banta, James V., Kent Diebolt, and Michael Gilbert. 2006. "The Development and Use of a Tablet PC Annotation System for Conditions Surveys." *APT Bulletin* 37 (2/3): 39–45. Retrieved March 9, 2013 from <http://www.jstor.org/stable/40004689>.
- Barbo, Lenora de Castro. 2010. "Preexistência de Brasília : reconstruir o território para construir a memória." Dissertação (mestrado), Brasília: Universidade de Brasília, Faculdade de Arquitetura e Urbanismo. Retrieved March 25, 2014 from <http://repositorio.unb.br/handle/10482/8547>.
- Bertran, Paulo. 2011. *História da terra e do homem no Planalto Central: eco-história do Distrito Federal : do indígena ao colonizador*. Brasília: Editora UnB.
- Boido, Cristina. 2010. "Progetti conoscitivi per la città e supporti di base dati multirelazionali." In *Rilievo urbano: conoscenza e rappresentazione della città consolidata*, edited by Dino Coppo and Cristina Boido, 188–94. Florence: Alinea.
- Bryan, Paul. 2010. "Metric Survey for Preservation Uses: Past, Present, and Future." *APT Bulletin* 41 (4): 25–29. Retrieved March 9, 2013 from <http://www.jstor.org/stable/41000034>.
- Campos, Ana Cristina Pinheiro, ed. 1985. *Planaltina... Relatos*. Planaltina (DF): Administração Regional de Planaltina.
- Castro, Mário. 1986. *A Realidade Pioneira*. Brasília: Thesaurus.
- Chuva, Márcia. 2009. *Os arquitetos da memória: sociogênese das práticas de preservação do patrimônio cultural no Brasil (anos 1930–1940)*. Rio de Janeiro: Editora UFRJ.
- Cohen, Nahoum. 1999. *Urban Conservation*. Cambridge, MA: MIT Press.
- Coppo, Dino. 2010. "Contenuti e finalità del rilievo urbano." In *Rilievo urbano: conoscenza e rappresentazione della città consolidata*, edited by Dino Coppo and Cristina Boido, 12–18. Florence: Alinea.
- Costa, Emilia Viotti da. 2003. *The Brazilian Empire: Myths and Histories*. Chapel Hill: University of North Carolina Press.
- Darling, Arthur. 2001. "Brazil's Monumenta Program: Sustainable Preservation of Historic Cities." In *Historic Cities and Sacred Sites: Cultural Roots for Urban Futures*, edited by Ismail Serageldin, Ephim Shluger, and Joan Martin-Brown, 195–201. Washington, DC: World Bank Publications.
- Duany, Andres, Jeff Speck, and Mike Lydon. 2009. *The Smart Growth Manual*. New York: McGraw-Hill Education.
- Fiori, Ruth. 2012. *L'invention du vieux Paris: naissance d'une conscience patrimoniale dans la capitale*. Wavre, Belgium: Mardaga.
- Fonseca, Maria Cecília Londres. 1997. *Patrimônio Em Processo: Trajetória Da Política Federal de Preservação No Brasil*. Rio de Janeiro: UFRJ.
- Freitas, Benedita Ribeiro de. 1995. *Reminiscência de Planaltina II*. Brasília: Edição do autor.
- Furtado, Celso. 1977. *Formação econômica do Brasil*. São Paulo: Companhia Editora Nacional.
- Gilbert, Cathy. 1991. "Cultural Landscapes and the New Technologies." *The Public Historian* 13 (3): 109–12. doi:10.2307/3378556.
- Giusti, Adriana Baculo, Ludovica Bucci de Santis, Antonella di Luggo, Riccardo Florio, and Fulvio Rino, eds. 1995. *Napoli Città in Vista*. Naples: Electa Napoli.
- Glassie, Henry. 1976. *Folk Housing in Middle Virginia: A Structural Analysis of Historic Artifacts*. Knoxville: University of Tennessee Press.
- Gomide, José Hailon, Patrícia Reis da Silva, and Sylvia Maria Nelo Braga. 2005. *Manual de Elaboração de Projetos de Preservação Do Patrimônio Cultural*. Brasília: Ministério da Cultura, Programa Monumenta.
- Gonçalves, José Reginaldo Santos. 1996. *A retórica da perda: os discursos do patrimônio cultural no Brasil*. Rio de Janeiro: Editora UFRJ : MinC-IPHAN.

- ICOMOS (International Council on Monuments and Sites). 1964. "International Charter for the Conservation and Restoration of Monuments and Sites (The Venice Charter 1964)." Retrieved August 27, 2017 from [http://www.icomos.org/charters/venice\\_e.pdf](http://www.icomos.org/charters/venice_e.pdf).
- . 1994. "The Nara Document on Authenticity." Retrieved August 27, 2017 from <http://www.icomos.org/charters/nara-e.pdf>.
- . 1996. "The Declaration of San Antonio." Retrieved August 27, 2017 from <http://www.icomos.org/en/charters-and-texts/179-articles-en-francais/ressources/charters-and-standards/188-the-declaration-of-san-antonio>.
- IPHAN (Instituto do Patrimônio Histórico e Artístico Nacional). 2007. *Inventário nacional de bens imóveis sítios urbanos tombados - INBI-SU: manual de preenchimento*. Brasília: Senado Federal: IPHAN.
- . 2012. *Inventário Do Setor Tradicional de Planaltina*. Brasília: IPHAN. Retrieved August 27, 2017 from <https://issuu.com/abacoarq/docs/planaltina-inventario?reader3=1>.
- Johnston, Chris. 1992. *What Is Social Value? : A Discussion Paper*. Canberra: Australian Heritage Commission. Retrieved September 1, 2017 from <http://trove.nla.gov.au/version/45432551>.
- Jokilehto, Jukka. 1999. *A History of Architectural Conservation*. Oxford: Butterworth-Heinemann.
- Kühl, Beatriz Mugayar. 2010. "Notas sobre a Carta de Veneza." *Anais do Museu Paulista: História e Cultura Material* 18 (2): 287–320. doi:10.1590/S0101-47142010000200008.
- Labaki, Lucila C., and Doris C. C. K. Kowaltowski. 1998. "Bioclimatic and Vernacular Design in Urban Settlements of Brazil." *Building and Environment* 33 (1): 63–77. doi:10.1016/S0360-1323(97)00024-3.
- Lara, Fernando Luiz. 2009. "Modernism Made Vernacular: The Brazilian Case." *Journal of Architectural Education* 63 (1): 41–50. doi:10.1111/j.1531-314X.2009.01027.x.
- Lemos, Carlos Alberto Cerqueira. 1999. *A república ensina a morar (melhor)*. São Paulo: Editora Hucitec.
- Lo, C. P. 2007. "The Application of Geospatial Technology to Urban Morphological Research." *Urban Morphology* 11 (2): 81–90.
- Magalhães, Luís Ricardo, and Robson Eleutério. 2008. *Estrada Geral Do Sertão: Na Rota Das Nascentes*. Brasília: Terra Mater Brasilis.
- Marcantonio, Dino. 2003. "Iconography and the Transect." *Planetizen*. May 19. Retrieved January 29, 2017 from <https://www.planetizen.com/node/89>.
- Martins, Anamaria de Aragão Costa, and Ricardo Costa Pinto. 1998. *Ruas de Planaltina. Projeto Ruas Da Cidade: Inventário de Planaltina*. Brasília: Depha.
- Martins, Sandra Cristina Fernandes, and João Adriano Rossignolo. 2013. "Fichas de Inventário: SICG (Sistema Integrado de Conhecimento e Gestão) do IPHAN: Estudo de Caso em Patrimônio Rural." *Revista Digital de Arqueologia, Arquitetura e Artes*, no. 1: 62–69. Retrieved January 28, 2017 from <http://bdpi.usp.br/single.php?id=002405039>.
- Mayumi, Lia. 2008. *Taipa, canela-preta e concreto: estudo sobre o restauro de casas bandeiristas*. São Paulo: Romano Guerra.
- Mongelli, Mônica de Medeiros, and Andrey Schlee. 2016. "Os inventários de jardins históricos e a construção das fichas de cadastro complementar para o Sistema Integrado de Conhecimento e Gestão—SICG." *Identidades: territorio, proyecto, patrimonio*, no. 6: 331–51. Retrieved September 1, 2017 from <http://upcommons.upc.edu/handle/2117/100127>.
- Monteiro, Juliana, and Marilda Ginez Lopes de Lara. 2014. "A noção de documentação em museus nas normas Spectrum e CIDOC/ICOM," December 18. Retrieved September 3, 2017 from <http://repositorios.questoesemrede.uff.br/repositorios/handle/123456789/2600>.
- Moutinho, Mário. 1995. *Arquitetura popular portuguesa*. Lisbon: Estampa.
- Murtagh, William J. 1997. *Keeping Time: The History and Theory of Preservation in America*. 3rd ed. New York: John Wiley & Sons.
- Noble, Allen. 2009. *Traditional Buildings: A Global Survey of Structural Forms and Cultural Functions*. London: I. B. Tauris.
- OAS (Organization of American States). 1967. "The Norms of Quito. Final Report of the Meeting on the Preservation and Utilization of Monuments and Sites of Artistic and Historical Value." Retrieved August 27, 2017 from <http://www.icomos.org/en/charters-and-texts/179-articles-en-francais/ressources/charters-and-standards/168-the-norms-of-quito>.
- Oliveira, Adriana Mara Vaz de. 2001. *Uma ponte para o mundo goiano do século XIX: um estudo da casa meia-pontense*. Goiânia: Agência Goiana de Cultura Pedro Ludovico Teixeira.
- Palazzo, Pedro Paulo. 2014. "Urbanisation in the Brazilian Hinterland's 'Forgotten Century': Growth Patterns in Planaltina." In *Our Common Future in Urban Morphology*, edited by Vítor Oliveira, Paulo Pinho, Luísa Mendes Batista, and Tiago Patatas, 2:504–15. Retrieved September 8, 2015 from <http://isuf2014.fe.up.pt/>.
- Paulino, Fernando Oliveira, Juliana Soares Mendes, Marcelo Ximenes Aguiar Bizerril, Leyberson Pedrosa, Eliana Machado dos Santos, Jairo Faria, Mel Bleil Gallo, Paulo Victor Chagas, Ingridy Peixoto, and Johnatan Reis. 2012. "Extensão, Comunicação e Accountability na promoção do Patrimônio Histórico de Planaltina." *Participação*, no. 21 (September): 23–30. Retrieved November 4, 2015 from <http://periodicos.unb.br/index.php/participacao/article/view/6320>.
- Rapoport, Amos. 1969. *House Form and Culture*. Englewood Cliffs, NJ: Prentice-Hall.
- Saint-Hilaire, Augustin François César Prouvençal de. 1848. *Voyage aux Sources du Rio de S. Francisco et dans la Province de Goyaz*. Vol. 2, Voyages dans l'intérieur du Brésil. Paris: Arthus Bertrand. Retrieved July 31, 2012 from <http://archive.org/details/voyagesdanslinte47sain>.
- Saygi, G., and F. Remondino. 2013. "Management of Architectural Heritage Information in BIM and GIS: State-of-the-Art and Future Perspectives." *International Journal of Heritage in the Digital Era* 2 (4): 695–714. doi:10.1260/2047-4970.2.4.695.
- SEC-DF (Secretaria de Estado da Cultura do Distrito Federal). 2002. *Patrimônio nas Ruas*. Brasília: Diretoria de Patrimônio Histórico e Artístico.
- SEPLAN (Secretaria do Planejamento e Desenvolvimento). 2003. *Goiás Em Dados 2003*. Goiânia: SEPLAN. Retrieved September 1, 2017 from [http://www.imb.go.gov.br/viewcad.asp?id\\_cad=1030](http://www.imb.go.gov.br/viewcad.asp?id_cad=1030).

- Signore, Oreste, Rigoletto Bartoli, Giuseppe Fresta, and A. Marchetti. 1997. "Issues in Historical Geography." In *Museum Interactive Multimedia: Cultural Heritage Systems Design and Interface: Selected Papers from ICHIM 97, the Fourth International Conference on Hypermedia and Interactivity in Museums, Paris, France, 3-5 September 1997*, edited by David Bearman and Jennifer Trant, 32-37. Paris: Archives & Museum Informatics. Retrieved January 15, 2017 from <http://www.archimuse.com/publishing/ichim97/bartoli.pdf>.
- Silva, Elias Manoel da. 2011. *De Mestre d'Armas a Planaltina: Reflexão Histórico-Crítica Sobre a Fundação da Cidade*. Brasília: self-published. Retrieved April 3, 2013 from <https://pt.scribd.com/document/98469123/De-Mestre-d-Armas-a-Planaltina-Reflexao-historico-critica-sobre-a-fundacao-da-cidade>.
- Simonsen, Roberto C. 1937. *Historia econômica do Brasil, 1500-1820*. Vol. 2. São Paulo: Companhia Editora Nacional.
- Skarmeas, George C. 2010. "From HABS to BIM: Personal Experiences, Thoughts, and Reflections." *APT Bulletin* 41 (4): 47-53. Retrieved March 9, 2013 from <http://www.jstor.org/stable/41000038>.
- Vieira, Liliane de Castro. 2016. "Ouro Preto e o século XIX: o mito da decadência." *Revista CPC*, no. 22: 145-89. doi:10.11606/issn.1980-4466.v0i22p145-189.
- Vozzola, Mariapaola. 2010. "Un'interpretazione di sistema informativo per piazza Carlo Emanuele II a Torino." In *Rilievo urbano: conoscenza e rappresentazione della città consolidata*, edited by Dino Coppo and Cristina Boido, 195-204. Florence: Alinea.
- Weimer, Günter. 2005. *Arquitetura popular brasileira*. São Paulo: Martins Fontes.
- Williams, Daryle. 2001. *Culture Wars in Brazil: The First Vargas Regime, 1930-1945*. Durham, NC: Duke University Press. Retrieved August 27, 2017 from <http://hdl.handle.net/2027/heb.09293>.
- Zhang, A., and D. Gourley. 2003. "A Digital Collections Management System Based on Open Source Software." In *2003 Joint Conference on Digital Libraries, 2003. Proceedings*. 381. doi:10.1109/JCDL.2003.1204928.
- information the author of this article was able to piece together from photographs, architectural evidence, and documents is still being analyzed, in an attempt to bridge the historiographical gap.
4. This name designates, in Portuguese and Brazilian architecture, rooms that were without natural lighting or ventilation, as was common up to the nineteenth century. The name "alcove" derives from the Arabic name, al qubba (Weimer 2005, 92).
  5. Ascribing functions and uses to specific rooms of the Brazilian colonial house is notoriously difficult. Dwellings had very little furniture, most of which could be moved around easily to adapt to activity patterns that varied according to the weather, family size, and context.
  6. For a thorough study on the modernization of housing plans from the perspective of São Paulo in the second half of the nineteenth century, see Lemos (1999).
  7. All of the little information available regarding the dates of buildings is based on oral records, most of which were collected in 2012 by the inventory team. The findings are recorded in the inventory report (IPHAN 2012). Some information had been previously published by the Federal District government (Campos [1985]; Freitas [1995]; SEC-DF [2002]) and by Mr. Mário Castro, the town's leading historian (1986).
  8. On the matter of constructed discourses on Brazilian heritage, see Gonçalves (1996).
  9. Darling (2001) gives a short account of the Monumenta program, focusing on its financial instruments.
  10. For a dispassionate account of IPHAN's ideology over the years, see Mayumi (2008).
  11. To date, the most complete accounts of IPHAN's history and ideology are provided by Fonseca (1997) and Chuva (2009).
  12. A technical account of this project was given, more recently, by Boido (2010). The methodology outlined in the Naples project served as the basis for other visualization projects, such as one in Turin (Vozzola 2010, 195).
  13. Content management systems are programs for managing the digital publication of content. They are often used as backends to websites in which content input is carried out by users who are not programmers, and thus are popular choices for news portals, corporate websites, and blogs. Common features of CMSs include web-based interfaces for site administration, content creation, and media management. Many popular programs, such as Drupal and Joomla, focus on article-like content with a main body of text and media, but also support customization of content types. Some add-ons are available to enable geospatial features, but for the purpose of this project, their implementation was not deemed cost effective.
  14. A more advanced implementation could have the lot geometries and spatial coordinates recorded in the database itself, but this solution would have increased the complexity of the Drupal setup without clear gains in productivity.

## ENDNOTES

1. The historic preservation inventory described in this article was conducted by the firm Ábaco Arquitetura & Design Ambiental, whose team was led by the author of this paper with Ana Laterza and Alessio Gallizio. It was publicized in an official report (IPHAN 2012). The author extends thanks to the survey team members, Caroline Albergaria, Renata Neves, and Leandro Peredo, as well as to the contract managers at IPHAN, Thiago Perpétuo and Juliana Prata. Ana Laterza had a major role in crafting the morphological tree and defining management criteria for the proposed listings.
2. Ancien régime Portuguese law did not allow for nominally private land property. Lifetime grants of land by the crown, known as sesmarias, were standardized at one league (six kilometers) wide by three leagues deep, obligatorily along a highway. In practice, they were transmitted through inheritance up to 1850, when the Brazilian land act recognized all sesmarias as private property (Costa 2003, 79-82).
3. The history of Planaltina from 1930 to 1960 is sparsely documented, since most historians focus on its heyday from 1891 to the 1920s or else its fate as a satellite town of Brasília. What little

