Framework for Assessing Building Potential Based on the Relational Model of the Multipurpose Cadastre

Felipe Paulo de OLIVEIRA and Everton da SILVA, Brazil

Key words: Land management; Multipurpose Territorial Cadastre; relational model; building potential.

SUMMARY

Effective building potential is a critical metric for evidence-based urban planning, offering a comprehensive understanding of what is legally permissible, spatially feasible, and actually achievable on urban land. Unlike simplified theoretical estimates, this potential must account for multiple regulatory constraints, including environmental restrictions, urban planning rules, and legal incentives. This paper presents a relational model for a Multipurpose Cadastre (MTC) designed to accurately structure and spatialize this effective building potential. The core innovation lies in systematically linking land parcels to applicable Legal Territorial Objects (LTOs), which represent spatialized normative constraints and rights. The model's structure aligns conceptually with the Land Administration Domain Model (LADM – ISO 19152) and adheres to Brazilian national guidelines (Federal Ordinance MDR n° 3.242/2022), ensuring its conceptual soundness and interoperability. The methodology, which calculates the Effective Floor Area Ratio (FAReff) and the Effective Buildable Area (EBA) by combining regulatory factors, was successfully tested in a case study in Florianópolis, Brazil. The application demonstrated the model's technical feasibility and its capacity to generate consistent, multi-scalar spatial indicators. Key findings revealed significant disparities between theoretical zoning potential and actual buildable capacity, with a large concentration of potential in only a few areas of the city. Operationally, the model required migration to a robust geospatial relational database environment (PostgreSQL/PostGIS) to manage the high volume and complexity of spatial data, overcoming performance limitations encountered in desktop GIS software. The results confirm the model's utility as a technical basis for territorial management, supporting the identification of regulatory gaps, the monitoring of urban instruments, and the design of targeted densification policies. This relational framework is highly replicable, scalable to other urban indicators, and essential for advancing evidence-based, sustainable urban governance.

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1. INTRODUCTION

Urban planning and territorial management increasingly require data-driven approaches capable of accurately representing the regulatory and spatial constraints that shape urban development. In this context, effective building potential emerges as an important metric to comprehensively understand what is legally allowed, spatially feasible, and actually achievable on urban parcels. Unlike theoretical estimates based solely on zoning regulations, effective building potential considers environmental restrictions, urban planning constraints, and legal incentives that modulate the buildable capacity of each territorial unit.

This paper presents a relational model for a Multipurpose Cadastre (MC) that structures and spatializes the effective building potential by linking land parcels to applicable regulatory elements, referred to as Legal Territorial Objects (LTO). The model was developed in compliance with the guidelines of Brazilian Federal Ordinance MDR 3.242/2022 and conceptually aligns with the Land Administration Domain Model (LADM – ISO 19152), enabling its application in different municipal contexts. The proposal aims to establish interoperable relational databases that can support urban planning, public policy design, and land use monitoring.

The methodology was tested in Florianópolis. The case study assessed both the model's technical feasibility and its ability to generate consistent spatial indicators at multiple scales. The analysis incorporated both the normative structure of the city Master Plan and the physical and cadastral complexity of the territory. The results revealed patterns of building potential distribution, regulatory gaps, and mismatches between current land occupation and legal parameters, reinforcing the model's utility as a technical tool for evidence-based territorial management.

2. THEORETICAL GROUND

2.1 Territorial Planning and Management

Territorial planning and management are distinct but complementary practices. Territorial planning involves the technical and participatory construction of an agreed-upon future intention, considering conflicting interests, action possibilities and real-world constraints (Souza, 2015). It is a prospective exercise, oriented toward the medium and long term, focused on formulating guidelines that anticipate challenges and opportunities. Territorial management, in turn, is the application of these guidelines in the present, involving daily administration and the adaptation of available instruments to real conditions (Souza & Rodrigues, 2004; Souza, 2015).

In this work, the term territorial planning refers to the strategic formulation of guidelines for the entire municipal territory, while territorial management is the implementation, monitoring, and continuous revision of these guidelines. The distinction, especially in their temporal horizons, is essential for understanding the objectives and scope of the territorial information systems proposed in this study.

2.2 Building Potential as a Territorial Management Indicator

Building potential is a normative territorial variable that expresses the legal capacity for construction on a given spatial unit. This indicator is often estimated in a simplified manner through the product of the floor area ratio (FAR) defined in the zoning regulations and the area of the lot or parcel (Souza, 2015). However, this conventional approach disregards the multiple regulatory constraints that affect the territory, such as environmental restrictions, urban planning incentives, easements, and other legal instruments that shape land occupation. As a result, it often yields incomplete estimates that may misrepresent the actual right to build assigned to each land parcel, either by overstating or understating it.

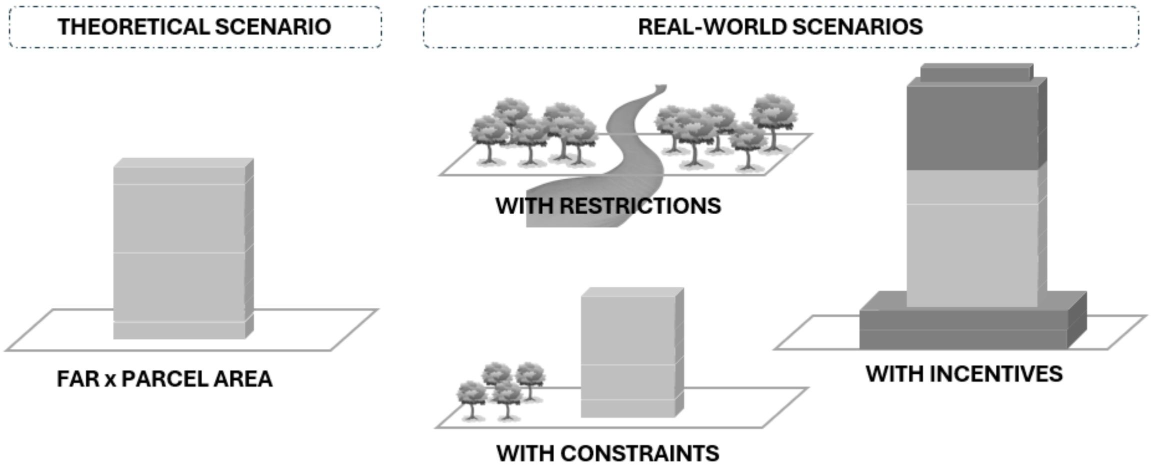

Figure 1. Building potential as in theory and real-world scenarios.

To overcome these limitations, this study proposes a relational model that integrates the applicable regulations and their spatial implications on land parcels. In this context, a territorial parcel is defined as a continuous feature, georeferenced to the official cadastral system, with a unique and stable identifier, capable of being linked to thematic registers (Brasil, 2022). This concept goes beyond conventional lots by including large tracts, public areas, urban voids, and non-buildable sections of land.

The set of regulations affecting these parcels is represented by Legal Territorial Objects (LTOs), defined as portions of the territory with homogeneous normative conditions. LTOs correspond to rights, restrictions, and responsibilities established by legal instruments, regardless of their immediate physical materialization. Examples include land use zones, permanent preservation areas, administrative easements, landmark boundaries, and airport approach surfaces. LTOs differ from Physical Territorial Objects (PTOs), which are material features on the ground, such as buildings, vegetation, water bodies, and infrastructure (Oliveira, Carneiro & Silva, 2023).

The effective building potential, as defined in this study, results from the relationship between the territorial parcel and the set of LTOs affecting it. Through spatial operations and explicit normative rules, the Effective Floor Area Ratio (FAReff) is calculated based on the weighted combination of regulatory parameters, along with the Effective Buildable Area, which excludes portions affected by prohibitive restrictions.

2.3 The MTC as a Territorial Governance Infrastructure

The Multipurpose Cadastre is essential for territorial governance, enabling the integration of physical, legal, regulatory, and administrative data of land parcels. Its role is recognized in Brazilian legislation – such as the City Statute (Law n° 10.257/2001) – and in specialized literature, as it facilitates the qualified use of urban planning instruments, supports public policy design, and improves territorial administration (Cunha, 2020; Cunha & Erba, 2010; Oliveira, Carneiro & Silva, 2023).

Federal Ordinance MDR 3.242/2022, issued by the Brazilian Ministry of Regional Development, consolidated technical guidelines for the creation and updating of MTCs in Brazilian cities, recognizing it as the common geometric base for all thematic cadastres (e.g., environmental, housing, tax), and serving as a connector through the interoperability of spatial and alphanumeric databases. However, data from IBGE (2019, 2022) reveal that only 20.8% of municipalities have georeferenced cadastres, and regular updates are still rare – only 9.5% of municipalities required to maintain Master Plans have a cadastre updated annually.

As Souza (2015) warns, data scarcity undermines the effectiveness of urban planning instruments and limits management capacity. The consolidation of a georeferenced, interoperable, and up-to-date multipurpose cadastre is, therefore, a necessary condition for strengthening evidence-based territorial governance.

Nevertheless, reliable data alone is not enough. It is necessary to structure relational databases capable of storing, retrieving, modeling, and analyzing spatial data dynamically (Morimoto & Oliveira, 2019). Spatial analysis and geoprocessing significantly expand the possibilities for diagnosis, simulation, and monitoring, allowing the identification of land use patterns, priority areas for intervention, special interest zones, and scenarios of territorial transformation (Souza, 2015; Erba, Oliveira & Lima Jr., 2005).

2.4 Alignment with LADM and National Guidelines

The proposed model in this paper conceptually adheres to the Land Administration Domain Model (LADM – ISO 19152), which structures territorial cadastres around the "parcel–party–right" triad. By establishing relationships between parcels and LTOs, the relational model converges with the LADM's logic, especially regarding modularity, traceability, and versioning.

It also aligns with Federal Ordinance MDR 3.242/2022, adopting multipurpose use, spatialization, and interoperability as central principles. Although not formally implemented under the LADM standard, the model developed herein can be understood as a preliminary step toward full compliance with international standards and future integration with Brazilian national systems such as SINTER (National Territorial Information Management System), established by Decree n° 11.208/2022.

3. MATERIALS AND METHOD

The method aims to structure how to model, calculate, and spatialize the effective building potential of land parcels by linking registered parcels with the legal objects affecting the territory. The proposal is grounded in the understanding that the spatial quantification of building potential depends on a relational cadastral base composed of integrated geospatial and regulatory data, following a replicable logical structure. The methodological framework is organized into six steps.

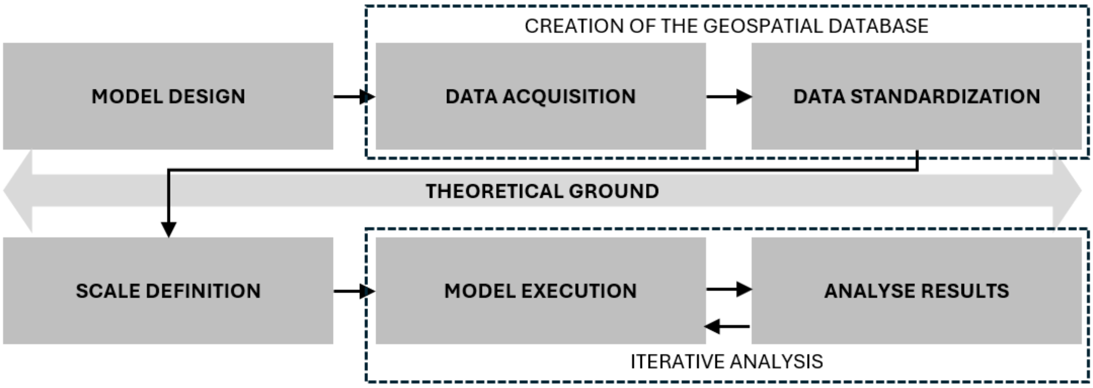

Figure 2. Steps of the method.

3.1 Step 1 – Model Design

The first step is to formulate a schematic analysis model responsible for organizing and delimiting the fundamental components of the method, including the required data classes, their linkages, and their functions in the calculation process. The model is a variation of the framework proposed by Oliveira (2025) and was designed to integrate urban, environmental, and cadastral dimensions, focusing on spatializing the territory's regulations and quantifying each parcel's legal building capacity.

The schematic model assumes that all regulatory data can be converted into spatialized and quantifiable parameters, based on criteria defined by applicable urban and environmental legislation. These parameters must be amenable to spatial aggregation and technical parametrization, allowing cross-reference with geographic layers.

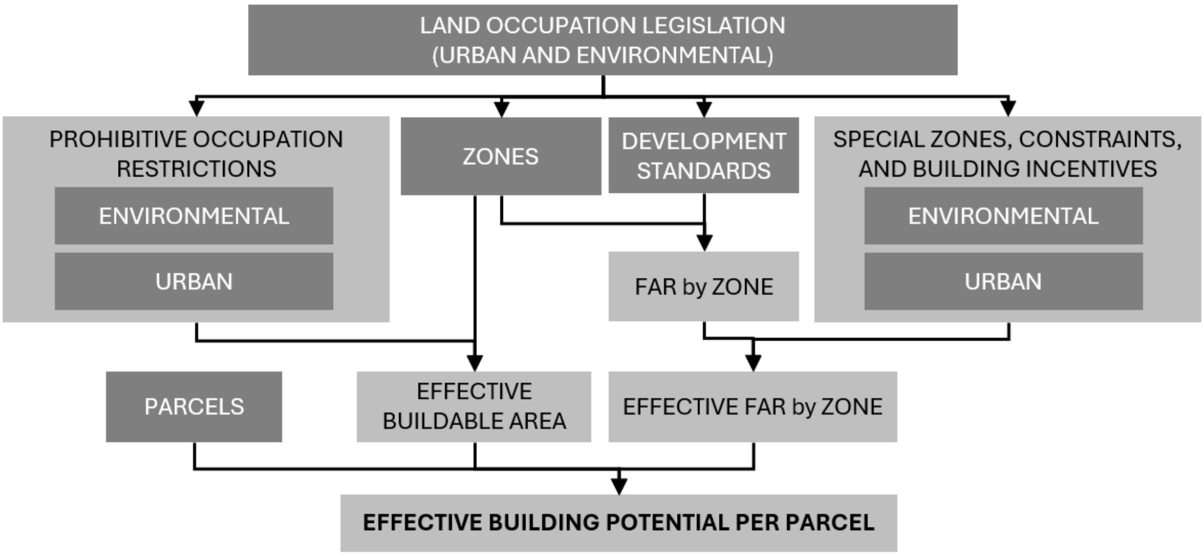

Figure 3. Framework for analyzing effective building potential.

The model is structured into two main blocks of regulatory incidence:
- Prohibitive occupation restrictions: territorial spaces where construction is entirely prohibited by law, whether for environmental or urban reasons. Such restrictions imply the total exclusion of the affected area from the calculation of the parcel's Effective Buildable Area (EBA). Typical examples include Permanent Preservation Areas (PPAs), road setbacks, sanitary easements, and public domain strips.
- Special zones, constraints, and building incentives: regulations that modulate, increase, or condition the building capacity of the parcel without fully prohibiting its occupation. This includes both partial restrictions (such as reduced potential due to landmark protection or the need for vegetation maintenance) and incentives (such as bonus factors in high-density zones). Spatializing these zones allows for the assignment of multiplier factors to the floor area ratio, adjusting it to reflect the regulations affecting each territorial unit.

These two blocks form the basis for the parcel's normative composition and for the subsequent calculation of the Effective Floor Area Ratio (FAReff) per parcel, as operationalized in the following steps.

3.2 Step 2 – Data Acquisition

This step involves identifying and systematizing all legal instruments that define, condition, or alter land occupation parameters, including master plans, zoning regulations, environmental restrictions, construction incentives, and supplementary legislation. Federal and state laws establishing protected areas, conservation units, heritage protection or any other boundaries that affect the potential for land occupation must also be incorporated.

Beyond regulatory sources, it is necessary to assemble georeferenced spatial data from public platforms, municipal geoportals, territorial management systems, and internal databases. The vector dataset should include, at least: parcel/lot boundaries, zoning, restricted areas, road network, administrative divisions, and land cover. The data's quality directly affects the results.

3.3 Step 3 – Data Standardization

The collected data must be converted to a common spatial reference system (SIRGAS 2000 in the Brazilian context) and topologically cleaned. All layers must be spatially compatible, correcting errors such as geometry inconsistencies, overlaps, or duplicated vertices.
Parameterization consists of assigning standardized regulatory values to each layer or attribute, ranging from 0 (absolute restriction) to values greater than 1 (construction incentives). This operation transforms legal rules into spatialized numerical values, enabling the subsequent calculation of the Effective Floor Area Ratio (FAReff).
The processed and parameterized vector layers must then be integrated through common identifiers or spatial operations with the parcel layer, allowing the association between each territorial parcel and the set of legal objects affecting it.

3.4 Step 4 – Scale Definition

The method recommends that the basic unit of analysis be the minimum territorial parcel (MTP), which is the result of the intersection between the original parcel and Legal Territorial Objects (LTOs).

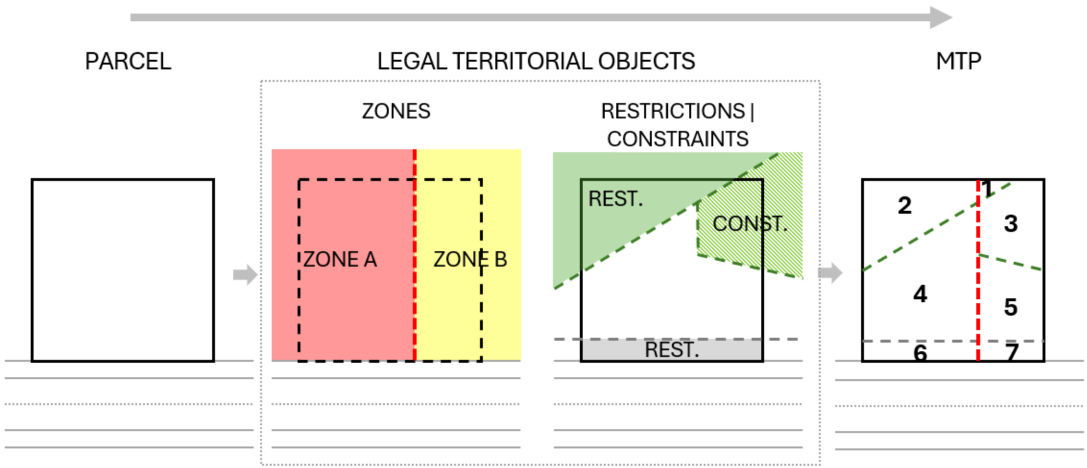

Figure 4. Subdivision of parcels into MTP.

The MTP must then be aggregated into higher levels — such as parcel, block, neighborhood, sector, or district – through spatial keys or structured attributes (such as the cadastral identifier).

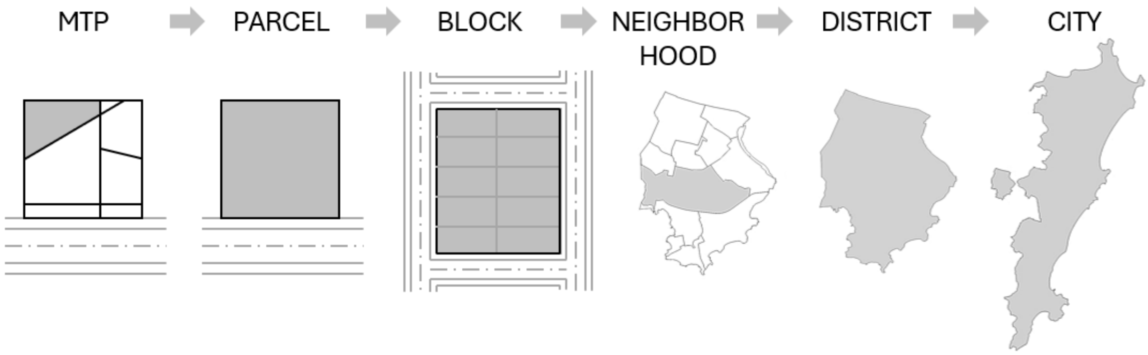

Figure 5. Aggregation levels.

The choice of spatial units should consider both technical criteria and the social and administrative legibility of the units of analysis. The methodology can be applied to any registered territory, if sufficient and compatible data are available.

3.5 Step 5 – Model Execution

In executing the method, regulatory precedences are clearly defined and applied consistently across the dataset: (i) prohibitions remove any portions where building is legally barred; (ii) caps/constraints set ceilings for the applicable coefficient on the remaining portions; and (iii) incentives/modifiers adjust that coefficient, always within legal limits. The minimum territorial part (MTP) is the processing unit obtained by overlaying parcel geometry with all Legal Territorial Objects (LTOs). For each MTP, the effective buildable area is determined by masking prohibitions; caps are then enforced, and modifiers applied in sequence. Parcel-level results are obtained by aggregating the capacities of its MTPs. Ambiguous overlaps, missing inputs, or normative conflicts follow a precautionary stance—the most restrictive rule prevails—and are logged with timestamps and input versions to ensure auditability. All operations use a projected CRS suitable for metric calculations and explicit topological tolerances to eliminate residual geometries.

The application of the model requires the use of a geospatial relational database – preferably PostgreSQL with the PostGIS extension – which allows for the storage, cross-analysis, and manipulation of large volumes of vector data and associated tables.

Additionally, GIS tools such as QGIS may be used for visualization, exploratory analysis, and cartographic refinement of the results. In GIS projects, it is recommended to organize layers into thematic groups (restrictions, incentives, consolidation, cadastral base, etc.) following the schematic model, especially when the model is applied in contexts with a large number of information layers and tables.

3.6 Step 6 – Analyze Results

Once the relational database is consolidated, it becomes possible to calculate the Effective Building Potential (EBP) for each parcel. This indicator results from the product of the Effective Floor Area Ratio (FAReff) – obtained from the weighted combination of legal parameters affecting the parcel – and the Effective Buildable Area of the MTP. This value represents the legally and spatially delimited building capacity of each parcel.

The results can be evaluated at different levels of spatial aggregation, such as parcels, blocks, neighborhoods, districts, and the entire city. This multi-scalar approach supports the identification of legal and building patterns, contrasts between regions, and areas with potential for densification or regulatory fragility. The model's relational structure facilitates the transition between scales, enabling interpretations adapted to different technical, political, or participatory demands.

In addition, descriptive statistics are a key tool for exploring the obtained data. Boxplots, Pareto charts, and ring diagrams help analyze value dispersion, identify concentrations, outliers, and influential points. These tools enhance the interpretive capacity of the results and contribute to more accurate diagnostics.

Graphical representation also plays a decisive role in understanding the outcomes. Thematic cartography, in this context, allows for translating normative complexity into clear and legible maps. The choice of classes, intervals, and color palettes must consider both technical and communicational criteria to ensure fidelity to the data and accessibility of the analyses. Inadequate representations, such as ambiguous symbologies or arbitrary classifications, may lead to misinterpretations and compromise the results. Therefore, it is recommended to explicitly state the adopted classification criteria and ensure visual coherence between the maps and the analytical objectives proposed.

3.7 Limitations

The method depends on the availability, quality, and compatibility of legal and spatial data. In contexts where municipalities lack a structured geospatial cadastre with complete and updated regulatory layers, the model's implementation may be partial or require significant adaptations. The reliability of the results, however, depends on a more in-depth technical analysis. Even in the worst-case scenario, results can be used as indicators for temporal monitoring.

Among the main limiting factors are: (i) the absence or inaccuracy of legal vector layers (zoning, restricted areas, incentives, etc.); (ii) cadastral or geometric errors in parcel and building layers; and (iii) the lack of a structured and stable cadastral reference, hindering aggregations and linkages. In such cases, it is recommended to adopt complementary validation procedures, topological adjustments, and methodological approximations based on the available data, while transparently recording technical decisions made and the limits of result reliability.

4. APPLICATION OF THE MODEL: A CASE STUDY

The method was applied in the city of Florianópolis, capital of the state of Santa Catarina, in southern Brazil, as a case study to assess the technical feasibility of the relational structure. The goal was to assess the model's capacity to integrate regulatory and cadastral layers and generate consistent spatial indicators using real, institutionally available data. Florianópolis is a large city with approximately 537,000 inhabitants (IBGE, 2022), featuring a mixed territorial configuration composed of a continental area and a vast insular portion, which accounts for about 97% of its territory.

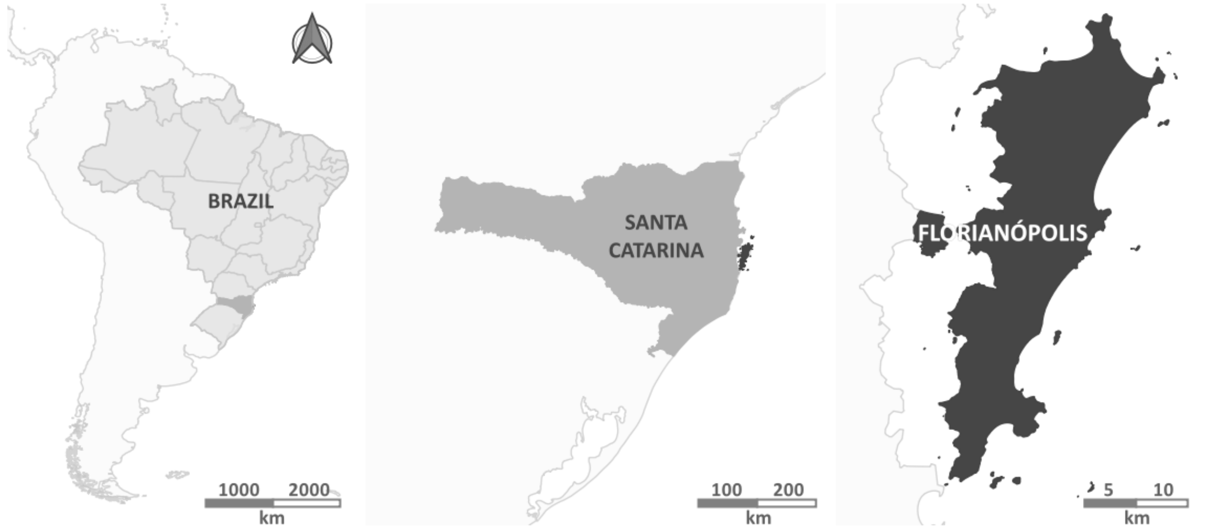

Figure 6. Location of Florianópolis.

Its territory is strongly characterized by natural features—such as rocky massifs, coastal indentations, and vegetated areas that cover more than 60% of the island. It also features extensive environmental restrictions and urban planning constraints, including protected cultural and landscape areas. These features impose limits on buildable land and increase the complexity of regulatory application. Demographic dynamics, according to IBGE census data (2000, 2010, 2022), indicate population growth above the national average and changes in household arrangements, with a rise in single-person households and a reduction in average residents per dwelling.

Recent studies by the city hall (Florianópolis, 2022) indicate that the urban footprint expanded by approximately 20% between 1994 and 2021, exhibiting a dispersed, low-density occupation pattern. Land informality remains predominant in several districts, reinforcing the importance of technical methods capable of accurately quantifying the effective building potential of each land parcel, considering real-world constraints on land occupation.

The territorial scales used respected the city's official administrative boundaries, starting from the MTP and aggregating into blocks and neighborhoods. In districts lacking formally defined neighborhoods, Spatial Planning Units (Unidades Espaciais de Planejamento – UEPs), established by previous legislation, were used as alternative units for equivalent-scale aggregation. The analysis also considered district-level divisions and the total municipal territory, enabling multi-scalar analysis and comparison across different territorial readings.

The database was structured based on the legal framework – particularly the Master Plan (Law 482/2014) and its supplementary regulations – and data accessed through WMS/WFS protocols from the municipal geoportal. Over 89 vector layers were accessed, covering parcel, environmental, urban planning, and administrative data. Despite limitations regarding standardization and completeness, these datasets were consolidated into a relational environment compatible with the proposed model's architecture.

In the model applied to Florianópolis, non-urban areas, conservation units, and zones without defined urban parameters were excluded. Parcels considered consolidated – due to cultural heritage protection, social interest designation, or the presence of pre-existing buildings with more than three stories and multifamily condominium typology – were also excluded.

Prohibitive restrictions were identified based on the following spatial elements: (i) Permanent Preservation Areas (PPA), protected by Federal Law 12.651/2012 and the city's Master Plan; (ii) Areas of Atlantic Forest vegetation where suppression is legally prohibited, pursuant to Federal Law 11.428/2006; (iii) Road setback areas; and (iv) Areas of Federal coastal land (Terrenos de Marinha), where building is legally prohibited.

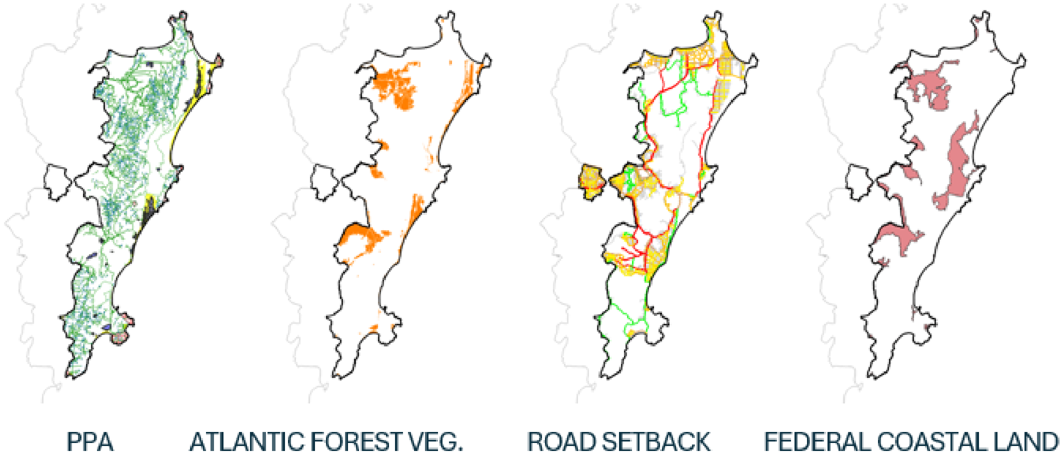

Figure 7. Areas under prohibitive occupation restrictions.

Zones with Special Regulations, Constraints, and Incentives included: (i) Priority Areas for Urban Operation Consortium (UOC); (ii) Central Polygon Area; (iii) Areas eligible for mixed-use building incentives; (iv) Areas subject to the Charges for Additional Building Rights ("Outorga Onerosa do Direito de Construir – OODC"), allowing increases in building coverage ratio; (v) Areas with differentiated coverage ratios for ground floors; (vi) Atlantic Forest vegetation areas eligible for partial suppression under specific legal provisions; (vii) Urbanizable land tracts, which require prior land subdivision (lotting).

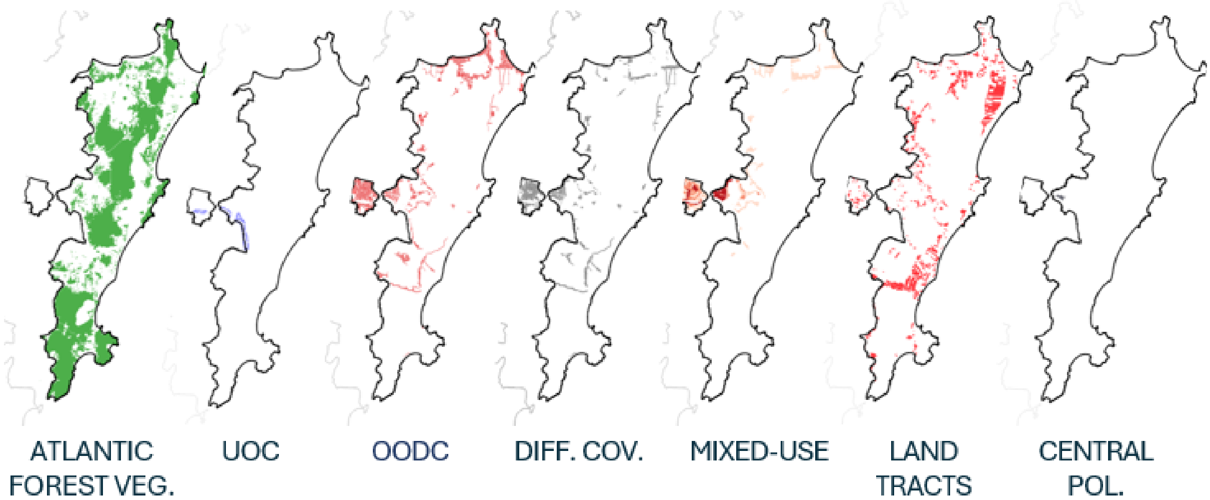

Figure 8. Areas within special zones, constraints, and building incentives.

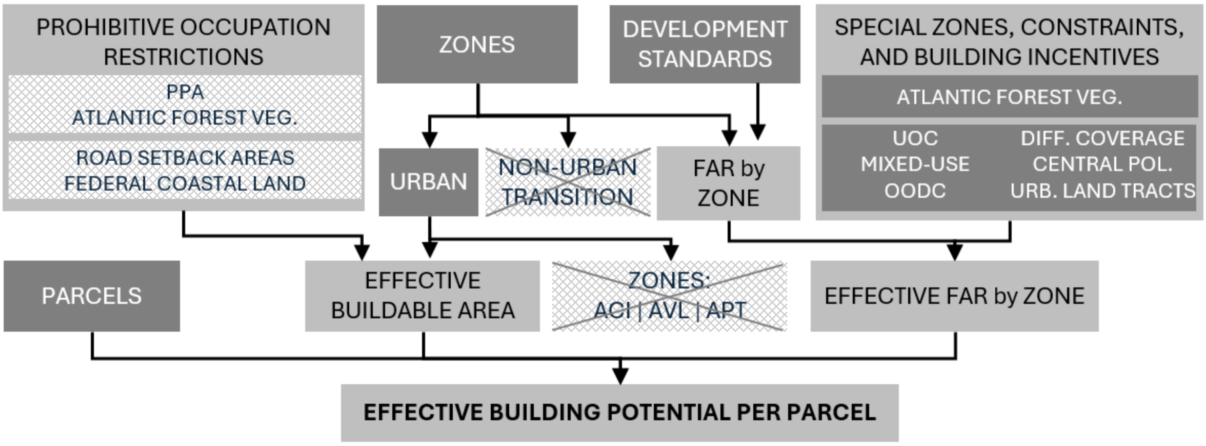

Figure 9. Relational Framework applied to Florianópolis.

As a preliminary result, after excluding non-urban areas and prohibitive restrictions, it was found that out of 120,000 registered parcels – representing 47.82% of the city's total area – only around 88,000 had any level of building potential. These parcels account for just 12.96% of the municipal territory, which reinforces the inadequacy of methods that rely solely on the product of the floor area ratio and the total area of the urban zone. In contexts with significant environmental and legal constraints, as in Florianópolis, the effective building potential may be significantly lower than the theoretical potential assigned through zoning.
Spatialization of the results showed that building potential is concentrated in specific areas of the city. A concentration analysis, using the Pareto chart (Figure 10) for the continental area, for instance, revealed that 25% of the blocks concentrate nearly 60% of the area's total building potential. At the neighborhood level, only two of the ten neighborhoods stood out as those with the highest available potential, together representing almost half of the total within the continental area. These findings underscore the importance of detailed spatial analysis for guiding densification policies, urban control, and managed growth strategies.

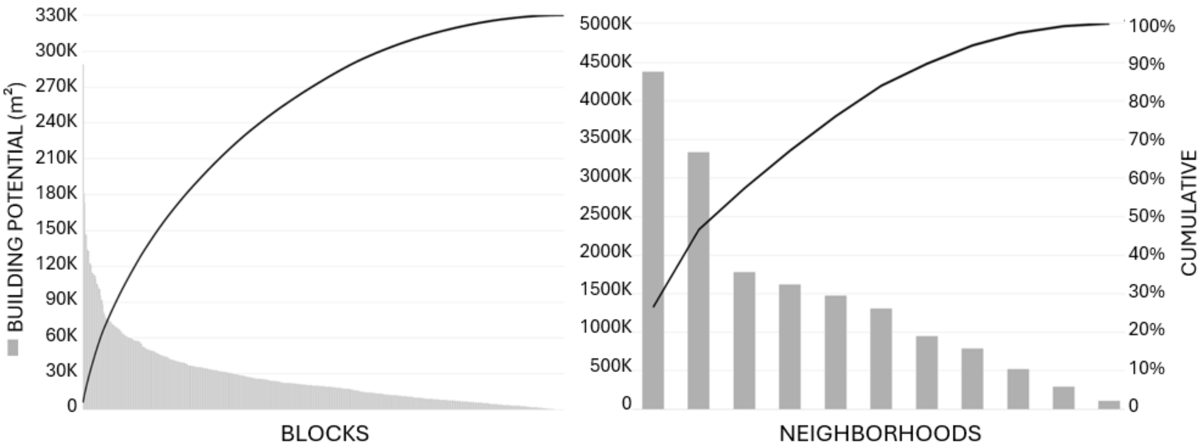

Figure 10. Pareto chart of building potential in the continental area, by block and neighborhood.

The application of the model demonstrated that effective building potential is a valuable metric for territorial management, enabling the assessment of legal densification capacity in different parts of the territory. By considering legal constraints and incentives at the level of the MTP, the model surpasses simplified approaches based solely on zoning coefficients and lot areas. The results show the indicator's utility for both intra-urban diagnostics and the formulation of land use and occupation policies.

Furthermore, the relational model provides a technical ground for the analysis of complementary variables such as identification of vacant properties, consolidated urban sectors, and remaining stock of building potential – elements that can guide land use regulation strategies.

From an operational perspective, the multipurpose cadastre and the relationships defined in the model enabled an understanding of different structural patterns within the same city and under a common legislation. This demonstrated the model's capacity to support decision-making processes, particularly in Master Plan reviews as well as in the monitoring and application of urban instruments.

The use of descriptive statistics and thematic cartography reinforced the model's ability to represent land occupation patterns with both technical precision and communicational clarity, contributing to multiscale interpretations grounded in empirical evidence.

However, direct application of the model within desktop environments – such as QGIS on a personal computer – proved unfeasible at various stages due to the high volume of data and complexity of spatial operations. Intersections between parcels and multiple regulatory layers (e.g., vegetation areas, special zones, incentives, and setbacks), for example, caused system overloads, leading to crashes and reduced performance. Migration to a geospatial database environment (PostgreSQL/PostGIS), with SQL command execution via pgAdmin, was essential for ensuring stability and processing efficiency, enabling the complete implementation of the model and the extraction of large-scale spatial indicators.

5. SCALABILITY, REPLICABILITY, AND INTEROPERABILITY OF THE RELATIONAL MODEL

The proposed relational model demonstrated a high capacity for replicability, adaptable to different municipal contexts, as long as minimally structured spatial and legal data are available. Its logic, based on the relationship between territorial parcels and legal objects, allows for the accommodation of local variations in urban and environmental legislation while preserving conceptual coherence. The experience in Florianópolis revealed that even in settings of high regulatory complexity and imperfect cadastral databases, the model maintained satisfactory technical performance.

The scalability of the methodology also proved feasible, with potential for expansion to additional urban indicators such as consolidation levels, building potential stocks, and the classification of vacant lots. The modular structure of the relational database allows for the progressive integration of these indicators without compromising the integrity of the original data. This flexibility broadens the model's applicability in various planning fronts, including land regularization, urban impact assessments, and regulatory reviews.

Regarding interoperability, the model adopts principles compatible with the guidelines of Brazilian Federal Ordinance MDR 3.242/2022, structuring the multipurpose cadastre as an integrative infrastructure for thematic systems – such as housing, taxation, mobility, and environmental management. Its conceptual adherence to the LADM reinforces the prospect of international compliance, especially by adopting the logic of linking parcels, rights, and restrictions. Although the model is not formally implemented under the LADM standard, its structure favors alignment with future interoperable implementations.

6. FINAL CONSIDERATIONS

This paper presented a relational model for the multipurpose cadastre, designed to structure, spatialize, and analyze the effective building potential of land parcels. Based on legal and cadastral concepts, the model links parcels to LTOs, enabling a more precise and replicable legal interpretation of the urban territory. The proposal aligns with the guidelines established by Brazilian Federal Ordinance MDR 3.242/2022 and conceptually adheres to the LADM, contributing to the advancement of national cadastral frameworks.

The application of the model in the city of Florianópolis validated its architecture, even in the face of challenges such as the absence of standardized metadata, overlapping regulations, and computational limitations when handling large volumes of spatial data. The use of the PostgreSQL/PostGIS database, with operations executed via SQL language in pgAdmin, proved essential for the stability and efficiency of the process, overcoming the performance limitations of QGIS in high-complexity spatial environments.

The results demonstrated that effective building potential, when properly spatialized and cross-referenced with legal realities, provides valuable technical input for territorial planning and management. The adopted relational structure enabled the generation of consistent indicators at multiple spatial scales and provided an empirical basis for statistical and cartographic analyses, reinforcing its utility in master plan reviews, monitoring of urban planning instruments, and the design of qualified densification policies.

The model is not limited to the analytical possibilities of a relational multipurpose cadastre; it points to promising avenues for expansion. The same logic can be applied to other territorial indicators – such as consolidation, stocks, densities – thus consolidating an integrated, evidence-based approach to urban governance. Beyond its technical implementation, the work underscores the urgency of fostering an institutional culture centered on the organization and interoperability of territorial data – a critical condition for cities to advance toward more equitable, efficient, and sustainable models.

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BIOGRAPHICAL NOTES

Felipe Paulo de Oliveira is a Civil Engineer with a Master's degree in Territorial Management from the Federal University of Santa Catarina (UFSC). His research focuses on the relational modeling of Multipurpose Territorial Cadastre (MTC) and the assessment of urban building potential based on spatial and legal data. He is a specialist in Environmental and Urban Law and works at the Florianópolis Urban Planning Institute (IPUF). He is a member of the Group for Observation and Transformation of the Territory (GOTT/UFSC) and participates in the Community of Practice on MTC, linked to the Sustainable Urban Development Network of the Ministry of Cities.

Everton da Silva is a Geodetic Engineer with a Master's degree in Civil Engineering and a Ph.D. in Production Engineering from the Federal University of Santa Catarina (UFSC), where he is a professor in the Department of Geosciences. He has extensive experience in cartography, multipurpose cadastral systems, mass property appraisal, and modernization of territorial management. He is a member of the Latin American Academic Cadastre Network (RACAM) and an associate professor at the Lincoln Institute of Land Policy. He coordinates the Territorial Observation and Transformation Group (GOTT/UFSC) and the Brazilian Congress on Multipurpose Cadastre (COBRAC). He also contributes to the Graduate Program in Transport Engineering and Territorial Management at UFSC, with emphasis on territorial governance, fiscal justice, and methodological innovation in property valuation.

CONTACTS

Felipe Paulo de Oliveira
Universidade Federal de Santa Catarina
Rua João Pio Duarte da Silva, 205, Córrego Grande
Florianópolis
BRAZIL
+55 48 99626 8012
finho.fpo@gmail.com

Everton da Silva
Universidade Federal de Santa Catarina
Rua João Pio Duarte da Silva, 205, Córrego Grande
Florianópolis
BRAZIL
+55 48 3721 7772
everton.silva@ufsc.br
http://ppgtg.ufsc.br/