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Use of AutoCAD in the Design and Technical Development of Social Interest Housing in Guayaquil, Ecuador

Uso de AutoCAD en el diseño y desarrollo técnico de viviendas de interés social en Guayaquil, Ecuador

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ABSTRACT

Social interest housing (SIH) is a priority within urban development policies in Ecuador, particularly in Guayaquil, a city facing rapid population growth, high urban density, and budgetary constraints that limit access to adequate housing. In this context, computer-aided design (CAD) tools have become strategic instruments for optimizing architectural planning and construction documentation in socially oriented housing projects. This paper analyzes the use of AutoCAD as

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a technical drafting and planning tool in the design of social interest housing in Guayaquil. A qualitative–comparative approach was adopted, focusing on AutoCAD's contribution to precision in architectural layouts, plan standardization, technical coordination, and compliance with local regulations. The methodology involved the development of social housing prototypes with built areas between 45 and 60 m², integrating variables such as spatial distribution, cross-ventilation, orientation, and municipal requirements. The results show that AutoCAD enables accurate representation of reduced spaces, facilitates the reuse of standardized elements, and supports reliable area and quantity measurements. Although AutoCAD does not natively include advanced parametric capabilities, its accessibility, low hardware requirements, and compatibility with institutional approval processes make it a widely used tool in social housing projects. The study concludes that AutoCAD remains a fundamental resource for the technical development of social interest housing in Guayaquil, particularly in contexts with limited economic and technological resources.

RESUMEN

La vivienda social (SIH) es una prioridad dentro de las políticas de desarrollo urbano en Ecuador, especialmente en Guayaquil, una ciudad que se enfrenta a un rápido crecimiento demográfico, una alta densidad urbana y restricciones presupuestarias que limitan el acceso a una vivienda adecuada. En este contexto, las herramientas de diseño asistido por ordenador (CAD) se han convertido en instrumentos estratégicos para optimizar la planificación arquitectónica y la documentación de la construcción en proyectos de vivienda de orientación social. Este artículo analiza el uso de AutoCAD como herramienta técnica de dibujo y planificación en el diseño de viviendas de interés social en Guayaquil. Se adoptó un enfoque cualitativo-comparativo, centrándose en la contribución de AutoCAD a la precisión en los diseños arquitectónicos, la estandarización de los planos, la coordinación técnica y el cumplimiento de la normativa local. La metodología consistió en el desarrollo de prototipos de viviendas sociales con superficies construidas de entre 45 y 60 m², integrando variables como la distribución espacial, la ventilación cruzada, la orientación y los requisitos municipales. Los resultados muestran que AutoCAD permite una representación precisa de espacios reducidos, facilita la reutilización de elementos estandarizados y permite realizar mediciones fiables de superficie y cantidad. Aunque AutoCAD no incluye de forma nativa capacidades

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paramétricas avanzadas, su accesibilidad, sus bajos requisitos de hardware y su compatibilidad con los procesos de aprobación institucional lo convierten en una herramienta muy utilizada en proyectos de vivienda social. El estudio concluye que AutoCAD sigue siendo un recurso fundamental para el desarrollo técnico de viviendas de interés social en Guayaquil, especialmente en contextos con recursos económicos y tecnológicos limitados.

Keywords / Palabras clave

AutoCAD, social interest housing, CAD, architectural design, Guayaquil.

AutoCAD, viviendas de interés social, CAD, diseño arquitectónico, Guayaquil.

Introduction

Social interest housing (SIH) has become a central topic in contemporary urban and architectural research due to its direct relationship with social equity, quality of life, and sustainable urban development. In Latin American cities, rapid urbanization processes, informal settlement growth, and economic inequality have intensified the demand for affordable and well-planned housing solutions. Ecuador reflects this regional reality, particularly in Guayaquil, the country's largest and most populous city, where housing demand continues to outpace supply (Florio & Tagliari, 2021).

Guayaquil's accelerated demographic growth, combined with high land values and climatic conditions characteristic of a tropical coastal city, poses complex challenges for the planning and construction of social interest housing. Public housing programs and private initiatives aimed at low-income populations must operate under strict budgetary limitations while ensuring minimum habitability standards, structural safety, and compliance with municipal regulations. These constraints require design processes that are not only technically accurate but also efficient, adaptable, and cost-effective.

Within this context, the adoption of digital tools for architectural design has transformed traditional workflows. Computer-aided design (CAD) systems have replaced manual drafting, enabling higher levels of precision, faster modifications, and improved coordination among project stakeholders. Among these tools, AutoCAD—developed by Autodesk—remains one of the most widely used CAD platforms in

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architectural and engineering practice worldwide. Despite the emergence of Building Information Modeling (BIM) technologies, AutoCAD continues to play a crucial role in the production of technical drawings, particularly in small- and medium-scale housing projects (Li et al., 2026).

The relevance of AutoCAD in social interest housing lies in its capacity to generate accurate two-dimensional documentation required for construction, budgeting, and regulatory approval. In cities such as Guayaquil, municipal authorities frequently require architectural plans in DWG format, reinforcing AutoCAD's institutional relevance. Additionally, its relatively low hardware requirements and widespread professional familiarity make it accessible to small design firms, public institutions, and academic environments involved in SIH development (Burgess et al., 2026).

From an architectural perspective, social interest housing is characterized by reduced floor areas, repetitive unit typologies, and standardized construction systems. These characteristics demand precise spatial planning to ensure functional layouts, adequate ventilation, and compliance with minimum living standards. AutoCAD supports this process by allowing exact control over dimensions, efficient use of layers for technical coordination, and the reuse of standardized blocks for architectural and construction elements. Such features contribute to reducing design errors and improving the clarity of construction documentation.

Recent academic and professional studies emphasize that while parametric and BIM-based tools offer advanced capabilities for automation and data integration, traditional CAD platforms remain highly relevant in contexts with limited technological and economic resources. In Guayaquil, where public housing programs often prioritize cost efficiency and rapid execution, AutoCAD serves as a practical and reliable solution for the technical development of housing projects. Moreover, its compatibility with other digital tools allows it to function as part of hybrid workflows that incorporate parametric design or BIM methodologies when required (Liao et al., 2026).

This research aims to analyze the application of AutoCAD in the design and technical development of social interest housing in Guayaquil, focusing on its contribution to spatial optimization, plan standardization, technical coordination, and regulatory compliance.

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By examining its role within contemporary housing design processes, the study seeks to demonstrate that AutoCAD remains a relevant and effective tool for addressing the challenges associated with socially oriented housing projects in rapidly growing urban environments (Tian, 2020).

Materials and Methods

This research was developed using a qualitative–descriptive methodological approach, supported by a comparative technical analysis of digital design processes applied to social interest housing (SIH). The study focuses on the use of AutoCAD as a computer-aided design tool for architectural drafting, technical coordination, and documentation of housing projects in the urban context of Guayaquil.

A. Materials

The materials used in this study include digital tools, technical documentation, and regulatory references related to social interest housing design. The primary materials are described below:

Computer-Aided Design Software.

The main tool employed was AutoCAD, developed by Autodesk, due to its widespread use in architectural and engineering practice in Ecuador. AutoCAD was used for the development of two-dimensional architectural drawings, including floor plans, elevations, sections, and building services layouts. Its functionalities for layer management, block creation, dimensioning, and digital measurement were essential to the research process.

Housing Design Prototypes.

Standardized social interest housing prototypes were developed as case-study models. These prototypes were designed with built areas ranging between 45 and 60 m², consistent with typical SIH standards in Ecuador. The housing units included basic functional spaces such as living-dining areas, kitchen, bathroom, and one to three bedrooms.

Technical and Regulatory Documentation
Local building regulations, municipal guidelines, and minimum habitability standards applicable to housing projects in Guayaquil were reviewed and applied during the design process. These documents provided constraints related to minimum room

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dimensions, circulation widths, ventilation requirements, and construction specifications.

Computing Equipment.

The design work was carried out using mid-range personal computers, reflecting the typical technological resources available in small architectural offices and academic environments. This condition ensured that the methodology and results were replicable under common professional circumstances.

B. Methods

The methodological process was structured into four sequential phases, aimed at evaluating the effectiveness of AutoCAD in the design and technical development of social interest housing.

1) Architectural Drafting and Spatial Configuration

In the first phase, architectural layouts were developed using AutoCAD based on functional requirements and minimum habitability standards. Floor plans were drafted with precise control over dimensions to optimize reduced spaces characteristic of SIH. Particular attention was given to spatial efficiency, circulation clarity, and the logical arrangement of service areas (Hamed, 2021).

2) Standardization and Layer Organization

The second phase focused on the organization and standardization of drawing elements. Reusable blocks were created for architectural components such as doors, windows, sanitary fixtures, and basic furniture. These elements were organized using a layered drawing structure, separating architectural, structural, and building services components. This approach improved drawing clarity and facilitated modifications during the design process (de Diego et al., 2022).

3) Technical Coordination of Building Systems

In the third phase, technical coordination was addressed through the integration of electrical, plumbing, and sanitary layouts within the architectural drawings. The use of layers allowed for the superposition and verification of different systems, helping to identify potential conflicts and ensuring consistency between plans. This step was essential for producing construction-ready documentation.

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4) Measurement, Quantification, and Documentation

The final phase involved the use of AutoCAD's digital measurement and annotation tools to calculate areas, perimeters, and quantities of construction elements. These measurements supported preliminary cost estimation and technical validation of the design proposals. The resulting drawings were formatted according to standard DWG requirements, suitable for municipal submission and construction use (Toledo et al., 2016).

Results

As a result of a preliminary evaluation, the basic needs of social housing were identified through a sample of dwellings in the Guayaquil suburbs, where more than 60% of social housing typologies are concentrated. It was determined that the established social housing typologies include concrete block dwellings with zinc roofs and partition structures with wooden enclosures, reflecting a traditional design. Therefore, an approach was developed toward a scheme using AI and Autodesk (Chi et al., 2015).

Specific parameters were designed for horizontal housing algorithms. Initially, the objective was to define general parameters. As the research progressed, design strategies were established to meet specific habitability needs. Reference projects provided the necessary parameters to begin designing the algorithms for creating residential units through Project Management (PM). There are two types of parameters:

1) for general building definitions and

2) for the specific elements of the building.

The objective of the proposal is to provide housing for families of three (45 m² units) to six (60 m² - regulatory standard), which represents the primary population in suburban areas. This algorithm (Table 1) contains a set of building parameters:

a) variations in width and length of each unit (from A to F);

b) one, two or three-story unit;

c) specific location of hydraulic zones;

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d) five types of stairs;

e) definition of the dimensions and positions of the mezzanine openings;

f) types of window frames and their position (based on Modulor);

g) dimensions and position of the walls;

h) dimensions and location of six types of skylights;

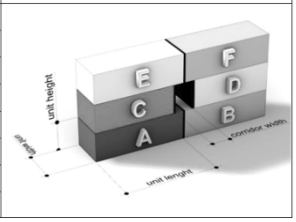
i) dimensions of terraces, windowsills and benches;

j) two types of doors, and

k) kitchen sink countertop dimensions.

Unit types were generated from combinations of units A, B, C, D, E, and F. Parameter manipulation allowed for the generation of many unit types, with large variations in area, from 45 to 60 m². Since the stated objective was to create a variety of unit types, primarily derived from strategic traffic location, parameters were inserted into the algorithm to enable such combinations.

Table 1. *Parameterization of spatial units*

Parameters	Minimum	Máximum	Geometry/dimensions
Unit width	3,0	6,0	
Length of unit A	3,0	12,0	
Length of unit B	3,0	12,0	
Length of unit C	3,0	11,0	
Length of unit D	3,0	11,0	
Length of unit E	3,0	12,0	
Length of unit F	3,0	12,0	
Hallway width	1,2	2,5	

The carefully designed algorithm generated a diverse set of units, with the goal of creating three units for each modularity(Ali et al., 2020; Kalach et al., 2021). Following this step, the unit elements were detailed: floors, stairs, walls, windows, doors, benches, and washbasin countertops.

The flexible arrangement of stair types and spaces by use allowed for the distribution of social, private, and service areas in different positions within the space. Furthermore, the possibility of generating

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different openings in the units provided alternate heights and different internal views.

This figure provides a schematic view of the main decisions made to define the building components.

Le Corbusier's Modulor system was adopted to define the windows that contribute to the dynamic facade. The parametric approach promotes many alternatives for the openings of the VIS units. The diversity of the units, resulting from the manipulation of parameters, responds to new contemporary lifestyles, which demand flexibility and the ability to adapt to different internal and external environments.

Data Analysis

The application of AutoCAD and general data based on the synthesis of information filtered using AI in the design and technical development of social interest housing (SIH) produced positive results in drafting accuracy, spatial efficiency, and technical coordination. The development of standardized housing prototypes demonstrated that AutoCAD is an effective tool for managing reduced floor areas and repetitive design typologies, which are characteristic of SIH projects (Liao et al., 2026).

One of the most significant results was the high level of dimensional precision achieved in architectural layouts. AutoCAD allowed exact control over minimum room dimensions, circulation widths, and spatial relationships, ensuring compliance with habitability standards and local building regulations. This precision was particularly relevant in housing units with built areas between 45 and 60 m², where small dimensional errors can significantly affect functionality.

The use of blocks and layered drawings contributed to improved efficiency during the design process. Standardized blocks for doors, windows, sanitary fixtures, and furniture reduced drafting time and ensured consistency across multiple housing units. Layer-based organizations facilitated the separation and visualization of architectural, electrical, and plumbing systems, improving the clarity of technical documentation and reducing the likelihood of design conflicts (Gómez-Sánchez et al., 2019).

Additionally, AutoCAD's digital measurement tools enabled accurate calculation of built areas and construction quantities. These measurements supported preliminary cost estimation and material

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planning, which are critical factors in social housing projects constrained by limited budgets. The DWG format generated by AutoCAD also proved effective for institutional review, as it is widely accepted by municipal authorities and technical departments involved in housing approval processes (Alawi et al., 2024; Hosseini Khorasani et al., 2024).

The analysis was conducted through a qualitative evaluation of the design process, focusing on drafting accuracy, time efficiency, ease of modification, and technical coordination. Observations were recorded during each methodological phase, allowing for the identification of advantages and limitations associated with the use of AutoCAD in SIH projects. The results were interpreted in relation to the specific urban, economic, and institutional conditions of Guayaquil.

Figure 1. Social housing based on modular design in Autodesk and data analysis applying Artificial Intelligence for 3D visualization

B. Discussion

The results confirm that AutoCAD remains a highly relevant design tool for social interest housing projects, particularly in urban contexts with economic and technological constraints. In Guayaquil, where housing demand is high and public resources are limited, the efficiency

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and accessibility of AutoCAD provide a practical advantage over more complex digital platforms.

Although Building Information Modeling (BIM) tools offer advanced capabilities such as parametric modeling, automated quantity takeoffs, and integrated data management, their implementation often requires higher levels of investment, training, and hardware performance. In contrast, AutoCAD—developed by Autodesk—offers a balance between technical precision and operational simplicity, making it suitable for small architectural offices, public institutions, and academic environments involved in SIH development.

The discussion also highlights that AutoCAD's two-dimensional approach is well aligned with the documentation requirements of social housing projects. The focus on clear, construction-ready drawings supports effective communication between designers, engineers, and construction teams. This is particularly important in projects where construction methods are standardized, and execution timelines are tight (Gómez-Sánchez et al., 2019).

However, the limitations of AutoCAD must be acknowledged. The lack of native parametric and data-driven functionalities restricts its capacity for automated design optimization and lifecycle analysis. As housing projects become more complex and sustainability requirements increase, the integration of AutoCAD with complementary tools—such as BIM or energy analysis software—could enhance overall project performance.

Despite these limitations, the findings indicate that AutoCAD continues to play a fundamental role in the technical development of social interest housing. Its widespread institutional acceptance, ease of use, and adaptability to local workflows ensure its continued relevance in cities like Guayaquil, where the primary design challenge lies in balancing cost efficiency, technical accuracy, and social impact (Villegas et al., 2020).

Conclusions

This study demonstrates that AutoCAD continues to be a fundamental and effective tool for the design and technical development of social interest housing (SIH) in Guayaquil. Its application enables a high level of precision in architectural drafting, which is essential for projects characterized by reduced floor areas, repetitive housing typologies, and strict budgetary constraints.

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The results confirm that AutoCAD supports efficient spatial optimization, allowing designers to comply with minimum habitability standards while maximizing functional use of space. The use of layers and standardized blocks improves drawing clarity, reduces design errors, and enhances coordination among architectural, structural, and building service systems. These advantages contribute directly to improved technical quality and reduced development time in SIH projects.

Furthermore, AutoCAD's accessibility, moderate hardware requirements, and widespread institutional acceptance make it particularly suitable for the urban and administrative context of Guayaquil. The use of standardized DWG formats facilitates municipal approval processes and supports effective communication between designers, engineers, and construction teams, which is critical for the successful execution of social housing projects (AlSagri & Sohail, 2024).

Although AutoCAD presents limitations related to parametric modeling and integrated data management, these constraints do not diminish its relevance in socially oriented housing design. Instead, they highlight the opportunity to integrate AutoCAD with complementary digital tools, such as BIM platforms or performance analysis software (Ismail et al., 2023; Jorge et al., 2023), to enhance design efficiency and sustainability in future projects (Qin et al., 2024).

In conclusion, AutoCAD remains a practical, reliable, and accessible solution for addressing the technical challenges of social interest housing in Guayaquil. Its continued use, combined with emerging digital methodologies, can contribute to the development of more efficient, sustainable, and socially responsive housing solutions in rapidly growing urban environments(Guardiola & García-Quero, 2014; Paredes & Perez, 2025).

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