2025
volume 22 | issue 2

ENQ
The ARCC Journal for Architectural Research

From School to Housing: A Typological Analysis for the Adaptive Reuse of Historic Public Schools in Oklahoma City, USA

Hiroki Mishima[1], Francesco Cianfarani[1]

Abstract

Abandoned public schools have become a growing concern for communities in the United States, affecting social, environmental, and civic aspects of urban life. Their vacancy stems from demographic shifts, economic restructuring, and reduced public funding, factors that have contributed to rising maintenance costs, declining neighborhood property values, informal occupation, and, ultimately, frequent demolitions. Focusing on Oklahoma City as a case study, this paper investigates the adaptive reuse viability of urban public schools. By analyzing 17 schools in the city's urban core, we explore their typological characteristics through historical research, morphological analysis, cluster analysis, and precedent study. Given the city's current housing-affordability shortage, reflecting a broader national crisis, we evaluate the possibility of repurposing historic school buildings into affordable housing. The study outlines the principal design considerations involved in such conversions and simulates one adaptation through an AI-supported exercise. Adapting historic schools for multifamily housing offers a strategic opportunity to address affordability needs while advancing community and preservation goals. Building on this potential, the paper concludes by presenting a set of design guidelines that outline key considerations for residential conversion. The findings and recommendations can be generalized to similar contexts across the United States facing concurrent challenges of urban decline and housing shortage

Keywords: adaptive reuse; affordable housing; schools; typological analysis; U.S. cities.

Stable URL: https://arcc-journal.org/index.php/arccjournal/article/view/1254
DOI 10.17831/enq:arcc.v22i2.1254

Corresponding Author: Francesco Cianfarani < francesco.cianfarani@ou.edu > https://orcid.org/0000-0002-2399-252X.
[1]Christopher C. Gibbs College of Architecture, The University of Oklahoma

ISSN 2329-9339

1. INTRODUCTION

1.1 Research Questions

The future of abandoned urban schools is a growing concern for U.S. cities. According to the National Center for Education Statistics, an average of 1,200 public schools closed annually between 2010 and 2022, corresponding to about 1 percent of the total number of national public educational facilities (National Center for Education Statistics 2023). This trend raises concerns about the role of educational facilities in the social and physical fabric of cities, particularly for early twentieth-century buildings, often located in central neighborhoods.

Like other vacant public properties, abandoned schools present complex challenges for urban communities, affecting economic, social, and environmental conditions. Research has widely examined the effects of building and land vacancy on urban economies (Accordino and Johnson 2000; Barber 2018; Bowman and Pagano 2004; Garvin et al. 2013; Newman et al. 2016). In the case of educational facilities, prolonged school closures reduce surrounding property values, lower municipal tax revenues, and weaken local businesses. Environmentally, deteriorating historic school buildings often contain hazardous materials such as asbestos and lead paint, which pose public health risks (Environmental Protection Agency 1979). Socially, school abandonment disrupts community cohesion and safety, undermining essential civic infrastructure (Davis et al. 2023).

Multiple factors contribute to the abandonment of public schools in the US, including urban economic decline, population loss, funding reductions in school systems, and the growing influence of the "school choice" movement. In addition, shifts in pedagogy, functional obsolescence, and increasingly stringent code requirements have made the layouts of many historic educational buildings outdated (Barber 2018; Spinaris 2012).

The problem of school vacancy is tied to the broader, long-standing phenomenon of urban decay in U.S. city cores. This condition continues to result from complex social, political, and planning shifts that began in the post–World War II period (Garvin 2013). Suburbanization, fueled by mass automobile production and highway expansion, led to the physical decay and population loss of many city cores, exemplified by the phenomenon commonly called "white flight." At the same time, urban renewal initiatives and the construction of interstate corridors within cities displaced established communities, replacing walkable blocks with superblocks and failing to reestablish a cohesive urban fabric (Jackson 1987).

As urban populations declined, school infrastructure in urban cores, which was reliant on local property taxes, suffered underfunding. This led to deteriorating facilities, teacher shortages, and widespread school closures, leaving many buildings vacant and unused for decades (Augenblick and McGuire 1983; OKCPS 2019).

Building vacancy resulting in urban decay is closely connected to another major challenge in U.S. cities: the shortage of affordable housing, particularly for lower-income renters. While historically concentrated in dense coastal areas, this problem has increasingly affected cities in interior states as well (Badger and Washington 2022). Multiple factors contribute to the housing shortage, including rising land and construction costs, persistent barriers to new development, such as restrictive zoning ordinances and NIMBYism (Joint Center for Housing Studies of Harvard University 2023; McCue and Huang 2024), and the broader commodification of housing in neoliberal economies (Madden and Marcuse 2016). This social and economic landscape has reduced federal involvement in housing provision, increasing reliance on public–private initiatives like the Low-Income Housing Tax Credit (LIHTC), the primary tool for financing affordable housing in the US (Schwartz 2021).

Housing affordability is also closely tied to housing quality. The U.S. housing stock is dominated by low-rise, single-family homes of relatively low construction value, which are often oversized for their occupants. Although 28 percent of households consist of single individuals, only 13 percent of housing units are studios or one-bedroom apartments, highlighting a significant mismatch between supply and household needs (U.S. Bureau of the Census 2021a; 2021b). High automobile dependence in low-density, land-use-segregated, and poorly transit-served U.S. urban areas further increases living costs (US Department of Housing and Urban Development Location Affordability Portal 2019). Building vacancy plays a role in the lack of affordable housing by leaving centrally located land and structures underutilized, contributing to the reduction of the overall housing supply in city cores. At the same time, demand for housing in these areas remains high, particularly for low-income units, creating a direct link between persistent vacancy and housing affordability challenges.

Therefore, this paper examines how adaptive reuse practices can help tackle both urban vacancy and housing affordability by converting abandoned schools to residential use. Despite challenges, the presence of vacant public properties in urban neighborhoods creates opportunities for communities to respond to emerging, localized needs (Davis et al. 2023). When redeveloped within the framework of sustainable adaptive reuse, these properties can serve as catalysts for urban revitalization, enhancing public health and

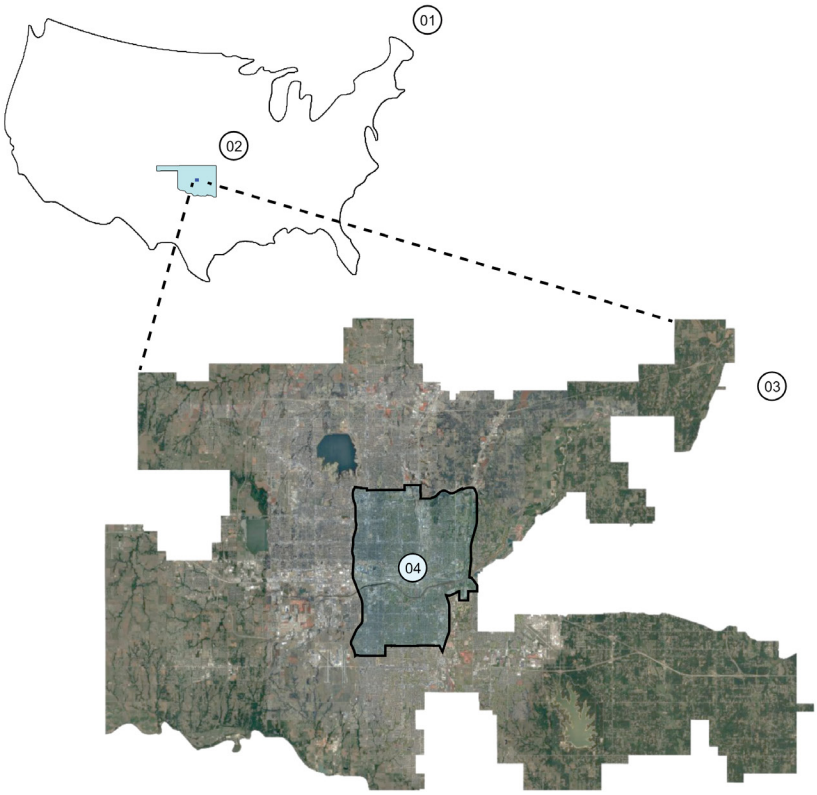


Figure 1: The City of OKC in the U.S. context. 1. The United States of America. 2. The state of Oklahoma. 3. OKC. 4. OKC's Urban Core. Source: authors.

well-being while preserving social and historical value.

In this paper, we examine the urban context of Oklahoma City (hereinafter, OKC), the capital of Oklahoma, a state in the south-central region of the US (Figure 1). By using OKC as a case study, we explore the design challenges of adaptive reuse at both urban and architectural scales.

Research on adaptive reuse has discussed the potential for converting existing buildings into housing (O'Meara 2015; Tsenkova 2023). Architectural practice, both worldwide and in the US, has provided examples testing the possibilities of such conversions. In OKC, sustainable adaptations of schools into housing have successfully contributed to local urban revitalization efforts (Pfister 2018). However, given the number of public schools in OKC identified for future transformation or at risk of demolition (Willert 2019), a systematic study of the typological feasibility of conversion is needed. This paper seeks to address this research gap by assessing the adaptability of urban schools for multifamily housing and addressing the following questions: What are the main challenges in adapting the most common urban school types? Which historic school layouts are best suited for conversion? To answer these questions, we study existing public educational facilities and potential school-to-housing conversions using a mixed-method approach focused on typological analysis.

1.2 Literature Review

The literature defines adaptive reuse as the processes and practices that convert heritage buildings for new uses, maximizing the economic and social benefits of historic structures while restoring their value to the community (Li et al. 2021; Tsenkova 2023). This approach offers a unique opportunity for converting abandoned schools—whether historically designated or not—given their architectural significance and social legacy. Adaptive reuse differs fundamentally from preservation and rehabilitation in its goal to assign a building an entirely new function while retaining key structural or architectural features, rather than merely maintaining or upgrading its original use (Shahi et al. 2020; Vafaie et al. 2023).

Adaptive reuse practices offer multiple benefits when planned and implemented within a sustainability framework. From a community perspective, revitalizing

a historic school building fosters a sense of pride and reinforces emotional and cultural connections (Davis et al. 2023). Adaptive reuse can help preserve both the historical and aesthetic value of a neighborhood (Vafaie et al. 2023). From a social perspective, maintaining a school leads to the conservation of a community's heritage while serving as a catalyst for neighborhood revitalization. In U.S. urban cores, preserving schools holds particular significance for minority communities, as these buildings reflect struggles and progress in civil rights and public education (Erickson 2018; Montgomery and Gaston 2017).

Opportunities to convert historic schools into housing arise for multiple reasons beyond their inherent heritage value. First, from a financial perspective, culturally significant school buildings may qualify for substantial incentives, such as historic tax credits, which support their preservation (O'Meara 2015). Current U.S. tax incentives for preservation include a 20 percent federal tax credit for the rehabilitation of certified historic structures. Many states also offer their own historic rehabilitation tax credits, which can be claimed in addition to the federal credit and vary in rate and eligibility by state. When combined with LIHTC, these historic tax credits make converting urban schools into homes more financially viable for the private sector.

Second, the urban locations of most educational facilities are well suited for housing developments, as they benefit from existing infrastructure and services, including transit. Given that transportation costs often exceed housing costs for suburban households (US Department of Housing and Urban Development, Location Affordability Portal 2019), developing housing in walkable, transit-oriented areas is essential for achieving affordability.

Third, most pre–World War II schools in the U.S. share common typological characteristics—such as floor plans and construction techniques—appropriate for multifamily housing. Their spacious classrooms, wide corridors, and high ceilings can be adapted into residential units while retaining significant architectural features, allowing for functional and attractive living spaces within a historic framework (O'Meara 2015).

1.3 Research Methods

For this study we adopt a mixed-methods approach to develop a typological analysis of historic urban schools. The analysis is organized into four major sections, each one corresponding to a distinct aspect of the typological investigation: a historical overview, morphological analysis, cluster analysis, and precedent study.

The first section provides a historical overview of U.S. educational buildings from the mid-nineteenth century to the post–World War II era. It traces the evolution of school building types over time and documents recurring patterns of form, structure, and spatial organization (Stouffs and Tunçer 2015). Drawing on primary sources, such as historic design manuals, and secondary sources, including recent studies on school architecture, we develop a chronological narrative of school facilities in OKC, situating them within broader social, economic, and architectural contexts.

The second section is a formal comparison of 17 public school buildings in OKC's urban core that, over the past decade, have been abandoned, at risk of abandonment, or under consideration for reconversion. Through a morphological analysis, we examine this sample to identify key metrics and spatial relationships at both the block and building scales. This qualitative assessment provides a foundational understanding of school typologies, highlighting recurring spatial and formal attributes through archival research, direct observation, and digital 3-D modeling.

The third section of the typological analysis builds on the quantitative statistical method of a cluster analysis, which aims to validate our visual inspections by uncovering hidden patterns that may not be immediately apparent through historical documentation, visual comparison, and modeling (Martínez-Rocamora et al. 2024).

The fourth part of our typological study examines the reuse potential of historic schools through recent conversions to housing in OKC. We analyze three case studies by comparing the original school floor plans with the new housing layouts to identify patterns of transformation and redevelopment constraints. This analysis further investigates the key modifications required to convert historic educational facilities into housing, with particular attention to local regulatory and market contexts.

The final part of the analysis compares the floor plans of the identified clusters with optimized, AI-generated multi-family housing layouts to assess their adaptive reuse feasibility. When distinct clusters emerge, they are described in terms of their housing potential, highlighting specific design challenges and targeted reuse strategies. The results of this typological research are then presented in a discussion, synthesized as a set of design considerations for a sustainable reuse plan for OKC's schools, illustrated through concise texts and diagrams.

2. HISTORICAL OVERVIEW

2.1 A History of Standards

The design of U.S. school buildings has evolved over the past 150 years, shaped by enrollment fluctuations, health and safety concerns, technological advancements, pedagogical shifts, and curricular reforms (Baker 2012; Erickson 2018; Moore 1991). Despite these changes,

school design has increasingly followed standardized guidelines. As Hamlin noted in 1910, "The data for the designing of public school buildings have been more completely standardized than for any other type of structure, except the American public library" (Hamlin 1910). The literature on school design typically differentiates school types chronologically, identifying each type with a specific "era" and discussing how the evolution of the concept of standard developed alongside evolving school typologies. Below is a summary of recurring classifications, with a focus on nineteenth- and early twentieth-century school types.

2.2 Schoolhouses

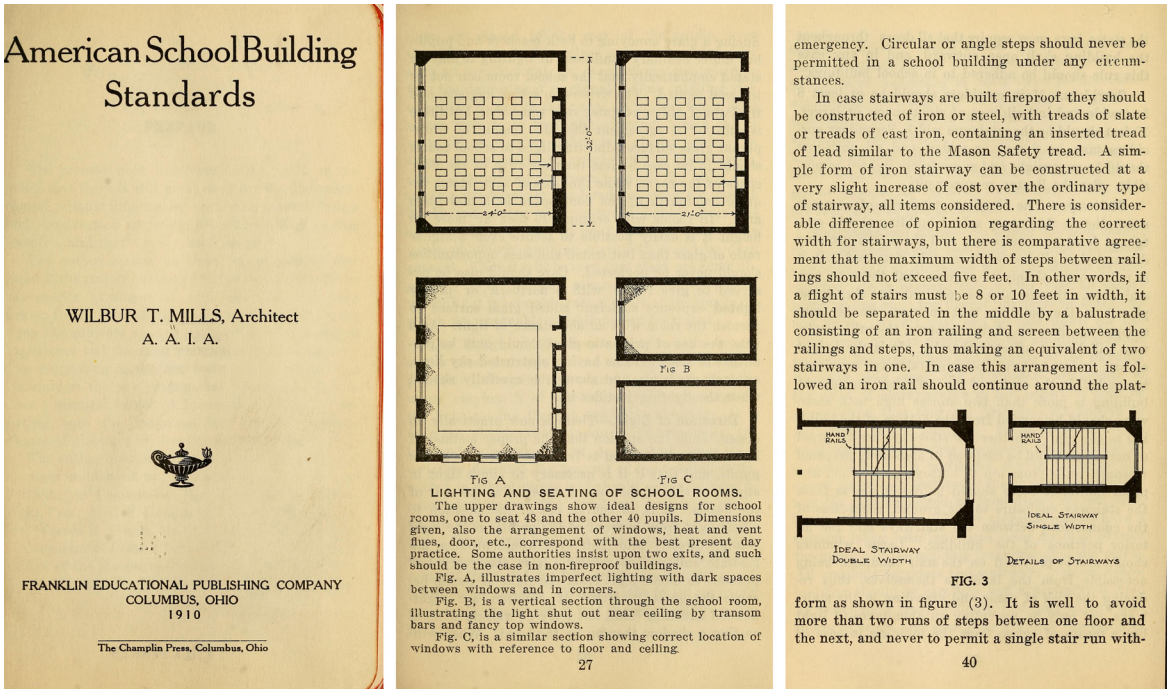
Early U.S. education took place in diverse indoor settings, including church basements and private homes. The first dedicated schoolhouses were one-room spaces serving all grade levels without standard criteria (Gulliford 1996). Standardization began in the 1830s, following the establishment of the U.S. public education system, led by Horace Mann. Early design and construction manuals, developed by educational reformers like Henry Barnard, played pivotal roles in disseminating key standards and requirements for public schools throughout the country. In the manual "School Architecture," for example, Barnard emphasized programmatic design, functionality, and the maintenance of educational spaces, addressing issues related to indoor light, warming, and overcrowding.

The Common School movement, funded by local property taxes, further expanded public education (Baker 2012). While early examples of schoolhouses still exist across the nation, no pre–twentieth–century schools can be found in OKC today, as the city was founded in 1891, and Oklahoma became a state in 1907.

2.3 Early Standards and Manual Schools

With late–nineteenth–century industrialization, educational philosophy shifted toward a more structured learning system, giving rise to a compartmentalized school building type. As child labor declined and urban populations grew, schools expanded to include more educational and recreational spaces to accommodate rising enrollment while maintaining a compact footprint. Multi–story buildings became standard, with floors typically organized by age group. Typical layouts featured two rows of classrooms accessed via a wide corridor, with few specialized spaces beyond a separate headmaster's office, bathrooms, and assembly hall for gatherings. Larger schools included a library, arts and science classrooms, workshops, and an auditorium.

In the 1910s, several manuals on school building design were published, detailing layouts, construction methods, and environmental system requirements. This period marked the standardization of spatial


American School Building Standards

WILBUR T. MILLS, Architect
A. A. I. A.

FRANKLIN EDUCATIONAL PUBLISHING COMPANY
COLUMBUS, OHIO
1910

The Champlin Press, Columbus, Ohio

FIG A FIG B FIG C

LIGHTING AND SEATING OF SCHOOL ROOMS.

The upper drawings show ideal designs for school rooms, one to seat 48 and the other 40 pupils. Dimensions given, also the arrangement of windows, heat and vent flues, door, etc., correspond with the best present day practice. Some authorities insist upon two exits, and such should be the case in non-fireproof buildings.

Fig. A, illustrates imperfect lighting with dark spaces between windows and in corners.

Fig. B, is a vertical section through the school room, illustrating the light shut out near ceiling by transom bars and fancy top windows.

Fig. C, is a similar section showing correct location of windows with reference to floor and ceiling.

27

emergency. Circular or angle steps should never be permitted in a school building under any circumstances.

In case stairways are built fireproof they should be constructed of iron or steel, with treads of slate or treads of cast iron, containing an inserted tread of lead similar to the Mason Safety tread. A simple form of iron stairway can be constructed at a very slight increase of cost over the ordinary type of stairway, all items considered. There is considerable difference of opinion regarding the correct width for stairways, but there is comparative agreement that the maximum width of steps between railings should not exceed five feet. In other words, if a flight of stairs must be 8 or 10 feet in width, it should be separated in the middle by a balustrade consisting of an iron railing and screen between the railings and steps, thus making an equivalent of two stairways in one. In case this arrangement is followed an iron rail should continue around the platform as shown in figure (3). It is well to avoid more than two runs of steps between one floor and the next, and never to permit a single stair run with-

HAND RAILS

IDEAL STAIRWAY DOUBLE WIDTH

IDEAL STAIRWAY SINGLE WIDTH

DETAILS OF STAIRWAYS

FIG. 3

40

Figure 2: Wilbur T. Mills's American School Building Standards. Source: Library of Congress, https://www.loc.gov/item/11001012/

dimensions as well as heating, daylighting, ventilation, and acoustics in school design. Natural lighting and ventilation were particularly debated, considering the absence or scarcity of engineered solutions at the time (Baker 2012). The classroom layout became a key focus, with authors like Alfred Dwight Foster Hamlin and Wilbur Mills emphasizing the importance of students' learning experience (Figure 2).

Classrooms were typically rectangular, measuring approximately 24 by 32 feet. A common standard for the time, which remained influential for decades, specified that main corridors in buildings with at least eight classrooms had to be no less than 10 feet wide (Hamlin 1910; Mills 1910). Additionally, manuals reported a description of specific programmatic spaces or "special rooms", including a coal room adjacent to a boiler or furnace rooms. Stylistic solutions were also standardized, with a preference for brick veneering and Richardsonian Romanesque, Queen Anne, or Collegiate Gothic styles. Early examples of this school type in OKC include Lowell School (later Douglass High School, then Page Woodson), a red-brick Collegiate Gothic building completed in 1910, one of the early statehood schools in Oklahoma.

2.4 Progressive and Depression Era Schools

From the 1920s, the "open air school" movement, led by a new generation of reformers and architects, significantly influenced educational building design in the U.S. This movement aimed to fight the rise of tuberculosis, emphasizing a healthy learning environment with natural ventilation, light, and outdoor activities. Consequently, schools were increasingly segregated from other urban land uses, following the rise of modern zoning practices, and were often located near green areas to provide healthy, pollution-free spaces (Baker 2012).

A new wave of school layouts prescribed narrower and longer buildings, with expansive windows for more natural lighting, and cross–ventilation. Direct connection to the outdoors was also encouraged to blend outside and interior spaces, and to accommodate the pedagogical ideas of progressive school reformers such as John Dewey and Maria Montessori. This period also saw a shift toward more flexible construction systems, such as light-frame construction, resulting in freer, more open layouts, and simplified façades and flat roof details, in most cases (Baker 2012).

Between the 1920s and 1930s, approximately 30 schools were built in OKC, reflecting the city's growth. In this period, the OKC school district implemented a modular approach to school design, which was referred to as the "Unit Plan." Following this approach, most elementary schools were initially constructed with eight classrooms, with plans for future expansions (Sheals and Martel 2018). The Classical Revival style, characterized by simplified massing, patterned brickwork, and flat roofs, was common for these schools. However, only seven schools were built from 1931 to 1945, a period marked by a slowdown in the city's growth and prewar austerity, funded by the Works Progress Administration (Jo Meacham Associates 2001).

2.5 Postwar Changes

The introduction of new technology in postwar schools led to more architectural freedom for educational spaces, making it difficult to identify common typological characteristics. Pre–World War II schools often implemented similar massing strategies, floor plan schemes, classroom layouts, and façades. However, the postwar baby boom in suburban neighborhoods led to a surge in school population, which resulted in more flexible, adaptable, and expandable floor plans. These plans featured rows of classrooms with direct light and outside access via exterior doors (Baker 2012). The concepts of "finger plan" or "campus plan" became popular, allowing each classroom to have light and outdoor access through exterior doors. These facilities were often flat-roofed, with steel or concrete structures and curtain wall systems (Tanner and Lackney 2005). Air conditioning also became standard, improving indoor environmental quality, while the increased use of plastics, glass, and steel led to the proliferation of lightweight, single-story school buildings by the late 1950s (Moore 1991). Additionally, the advent of fluorescent lighting enabled the design of deeper buildings with artificial lighting. These structures were less expensive, easier to construct, and more adaptable to curricular changes. Although their life expectancy was shorter, schools still required periodic rebuilding (Hille 2011).

3. MORPHOLOGICAL ANALYSIS

3.1 Inclusion Criteria for Case Studies

Following the historical overview, we now focus on a morphological study of OKC's educational facilities. This section analyzes the formal characteristics of a selected sample of school buildings in OKC to identify broader patterns of relationships, ranging from the block scale to the classroom scale. Our morphological study provides a foundational qualitative understanding of school buildings, identifying recurring spatial attributes through direct observation and digital modeling.

First, to identify the sample to be studied in our analysis for OKC schools, we referenced the "List of Buildings Throughout Oklahoma City Public Schools' History" administered by the Oklahoma City Metropolitan Library System archival database (Metropolitan Library System 2020). The database lists 135 buildings that

were once part of the city of OKC Public School District (hereinafter, OKCPS), including schools still in operation. Based on our research goals, we applied the selection criteria below to filter the list and identify our case studies for the analysis.

The scope of the study is limited to schools that are within OKC's urban core, defined as the "Urban, Medium Intensity" area (City of Oklahoma City, Planning Commission 2020). The focus on the urban core results from the scope of this research on housing affordability, as urban core neighborhoods reveal more severe shortages of affordable housing in OKC (PolicyMap 2025; Economic and Planning Systems, Inc. 2021). Additionally, schools in the urban core present other important benefits, including proximity to amenities and denser mixed urban communities that reuse practices can support. The significance of the schools' locations as an inclusion parameter for case study selection stems from the critical role that proximity to central public infrastructure plays in real estate, and specifically for affordable housing.

Besides location, to be part of the case study list, selected schools need to be structurally intact by the time of this research (December 2024). Additionally, the building must have been abandoned, under threat of closure, or slated for transformation within the last 10 years (2014-2024).

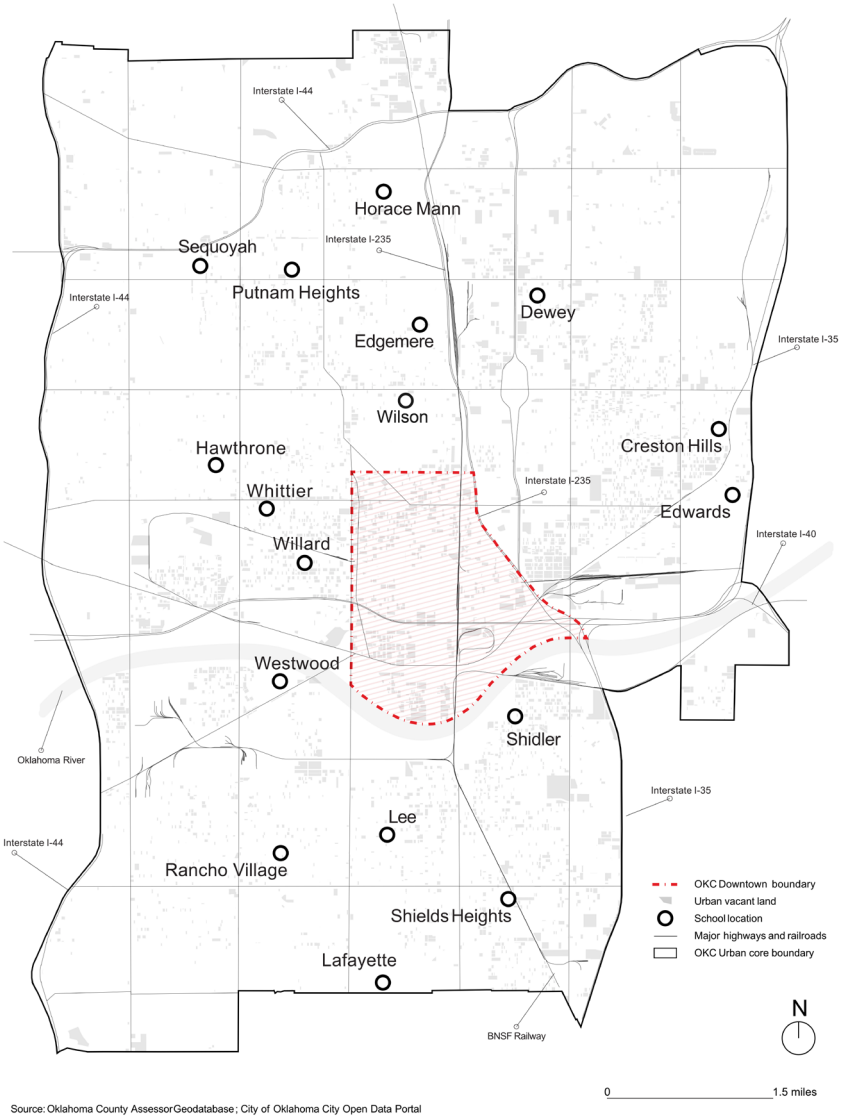


Figure 3. OKC's urban core showing the identified schools. Source: Authors.

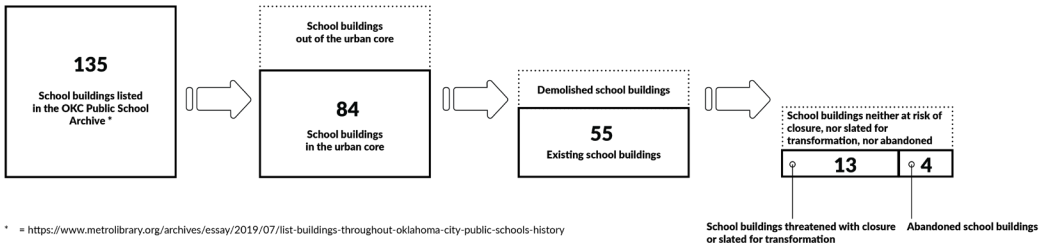


Figure 4. Workflow for identifying the case studies. Source: Authors.

Figure 5. Historical photographs of selected schools. Source: Oklahoma Historical Society, https://gateway.okhistory.org/.

1: Creston Hills 2: Dewey 3: Edgemere 4: Edwards 5: Hawthorne 6: Horace Mann 7: Lafayette 8: Lee 9: Putnam Heights 10: Rancho Village 11: Sequoyah 12: Shidler 13: Shields Heights 14: Westwood 15: Whitter 16: Willard 17: Wilson

To determine closure or conversion potential, we reviewed OKCPS-wide facilities plans from the past decade, with particular focus on the 2019 Pathway to Greatness plan (OKCPS 2019).

3.2 Identification and Introduction of Selected Schools

Out of the 135 schools presented on the "List of Buildings", 17 fall within the research scope. Their locations within OKC's urban core are depicted in Figure 3.

Figure 4 shows the workflow for identifying the selected schools, while Figure 5 provides a visual comparison using historical photographs.

3.3 Data Organization

We collected data for all selected facilities for formal analysis using archival documents, including Sanborn Fire Insurance Maps, historical drawings, and photographs, and cadastral records, and compared them with materials from site surveys. The data were organized into four categories: plan features, elevation features, size features, and history features. Additionally, we created 3D models of all the facilities (Figure 6). A preliminary overview of the data, combined with comparison to the 3D massing models, revealed a series of consistent characteristics across the identified schools, as described in the following sections.

3.4 Common characteristics

3.4.1 Similarities in construction year, designers, and building structure

The identified schools were constructed between 1910 and 1950, spanning approximately 40 years of educational facility development in OKC. An overview based on the 3D-modeling phase revealed notable similarities in building form. These similarities can be attributed in part to many buildings being designed by the same architects and engineers, often led by Solomon Andrew Layton (Montgomery and Gaston 2017), and in part to the implementation of district-level design guidelines aimed at standardizing outcomes. Analysis of Sanborn Maps and fieldwork confirmed that fourteen buildings feature load-bearing brick walls with concrete floors and roofs, while the remaining schools employ wood-frame and steel construction (Figure 7).

3.4.2 Prevalent locations and coverage factors

Half of the facilities occupy an entire urban block, while the remaining half are located on corner lots. The building coverage ratio of these schools relative to their parcels ranges from 2% – 8%, leaving substantial open areas for outdoor activities and potential future expansions, in line with national building standards and local design guidelines, such as the "Unit Plan" (Mills 1910; Sheals and Martel 2018).

3.4.3 Building form: classroom bar

The lengths of the original layouts of the identified school buildings range from 63 to 222 feet. In general, older buildings tend to be shorter and more compact. Building footprints vary between 10,000 and 25,000 square feet, with most structures exhibiting a two-story, double-loaded corridor scheme.

Based on relative standard deviation values, the most consistent characteristics among the sampled schools are classroom sizes, averaging 25 by 33 feet, corridor widths of approximately 10 feet, and an overall building depth of about 61 feet.

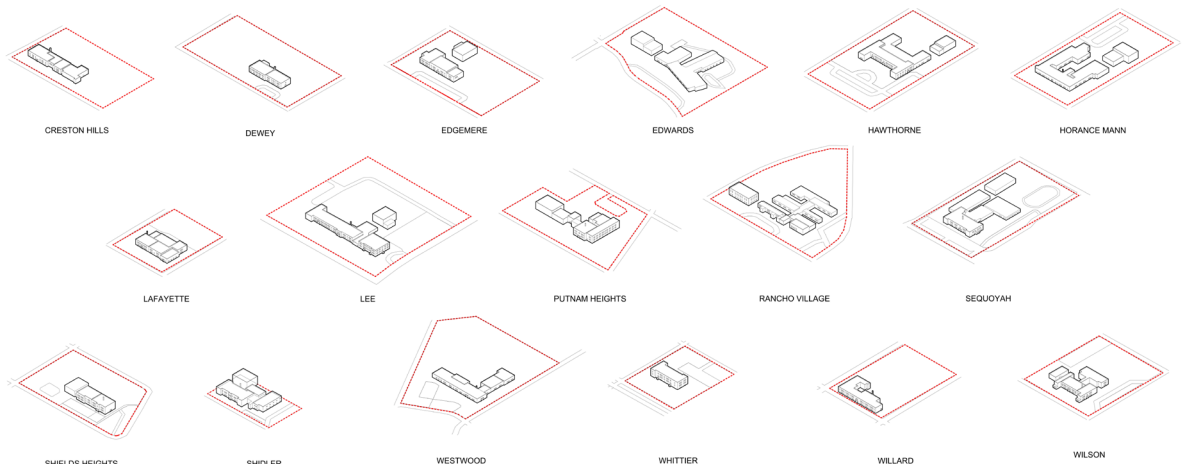


Figure 6. Historical photographs of selected schools. Source: Oklahoma Historical Society, https://gateway.okhistory.org/.

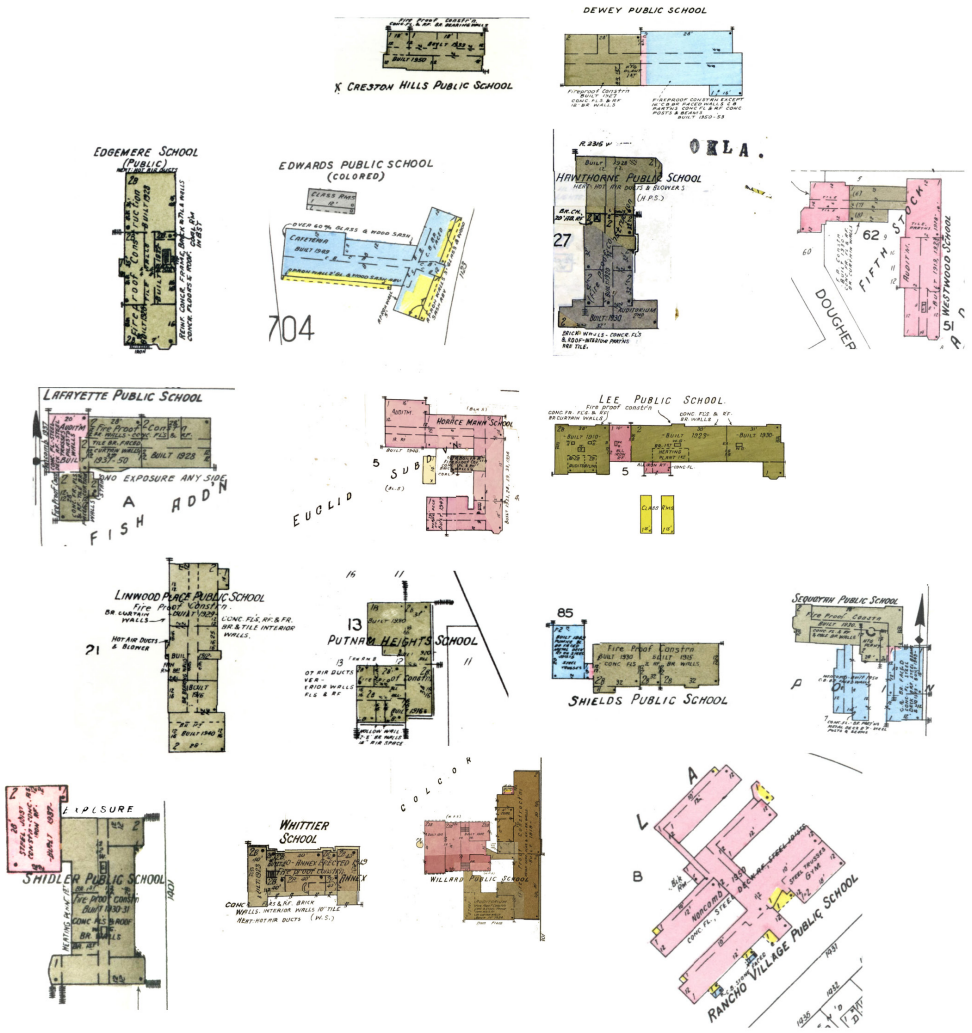


Figure 7. Samples of Sanborn Fire Insurance Maps for the selected schools, revealing in most cases an original fireproof load-bearing wall structure in bricks (greenish–brown color). Source: Sanborn Maps, Library of Congress, https://catalog.loc.gov/vwebv/holdingsInfo?bibId=12632128

The buildings range from one-to two- story buildings above a basement. Basements are typical in schools built in the early 1910s, whereas single-story structures are more common in the 1920s and 1930s. For double-loaded-corridor buildings, widths range from 61 to 81 feet, classroom depths from 23 to 25 feet, and corridor widths between 10 and 14 feet. A comparison of building-form ratios (envelope area divided by volume) indicates a shared pattern across the sample, ranging from 0.08 to 0.13 square feet per cubic foot.

3.4.4 Building form: Additions

As shown by the Sanborn Maps, each identified building was expanded over time and drastically differs from the original layout. Figure 8 presents an overlap of the current ground-floor plans of the sampled schools, revealing added wings and extensions. The original cores are visible in the areas with the highest density of overlapping lines.

As shown in the Sanborn Maps (Figure 7), all surveyed schools feature either a classroom extension from the main wing or a double-height amenity space, such as a gymnasium or auditorium. Archival research indicates that these additions were often part of a second stage of construction, sometimes occurring less than a decade after the initial building. This rapid expansion was likely driven by student population growth in OKC's urban core through the 1940s.

3.4.5 Building form: Coal room and chimney

Most of the identified school buildings feature a chimney, a neighborhood landmark typically located

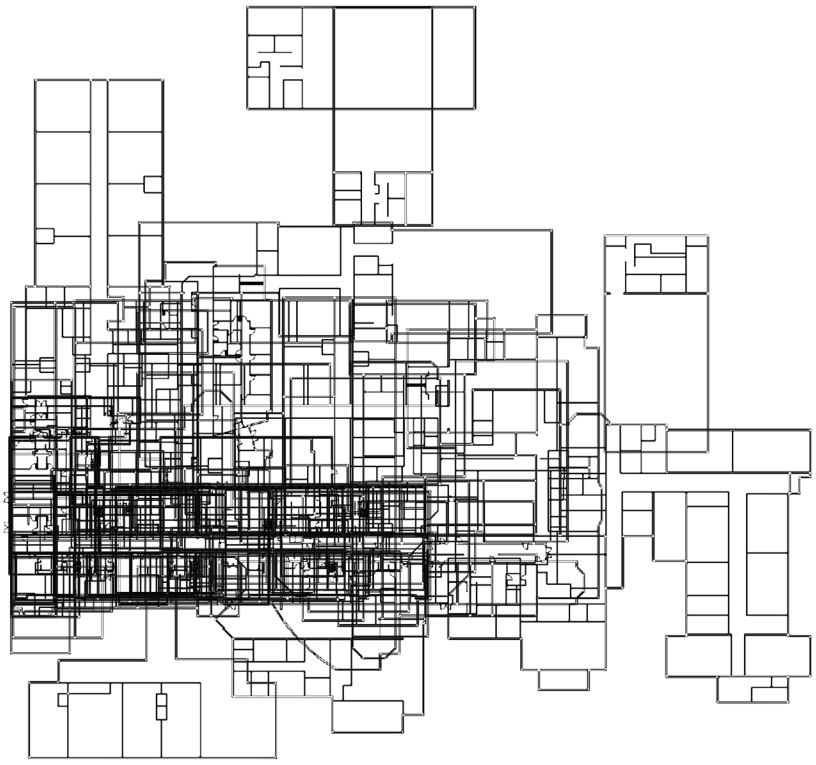


Figure 8. Current plans of sampled schools overlapped. The result of the overlapping identifies a recurring compact, double-loaded corridor scheme, approximately 60 feet wide. Source: Authors.

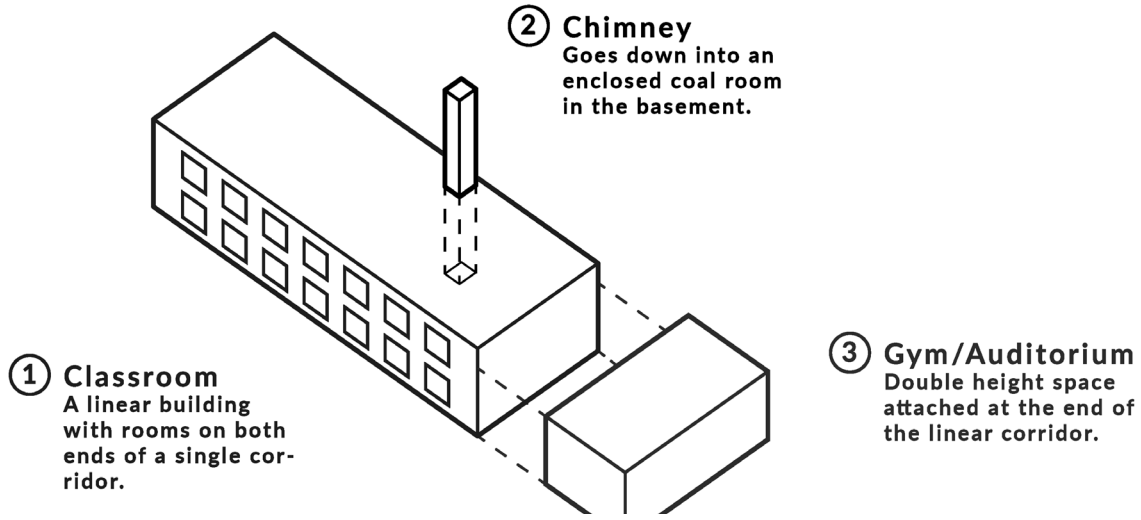


Figure 9. School building typology according to three main formal features: classroom bar, chimney, and gym/auditorium spaces. Source: Authors.

on the long rear façade, opposite the main entrance. Historically, these chimneys were connected to a furnace and a ground-level or basement coal room, serving both to vent fumes and provide ventilation. Mills' design guidelines recommend that coal rooms be located outside the building, when possible, but always adjacent to the furnace room, and sized to store at least half a season's supply of coal (Mills 1910). Along with the classroom bar and the gymnasium / auditorium, the chimney encapsulates the key massing features of early twentieth century OKC schools (Figure 9).

4. CLUSTER ANALYSIS

4.1 Results

To further investigate the typological analysis results and identify patterns in spatial and metric indices, we performed a cluster analysis. Building on literature (Ohmura et al. 2019), for the cluster analysis we gathered key variables from the original school designs. We used data related to the presence or absence of formal features, and data pertaining to building sizes, focusing on the following: form factor; length–width ratio of the building and classrooms; corridor width; number of stories; window/wall ratio; number and position of accesses; number and position of stairs. We used IBM SPSS Statistics software to run various clustering techniques and test multiple trials with different numbers of clusters to determine the optimal grouping that best summarized the key differences. Ultimately, we opted for Ward's method as a hierarchical clustering technique based on squared Euclidean distance, as it yielded the most consistent results relative to our knowledge of the sample.

The dendrogram in Figure 10 displays the analysis results with a proposed cutline that identifies six clusters.

4.2 Cluster Description

Figure 11 shows the main massing characteristics of each identified school cluster, followed by an individual description.

The first cluster, which we have named "Dual Entry Schools", groups schools featuring two access points on the main facade, usually differentiated by gender. They are two and a half stories tall, with four to six classrooms per floor. The basement level often houses coal and furnace rooms, as well as playrooms or a gymnasium. In this cluster, vertical circulation is placed in front of the two main access points. Building depths range from 61 to 81 feet. In the case of buildings wider than 65 feet, an auditorium is present at the ground level. This cluster presents the lowest form factors, between 0.08 and 0.09 square feet/cubic feet, and the highest windows/wall ratios, with ample window panels reaching up to

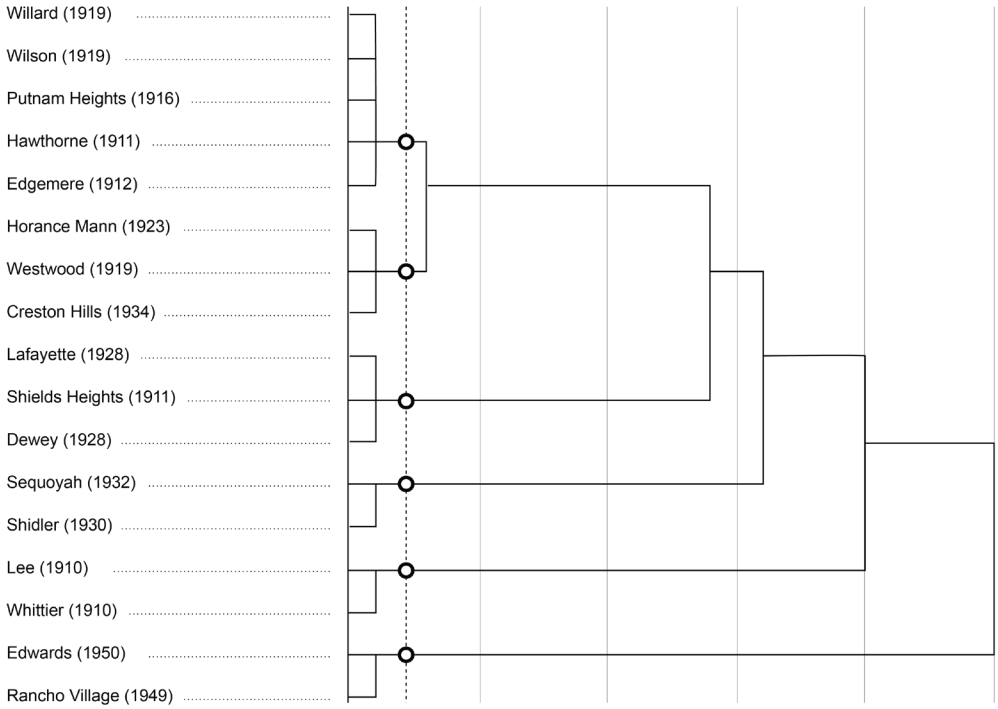


Figure 10. Cluster dendrogram of selected schools according to the proposed cutline. Source: Authors.

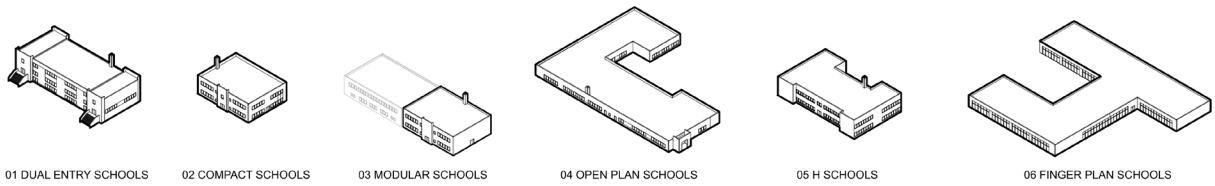


Figure 11. Isometric view of the identified clusters. Source: Authors.

eight feet. Classrooms in these schools are, on average, 26 by 30 feet, with no adjacent coat room.

The second school cluster, called "Compact Schools", groups two-story buildings with a single entrance on the main façade. Each floor typically contains four to eight classrooms, on average smaller than the other recorded classroom sizes, making them the smallest buildings in terms of footprint and among the most compact. Vertical circulation usually consists of two stairs, placed at the ends of the longitudinal hallway.

The long elevations are distinguished from the other clusters because of the recurring presence of two window types. The first one is the classroom wood window, an approximately 18 by 8 feet long opening divided into five panels. The second is a smaller opening, often proportioned to provide light to the coat room connected to the classroom. The short elevations have fewer openings than the long elevations, but remain richly decorated, with corners defined by buttresses or unique decorative solutions. This design suggests that the buildings were not intended for future expansion.

Developed as two-story structures, the third school cluster samples, named "Modular Schools", are designed consistently around a 24 by 34 feet classroom module. They typically follow a double-loaded corridor layout with four classrooms per floor. Unlike the compact schools, vertical circulation consists of a single stair, placed adjacent to the main access. This characteristic facilitates future expansion along the main hallway. The short façades lack decorations and apertures, except for hallway exits at the ground level, further facilitating future expansion.

The fourth cluster, called "Open Plans", groups one-story, wood-frame buildings with larger footprints than their contemporary clusters, therefore requiring multiple access points. This cluster is also characterized by the largest classroom size, averaging 28 by 33 feet.

The fifth cluster groups the "H Schools", or buildings with an H-shaped layout on two stories, featuring typically eight classrooms per corridor. Notably, they have the second largest fenestration area per classroom, and the widest coat rooms. The short sides of the classrooms facing the main elevation lack windows, resulting in solid walls.

The last cluster, or "Finger Plan Schools", groups Rancho Village and Edwards, two one-story schools characterized by a large, non-compact footprint. These schools are developed on one story, and present the highest number of classrooms per corridor.

5. ADAPTIVE REUSE PRECEDENTS

5.1 Three projects in Northeast OKC

The following paragraphs focus on the recent conversion of three public schools into housing, driven by private initiatives and supported by the local community. The original schools were all constructed between 1910 and 1928 in Northeast OKC.

This overview aims to identify typical capital-raising strategies, site subdivision practices, and programmatic requirements common to these projects. Additionally, it provides general guidelines and dimensional standards for conducting an AI-supported exercise, in which AI-generated layouts simulate potential multifamily housing configurations within the identified cluster floor plans. This approach enables a systematic evaluation of spatial efficiency, circulation, unit mix, and compliance with local building codes.

5.2 Page Woodson Apartments

Page Woodson Apartments is an award-winning, 65-unit affordable housing project in Northeast OKC (Figure 12). The building, formally known as Lowell School, was originally designed for white students by the architectural firm Layton Smith & Hawk, and represents the oldest example of an educational facility in the city (Robertson 2006). With its two-story volume over a basement and symmetrical dual access, the building belongs to the Type 1 cluster: Dual Entry.

Renamed Douglass High School in the 1930s, the facility became the first in OKC dedicated to educating upper-grade students in the African American community, establishing itself as one of the leading educational institutions in the region (Robertson 2006). The surrounding neighborhood was negatively affected by urban renewal and interstate highway projects from the 1960s to the 1980s, resulting in dramatic population and economic decline, which ultimately led to the

school's closure in 1993. In the 2010s, the building was converted into affordable housing, incorporating community spaces and a 700-seat auditorium. The reuse project, designed by Smith Dalia Architects, leverages LIHTC and historic tax credits to create a fully affordable development. The original classroom layout was largely preserved, with classrooms of almost 900 square feet converted into two-bedroom, two-bathroom units. To maximize the number of affordable units, the gymnasium was transformed into studio apartments (Figure 13). The original parcel of the Douglass High School was further divided to create another mixed-use building adjacent to the school, designed by Butzer Architects and Urbanism, maximizing the overall development.

5.3 Dunbar Commons

Dunbar Commons is a two-story senior housing development located in the former Dunbar Elementary School. Historically known as the "Fairgrounds",

Figure 12. External view of Page Woodson Apartments as of today. Source: Authors.

Figure 13. First floor plan of demolitions and new construction of Page Woodson Apartments. Source: Authors.

today this residential area is referred to as the John F. Kennedy neighborhood. The school, originally designed in 1922 by Solomon Layton, was named in honor of African American poet Paul Lawrence Dunbar, and is the only extant example of a "separate" school in OKC (Montgomery and Gaston 2017). Its original structure features load-bearing, multi-wythe brick walls, distinguished elevations with large classroom windows and slit openings for coat rooms (Figure 14). With the original classroom sizes averaging 24 by 30 feet, Dunbar can be classified as a Compact School. The facility closed in 2010 and was recently repurposed as senior housing with the name Dunbar Commons, by the firm M+A. Like Page Woodson, this project utilized both tax credits and LIHTC funding for its redevelopment.

While the reuse project maximizes all available square footage for housing—similar to Page Woodson, with the gymnasium converted into units—it demonstrates a careful sensitivity to the existing structure. As shown in the demolition and new construction plan (Figure 15), the unit layouts are designed to align closely with the original classroom dimensions, minimizing the need for structural alterations. The 800-square-foot classrooms are transformed into two-bedroom units while retaining the original entry doors and window configurations. Furthermore, the coat rooms adjoining each classroom are repurposed as mechanical rooms and closet spaces for the units.

5.4 Marcus Garvey Harmony Apartments

Marcus Garvey Harmony Apartments is an ongoing adaptive reuse project focused on converting Harmony School into low-income rental senior housing (Figure 16).

Originally called King Elementary, Harmony School was built in 1928. With its two-story layout mostly consisting of 24 by 30 feet classrooms served by a single stair adjacent to the main entry, the school belongs to the Modular cluster. For much of its history, Harmony was a white-only institution and became one of the early facilities in the OKC public school system to be integrated (Sheals and Martel 2018). The educational facility closed in 2002.

The building consists of a classroom bar along with an auditorium space added to the west. With a gross area of 26,400 square feet, the project provides 61 percent of the total area for housing, reutilizing the existing classroom spaces, for a total of 20 units. Nine percent of the overall building area, corresponding to the original auditorium, was converted into community spaces for the residents (Figure 17). The project is also part of a larger housing development, with new affordable units built on the north side of the original parcel.

5.5 Floor Plan Comparison with precedent standards

The final part of the typological study compares six plan

Figure 14. External view of Dunbar Commons as of today. Source: Authors.

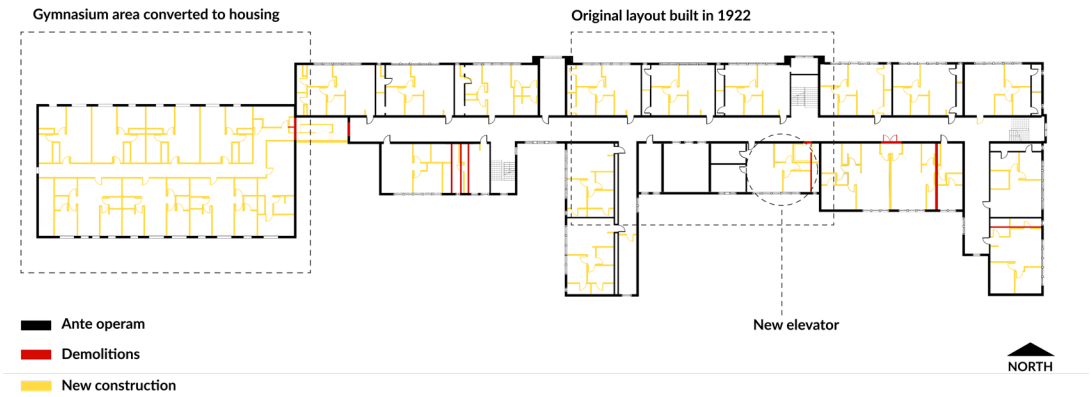


Figure 15. Second floor demolition and new construction plans of Dunbar Commons. Source: Authors.

Figure 16. External view of Marcus Garvey Harmony Apartments as of today. Source: Authors.

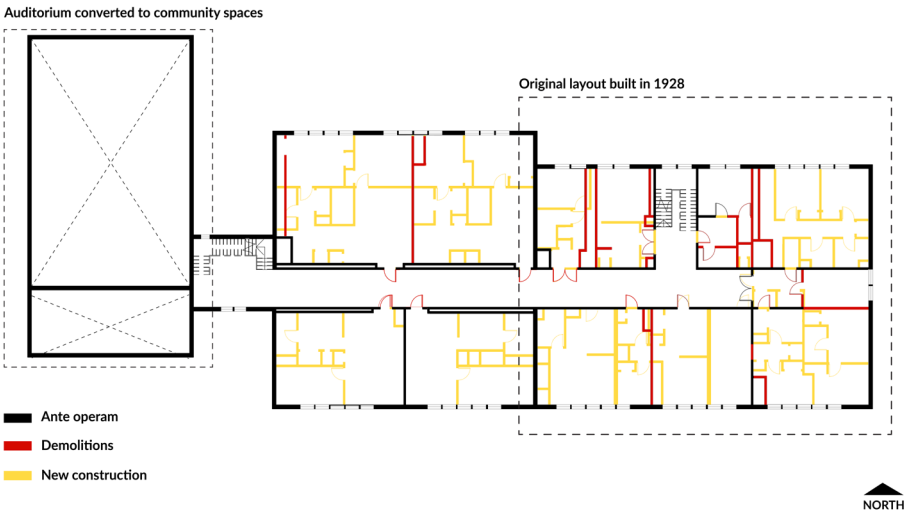


Figure 17. Second floor plan of demolitions and new construction of Marcus Garvey Harmony Apartments. Source: Authors.

layouts—each corresponding to one of the identified clusters—with a series of AI-generated, optimized multifamily housing layouts, through the software Finch 3-D. This exercise presents an overview of the challenges and opportunities represented by each cluster for housing redevelopment (Figure 18).

The horizontal circulation of historic schools can translate well into housing layouts. A typical 10-foot-wide corridor already satisfies multifamily circulation standards. In our analysis, open-plan schools demonstrated the highest plan efficiency (rentable square footage divided by gross square footage) at 82.8%. When paired with the finger-plan configuration at 76.6%, these formats offer a compelling case for residential conversion,

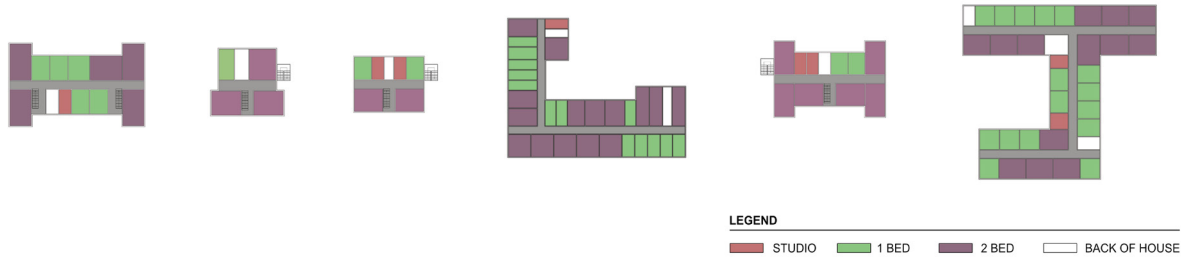


Figure 18. Iterations of floor plans developed through Finch 3-D according to the main cluster layouts. Source: Authors.

Following the analysis of the adaptive reuse projects, we ran iterations of multiple floor plan configurations based on the following unit mix: 10 percent of rentable area allocated to no-bedroom (studio) units, 50 percent to one-bedroom units, and 40 percent to two-bedroom units. Similarly, from the adaptive reuse precedent analysis we determined market-feasible apartment sizes for OKC's core, adopting a range of 336–503 square feet for studio units, 528–698 square feet for one-bedroom units, and 768–989 square feet for two-bedroom units. Typical window layouts within each cluster were considered to avoid partition walls obstructing openings.

Results show that most classroom layouts, typically measuring 25 by 33 feet, align well with optimized affordable two-bedroom, two-bath unit floor plans found in contemporary North American midrise multifamily housing standards (Mosey and Deal 2021; Steffen and Walsh Construction Co. 2021; Hoyt 2020; O'Meara 2015). A single classroom layout can accommodate a fully accessible one-bedroom, one-bath unit, while two classrooms can accommodate a two-bedroom unit alongside a studio. The emphasis on natural daylighting and ventilation in the studied OKC urban schools—often resulting in compact, double-loaded corridor schemes that exceed 70 feet in only one case—translates effectively to contemporary multifamily housing designs. Additionally, due to their structural configuration, these clusters can support a variety of layout solutions. In terms of layout flexibility, Type 6 produced both the highest number of unit combinations and the largest average unit count (26 units), whereas Types 1 and 2 exhibited the fewest combinations and the lowest average unit count (11 units).

further supported by the absence of required vertical circulation. Among school typologies that include stairs or elevators, the H-plan shows the best efficiency rate (78%), followed by the dual-entry plan (76.6%), the compact plan (74%), and the modular plan (72%).

6. DISCUSSION

6.1 Financial Viability and Market Analysis

Based on typological analysis, we identified key building characteristics that capture the historical and architectural significance of urban historic schools in OKC. Given their cultural importance, these characteristics should be carefully considered in the ideation and design stages of any sustainable adaptive reuse project. Therefore, in the last part of the study we connect these features to a specific design theme, offering insights and diagrammatic solutions through illustrations and concise descriptions.

As shown by precedents, the viability of school conversions for private developers greatly depends on financial access to Historical Preservation Tax Credit and LIHTC programs. As of now, all the sampled schools are eligible for historical preservation and affordable housing tax credits. Some conversions may present financial challenges, due to the small school size, or low floor plan efficiency. Thus, subdividing the historic land plot can maximize the number of units on the property, increasing opportunities for complementary housing solutions, including market-rate units, while still supporting preservation and affordability goals.

Another key factor in the project's success is target market analysis, which informs the scope of the housing conversion and the pro forma. According to a 2021 market study prepared by Economic & Planning Systems, OKC's housing market faces a severe shortage of specifically one-bedroom and two-bedroom rental units (Economic and Planning Systems, Inc. 2021). These unit types are the focus at Marcus Garvey, Dunbar, and Page-Woodson Apartments, each organized around a consistent area ratio of 10–50–40 for studios, one-bedroom units, and two-bedroom units. In comparing the three housing precedents in Northeast OKC, we found a recurring programmatic ratio for available square footage: 56-61% for dwelling units, 9–13% for amenity space, 2% for mechanical, electrical, and service spaces, and 27-39% for lobbies and circulation (Table 1).

Project Name	Gross Area (sq ft)	Units (no.)	Housing (sq ft)	Amenity (sq ft)	MEP (sq ft)	Circulation (sq ft)	Housing (%)	Amenity (%)	MEP (%)	Circulation (%)
Page Woodson	83,837	68	46,725	10,550	1,400	25,162	55.7	12.6	1.7	30.0
Dunbar Commons	50,188	36	26,455	3,371	1,000	19,362	52.7	6.7	2.0	38.6
Marcus Garvey Harmony	26,400	20	16,113	2,454	585	7,248	61.0	9.3	2.2	27.5

Table 1: Precedent programmatic comparison. Source: Authors.

Associated with housing needs is the demand for parking spaces. On average, the number of proposed parking spaces in these developments follows the 1.5 : 1 ratio between parking spaces and dwelling units.

6.2 Urban and Architectural Considerations

Sustainable reuse practices should respect the inherent values of the existing building. Thus, value assessment becomes a primary methodological step for designers working on the transformation of historic facilities. These values should be balanced with the practical dimensions of adaptive reuse, which include a variety of functional levels, technical performances, and budget considerations (Jonge 2017; Kuipers and Jonge 2017). A starting point for achieving this balance lies in a shared principle in preservation theories and practices: interventions should respect the historic form of the building. Adapting the program to align with the building's original rationale, or allowing function to follow form, is a recommended approach to avoid inappropriate demolitions and incongruous uses of spaces (Jonge 2017). The next paragraphs present key design themes for converting schools into housing, each defining opportunities to balance the original building's logic with the new program.

6.2.1 New Alleys

The abundance of outdoor, undeveloped spaces in educational facilities in OKC is a potential catalyst for new, denser mixed-use developments. To maximize profitability, the land can be subdivided and sold or kept for a complementary project. An alleyway is an ideal solution to load parking on the back of the building, preserving the continuity of the streetscape while serving as a backbone for the passage of new utility lines. When possible, existing impervious parking needs to be restored and reutilized before adding new parking spaces to the site.

Following the precedents of Page Woodson and Marcus Garvey, using below the case of Willard School as an example of reuse, new service alleys can be traced through the site to support further developments in a second parcel (Figure 19).

6.2.2 Entrance Points and Main Lobby Spaces.

The main entrance of the new housing complex should align with the original main entrance of the historic school, to reactivate the street frontage and restore a clear relationship with the public realm. When this is not possible due to multiple additions to the original school layout, as in the case of Page Woodson, secondary accesses to the corridors or the additions should be considered.

6.2.3 Coal and Furnace Rooms

Because coal and furnace rooms in historic schools typically lack sufficient openings and are challenging to convert into residential spaces, they can be repurposed as offices, small gyms, or storage areas. This strategy enables the creation of additional common spaces on the ground floor and in the basement, enhancing resident amenities while preserving the building's original structure.

6.2.4 Accessibility

For multifamily housing projects designated for senior housing an elevator is required. As shown by the Dunbar project (Figure 15), a new elevator shaft should be located on the rear façade and directly connected to the lobby. Since the sampled two-story and one-and-a-half-story schools are all elevated between three and eight feet above grade, an external ramp system along the main façade should be added to provide ADA-compliant access. This approach minimizes internal demolitions, as successfully implemented at Page Woodson.

6.2.5 Non-classroom Spaces: Gymnasiums and Auditoriums

The precedent analysis highlights two opportunities for large, single-span spaces in historic schools, such as gymnasiums or auditoriums. Both at Dunbar and Page

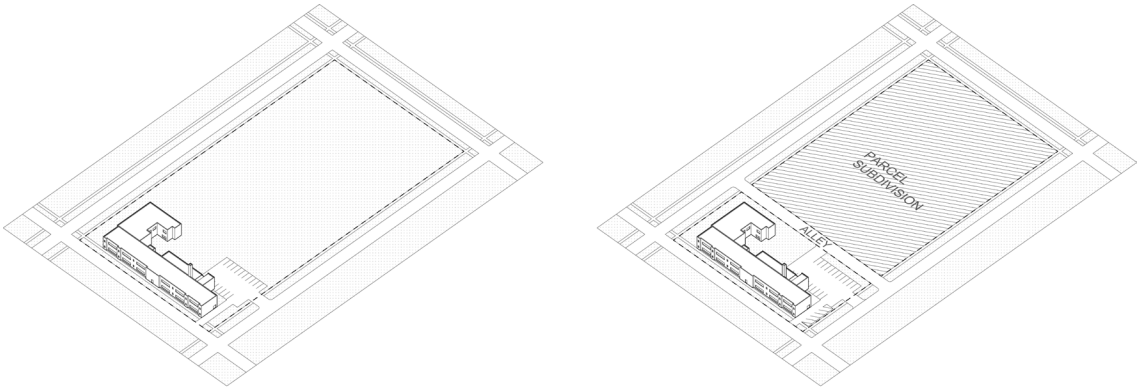


Figure 19. Diagram showing parcel subdivision strategies for Willard. Source: Authors.

Woodson, the school gymnasiums were converted into residential spaces by adding a second floor (Figures 13 and 15). Conversely, an auditorium of a former school can be repurposed for various community-centered uses that foster public engagement and support local needs. This was the case at Page Woodson, where the auditorium was transformed into a neighborhood facility, independent from the housing component. Depending on neighborhood analysis, market studies, community engagement activities, and existing spatial layouts, these uses can include event spaces, co-working rooms, multi-purpose gathering spaces, indoor community markets, emergency shelters, or disaster relief spaces.

6.2.6 Housing Units

Housing units should be designed with careful consideration of the layout of the original classroom windows and the location of load-bearing walls. In the case of OKC's historic schools, the structural configuration, façade composition, and number of openings facilitate the adaptation of classroom layouts into various unit sizes. These include optimized two-bedroom, one-bath units, ranging from 690 to 770 square feet (as seen in Dunbar), or into spacious two-bedroom two-bath units, approximately 850 square feet, (as in Page Woodson). Additionally, a classroom can be further transformed into an accessible 720 square feet one-bedroom unit, as in the adaptive reuse of Marcus Garvey Apartments (Figure 17). When converting classrooms into dwelling units, the original openings must be considered. As for the case of compact school types, such as Dunbar, the building elevations show two distinct opening types which could define two different spaces within the units (Figure 20). The floor plans of Dunbar's units, for example, illustrate how the original four-foot-wide coat room spaces can be reused as wardrobes or bathrooms (Figure 15).

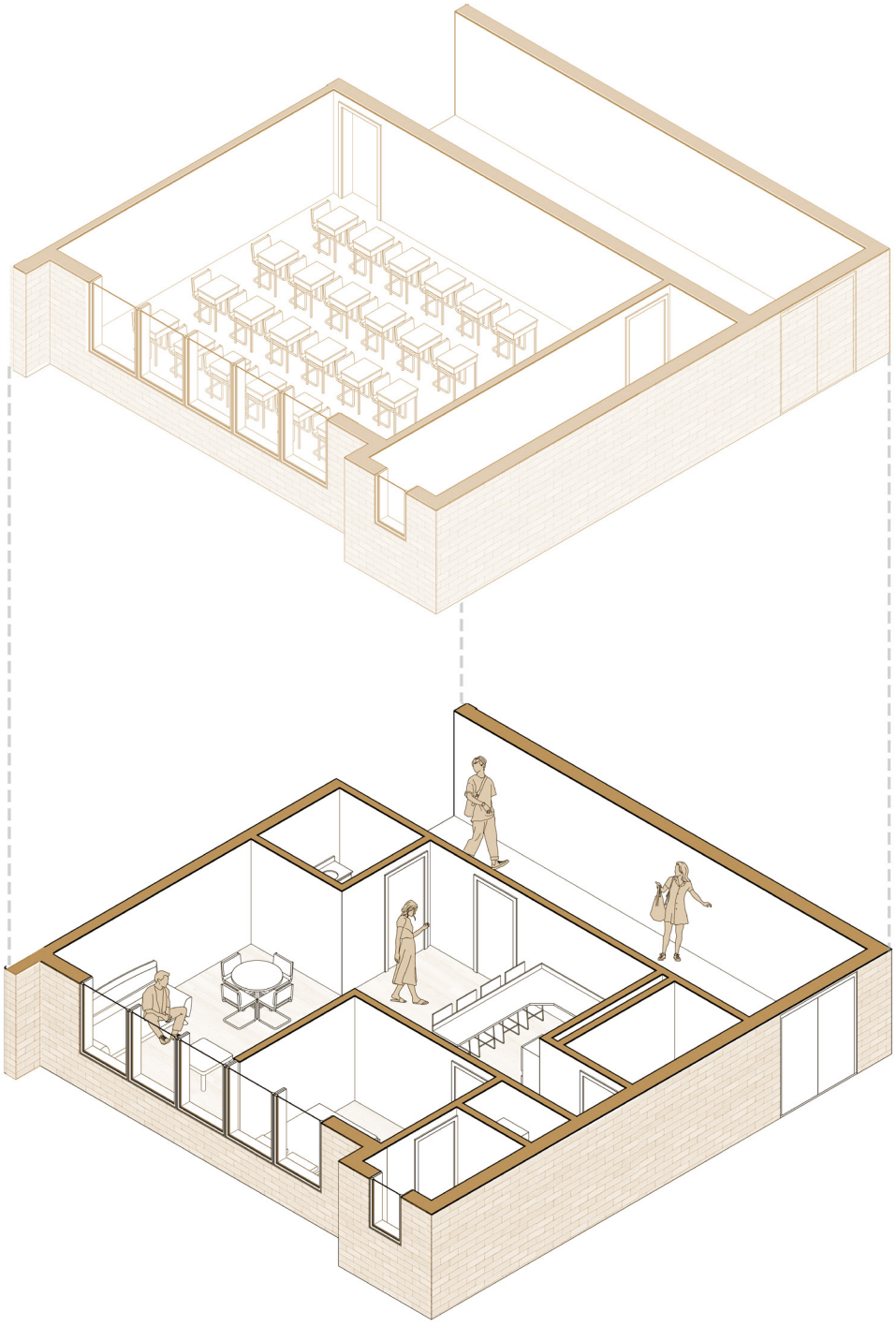


Figure 20: Isometric view showing the potential transformation of a classroom into a dwelling unit at Willard.
Source: Authors.

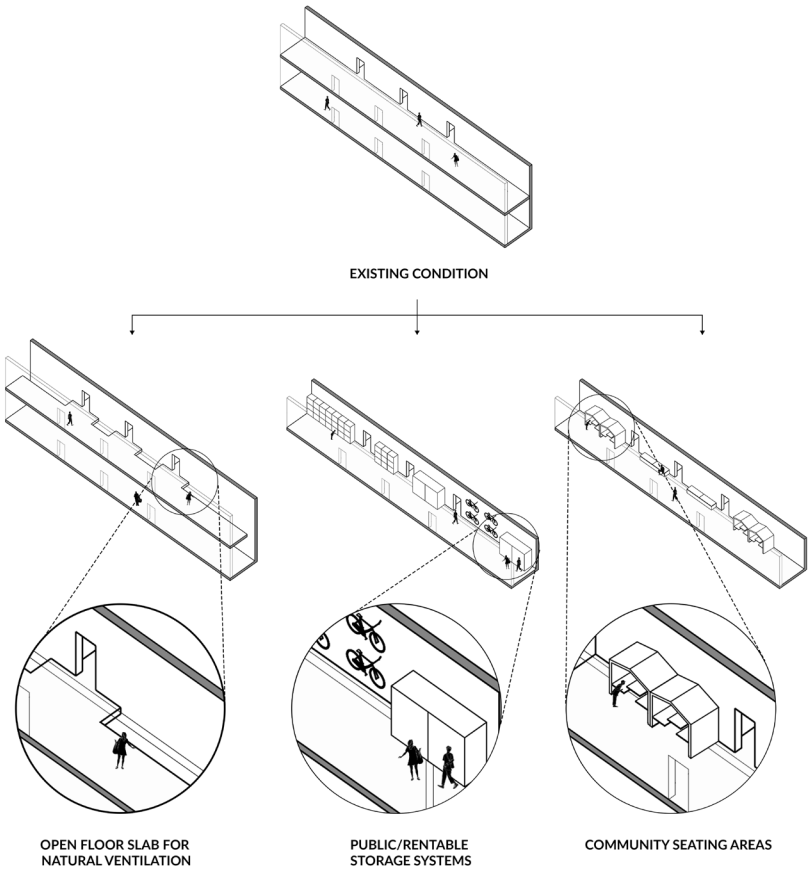


Figure 21. Isometric view showing the transformation of a school corridor into residential use. Source: Authors.

6.2.7 Corridors

With the program changing from classrooms to dwelling units, the building is left with a wide corridor disproportionate to its new occupancy. The sample school buildings are characterized by long and wide corridors—often up to 150 in length and 11.5 wide—lacking natural lighting or ventilation. Design proposals should focus on improving corridor efficiency and user experience by creating floor openings for ventilation purposes and social interaction, installing bike racks at the ground floor, or incorporating storage spaces such as mailboxes and rentable lockers, as implemented at Dunbar (Figure 21). Some modifications may be affected by fire code regulations and therefore may need to comply with fire separation assembly requirements.

6.3 Policy Implications

Given the number of vacant urban schools in OKC's urban core and the anticipated closure of others , the typological structure of these facilities presents an opportunity to address the city's housing shortage and land vacancy through a systematic approach.

As public assets, we advocate for the creation of a comprehensive guide, supported by the OKCPS, outlining best practices for their conversion into urban affordable housing. This guide should include case studies and design recommendations to inform sustainable redevelopment practices that recognize the characteristics of each school type. To incentivize these projects, financial mechanisms, such as Tax Increment Financing (TIF), tax credits, or density bonuses should be offered to developers who adhere to these guidelines and commit to responsible, historically sensitive conversions.

To further support this effort, future research should explore financial frameworks in detail, including tax credit strategies and land-subdivision recommendations, to strengthen the feasibility of adaptive reuse projects. A critical step for research is gathering community input through engagement activities such as public presentations, forums, and site visits with neighborhood representatives. These discussions help assess the local impact of such developments and shape the most appropriate community programs.

7. CONCLUSION

The study of educational facilities in OKC's urban core has identified six historically significant clusters or types. When compared with a set of relevant precedents and optimized residential floor plans, these schools show strong potential for adaptation into low-rise multifamily housing. Their corridor widths, structural systems, daylighting patterns, and plan configurations often align with contemporary residential standards, reducing the need for major structural intervention.

The analysis also highlights that each typology carries distinct spatial strengths, whether in horizontal circulation, modular classroom dimensions, or courtyard and wing arrangements, that can directly support efficient housing layouts. Recognizing these characteristics allows adaptive reuse designs to leverage existing assets rather than impose new organizational systems that could compromise historic value.

Design recommendations grounded in the logic of each school type can guide future adaptive reuse efforts. By identifying the typological specificity of each cluster, reuse designs can more effectively align schools with appropriate housing programs, maintain key architectural elements, and ensure that newly introduced residential functions remain compatible with the historic fabric.

REFERENCES

Accordino, John, and Gary T. Johnson. 2000. "Addressing the Vacant and Abandoned Property Problem." Journal of Urban Affairs 22 (3): 301–15. https://doi.org/10.1111/0735-2166.00058.

Augenblick, John, and Kent C. McGuire. 1983. "Changes in the Equity of School Finance Systems in Oklahoma, Delaware, and Alaska on JSTOR." Journal of Education Finance 8 (4): 436–48.

Badger, Emily, and Eve Washington. 2022. "The Housing Shortage Isn't Just a Coastal Crisis Anymore." The New York Times, July 14.

Baker, Lindsay. 2012. A History of School Design and Its Indoor Environmental Standards, 1900 to Today. National Clearinghouse for Educational Facilities. Washington, DC.

Barber, Brendan P. 2018. "Public School Closures: The Fate of Abandoned School Buildings." Notre Dame Journal of Law, Ethics & Public Policy 32: 329.

Bowman, Ann, and Michael Pagano. 2004. Terra Incognita: Vacant Land and Urban Strategies. Georgetown University Press.

City of Oklahoma City, Planning Commission. 2020. "PlanOKC. Planning for a Healthy Future." City of Oklahoma City, Planning Commission. https://planokc.org/wp-content/uploads/2020/04/01_planokc_final_20201210.pdf.

Davis, John Michael, Mariana Reyes, Jacob Abrogar, et al. 2023. "Puerto Rico's Rescued Schools: A Grassroots Adaptive Reuse Movement for Abandoned School Buildings." Social Sciences 12 (662). https://www.mdpi.com/2076-0760/12/12/662.

Economic and Planning Systems, Inc. 2021. Housing Affordability Study. Prepared for: City of Oklahoma City Planning Department. Denver, CO. https://www.okc.gov/files/assets/city/v/1/planning/plans-amp-studies/housing-affordability-study-2021.pdf.

Environmental Protection Agency. 1979. Asbestos Containing Materials in School Buildings. A Guidance Document. Part 1. Washington, DC.

Erickson, Ansley. 2018. "Schools in U.S. Cities." In Oxford Research Encyclopedia of American History. October. https://doi.org/10.1093/acrefore/9780199329175.013.128

Garvin, Alexander. 2013. The American City: What Works, What Doesn't: 3rd edition. McGraw Hill.

Garvin, Eugenia, Charles Branas, Shimrit Keddem, Jeffrey Sellman, and Carolyn Cannuscio. 2013. "More than Just an Eyesore: Local Insights and Solutions on Vacant Land and Urban Health." Journal of Urban Health: Bulletin of the New York Academy of Medicine 90 (3): 412–26. https://doi.org/10.1007/s11524-012-9782-7.

Gulliford, Andrew. 1996. America's Country Schools. University Press of Colorado.

Hamlin, A.D.F. 1910. Modern School Houses; Being a Series of Authoritative Articles on Planning, Sanitation, Heating and Ventilation. Vol. 1. The Swetland Publishing Co.

Hille, T. 2011. Modern Schools: A Century of Design for Education. 1st edition. Wiley.

Hoyt, Hannah. 2020. More for Less? An Inquiry into Design and Construction Strategies for Addressing Multifamily Housing Costs. Joint Center for Housing Studies of Harvard University. https://www.jchs.harvard.edu/sites/default/files/harvard_jchs_gramlich_design_and_construction_strategies_multifamily_hoyt_2020_3.pdf.

Jackson, Kenneth T. 1987. Crabgrass Frontier: The Suburbanization of the United States. First Edition. Oxford University Press.

Jo Meacham Associates. 2001. Architectural Historical Survey of Oklahoma City's Historic School Buildings. Oklahoma City, OK.

Joint Center for Housing Studies of Harvard University. 2023. The State of the Nation's Housing 2023. Joint Center for Housing Studies of Harvard University. https://www.jchs.harvard.edu/sites/default/files/reports/files/Harvard_JCHS_The_State_of_the_Nations_Housing_2023_0.pdf

Jonge, Wessel de. 2017. "Sustainable Renewal of the Everyday Modern." Journal of Architectural Conservation 23 (1–2): 62–105. https://doi.org/10.1080/13556207.2017.1326555

Kuipers, Marieke, and Wessel de Jonge. 2017. Designing from Heritage: Strategies for Conservation and Conversion. BK BOOKS. https://doi.org/10.7480/isbn.9789461868022.

Li, Yuan, Long Zhao, Jingxiong Huang, and Andrew Law. 2021. "Research Frameworks, Methodologies, and Assessment Methods Concerning the Adaptive Reuse of Architectural Heritage: A Review." Built Heritage 5 (1): 6. https://doi.org/10.1186/s43238-021-00025-x.

Madden, David, and Peter Marcuse. 2016. In Defense of Housing: The Politics of Crisis. Verso.

Martínez-Rocamora, Alejandro, Pilar Díaz-Cuevas, Juan Camarillo-Naranjo, David Gálvez-Ruiz, and Patricia González-Vallejo. 2024. "Identification of Residential Building Typologies by Applying Clustering Techniques to Cadastral Data." Journal of Building Engineering 86 (June): 108912. https://doi.org/10.1016/j.jobe.2024.108912.

McCue, Daniel, and Sophie Huang. 2024. "Estimating the National Housing Shortfall." Joint Center for Housing Studies of Harvard University, January 29. https://www.jchs.harvard.edu/blog/estimating-national-housing-shortfall.

Metropolitan Library System. 2020. "List of Buildings throughout Oklahoma City Public Schools' History." https://www.metrolibrary.org/archives/essay/2019/07/list-buildings-throughout-oklahoma-city-public-schools-history.

Mills, Wilbur T. 1910. American School Building Standards. Franklin Educational Publishing Company.

Montgomery, Catherine, and Kelli Gaston. 2017. Dunbar School. National Register of Historic Places Registration Form. Oklahoma City, OK. http://nr2_shpo.okstate.edu/pdfs/SG100002217.pdf.

Moore, Deborah P., Ed. 1991. Guide for Planning Educational Facilities: An Authoritative and Comprehensive Guide to the Planning of Educational Facilities from the Conception of Need Through the Utilization of the Facility. Council of Educational Facility Planners, International.

Mosey, Grant, and Brian Deal. 2021. "Optimizing Multi-Family Building Massing for Affordability and Envelope Performance: An Investigation of the Trade-Offs Implicit in Low Rise Residential Buildings." Buildings 11 (3): 3. https://doi.org/10.3390/buildings11030099.

National Center for Education Statistics. 2023. "Closed Schools." https://nces.ed.gov/fastfacts/display.asp?id=619.

Newman, Galen, Donghwan Gu, Jun-Hyun Kim, Ann O''. M. Bowman, and Wei Li. 2016. "Elasticity and Urban Vacancy: A Longitudinal Comparison of U.S. Cities." Cities 58 (October): 143–51. https://doi.org/10.1016/j.cities.2016.05.018.

Ohmura, Takahiro, Yuji Katagiri, and Tatsuo Iwaoka. 2019. "Typological Structure in Contemporary Architecture Made of a Square Plan—A Study on the Geometry and Scale in Architecture." Japan Architectural Review. https://doi.org/10.1002/2475-8876.12121.

OKCPS. 2019. Oklahoma City Public Schools Pathway to

Greatness https://www.okcps.org/domain/1312.

O'Meara, Mark. 2015. "Historic Schools Go Hand-In-Hand with Housing." Novogradac Journal of Tax Credits VI (XII).

Pfister, Tom. 2018. "Why An Oklahoma City Real Estate Development Scored A Prestigious Preservation Award." Forbes, November 17.

PolicyMap. 2025. "Estimated Percent of All Renters Who Are Cost Burdened, between 2019-2023." https://www.policymap.com/newmaps/e/www.

Robertson, Claudette. 2006. Douglass High School. National Register of Historic Places Registration Form. http://nr2_shpo.okstate.edu/pdfs/7000259.pdf.

Schwartz, Alex F. 2021. Housing Policy in the United States. 4th ed. Routledge.

Shahi, Sheida, Mansour Esnaashary Esfahani, Chris Bachmann, and Carl Haas. 2020. "A Definition Framework for Building Adaptation Projects." Sustainable Cities and Society 63 (December): 102345. https://doi.org/10.1016/j.scs.2020.102345.

Sheals, Debbie, and Mason Martel. 2018. Harmony School. National Register of Historic Places Registration Form. http://nr2_shpo.okstate.edu/pdfs/SG100004742.pdf.

Spinaris, George J. 2012. Feasibility of Decommissioned Urban Schools: Emphasis Private Involvement. Purdue University, College of Technology. https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1082&context=techmasters.

Steffen, Mike, and Walsh Construction Co. 2019. Exploring a Path Towards Cost-Efficient, Energy Efficient Affordable Housing. 23rd Annual Westford Symposium on Building Science, August 5-7, 2019.

Stouffs, Rudi, and Bige Tunçer. 2015. "Typological Descriptions as Generative Guides for Historical Architecture." Nexus Network Journal 17 (3): 785–805. https://doi.org/10.1007/s00004-015-0260-x.

Tanner, C. Kenneth, and Jeff Lackney. 2005. Educational Facilities Planning: Leadership, Architecture, and Management. Pearson.

Tsenkova, Sasha. 2023. "Perspective Chapter: Reimaging Affordable Housing through Adaptive Reuse of Built Heritage | IntechOpen." In Future Housing, Edited by Alessandra Battisti. Intechopen.

U.S. Bureau of the Census. 2021a. "ACS 5-Year 2021 DP05 Demographics and Housing Estimates." American Community Survey. https://data.census.gov/table/ACSDP5YSPT2021.DP05?q=population%20oklahoma%20&g=040XX00US40$3100000_310XX00US36420&y=2021.

U.S. Bureau of the Census. 2021b. "ACS 5-Year 2021 S2504 Physical Housing Characteristics for Occupied Housing Units." American Community Survey. https://data.census.gov/table/ACSST5Y2021.S2504?q=housing%20characteristics&g=040XX00US40&y=2021.

US Department of Housing and Urban Development Location Affordability Portal. 2019. "HUD Location Affordability Index." https://www.hudexchange.info/programs/location-affordability-index/.

Vafaie, Fatemeh, Hilde Remøy, and Vincent Gruis. 2023. "Adaptive Reuse of Heritage Buildings; a Systematic Literature Review of Success Factors." Habitat International 142 (December): 102926. https://doi.org/10.1016/j.habitatint.2023.102926.

Willert, Tim. 2019. "OKC District Could Close as Many as 20 Schools." The Oklahoman (Oklahoma City, OK), January 18.