Using Grammars to Trace Architectural Hybridity in American Modernism

The case of William Hajjar single-family house

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In this paper, mid-century modern single-family houses designed by William Hajjar are analyzed through a shape grammar methodology within the context of the traditional architecture of an American college town. A member of the architecture faculty at the Pennsylvania State University, Hajjar was a practitioner in State College, PA, where the University Park campus is located, and an influential figure in the history of architecture in the area. The residential architecture he designed for and built in the area incorporates many of the formal and functional features typical of both modern European architecture and traditional American architecture. Based on a computational methodology, this study offers an investigation into this hybridity phenomenon by exploring Hajjar's architecture in relation to the traditional American architecture prevalent in the college town of State College.

Keywords: *shape grammar, American architecture, William Hajjar, hybridity, college town*

INTRODUCTION

The residential architecture of A. William Hajjar, a member of the architecture faculty at Penn State in the mid-twentieth-century period and a practitioner in the area incorporates many of the shapes and features of both modern European architecture and traditional American architecture-a distinctive quality of his work, which, however, can also be found in the work of his fellow faculty practitioners in other US college towns. A quality, too, that helped popularize modernism in the United States. The present paper is part of a larger-scale study in which this hybridity phenomenon between modernism and traditional American architecture is verified and described using computational methodologies. In this paper, Hajjar's single-family architectural language is analyzed in relation to its specific local context-i.e., the traditional architecture of State College, a typical American college town. On this basis, the architectural significance of Hajjar's work in regard to popularizing/Americanizing a non-popular and imported architectural style is explored. The theoretical outcomes of this study build on the use of shape grammar in verifying and describing the possible hybridity between modern and traditional architecture and more broadly the potential of this tool to describe ar-

chitectural hybridity in general.

METHODOLOGY

The present paper, as noted, is part of a larger-scale project in which computational design methodology is used to verify and describe hybridity in architectural design with Hajjar's architecture featured as a case study. In the larger-scale project, Hajjar's work is explored via five principal steps: (1) Hajjar's life and practice are traced to identify likely influences on his work; (2) a shape grammar is developed for the houses he designed for and built in State College; (3) the grammars of some of his likely influences are identified or developed; (4) Hajjar's grammar is compared to the grammars of such influences to determine the nature and extent of their impact on his work; and (5) aspects of the social and technological context that may explain such influences are identified-i.e., trends in regard to lifestyle and the availability of materials and technologies.

In previous papers, the authors described Hajjar's single-family architecture in comparison with European architecture and the Bauhaus style through the work of Gropius and Breuer in the United States, whom he met during his architectural studies. This comparison was performed by developing a grammar of Hajjar's work in State College and comparing the rules identified with those of a grammar developed for the Gropius-Breuer partnership in the United States. However, the focus of the current research is on comparing Hajjar's architecture with the traditional American architecture of the context in which his work evolved. The paper includes the rules of a grammar developed for traditional American houses in State College, a derivation of a traditional house in State College (very similar to the traditional house owned by Hajjar in the area), and a comparison of the rules of this grammar with rules of the grammar previously developed for Hajjar's architecture. Two ways to identify similarities between the rules of the two grammars are used: (1) the derivations of houses-with similar layouts-generated by each of the grammars are compared step by step, and (2) plans for a traditional house constructed in the area-with a common interior layout similar to those generated by the grammars-are produced through both the grammar of traditional architecture and the grammar for Hajjar's architecture, and then compared with each other.

SHAPE GRAMMAR

Introduced by Stiny and Gips in 1972, the concept of shape grammar in computation is defined as a class of production systems based on an initial shape (or a set of finite shapes) and transformational rules that can be applied to the original shape recursively. This method has been used to analyze examples of historical architecture, such as the Palladian villas (Stiny & Mitchell, 1978), Frank Lloyd Wright's Prairie houses (Koning & Elizenberg, 1981), bungalow houses (Downing & Flemming, 1981), Queen Anne houses (Flemming, 1987), and Alvaro Siza's houses at Malagueira (Duarte, 2005).

In the past three decades, using the concept of shape grammar, several scholars have studied the notion of stylistic evolution and introduced the idea of grammatical transformation. This scholarship includes Knight's seminal work on the transformation of Wright's Prairie houses into Usonian houses (1983), Çolakoğlu's contemporary houses based on vernacular Turkish Hayat houses (2005), Chase and Ahmad's account of hybridity in design (2005), Eloy and Duarte's adaptation of existing house types to meet contemporary needs (2011), Kruger, Duarte, and Coutinho's study of Alberti's influence on classical Portuguese architecture (2011), and Benrós's (2018) study of the phenomenon of hybridity in architectural languages. Extending the research cited, the present paper is principally concerned with using shape grammar to describe the influence of traditional American architecture on Hajjar's single-family architecture in the context of a central Pennsylvania college town.

WILLIAM HAJJAR

Abraham William Hajjar (1917-2000) studied architecture at the Carnegie Institute (now Carnegie Mellon) (1936-1940) and the Massachusetts Institute of Technology (MIT) (1940-1941) and served as both a faculty member at the Pennsylvania State University (Penn State) and a practitioner in the area in the mid-twentieth-century period (1946-1963). While Hajjar was a student at the Carnegie Institute, most of the architecture faculty, like the majority of U.S. architecture programs, favored the Beaux-Arts philosophy of design. Yet, some young faculty members, especially during the late 1930s, who were assigned to teach freshman and sophomore studios favored International Style architecture. At the invitation of these faculty members, Walter Gropius, as the new director of Harvard's architecture program, gave a lecture at Carnegie Mellon in March 11, 1938, while Hajjar was a sophomore there.

At Carnegie, the students were doing ink drawings with washes of classic Greek columns, and as a result, Hajjar became interested in this genre such that he produced ink and watercolor renderings for most of the projects he designed in the following years. However, he became well-versed in modernism at MIT, especially while working under the supervision of Lawrence Anderson, who not only designed the first modernist building on an American campus (the MIT Alumni Pool, 1939) but also endeavored to bring a modern outlook to MIT's program in the late 1930s. While Hajjar was at MIT, Gropius and Breuer were invited regularly-mostly by Anderson-to deliver lectures there and to participate in student work reviews. Not only Hajjar, but also his classmates, learned about the Bauhaus style of modern architecture through these interactions with some of the pioneers of modern architecture.

After receiving his Master of Architecture degree from MIT in 1941, Hajjar initially joined the State College of Washington as a faculty member. In 1946, however, he joined the architecture faculty at Penn State. When Hajjar moved to State College with his family, most of the single-family houses in the area were in the Georgian revival, Colonial revival, Tudor, and Cape Cod styles, although ranch and split-level houses were starting to appear. Similar to other

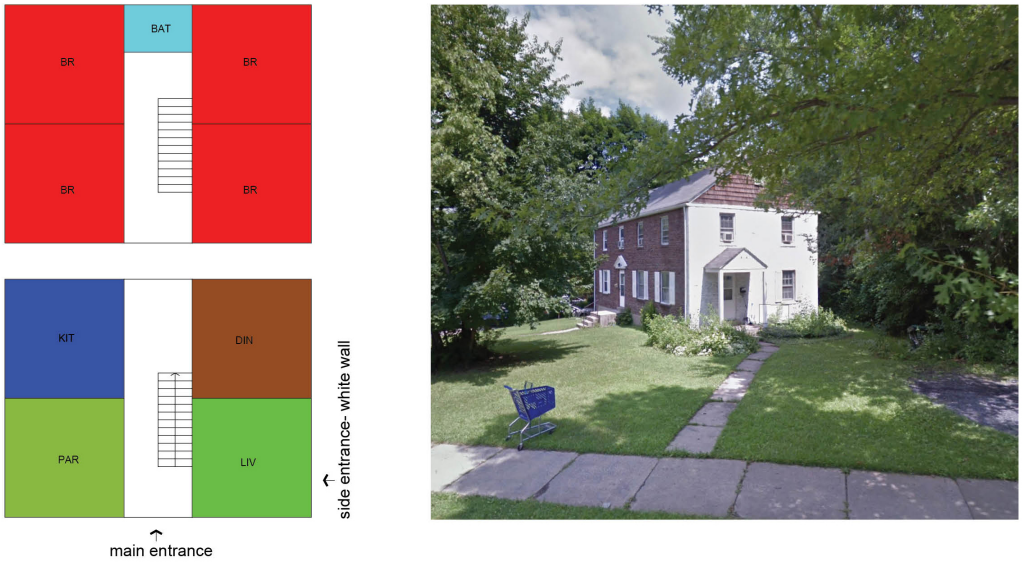


Figure 1
Hajjar's first house in the area and its schematic layout.

houses in the area, the first home that Hajjar bought for his family in the area was a Georgian revival house with a traditional four-square organization (Figure 1). His first project in the area was a house he designed for his own family in 1951-1952. This project was successful enough to attract local clients, many of whom were Penn State faculty members. In fact, Hajjar designed and built a total of thirty-three houses in the area. Many of his houses blend with the traditional houses in the neighborhood in terms of exterior building materials, volumes, and roof shapes. However, Hajjar's houses have an internal organizational structure that is both modern for the time and unique to his work.

THE COLLEGE TOWN: AN AMERICAN PHENOMENON

The college town, in its instantiation as an American phenomenon, is a community that is heavily dependent on the university it hosts (Brockliss, 2000). College towns have characteristics in common both with small towns and with cities: for example, in terms of population, urban setting, and most of the infrastructure, they are comparable to other kinds of small towns. However, in terms of culture and education, they are more comparable to cities. It is important to note, though, that colleges differ from each other in terms of size, mission, fields of study and degrees offered, entrance requirements, tuition costs, etc., and, therefore, attract students and faculty who reflect those differences and who, in turn, "shape the character of the towns in which they are located" (Gumprecht, 2008, p. 22).

The idea of university life and of the university community, as Laurence Brockliss argues, does not have its origins in the U.S., but in the medieval European universities where students and teachers lived, worked, and studied together in a "cloistered environment" (2000). Yet, the comprehensive planned modern university campus, or what Thomas Jefferson called the "Academical Village," is primarily an American phenomenon (Chapman, 2006). Beginning in the colonial period, American colleges followed the English "collegiate" model; even the large universities developed in the United States initially followed this model. Although they followed many English precedents, American colleges developed their own "American" character. For example, unlike in the European/English model, which favored separate colleges in separate locations within a town, colleges in the US were clustered together to create a campus, some of which were built in downtown city areas. However, as another innovation, or another break from European tradition, most campuses in the US were built in separate communities or towns in the countryside or even in the wilderness (Turner, 1984).

Modern houses in college towns, especially in neighborhoods near the universities, are usually the result of a specific set of conditions: for example, it was observed in a study of Urbana, IL, that professors were more likely to own or construct houses that were architecturally distinctive than to buy ordinary houses-as a way to set themselves apart as an educated class (Gumprecht, 2008). Furthermore, general awareness of modern movements through an architecture program might be another important condition in towns where people are likely to be very connected socially. This is in addition to the direct relationships between the architects and the clients, the latter of whom were also faculty members in some cases. Most college towns have at least one older neighborhood near campus that is home to a large number of professors. The College Heights Historic District in State College, PA, where nearly half of the houses Hajjar designed in the area are located, is an example of this kind of neighborhood.

TRADITIONAL AMERICAN ARCHITECTURE IN STATE COLLEGE, PA

In A Field Guide to American Houses, Virginia and Lee McAlester designated houses found in typical American neighborhoods as either "folk houses" or "styled houses." Folk houses or vernacular houses are built usually by the occupants or other non-professional builders without any specific intention

of following current fashion. However, as the researchers state, most American houses surviving from the 19th century are not folk houses but styled houses, which were built with "at least some attempt at being fashionable" (McAlester & McAlester, 2009 p. 5). The styles described in their book comprise Colonial houses (1600-1820) Romantic houses or revival houses (1820-1880), Victorian houses (1860-1900), Eclectic houses (1880-1940), and houses since 1940 (including contemporary and neo-eclectic). As noted, McAlester and McAlester based their stylistic approaches, descriptions, and style categories on domestic architecture found in typical American neighborhoods throughout the country. The present study, however, focuses on traditional American houses in State College, PA, with the goal of uncovering their architectural influences and analyzing how the latter relate to Hajjar's mid-twentieth century architecture.

Located in central Pennsylvania, State College is a college town dominated both economically and demographically by the University Park campus of the Pennsylvania State University (Penn State). Evolving from a village to serve the needs of the Pennsylvania State College (founded as the Farmers' High School of Pennsylvania in 1855), State College was incorporated as a borough in 1896. Expanding with the growth of the university, neighborhoods adjacent to the University Park campus started to be developed mostly in the early twentieth century. To study single-family domestic architecture designed in traditional styles in the area, it is instructive to explore the College Heights Historic District, a national historic district located north of campus that was added to the National Register of Historic Places in 1995 (National Register Information System). As stated in the National Park Service's registration form, College Heights encompasses land and historic buildings associated with the early residential history of the town and "represents its growth and architectural development as an emerging college town" (p. 2). All historic districts, including College Heights, consists of "contributing" and "non-contributing" properties. The registration form for the College Heights district indicates that there are 278 contributing properties in this area. Although all the contributing houses have a special characteristic(s) in relation to the history of the neighborhood, the registration document highlights some properties as best examples of houses designed by local architects/contractors or popular mail-order catalogues (Table 1). Most of these examples, constructed in the 1920s and 1930s, are built in bungalow, colonial (Dutch and Georgian), colonial revival, Georgian revival, and four-square styles. Figure 2 shows examples of the contributing houses in the College Heights Historic District. Of these architectural styles, two interior plans are particularly popular in the neighborhood: a four-square organization and a four-room organization with a hallway in the center, very similar to Hajjar's first house in the area. Figure 3 shows examples of each kind of interior organization.

Figure 2
Examples of traditional houses in the College Heights Historic District.

Address	Style	Date	Architect
214 Hartswick Ave	Craftsman bungalow	1920	Unknown
117 East Park Ave	Craftsman bungalow	1923	Unknown
326 West Ridge Ave	Dutch colonial	1920	Unknown
329 West Ridge Ave	Dutch colonial	1921	Unknown
722 Holmes Street	Georgian colonial	1935	Clarence M. Bauchspies
629 Sunset Road	Georgian colonial	c. 1935	Clarence M. Bauchspies
525 West Park Ave	English Tudor	1931	P. Boyd Kapp
525 McKee Street	Colonial revival	c. 1932	P. Boyd Kapp
172 Hartswick Ave	Mission style	c. 1921	Unknown
333 Arbor Way	Tudor	1935–1936	Kapp & Kennedy
705 McKee Street	Colonial revival	c. 1931	Unknown
711 McKee Street	Colonial revival	c. 1931	Unknown
154 Ridge Ave	Tudor revival	1928	Frederick Disque
714 McKee Street	Colonial revival	1931	Walter Trainer
311, 317, 323, 327 East Park Ave	Colonial revival	c. 1933	Clarence M. Bauchspies
625 Holmes Street	Colonial revival	c. 1933	Clarence M. Bauchspies
721 Holmes Street	Tudor revival	1933	Clarence M. Bauchspies
608 Sunset Road	English Tudor	c. 1935	Clarence M. Bauchspies
629 Sunset Road	Georgian revival	1935	Clarence M. Bauchspies
346 Ridge Ave	Colonial revival	c. 1934	Clarence M. Bauchspies
615 N. Burrowes	Colonial revival	c. 1935	John Breneman
235 West Ridge	Tudor revival	c. 1935	John Breneman
705 N Holmes Street	Tudor revival	c. 1937	Carl Wild
426 W Ridge Ave	Tudor revival	c. 1935	John Frises
326 W Ridge Ave	Four-square	1920	Mail order
243 West Park Ave	Four-square	1925	Mail order
210 Hartswick Ave	Four-square	1929	Mail order
217 West Park Ave	Half-timbered	c. 1925	Mail order
214 Hartswick Ave	Bungalow	c. 1925	Mail order-Sears
143 West Park Ave	Bungalow	c. 1925	Sears Westly
520 Holmes Street	Bungalow	c. 1922	Sears Westly
215 Ridge Ave	Dutch colonial	1922	Arthur Cowell
433 Mitchell Ave	Tudor cottage	c. 1928	Unknown
747 Holmes Street	Cape Cod	c. 1938	Mail order
320 Hartswick Ave	Colonial revival	1932	Cont: Albert Bartges/Sears

Table 1
Examples of Traditional American Houses designated as Contributing to the College Heights Historic District.

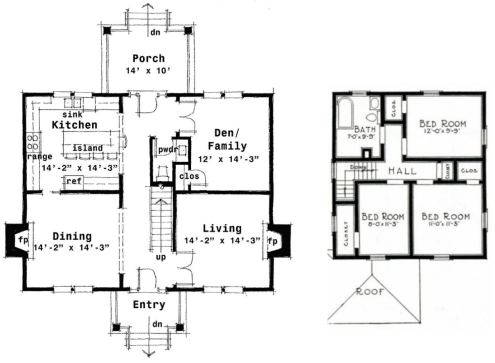


Figure 3
Main floors of a typical mail-order plan with a center hall colonial organization (left) and a four-square organization (right).

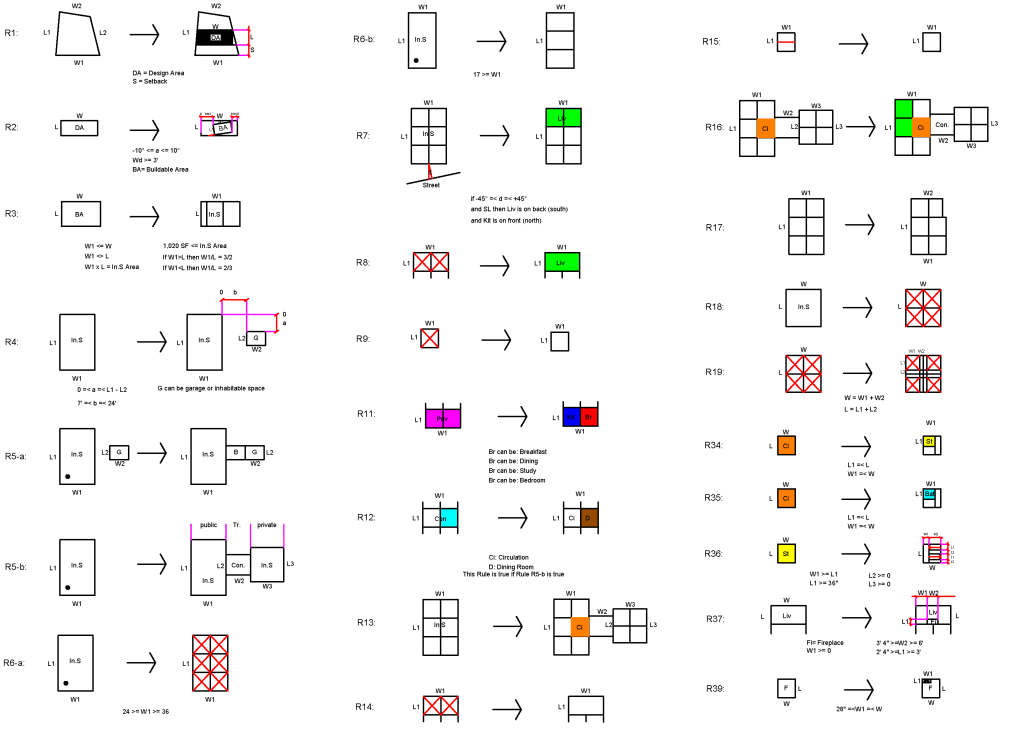
GRAMMAR FOR TRADITIONAL AMERICAN HOUSES

The grammar presented in this paper is introduced as a grammar for traditional American houses, although it is specifically a grammar for traditional American houses in the College Heights Historic District. The corpus of designs includes the houses noted in the previous section (Table 1). Interior organization was the main feature considered in the process of analysis, with an emphasis on the two most popular interior plans in the area: the four-square and the four-room organization with a central hallway. Given the popularity of these plans, this emphasis is appropriate. However, there is also another key reason: this

interior organization underlies most of Hajjar's designs. Additionally, as many of the houses in the district are bungalows, the grammar developed for this kind of house in Buffalo, NY, by Downing and Flemming (1981) was also considered in the development of the grammar presented herein. Although Downing and Flemming developed their grammar for houses in Buffalo, NY, as most of the houses in their corpus were catalogue homes similar to bungalow houses in State College, it is rational to use their rules in developing a grammar for traditional houses in the State College area. Especially given that many of the bungalow houses built in both cities were constructed during the same period (1920s) from the same design source (Sears).

It is important to note that only grammars developed with the same strategy, for example, additive or subtractive, can be compared accurately. Therefore, in some cases, it was necessary to slightly modify the rules of the Buffalo bungalow grammar in order to relate it to the grammar for traditional American houses in State College (College Heights district) and also to the grammar for Hajjar's architecture (Figure 4). An important similarity between the grammar for the bungalows and the grammar previously developed for Hajjar's single-family architecture (Hadighi & Duarte, 2018) is that both grammars start from the overall inhabitable space and then proceed to the allocation of spaces based on public and private functions. Of course, allocation of spaces or the way in which the larger spaces are divided into smaller spaces or rooms is strongly dependent on

Figure 4
Selected rules of Hajjar's grammar



both the technological and cultural aspects of the context: for example, the maximum width of a room is a dependent variable of maximum beam spam and the spatial flow or openness of the living room, dining room, and kitchen is very much related to prevailing notions of privacy in domestic life.

Similar to the grammar of the Buffalo bungalows, in Hajjar's grammar the inhabitable space can be divided into six (or four) functional spaces/rooms. In Hajjar's grammar, any of the "rooms," particularly the middle ones, can be divided into smaller spaces to create small hallways or stairways, or service areas, such as a bathroom or furnace room. On the other hand, in the grammar for the bungalows (like the grammar developed for the traditional houses) additional spaces were introduced between two "rooms" to create stairways or service areas. (Figure 5).

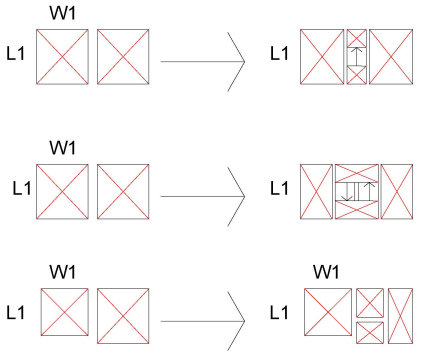


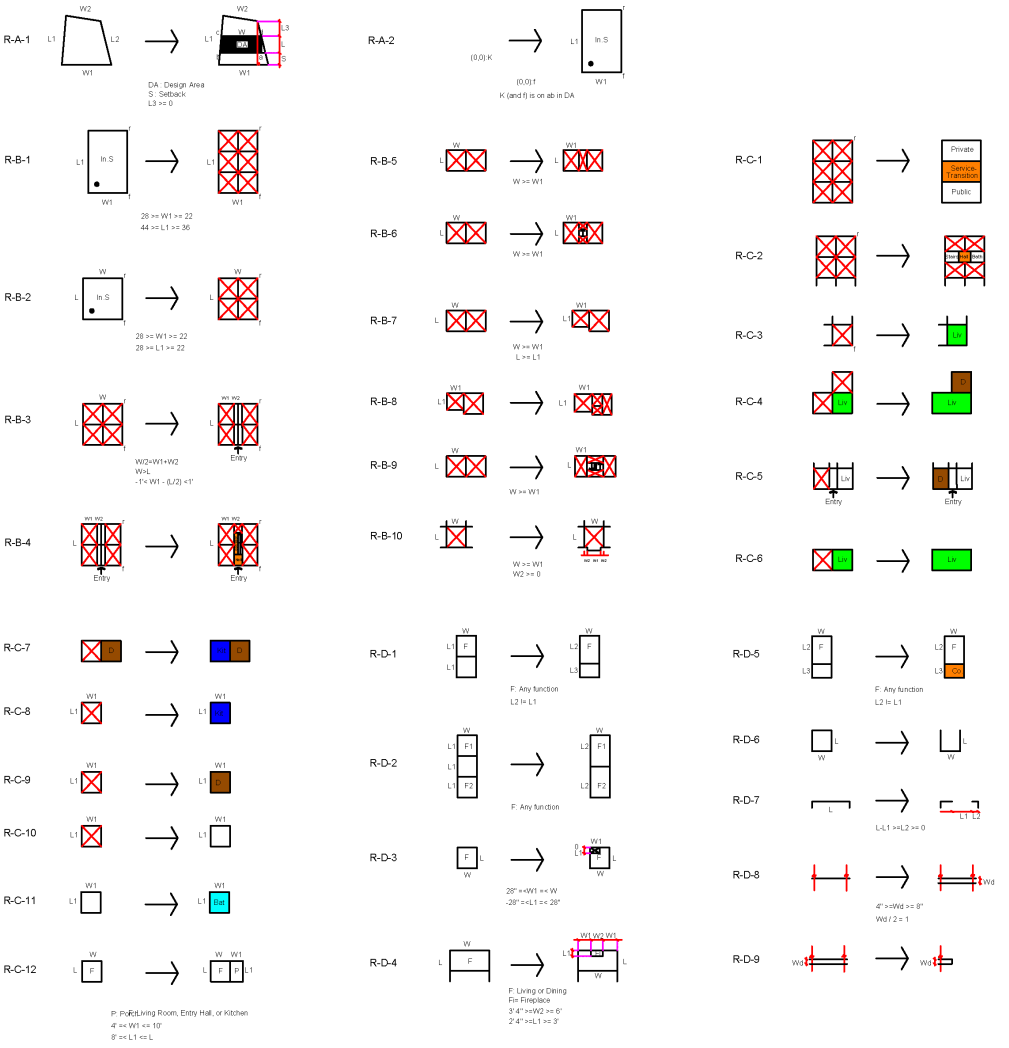
Figure 5
Rules to allocate staircase, bathroom, and halls adapted from the grammar for Buffalo bungalows (Downing & Flemming, 1981).

Based on the houses in the corpus and the rules adapted from the grammar for the Buffalo bungalows, a grammar was developed for traditional American houses in the State College area. Similar to the grammar for Hajjar's single-family houses, the grammar for traditional American houses encompasses different groups of rules: rules to define the overall inhabitable space; rules to describe the way in which interior space is divided into smaller spaces or rooms; rules to allocate the interior functions; and rules to generate details such as the placement of closets, the placement of a fireplace, and wall thickness. Selected rules of the grammar developed for traditional houses in the area are shown in Figure 6.

Figure 7 shows the derivation of a design in the corpus used to infer the grammar. The design is related to a house built in the colonial revival (neo-Georgian) style in the College Heights Historic District. It is very similar to the first house Hajjar bought in the area for his family. In an effort to compare the two grammars-the grammar for Hajjar's single-family houses and the grammar for traditional American houses-Hajjar grammar is used to derive a design solution with a fairly similar interior organization as the house in figure 7 (Figure 8). It is interesting to compare the two design solutions, one the result of the traditional grammar, actually a house built in the area, and the other a house produced by the grammar of Hajjar's work that is as close as possible to that traditional house (with the same geometry and the same idea of interior organization. The main differences between the two solutions are: (1) the placement of the main entrance door, which in the plan produced by Hajjar's grammar is at the side of the house instead of the dead center front; (2) the flow of spaces, which in the plan produced by Hajjar's grammar results in a very open floor plan; (3) the placement of the living area, which in the plan produced by Hajjar's grammar is at the back of the house facing the backyard. It is important to note that Hajjar generally designed his houses in a different orientation: the houses that he designed in the area commonly-though not always-have their longer side perpendicular to the street. Hajjar's houses in the area either have a square-shaped plan divided into four smaller squares (and nine squares in his second family house) or a rectangular shape divided into six smaller spaces. Figure 9 shows the step-by-step derivation (based on Hajjar's grammar) of a house built to Hajjar's design in 1959 in the area with a square-shaped plan and an interior allocation of spaces very similar to that of the colonial revival house generated by the grammars (Figure 7).

In general, it is evident that the geometry of Hajjar's designs is similar to that of other houses in the

Figure 6
Selected rules of the generic grammar for traditional houses in the State College area.



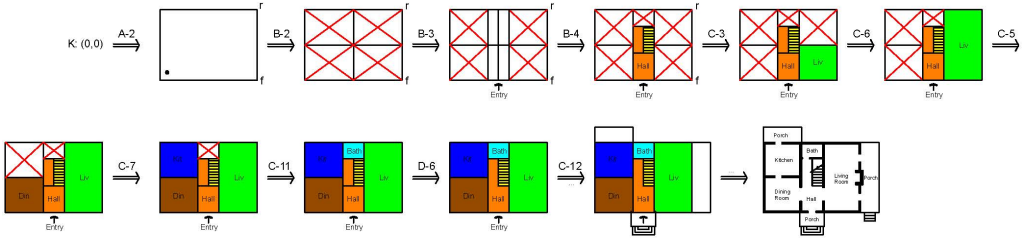


Figure 7
Derivation of a traditional house based on the generic grammar for traditional houses in the area.

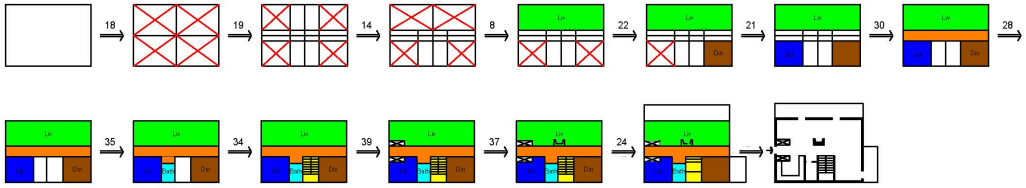


Figure 8
Derivation of the same traditional house shown in figure 7 based on Hajjar grammar.

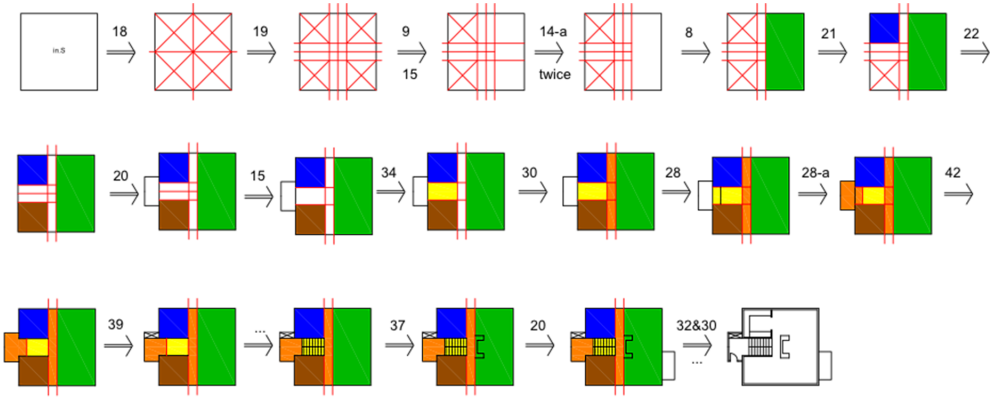


Figure 9
Derivation of the Snowdon House, designed by Hajjar in 1959 based on Hajjar grammar.

area. Also, the division of the main inhabitable space into smaller spaces/rooms in Hajjar's designs is very similar to that of the traditional houses in area. Hajjar's allocation of interior functions also shows similarities with the traditional architecture in terms of the flow of spaces. However, the flow of spaces and openness of his interior planning, and his attention to the idea of energy efficiency-for example by placing the fireplace not on an exterior wall, but as a main design aspect of the interior circulation distinguishes his architecture, all of which lean toward modern principles of design. In fact, these are all design elements that Hajjar learned from Anderson, his master at MIT, and through interacting with Gropius and Breuer and studying their architecture. This hybridity between European modernism and American traditional architecture was a key to Hajjar's success in practicing architecture at an American college town in the mid-twentieth century. A hybridity that helped popularize modern architecture in the area at that time. Of course, changes in people's lifestyles and the cultural and socio-economical changes after World War II in the United States led to a reassessment of the principles of residential architecture in the country-a need to which contractors and architects responded nationwide.

CONTRIBUTIONS

The purpose of the proposed study is to highlight the effectiveness of shape grammar as a computational tool for analyzing hybridity in architectural design and comparing styles with each other. In relation to Hajjar's architecture in the State College area, this study highlights his contribution to the stability and popularity of modern architecture in the United States by mixing the forms and functional features of modern European architecture with traditional American architecture to create an architectural "style" that may be unique to American college towns and that can be understood as a localized, Americanized, college town modernism. This idea needs to be more explored and further developed in future papers. The grammar of Hajjar's houses is presented in previous research (Hadighi & Duarte, 2018). Here, the grammar for traditional American houses is presented and then used to determine the extent to which Hajjar's houses are similar to traditional American houses in the area.

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