

VERNACULAR HOUSING, PAST AND PRESENT

Learning from the Past: Climatic Considerations in 19th Century Vernacular Architecture of Immigrants in South Central Texas

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Abstract

The paper analyzes the climatic considerations of 19th century vernacular architecture of immigrants in south central Texas. These analyses extend scholarly work that has been conducted on the evolution of vernacular architecture. Furthermore, the results of this study may serve as a platform for understanding the importance of ethnic cultural identity in vernacular architecture, and the significant role of passive energy systems in achieving thermal comfort and conserving energy. The paper is composed of three sections. The first part attempts to define vernacular architecture, raises the question of vernacular architecture of immigrants, and describes the context of inquiry of eight 19th century vernacular churches and eight houses constructed by immigrants who arrived from cold northern Europe directly to hot humid south central Texas. The second part describes the procedure and method of using computerized energy simulations in analyzing the thermal comfort and energy performance of the target buildings. The show that the architectural response to climate is a function of building type and its relation to the immigrants' cultural identity. Immigrants built their houses to accommodate the extreme hot humid summers of Texas, yet they maintained the old form of their churches that was originated in a cold climate. The third and final section describes a conceptual model drawn from the study's findings. This model summarizes the research and points out the important lessons that can be learned from the past.

The studies of sustainability of buildings recognize that climate considerations and energy conservation should be incorporate into design through a thorough investigation of climatic design strategies of passive cooling/heating systems (Guy and Farmer, 2001; Mendler and Odell, 2000; Lynn and Adams, 2000). In case of historic buildings it is recommended to implement the 'inherent' energy components of

the original design in the new preservation/restoration retrofit efforts (Geva, 1998, 2000). More so, it has become established that mechanical systems of buildings are more effective when they are supplemented by good climatic design strategies (such as orientation on the site, form, construction and finish materials, shading devices, openings, etc'). The importance of strategies of passive cooling/heating systems can best be studied by analyzing buildings that were constructed in an era when no contemporary mechanical systems for climate control existed in buildings and in a region with extreme climate conditions.¹ The need for climatic comfort in these conditions produced architectural solutions that reflect an unconfounded impact of local climate. It is being argued that the expression of such solutions is accentuated when people move from one region to another, especially when the new location is climatically incompatible with the old conditions. Moreover, studying vernacular architecture that was constructed by the community members, rather than by professionals, helps focus on the direct influence of the regional conditions and on the community's cultural identity.

Therefore, the objective of this paper is to analyze the climatic considerations of 19th century vernacular architecture of immigrants in south central Texas. These analyses extend scholarly work that has been conducted on the evolution of vernacular architecture. The results of this study may serve as a platform for understanding the built form of immigrants, and as a lesson for conserving energy in contemporary houses.

The paper is composed of three sections. The following *Background* section attempts to define vernacular architecture, raises the question of vernacular architecture of immigrants, and describes the context of inquiry of the 19th century buildings constructed by immigrants who arrived from northern Europe directly to south central Texas. The second section on the *Climatic Considerations of 19th Century Vernacular Architecture of Immigrants in South Central Texas* describes the procedure and method of using computerized energy simulations in analyzing the thermal comfort of the target buildings. This section includes also the results of these simulations in discomfort degree hours and in million Btu's that show that the response to climate is a function of building type and its relation to

the immigrants' culture and heritage identity. The last section of the *Summary and Conclusion* includes a description of a conceptual model drawn from the study's findings. This model summarizes the research and points out the important lessons that can be learned from the past.

Background

'Vernacular' is defined by the Shorter Oxford English Dictionary as being, among other things, "that which uses native or indigenous language of a country or district". Analogous to this definition, vernacular buildings are those that employ native or indigenous building folklore, materials and techniques of a country or district. Amos Rapoport (1969) and Peter Freeman (1990) describe vernacular architecture as folk or popular², and refers to vernacular buildings as those buildings rooted in the local tradition and regional conditions. Tradition represents beliefs and customs, which were passed from generation to generation and are expressed in historic buildings, districts, and towns, while regional conditions include factors like climate, type of terrain, and local materials. Victor Olgay (1963) examines the basic vernacular architectural forms as a response to regional climate. His conclusion that climate serves as a primary factor in modifying the indigenous built form is based on two observations. The first observation reveals that the same group of people with the same cultural background developed diverse architectural solutions in different climatic zones. His second observation shows the similarity of architectural solutions of different people with different cultural backgrounds in similar climate regions.

The linkage of vernacular architecture with a location raises a significant question concerning the vernacular architecture of immigrants coming from a distance to new places: *Whose vernacular architecture is it?* This paper attempts to answer the question describing the evolution of three patterns of vernacular architecture of immigrants. The first pattern develops when immigrants arrive in new locations and *maintain* their original (remote) vernacular architecture. The second pattern occurs when immigrants bring their old architectural forms to new frontier areas and *modify* them due to new environmental conditions. The third pattern evolves when immigrants arrive to already settled areas and they *imitate* the existing

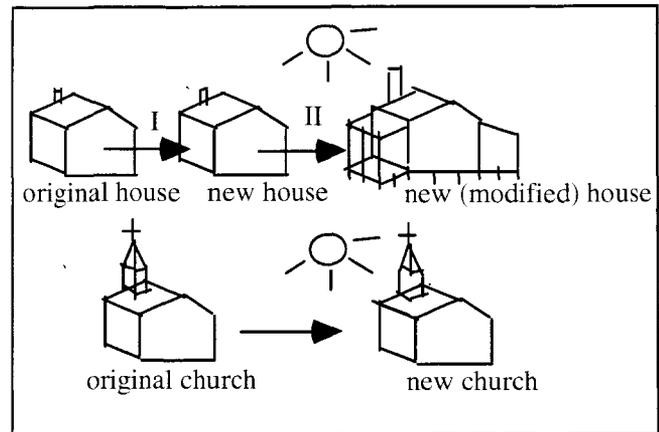


Fig. 1. Temporal trends in the evolution of forms of houses and churches of immigrants arriving in frontier areas

architectural forms, which represent the local culture as well as a response to local climatic conditions.

The paper focuses on the third pattern that occurred when immigrants arrived during 1840's-1890's from the cold northern European countries to the hot humid region of south central Texas, which was already occupied by Anglo and Spanish settlers. Before describing this pattern let me introduce in short the other two patterns of the evolution of the vernacular built form of immigrants coming from their homeland to new areas.

When immigrants perpetuated their original (remote) vernacular architecture in the new location, the form and content of their new buildings are influenced by their cultural heritage and less by the new environmental conditions. This tendency expresses the urge to preserve one's lifestyle, traditions and beliefs in familiar surroundings (Jacobi and Stokols, 1983). It has such a dominant force that immigrants attempted to choose frontier areas that resemble, as closely as possible, the terrain and climate of their native country (Seller, 1977). This pattern can be observed best in situations where the immigrants arrived in a vacant location with a moderate climate or with a compatible climate to their homeland.

Figure 1 illustrates the second pattern, where immigrants bring

their old architectural forms to new frontier areas of incompatible climatic surrounding. The figure shows that immigrants initially built a prototype home based on their knowledge from the homeland (Rapport, 1969). Then, experiences of climatic incompatibility yielded adaptation of the original prototype to local climate using local materials. In extreme climatic condition the settlers modified their houses as quickly as possible, i.e., after one harsh climatic season. This dynamic generally triggered architectural adaptation/modification that yields a "new" vernacular architecture.³ Geva (1995) in her study of the effect of climate and culture on built form, demonstrated that the extent of these architectural modifications is a function of building type.

Figure 2 demonstrates the third pattern of architectural form that evolves when immigrants arrive to an already settled area. The existing, already climatically modified houses in the new locations became the "model" for the new wave of settlers and immigrants. This phenomenon corresponds to the frontier theory of Turner (1893) stating that the frontier line disappears once the frontier is settled and the cultural and environmental modifications are accomplished. Then, the established frontier serves as a guide for the next wave of immigrants. Tracing the original form of the local society and how it affected the newcomers can be done by studying the diffusion maps of Kniffen (1936, 1976) and Glassie (1966, 1968, 1974, 1975). These maps graphically depict the trails of people migrating to different regions in the United States. The maps focus on the diffusion of architectural forms from their original location to the new place. The diffusion map of trails to Texas (Collier, 2000) shows that the Anglos and the Spanish, who occupied different parts of Texas, already had several generations of building experience in their pioneering across the south. They built their houses in Texas based on these experiences and knowledge accommodating the new environmental conditions (Bishop, 1975). The Anglo style served as the main "model" for the European newcomers who incorporated their construction technologies into the local Anglo existing forms (Alexander, 1975, 1979; Barnes, 1982; Collier, 2000). Thus, the houses of the newcomers did not require a second phase of modifications to the new climate as described in Figure 1, but rather the new homes resembled the local already modified houses. In other words,

the immigrants arriving in an already established community saw the existing forms of the houses and imitated them in the construction of their new homes. However, it seems that the form of churches did not succumb to the local modification forces, even under harsh climatic conditions such as the hot summers of Texas (Figure 2a). Churches represent the type of building in which society is ready to sacrifice comfort in order to maintain culture and heritage, since

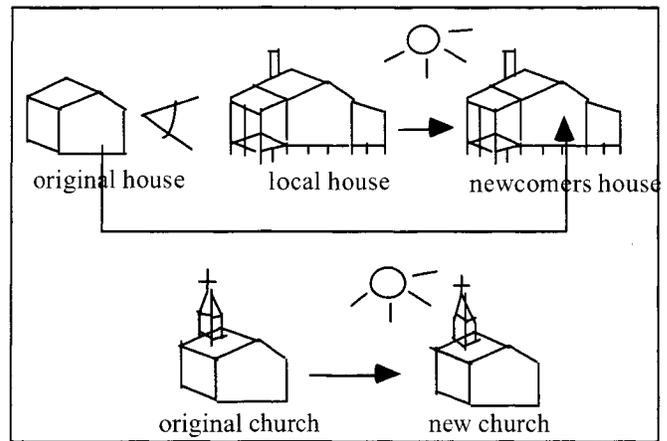


Fig. 2. The influence of local architectural forms on the immigrants' built form



Fig. 2a. Church in Europe (left) and Church in Texas (right)

"ethnic groups frequently build places of worship that are architecturally reminiscent of their homelands" (Upton, 1986). Thus, in this type of building, the original form takes precedence over comfort.

The paper focuses on this phenomenon as observed in south central Texas. Immigrants from North Europe built their houses to accommodate the extreme hot-humid climate condition, yet maintained the old form of their churches that was originated in a cold climate (Barnes, 1982; Geva, 1995).

The context of inquiry are eight mid-to-late 19th century (1850s - 1890s) ethnic vernacular churches and eight single family houses that were constructed by immigrants from north Europe (cold regions) in south central Texas (hot-humid area).⁴ The immigrants came to Texas directly from Europe, landing in Galveston, Texas and then spread into the rural areas of south central Texas.⁵ These European immigrants represented various ethnic groups who reflected different cultures and heritages (such as Czechs, Germans, Wends, Swedes, Wends, Poles, and French).⁶ These immigrants were quick to organize congregations and build their houses and churches in their new location, establishing cohesive communities (Driskill and Grisham, 1980; Barnes, 1982; Upton, 1986). The community members constructed their houses and churches with local materials imitating the local southern domestic architectural forms (Rapoport, 1969; Collier, 2000). However, their churches retained the architectural forms of the congregation's origin in Europe (Alexander, 1975; Barnes, 1982; Nielsen, 1989; Geva, 1994; Collier, 2000). The study of these 19th century (1850's-1880's) churches in south central Texas shows that many of the immigrants ethnic groups brought with them a deep sense of religion and heritage. The churches served as a reminder of cultural heritage shared by groups and served as a symbol combining faith and form (Jacobi and Stokols, 1983; Proshansky et al, 1983; Upton, 1986).

An example of this phenomenon can be found in Nielsen's comparative study of the 19th century Wends immigration to Texas, Canada, and Australia (Nielsen, 1989). In Canada, which has similar climate conditions to northeastern Germany, the immigrants made few changes in their built form, maintaining their culture and tradition.

While, in extreme changes of climate such as hot humid Texas and Australia, the immigrants modified their homes in response to the local conditions, perpetuating local architectural forms if they existed. However, the Wends did not change the original European form of their churches in all three locations. The churches continued to serve as mirrors of the cultural and heritage commitment of the immigrants.

To evaluate the extent of architectural modification of the vernacular architecture of immigrants as a function of building type (house and church) and the interactive effects of changes in climate and culture, the paper analyzes the climatic considerations of the eight targeted vernacular churches and eight single houses utilizing computerized energy simulations. The simulations assess the thermal comfort and energy performance in each of the buildings in their *actual* location in Texas and in their *simulated* location in Europe (the original northern European homeland of the immigrants). A good energy performance of a building implies a better adaptation of its form to the new climate. A poor energy performance indicates that the architectural form is more heavily influenced by the immigrants' cultural values and is less compatible with the local climate.

Climatic Considerations in 19th Century Vernacular Architecture of Immigrants in South Central Texas

Procedure and Research Instrument

The first pre-requisite condition for the analysis of the climatic considerations of vernacular buildings of immigrants is to determine the extent of compatibility or incompatibility of the old and new climate conditions. The study drew a comparison of the bioclimatic charts⁷ for the Texas location in relation to the European origin of each immigrant community. These charts imply that the greater deviation of a region's climatic conditions from a designated comfort zone the more extreme are the climatic conditions of the area. The comparison showed that the moderate winter of Texas suited the people, while the hot summer represented an extreme change of climate. Therefore, the study focuses on the summer season, examining whether the construction of the houses and churches addressed this climatic change or alternatively maintained their original forms, thus, retaining the cultural roots and heritage of the immigrants' homeland.

The second pre-requisite condition for this analysis is to define the relation of different types of buildings to culture. As described before the study uses two building types which are linked differently to culture: vernacular churches that are associated with rooted cultural values and vernacular single family houses constructed to achieve physical comfort. Moreover, the paper analyzes these buildings across a diversity of immigrants' population.

To evaluate the extent of architectural modification of the buildings as a function of building type and the interaction of climate and culture the paper utilized ENER-WIN — a computerized energy simulation program that assesses a building's energy performance in terms of thermal comfort and Btu's (Degelman and Soebarto, 1994). The program performs an hour-by-hour energy simulation based on given climatic, building and economic data. This software package includes a weather database of more than 280 US and foreign cities, an envelope materials catalog, and numerous user profiles that are based on ASHREA 90.1 energy efficiency standards, zone processing, building geometry processing, load calculations, energy summations, and life-cycle cost predictions. Two major steps are involved in the basic operations of this program: the input coding and the simulation runs.

Two input files were coded for each of the target buildings (8 houses and 8 churches). One input file consisted of the climatic data of

Texas and the other file had the climate conditions of the original European homeland of the immigrants who built these buildings.

The study utilized two modes of ENER-WIN simulation runs. First, the *passive system* that evaluate the comfort level of the passively heated and cooled buildings. This mode applies mainly to structures without HVAC. The output of these simulations represents the deviation of the internal conditions of the building from the designated comfort conditions.⁸ To assess the thermal comfort or discomfort in these buildings, the simulation provides a summary of total operative temperatures expressed by the total Discomfort Degree Hours (DDH) (Al-Homoud, 1994). This output implies an inverse relation between the DDH and the compatibility of the building to the local climate. The second run, the *active system* assesses the energy performance of a building with an HVAC system in energy units. This run was used in this study to simulate the historic buildings as if they include HVAC. The results of these simulations show the building's source energy in thousand Btu's per square feet (kBtu/sq.ft.),⁹ energy loads in million Btu's (MMBtu's)¹⁰, and energy cost analyses. This study focused on the energy loads (MMBtu's) and employed the premise that the more Btu's required to maintain thermal comfort, the less compatible the building is to the climate.

The simulation was run twice on each of the eight churches and

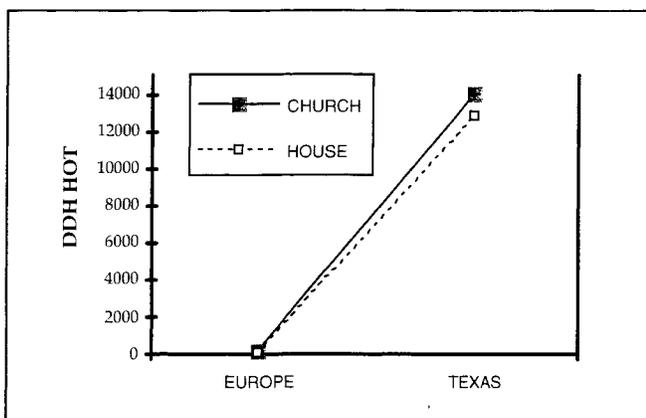


Fig. 3a. Mean DDH scores during the summer for houses and churches in Texas and Europe

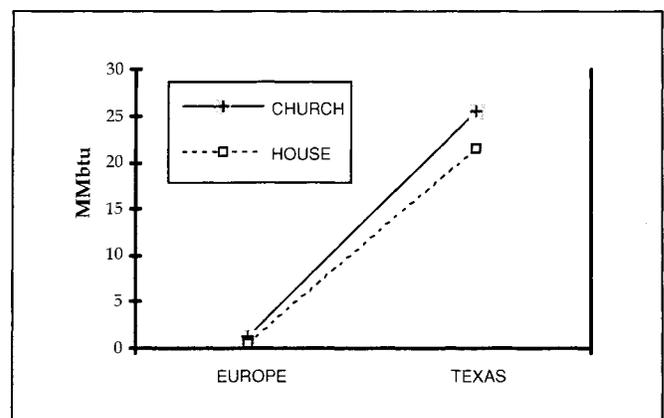


Fig. 3b. Mean cooling loads (MMBtu's) during the summer for houses and churches in Europe and Texas

eight houses. The first run used the first input file to analyze the thermal comfort and energy performance of each building in its Texan location. The second run assessed the building's thermal comfort and energy performance in a simulated location, *as if* transplanted to the original northern European homeland of the immigrants.

Analyses and Results

The simulations' results support the study proposition and provide quantitative analyses to the study of vernacular architecture of immigrants. The findings are summarized along three main contrasts that affect the built form: (a) the direct overall effect of location/climate (Texas and Europe); (b) the direct overall effect of building type (churches and houses); and (c) the interactive effect of these variables. As described before, the analyses of these three contrasts were performed on two sets of parameters: thermal comfort and energy performance. The first parameter summarizes the deviation of the building's conditions from a designated comfort zone in discomfort degree hours (DDH). The second demonstrates the energy performance of the building *as if* they consist of an HVAC system in million of Btu's (MBtu).

(a) The direct overall effect of location/climate (Texas and Europe):

The analysis of the location/climate (Texas and Europe) showed that during the summer both building types (churches and houses) are much less comfortable in Texas than in Europe (the mean DDH for the summer season in Texas is 13,441 while in Europe 103; The mean cooling loads for the summer in Texas is 24 MBtu while in Europe it is 1 MBtu). This significant difference in thermal comfort and energy performance of the buildings in Texas and Europe confirms the assumption that the Texas summer posed a climatic hardship on the *immigrants coming from northern Europe*. Moreover, this contrast validates the study's assumption that the immigrants' move from northern Europe to Texas represents an incompatibility of the hot-humid new climate with the original cold one (see Figures 3a and 3b).

(b) The direct overall effect of building type (churches and houses):

Figures 3a and 3b illustrate also the analysis of building type during the summer. It shows that across locations the houses are more comfortable and consume less energy than the churches. The mean of the DDH in summer of the houses (across location) is 6,456 which is better than the DDH of the churches (across location) 7,087 DDH. Likewise, the mean of the energy loads in the summer of the houses is 11 MBtu which is better than the energy performance of the churches 13.44 MBtu.

(c) The interactive effect of location/climate and building type on the built form:

This main contrast that is the key test of the research objective is expressed in the non-additive (interactive) effects of location (climate condition) and building type (house-church) on the thermal comfort and energy performance of the buildings. Figures 3a and 3b illustrates this interaction showing the difference in mean (M) of the thermal comfort (DDH) and the energy performance (MBtu) in the summer between the churches and the houses. In Texas the difference is 1,175 DDH ($M_{\text{church}}=14,028$; $M_{\text{house}}=12,853$), while in Europe it is 86 DDH ($M_{\text{church}}=146$; $M_{\text{house}}=60$). The difference in mean (M) of the energy performance (MBtu) in summer between the buildings shows 4 MBtu in Texas ($M_{\text{church}}=26$; $M_{\text{house}}=22$), while in Europe the comparable difference is negligible, 0.75 MBtu ($M_{\text{church}}=1.26$; $M_{\text{house}}=0.51$). The findings support the proposition that houses represent a building type that is more inclined to comfort than churches whose form represents symbolic cultural needs.

Figures 4a and 4b demonstrate the results of simulating a house and a church that were constructed by the same group of immigrants. Figure 5a demonstrates the thermal comfort (DDH) results in the summer of the Old St. Mary's Catholic Church built by German immigrants in Fredericksburg, Texas (13,470 DDH), and of the Staudt Sunday House built by this group of people (8,861 DDH). Analyzing these buildings in their simulated location Dresden, Germany yielded 0.00 DDH for the church and 6.00 DDH for the house during the summer season. The findings of the energy performance (MBtu) corroborate the results of the thermal comfort (DDH). Figure 5b demonstrates the cooling loads (MBtu's) of the St. Louis Catholic

Church built by French immigrants who came to Castroville, Texas (30 MBtu), and the Andrew Carlé House (23 MBtu). The relatively mild French summer demanded very low cooling loads from both buildings as if 'transplanted' to France (church: 1.4 MBtu and house: 0.23 MBtu). The results show that during the Texas summer, the houses are more comfortable than the churches. In Europe the climatic compatibility advantage of the houses as compared to the churches is relatively smaller.

It should be noted that although the paper focuses on the summer season the analysis of the thermal comfort and energy performance of the two building types during the winter season reveals a mirror image of the summer findings. The houses are less comfortable than the churches during the winter in Europe. This finding corresponds with the proposition that houses which were modified to accommodate the new hot humid climate of Texas lose their comfort compatibility with the original climate of the immigrants' homeland — the harsh winters in Europe.

In addition to the analyses of the contrasts across the different buildings in each category (location, building type, and interactive effect), the study examined two examples of houses that underwent two stages of construction, in different points of time. The John P.

Tatsch House and the Staudt Sunday House in Fredericksburg, Texas were analyzed by running an energy simulation on the original structure (the first form), and on their modified form, which included additions of bedrooms and a kitchen. The simulations were conducted on each building in their actual location in Texas (Fredericksburg) and in its simulated location in Germany (Dresden). A comparison of the thermal comfort and energy performance of the two stages of each house illustrates the climatic modification that the 'single family house' underwent in the new environment. The results support the study's hypothesis and reinforce its description of the susceptibility of houses to climatic adaptations. Furthermore, these results demonstrate the sensitivity of the research instrument (i.e., the computerized energy simulation) in capturing the extent of modifications of the built form.

The findings of this study illustrate the climatic considerations in 19th century vernacular architecture of immigrants arriving from cold countries to hot-humid region. The differences in the climatic considerations as function of building type highlight the importance of ethnic cultural identity in vernacular architecture, and the significant role of passive energy systems in achieving thermal comfort and conserving energy. In addition, the study's results demonstrate the

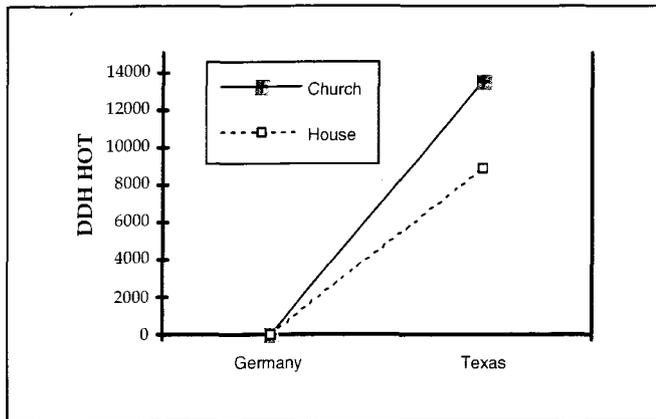


Figure 4a. DDH scores during the summer for the Old St. Mary's Catholic Church and the Staudt Sunday House in their actual location: Fredericksburg, Texas, and in their simulated location: Dresden, Germany

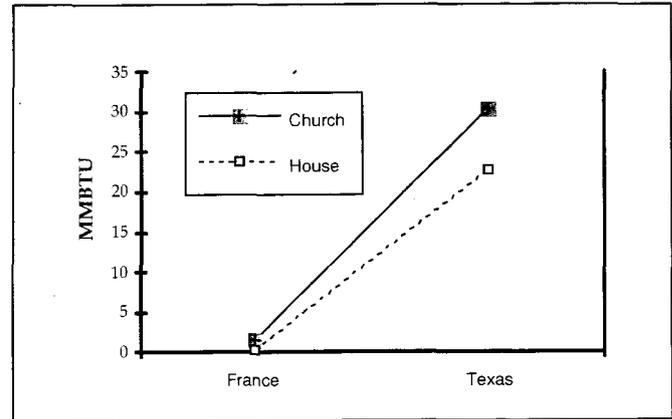


Figure 4b. Cooling loads in MBtu during the summer for the St. Louis Catholic Church and the Andrew Carlé House and in Castroville, Texas and Strasbourg, France

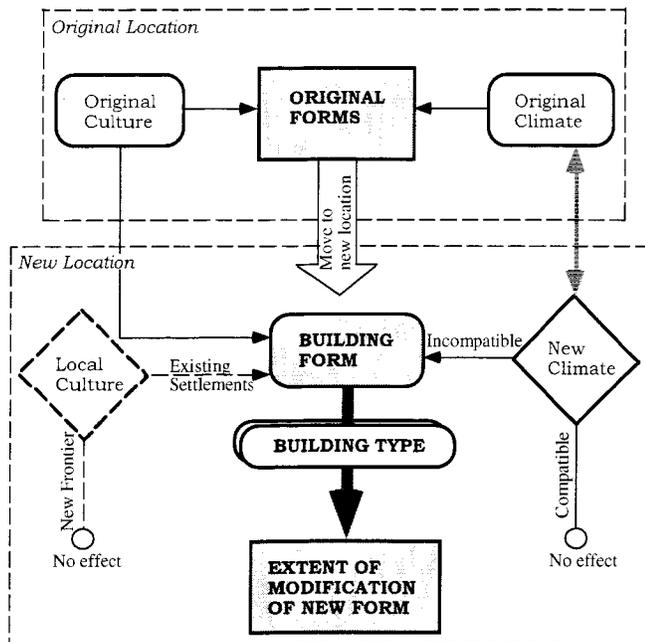


Figure 5. A summary of the interactive effect of culture and climate on built form as mediated by building type

utility of the empirical and rigorous methodology of using computerized energy simulations. However, it should be acknowledged that further research is necessary to cross-validate the present findings, in a variety of climatic and cultural contexts. New studies could address different changes in climate (e.g., immigrants coming from hot areas to cold regions), additional building types (e.g., courthouses, schools), and different periods in history.

Summary and Conclusion

Figure 5 summarizes the analyses and findings of this study. This conceptual model illustrates the interactive effect of climate and culture on vernacular built form as mediated by building type in the immigrants *original location* (their homeland) and in their *new locations*. The right side of the figure shows the changes of climatic conditions from the original to the new location. In cases of climatic incompatibility between the new and the original locations, the original form is being modified. Building type and its association with cultural

factor influences the extent of modification of the new form. Houses are modified to accommodate the new climate, while churches retain their old form to continue and symbolize the cultural and heritage values of the immigrants' community. In the case where the climate of the new location is similar to the one of the original location, there will be no effect of the new climate on the built form.

The left side of Figure 5 illustrates two sources of cultural influence. The first and most important cultural contributor to the built form is the impact of the original culture, i.e., the cultural heritage that the immigrants carry with them to new locations. The second cultural component that can affect the built form is the local culture of earlier settlements in the new location. This latter component is represented in the figure by a dashed line, rather than a solid one, to express that this factor is not always active.¹¹ In cases like in south central Texas in which immigrants arrived to an already settled environment, local houses served as an architectural "model" for the newcomers. This "model" can represent two different forms of the buildings. First, houses that already adapted to the new climate and local conditions. These structures demonstrate to the newcomers the developed regional local culture. Second, government facilities (e.g., courthouses, schools) that symbolize an assimilation process of the previous settlers to the new place. In cases in which immigrants arrive at unsettled areas ("new frontiers") there will be no effect of local culture on the built form. In these situations, the extent of modification of the built form of immigrants is a function of the local climate conditions and building type.

The analyses of vernacular architecture of immigrants of this paper suggest that the term 'local' may be interpreted not only as a physical attribute, but also as a psycho-social term. Thus, one should not be surprised to find "typical" European vernacular churches in various places in Texas, as well as "typical" vernacular European houses in areas of compatible climate with north Europe. This study extends scholarly work that has been conducted on the evolution of vernacular architecture. It provides an integrative conceptual understanding of the interactive effects of climate and culture on the built form, which is substantiated by a rigorous empirical methodology.

The identification of the factors underlying the modification versus retaining the old "imported" vernacularism may shed more light on the dynamic nature of vernacular architecture in general, and leads to further insights into preservation efforts of these special classes of architecture. The efforts of preserving vernacular architecture of immigrants accentuates in places like the US where the present vernacular architecture lost its ethnic and/or regional identity to industrialized construction built by contractors and which relies heavily on HVAC systems. Incorporating the lessons from the past into new development might provide more sustainable houses as well as diversity in form that will express the community's cultural identity.

In conclusion, the study highlights the culture and heritage of different ethnic groups that settled in south central Texas during the second half of the 19th century. It explores the built form of the people of Texas, as influenced by their ancestors' churches and houses. The findings provide a link between the current, rapidly changing world and the cultural roots from the past. This link enhances the architectural and social appreciation of the past and leads to better comprehension of current architectural phenomena, and to the recognition of the significance of identity, pride and place.

Notes

- 1 The form of vernacular buildings is the consequence of a whole range of environmental and/or cultural factors, and that the relative weight of each factor depends on the extremity of surrounding conditions (Rapoport, 1969; Olgyay, 1963).
- 2 For the study of the relation of folk and popular arts and artifacts, see Henry Glassie, (1968, 1972:253-280); and Michael O. Jones, (1972):43-60.
- 3 See the original work on the frontier in American history by Turner F.J. (1893): "The Significance of the Frontier in American History" in M. Ridge (Ed.), *History, Frontier, and Section*. (Albuquerque, NM: University of New Mexico Press, 1993); see also son Palmqvist, "Swedes" and Tishler, "Midwestern Germans" in Dell Upton, (Ed.), *America's Architectural Roots, Ethnic Groups that Built America*. (Washington, DC: The Preservation Press, 1986).
- 4 The study buildings: **Churches:** Old St. Mary's Catholic Church, Fredericksburg, Gillespie County (1861-63); Wesley Brethren Church, Wesley, Austin County (1866); The Bethlehem Lutheran Church, Round

Top, Fayette County (1866-67); St. Louis Catholic Church, Castroville, Medina County (1868); St. Paul's Lutheran Church, Serbin, Lee County (1871); The Nativity of the Blessed Virgin Mary Church, Cestohowa, Karnes County (1877); The Gethsemane Lutheran Church, Austin, Travis County (1883); The Bastrop Christian Church, Bastrop, Bastrop County (1895). **Houses:** The Staudt Sunday House, Fredericksburg, Gillespie County (1847); The Edward Henkel House Round Top, Fayette County (1851); The John Peter Tatsch House, Fredericksburg, Gillespie County (1852); The John Gawlik House, Panna-Maria, Karnes County (1858); The John Kowalik House, Panna-Maria, Karnes County (1860); The Andrew Carlé House, Castroville, Medina County (1864); The Machie Pawelek House, Cestohowa, Karnes County (1865); The Carl Wilhelm Rummel House, Round Top, Fayette County (1870).

- 5 See the population diffusion map of "trails to Texas" by Loyd G. (2000):20
- 6 They were part of the massive immigration waves from Europe to America in the mid 19th century (between 1815-1860 about five million people immigrated to the United States). They came to find a better life, escaping religious harassment, economic hardship, or personal difficulties (Seller, 1977).
- 7 See the bioclimatic charts in Norbert Lechner, (1991:32 Figure 3.9); in Victor Olgyay (1963); and in Baruch Givoni, (1976).
- 8 *The human thermal comfort zone is defined by ANSI/ASHRAE in terms of dry-bulb temperatures between 68° F and 79° F, relative humidity between 30% and 60% (50% optimum), and mean air speed equal or lower than 0.15 m/s (30 fpm).*
- 9 *Source Energy: energy consumed by the power plant to produce the total energy used by the building.*
- 10 *The building's cooling/heating loads: how much energy is required to cool or heat the building.*
- 11 In cases in which immigrants arrive at unsettled areas ("new" frontiers) there will be no effect of local culture on the built form.

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