Chapter 10

Rural Landscape Architecture: Traditional *versus* Modern Façade Designs in Western Spain

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Additional information is available at the end of the chapter

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Abstract

In any rural area, ensuring both architectural quality and preservation of rural characteristics must be a goal of building design for sustainable environments. Imitation of traditional building techniques and use of natural materials are trendy again in landscape architecture of rural areas in Spain. This is especially visible in architectural design of façades of new building. However, there are few researches that focus on analyzing the visual effect of this new architecture in landscape integration. In regards, this chapter explores visual quality impact of a façade based on their complexity degree. The aim was in particular to identify visual preference patterns in ornamentations with stone or wood of novel rural buildings. New architectural styles from an experimental rural area of Mediterranean basin are chosen for this purpose. Here, 15 secondary housing images were used to evaluate the visual preference of different façades: traditional vs. new archetypes. During the measuring process, scientific design theories of façade complexity were considered. Seventy-five observers scored images selected using a five-point Likert scale, and results were analyzed by appropriate statistical tests (Cohen's "d"). Surprisingly, as a main result, the simple use of natural materials is not enough to guarantee the design quality of a façade.

Keywords: architectural design, façade complexity, sustainable development, architectural heritage, visual preferences, esthetic characteristics, public participation, landscape planning

1. Introduction

A wider space between secondary residences is a growing requirement especially in rural tourist areas of the Mediterranean basin [1–3]. Ensuring both architectural quality and preservation of the rural landscape for sustainable environments must also be considered as a second homes' requirement to satisfy [4, 5]. The use of materials, quality, right colors, traditional techniques of construction, and/or designs of façades with coherent complexity must be taken into account for that purpose. Traditional materials help in imitating traditional styles, but the use of wood and stone material is not ever enough to achieve the desired visual quality [6, 7]. Inadequate legislation is a part of the problem, and improvements in transfer of scientific knowledge to professionals involved in urban and rural management could be a part of the solution [8]. The vague and subjective recommendations were found in most European legislations of sustainable rural landscape planning [9], which might be avoided on the basis of data from research studies. However, few scientific studies are available in regard to visual preferences and façade design.

Surface properties are the primary sensory characteristics affecting visually the appearance of the façade of a building [10–12]. Colors, materials, or windows and doors have a stronger impact on façade quality than the own volume of the building or its silhouette [7, 13–15]. The existence of a hierarchical size scaling among main openings (i.e., doors and windows) and textures (i.e., colors and materials) is important for the coherent understanding of a building [16, 17]. Since simplicity generates "gaps" on the visual reading of a building, it leads to psychological discomfort, and results in an unpleasant outcome, simple façades violate this hierarchical downscale [18]. A scaling based on gradation from large scale (formal) to fine scale (stylistic) elements is, therefore, recommended for improving the visual quality and acceptance of a building [19]. Intermediate-scale elements comprise what is known as ornaments, and are essential for the coherent scaling of a façade [20]. The scaling of sizes into large, intermediate, and small elements has been quantified as a function of the total length of the façade [21, 22]. The visual theory of "*septaves*" [23] classifies components into three levels: "part of the façade", if the component's length is within the range of 1–1/7 of the façade's length (large scale: 1st *septave*); "ornament", if in the range of 1/7–1/49 (intermediate scale: 2nd *septave*); and "texture", if in the range of 1/49–1/343 (small scale: 3rd *septave*). Door and window trims, cornices, and plinths fall in this theory into the consideration of ornaments. Ornaments and textures (2nd and 3rd *septaves*) represent the amount of visual details of a façade. The number of visual details increases the complexity of the design, and complexity has a demonstrated weight on acceptance [15, 23]. However, complexity is also affected by the novelty/familiarity of the details and by their level of organization within the façade [24].

Many studies attempting to find a correspondence between complexity and visual acceptance have been already performed. Most of them recorded a linear-positive correspondence [25–27], but the others found just up to a certain threshold and identified an inverted U-shaped correspondence [28, 29]. The architectural style (traditional vs. modern buildings) and the profession of the observer (architects vs. the other professionals) could have a significant influence on differences of response. High levels of complexity seem to be accepted better by architects than by the general public, in special for modern architectural styles [25, 30–32]. Traditional architectural styles achieved a better acceptation of complex patterns among the general public [33–36]. However, some researchers have found a threshold point in complexity above which the visual acceptance was impaired in all cases, irrespective of professions or architectural styles [24, 37]; so, the controversy remains open.

This paper attempts to explore aspects of the visual quality of a facade based on their degree of complexity for sustainable environments. Exploring how the size, amount, and arrangement of materials and ornaments may affect visual perception of a façade was the basis for the methodological design. The aim was in particular to identify visual preference patterns in ornamentations with stone or wood of new rural secondary residences for sustainable environments, taking mainly into account the new regional development of architectural styles of some rural examples of a Mediterranean environment (Casas del Castañar, Jerte Valley, Spain). The design of masonries imitating traditional styles often employs artificial stone coatings in which visual quality has not been evaluated in scientific studies. A threshold point in acceptation of the complexity derived from the use of these materials would be expected. Comparing the visual effect of traditional and novel techniques for arranging these materials on the façade, since the organization of visual details is expected to influence acceptance. Novel designs find often problems with the current regulations, but they are increasingly demanded in many rural areas of Spain. This chapter was structured first presenting "Materials and methods" section arranged in four parts, which is particularly tested in the proposed case study area. In the "Results and discussion" section, the results from the method application are discussed. In the last section, the "Conclusions", summaries considerations obtained from this approach and describes suggestions for future research.

2. Materials and methods

2.1. Pilot area and architectural styles

The pilot area selected for this research was Jerte Valley in north of the autonomous community of Extremadura, Spain. It is covering the area of 375 km^2 and occupying the space (X: 252,262, Y: 4,443,772, Datum: WGS84/UTM 30 N). The Jerte Valley mainly bases its economy on agriculture, particularly on Cherry crop. The Cherry crop phenology has led to a growing rural tourism, and as a result thereof, to an increase of buildings linked to ecotourism including the construction of second homes. Unfortunately, an illegal residential sprawl has taken place in most of the 11 municipalities of Jerte Valley and their neighborhoods [4, 38, 39]. Casas del Castañar was selected as a municipality for the study on the account of the quality of its rural landscape and of the urban expansion noticed in recent decades despite the population decreasing (see **Figure 1**). It was additionally selected because of its recent legal planning review performed after year 2000, although legal texts do not seem to be based on technical or scientific planning requirements from the point of view of visual building integration.

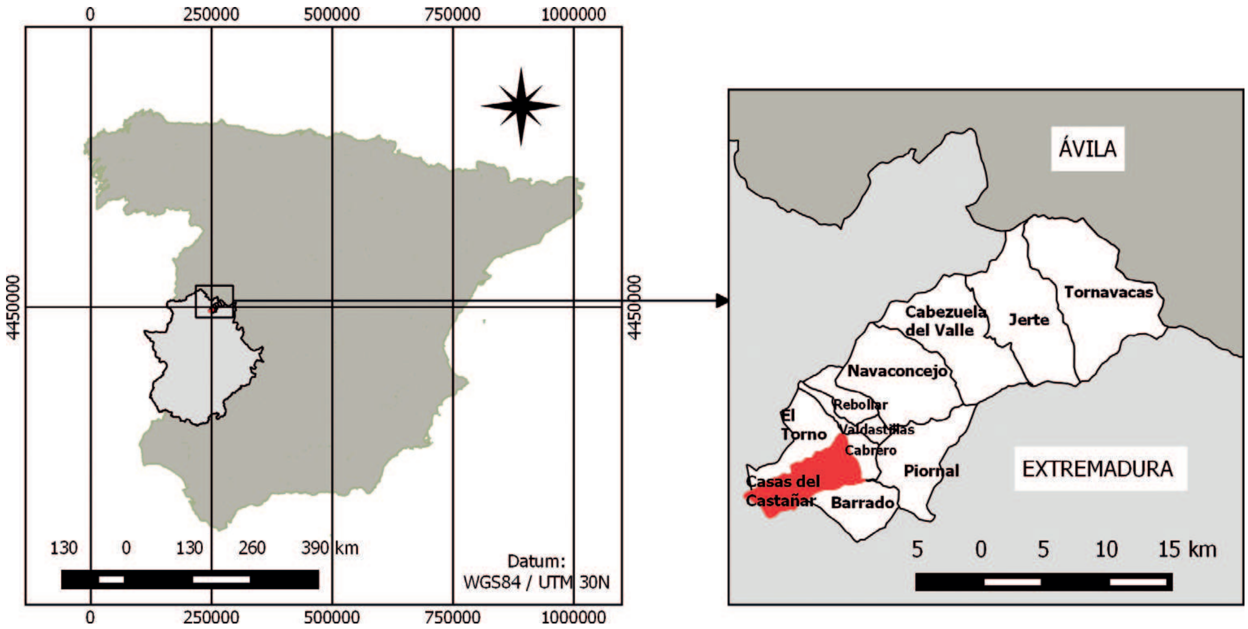

Figure 1. Geographical location of the pilot area.

Figure 2. Traditional mountain Mediterranean second homes from the pilot area: (a) stoned second home; (b) half-timbered second home limed on the upper floors; (c) half-timbered second home visible on the upper floors.

The traditional mountain Mediterranean second homes were chosen for the purpose of the study. Two main examples of this style exist: stoned and half-timbered second homes. Wood framing has been traditionally destined to the construction of the upper floors away from moisture and xylophages, using the masonry for the lower floor as the mainstay of the entire building. Framing is limed in some second homes and is visible in others, generating a greater visual complexity as shown in **Figure 2**. Most new buildings of the experimental

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area did not face any review of the design process because of their illegal conditions. In contrast, other buildings do not exactly match traditional esthetics that matches a legal status (see **Figure 3**). An inventory of the new buildings developed in the study area during the last decade was made by the means of geographical information systems (GIS) and ortho-aerial photographs, and cases with limited accessibility or visibility from main roads were excluded from the subsequent fieldwork. Examples of buildings displaying stone cladding and wood details imitating traditional types were recorded, and a set of three secondary residences was finally selected for the investigation. Only two-storey buildings were considered in this study. Selection criteria included two main requirements: similar volume and height of the building, and an adequate visible angle for image capturing (see **Figure 4**). Pictures were taken as necessary to record the highest amount of building details, since perspective does not influence the analysis [40]. Images were captured in sunny days of spring and early summer, and negative conditions such as rain, excessive cloudiness, fog, or midday sunlight were avoided [41, 42]. The observation line was kept as perpendicular as possible to the façades [33].

2.2. Visual stimuli and experimental design

Three sets of five façade simulations based on three secondary residences selected and on five different façade treatments were prepared. This work generated 15 pictures for evaluating visual stimuli (see **Figure 5**); this is an adequate number of pictures per interviewee, for

Figure 3. Examples of novel second home styles in the area of the study: irregular pattern of stone shingle distribution (house on the left) and wood framing imitation on the upper floor (house on the right).

Figure 4. Original images of three secondary residences selected for the study.

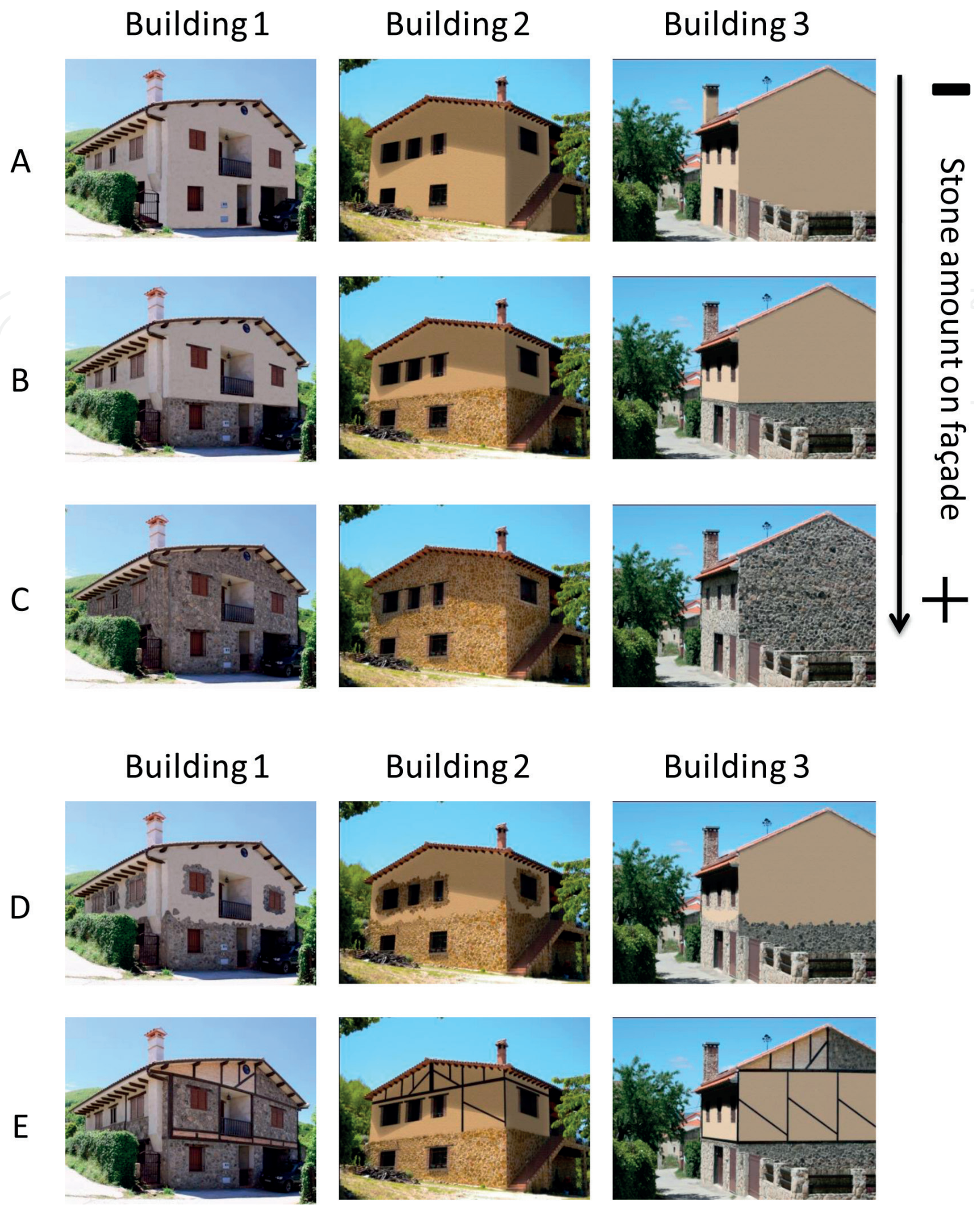

Figure 5. Scenarios and individual images used in the survey. A-C cases represent an increase gradient of stone cladding. Cases D and E represent respectively: new trends of ornamentation in stone and traditional stone and timber framing.

guaranteeing a correct visual attention until the end of a questionnaire and for achieving consistent results [15, 24, 32, 43, 44]. Adobe Photoshop TM CS3 was used for image processing. Use of both real pictures and photo-simulations for the purpose of the investigation is supported by prior studies [45–48]. Façade treatments represented two visual proposals as follows:

- First, a gradation of traditional stone cladding (image sets A–C) was ranging from null (set A, the lowest complexity) to total (set C, the highest complexity) coating. Image set B was the intermediate proposal, and displayed the plinth of stone cladding characteristic in traditional houses. The objective of these image sets was to evaluate how variation in complexity based on differences in stone amount on the façade may affect visual preference.

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- Second, a novel trend in façade ornamentation was developing at present in the region (image sets D and E). Image set D displayed a stone cladding of intermediate complexity that does not match the traditional design. Image set E imitated the traditional stone and timber framing, and displayed an intermediate to high complexity. The objectives of these two sets of images were: (1) to guess if a similar number of stone cladding may reach the same pattern of hedonic response irrespective of the shingle pattern distribution (comparison of B and D); and (2) to test how the novel trends in combining stone and wood on façades in imitation of the traditional style affect visual acceptation (comparison of B and E).

2.3. Participants and survey procedure

Image sets were shown to 75 participants recruited in the University of Extremadura, Spain, who freely agreed to collaborate the study. Among them, 39 participants (18 males and 21 females) were students and professors of architecture or other technical careers related to landscape. Thirty-six (18 males and 18 females) were students and professors from other university disciplines. The average age of the respondents was 29.17 years old (18–48 years old), and they were classified into three homogeneous groups: (1) undergraduate students from morning course (18–24 years old); (2) undergraduate students from evening course, and postgraduate students involved in master programs (25–33 years old); (3) professors (35–48 years old). All participants had never seen before the buildings shown and did not recognize the image sets as familiar to them. They were requested to fulfill a questionnaire form consisting of two parts. The first part collected demographic and educational data from the participant, and the second part involved the evaluation of the image sets. Every image was evaluated in terms of preference on an ordinal scale of five-point Likert test, from very unpleasant = 1 to very pleasant = 5. Bipolar rating scale was selected from previous researches, since semantic differential scales have been already used successfully to measure hedonic tone [27]. Images were presented at random order and image size (10 × 15 cm) was large enough to appreciate details.

2.4. Recording of results and statistical analysis

People's preference is variable dependent, and its ordinal character allows a continuous analysis of the data [49]. Mean values of preference were calculated for each photograph. Original building (OB) (1–3), type of Façade treatment (FT) (A-E), gender (G) (M-F), age (A) (1 = undergraduate, 2 = postgraduate, 3 = professors), and educational background (EB) (architects and engineers (I)/others (II)) of the participants were the independent variables (factors) of the study. Mean preference ratings were analyzed by a MANOVA factorial design: (2 (G) × 3 (A) × 2 (EB) × 3 (OB) × 5 (FT)). The latter two variables had a repeated measured analysis within subjects; gender, age, and educational background data comprised an analysis between subjects. The standardized mean differences for preference between levels of façade treatments and buildings were expressed as an index calculated from Eq. (1) as follows:

$$d = \frac{(\mu_1 - \mu_2)}{\sqrt{mse}} \tag{1}$$

where μ_1 represented the mean of preference responses for a level of a factor, and *mse* (mean square error) estimated the total error expected for a sample in the repeated measure analysis of variance with the total stimuli presented (15 images).

3. Results and discussion

The index "d" aforementioned is very useful not only to estimate the effect size of the differences found between two levels of a factor, but also to compare and discuss the results from different studies. In statistics, an effect size is a measure of the strength of a phenomenon. In the current study, it indicates not only if two pictures are significantly different, but also by how much are different. The contrast, for instance, between second homes with a plinth of stone cladding and without stone coating estimates how much significant improvement the stone presence in a partial covering would have; moreover, this possible effect can be numerically comparable with other researchers by using the index "d". For Cohen's d, an effect size up to 0.2 might be a "small" effect, around 0.5 a "medium" effect, and 0.8 to infinity, a "large" effect; $d > 0.2$ is accepted as good threshold for distinguishing significant from nonsignificant visual differences in environmental impact assessment [50]. Finally, the sample size ($n = 75$) is assumed as good enough since, at least, leads to detect effect sizes over 0.2 at significant thresholds of power analysis [$(0.75 = 1-\beta; \beta = 0.25); \alpha = 0.05$] [51]. For more information about this index, it can be consulted [52].

3.1. Preliminary results of MANOVA

Similar patterns of a five-point Likert test were found in the responses obtained in spite of small nonsignificant variations between the observers. Females and participants unrelated

Source	SS	df	MS	F	Level of significance*
Gender	0.014	1	0.014	0.003	0.957
Educational background	6.420	1	6.420	1.330	0.253
Age	1.945	2	0.972	0.202	0.818
Gender × educational background	0.076	1	0.076	0.016	0.901
Gender × age	5.011	2	2.506	0.519	0.597
Educational background × age	8.655	2	4.328	0.897	0.413
Gender × educational background × age	6.280	2	3.140	0.651	0.525
Error	303.999	63	4.825		

Significance level was set at 0.05.*Neither social variables nor interactions among them presented significant effects ($\alpha < 0.05$) on dependent variables (participants' responses).

Table 1. Results from testing between subject effects by MANOVA.

with landscaping sciences scored images higher than males and architects or engineers, but the differences lacked statistical significance (see **Table 1**). In addition, there was no interaction among these variables and the original buildings (OB) (1–3) or the façade treatments (FT) (A-E).

In relation to façade complexity, a consensus in the hedonic tone was also recorded among participants from prior studies. Akalin et al. [24] mentioned that gender and profession had an influence on preferences, but interactions between social variables and complexity were also not found. In contradiction, no main differences concerning profession were found in a prior study [37], except for some relative differences observed between architects and other observers but they occurred only for high levels of complexity. Data obtained from participants were also considered globally in the present study, and only original buildings (OB) (1–3) and the façade treatment (FT) (A-E) were analyzed in terms of preference. Data analysis from repeated measurements on single participants (within-subject analysis) showed a real influence of these variables (OB, FT) on responses, as well as that they interact in a two-way manner (see **Table 2**). Thus, participants did not equally accept the five proposals of façade design presented in the three building cases.

Source	SS	df	MS	F	d[1]
Building case (1–3)	61.59	2	30.80	38.34*	0.6
Error	101.21	126	0.80		
Façade treatment (A–E)	54.78	3.5	15.67	10.2*	0.4
Error	338.33	220.35	1.54		
Building case × façade treatment	18.279	8	2.285	6.380*	0.3
Error	180.502	504	0.358		

*Significant differences (alpha < 0.01) were found on participants' responses in function of the architectural variables and their interactions.
[1]Cohen's d > 0.2 indicates that these differences are visually important [50].

Table 2. Results from testing within subject effects by MANOVA with Huynh-Feldt correction.

3.2. Preference for stoned façades based on the amount of shingle (image sets A–C)

Mean of participants' Likert test regarding stone cladding increased from minimum (A) toward intermediate (B) complexity irrespectively of the second home presented. In addition, standardized mean contrast showed that the differences were significant at the 0.01 level, with an important effect size (d > 0.2) as shown in **Table 3**. The rating decreased for maximum façade complexity (C), although such decreasing was statistically significant only for building 2 (see **Table 3**). Therefore, the results showed an inverted U-shape correspondence between the degree of façade coverage and the people preference (see **Figure 6**). This was demonstrated for building 2 and suggested by results for buildings 1 and 3 as shown in **Figure 6**.

Building case	Level of shingle amount	Mean	d	F (1.74)	Level of significance
1	B (middle)	3.65	*0.602*	47.687	1.47E−09*
	A (absence)	2.96			
	C (high)	3.53	*0.497*	14.671	0.0003*
	A (absence)	2.96			
	B (middle)	3.65	0.105	0.714	0.4010
	C (high)	3.53			
2	B (middle)	2.97	*0.384*	14.049	0.0004*
	A (absence)	2.53			
	C (high)	2.53	0.000	0	1.0000
	A (absence)	2.53			
	B (middle)	2.97	*0.384*	16.664	0.0001*
	C (high)	2.53			
3	B (middle)	3.31	*0.500*	41.138	1.19E−08*
	A (absence)	2.73			
	C (high)	3.17	*0.384*	8.773	0.0041*
	A (absence)	2.73			
	B (middle)	3.31	0.116	0.818	0.3688
	C (high)	3.17			

MSE = 1.314 (with Huynh-Feldt correction).*Significant differences were found when comparing pairwise of scenes from top to bottom (alpha < 0.01). These differences also achieved an effect size above 0.2 [50].

Table 3. Standardized mean contrasts for visual response in function of the stone cladding amount (A–C comparisons by pairwise of scenes from top to bottom). *d'Cohen italic* values represent those mean comparisons reached statistical significance differences with strong effect size.

While façades of building 2 were coated with limestone, building 1 and 3 were coated in granite, and such difference in the nature of materials might have influenced the results. Granite masonry is common in the traditional Mediterranean mountain houses of Extremadura [53]. Since the less familiar a façade is, the worse the Likert test may result [24], limestone could have been recognized in the present study as an exotic material by observers, in special at high levels of cladding. Thus, they would have been easily linking granite to the traditional usages of the region as shown in **Figure 1**. During an informal interview performed after the survey, some participants manifested, indeed, some annoyance about the stone's color of building 2C in comparison with buildings 1C and 3C. This late information was not part of the investigation, but suggested that the nature of the stone could actually have influenced the results. The color of materials can turn the buildings into more striking and less preferred [7, 14].

In conclusion, traditional partial stone coating (image set B) achieved the highest level of acceptance irrespective of the stone type (see **Figure 6**). Whether the type of stone and the color affect significantly facade's assessment will be investigated in future studies.

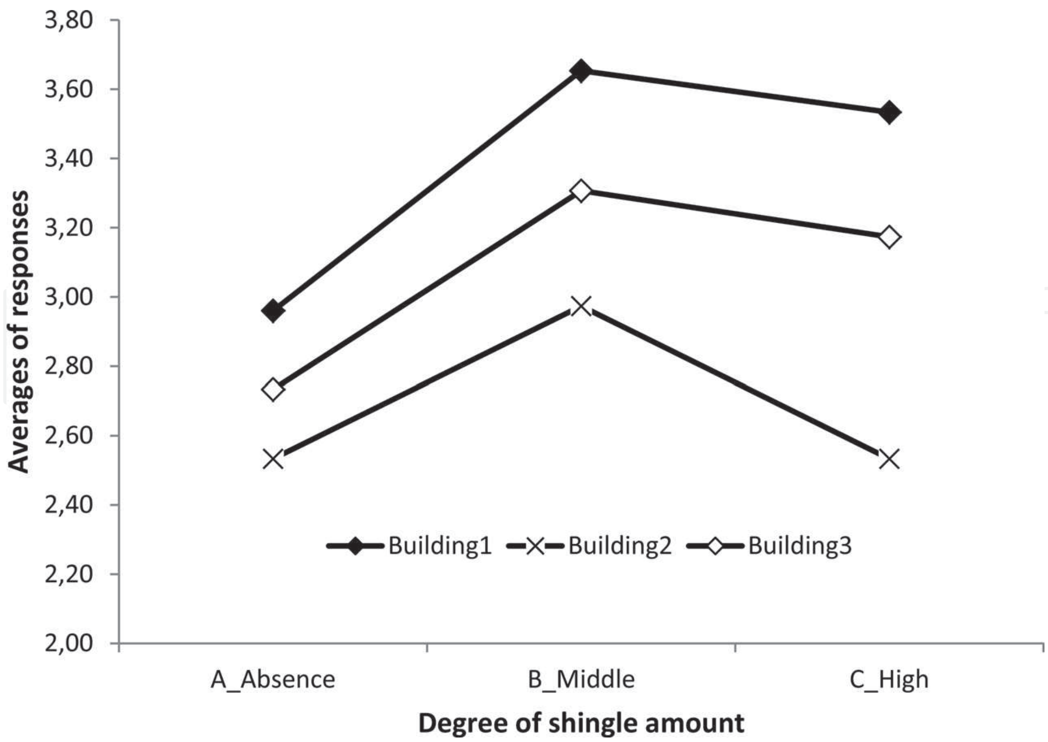

Figure 6. Mean values of Likert test as a function of the amount of shingle on the façade. A significant trend of inverted U-shaped was found for building 2, but not for buildings 1 and 3.

3.3. Preference for stoned façades based on the shingle pattern distribution (image sets A, B, D)

Similar amounts of stone coated the façades of buildings in B and D image sets, but D scenario received a significantly worse evaluation than B scenario as shown **Table 4**. In addition, irregular distribution of stone shingles (D) recorded the same results than the lack of stone coat (A) after statistical analysis for significance (see **Table 4**). Visual improvement of a façade requires, therefore, something more than the simple addition of stone.

The perception of a pattern depends on how visual information is presented and how it is organized [17]. Scaling coherence is a fundamental component of the structural morphology of forms, and is presented in façades from most traditional architectures. It involves a nested visual hierarchy of scales based on the arrangement of formal (openings) to stylistic (details) elements in structured patterns. Complex and ordered patterns display a tightly organized and large information content that looks coherent to the observer. Chaotic forms display, on the other hand, large amounts of uncoordinated information that may exceed the brain's processing capacity, turning the façade less familiar to the observer [18]. This is the most likely explanation for the low rating achieved by visual proposals presented in image set D, where the randomization of the boundaries of the stone baseboards did not follow either coherent or familiar design patterns. Such presentation disorganizes complexity and impairs human comprehension [36]. At the opposite extreme, small scales were removed from façades in image set A, which minimized the complexity of forms. The structure of both of the above extremes (A and D) lacked cooperation of hierarchical materials and

Building case	Arrangement of shingle pattern	Mean	d	F (1.74)	Level of significance
1	B (regular plinth)	3.65	*0.462*	13.303	0.0005*
	D (irregular plinth)	3.12			
	A (no shingles)	2.96	−0.140	1.245	0.2680
	D (irregular plinth)	3.12			
2	B (regular plinth)	2.97	*0.427*	19.093	3.9E−005*
	D (irregular plinth)	2.48			
	A (no shingles)	2.53	0.047	0.136	0.7130
	D (irregular plinth)	2.48			
3	B (regular plinth)	3.31	*0.541*	21.796	1.32E−005*
	D (irregular plinth)	2.69			
	A (no shingles)	2.73	0.035	0.08	0.7780
	D (irregular plinth)	2.69			

MSE = 1.314 (with Huynh-Feldt correction).

*Significant differences were found when comparing pairwise of scenes from top to bottom (alpha < 0.01). These differences also achieved an effect size above 0.2 [50].

Table 4. Standardized mean contrasts for visual response in function of the stone cladding pattern (A, B, and D comparisons by pairwise of scenes from top to bottom). *d'Cohen italic* values represent those mean comparisons reached statistical significance differences with strong effect size.

impaired the rating by observers in comparison with proposals from image set B (see **Tables 3** and **4**). Scenario B was simulated by following traditional techniques of structural arrangement of materials. Such techniques are the result of centuries of observation of nature are intimately related to mathematics [19], and optimized the visual comprehension in the present study.

In conclusion, arrangements related to mathematics and presence or absence of patterns in the surroundings influence the ability of the human brain to grasp concepts relying on patterns. Chaotic patterns on a façade become impressive but unfamiliar, and are less likely accepted by ordinary people. The characteristic, intimate relationship between architecture and mathematics in most traditional designs is broken when materials are inappropriately arranged on a façade, and this rupture has a negative impact on visual acceptation.

3.4. Comparison of preference for half-timbered façades vs. partially stoned houses (image sets A, B, E)

Half-timbered façades (image set E) scored as high as the stone claddings presented to participants for buildings 1 and 2 in image set B, but not so for building 3 (see **Table 5**). Actually, images of building 3 in scenario E were scored as poor as the corresponding images in scenario A (see **Table 5**).

Building case	Façade with stone plinth/wooden framing	Mean	d	F (1.74)	Level of significance
1	E (stone and wooden)	3.52	−0.113	0.7990	0.3800
	B (stone plinth)	3.65			
	E (stone and wooden)	3.52	*0.489*	11.882	0.0010*
	A (only painted)	2.96			
2	E (stone and wooden)	3.12	0.128	1.721	0.1937
	B (stone plinth)	2.97			
	E (stone and wooden)	3.12	*0.512*	14.902	0.0002*
	A (only painted)	2.53			
3	E (stone and wooden)	2.80	*−0.442*	10.897	0.0010*
	B (stone plinth)	3.31			
	E (stone and wooden)	2.80	0.058	0.171	0.6809
	A (only painted)	2.73			

MSE = 1.314 (with Huynh-Feldt correction).*Significant differences were found when comparing pairwise of scenes from top to bottom (alpha < 0.01). These differences also achieved an effect size above 0.2 [50].

Table 5. Standardized mean contrasts for visual response in function of adding a wood framing on the upper floor (A, B, and E comparisons by pairwise of scenes from top to bottom). *d'Cohen italic* values represent those mean comparisons reached statistical significance differences with strong effect size.

Materials and surfaces are selected in traditional architecture mainly based on structural, functional, and climatic considerations, and stylistic factors are considered of secondary importance. Wood has always been a significant element because of its flexibility, ductility, and strength. It enables a lighter and cheaper construction, setting up wide interiors and large external openings, in special on upper floors [54]. Materials and structural subdivisions create architectural scales by themselves that can be intensified through moderate intervention [36]. Setting these materials together is not, however, enough, but the achievement of a coherent whole via hierarchical and structural organization of the materials is required. This requirement was fully achieved in the past by half-timbered traditional buildings, and this building technique evolved over time into a style [55]. Combination of horizontal and vertical elements (wooden beams) with diagonal elements (wooden braces) diversified structural complexity in adaptation to climate factors or in satisfaction of local traditions, achieving an almost perfect cooperation between the scales of the elements on the façades. After centuries, these buildings have kept esthetically readable and recognizable, and represent often by themselves the identity of a culture. Examples of this style in the European setting are found from the ancient Roman world until present [3, 31]. Partial stone claddings and wooden timbers are currently arranged into the façades just for decoration purposes. Decorative arrangements imitating as much as possible the traditional patterns evolved from the former structural roles of these materials would be expected to optimize the visual coherence of a façade. Images of buildings 1 and 2 from image sets B and E were prepared in agreement with this idea, while the pattern of distribution of timber elements presented for building 3 in image set E was not. The results obtained in the present investigation (see **Table 5**) supported the proposal.

In conclusion, the agreement between novel proposals and traditional styles does not depend only on the quantity of critical common features, but also of their quality, i.e., of their complexity [55]. A feature consists of the sum of materials and the hierarchical cooperation, the functionality, and the structural patterns of distribution of these materials. Different combinations of features yield different expressions and different levels of perceptibility. The stylistic features represented by proposals from image set B achieved a satisfactory and understandable complexity in all cases, while proposals from scenario E were visually weaker and less satisfactory for building 3, despite of presenting a similar quantity of features than the rest.

3.5. The influence of large-formal elements in façade complexity: void-to-solid ratio

Theories based on cooperation among façade's elements in hierarchical scales also take into consideration the influence of large elements, like windows and doors, on the visual integration of a building (1st septave). However, most prior studies analyzed façade complexity only in terms of the small elements (2nd–3rd septaves). Void-to-solid (VTS) ratio is defined as the ratio between the area of the façade covered by openings and the area of the solid wall. The optimal ratio for buildings of two floors has been estimated in the range of 0.3–0.4, and ratios less than 0.2 have been found unsuitable in terms of visual acceptance [13].

Main façade VTS ratios of buildings 1 and 3 ranged between 0.26 and 0.27. Although out of the optimal range, these values were very close to the lower limit and were not expected to impair or influence significantly visual acceptance. However, building 3 was significantly less preferred, on average, than building 1 (see **Figure 7**). Similar colors and the same type of stone (granite) were used in both simulations, and the results might perhaps respond to the absence

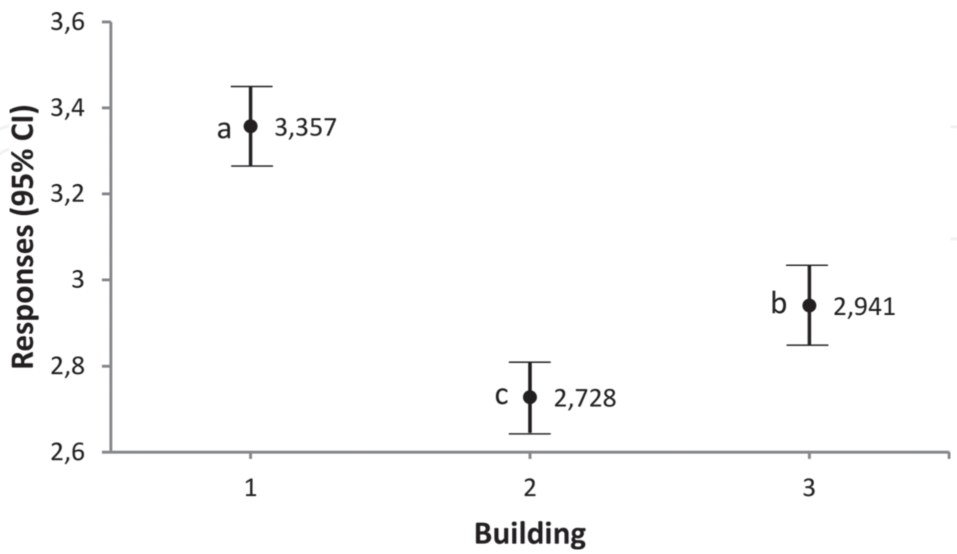

Figure 7. Mean values of Likert test as a function of the building shown. Significant differences at alpha <0.05 are given (Bonferroni test of post hoc comparison).

of openings in the secondary façade of building 3 (VTS ratio = 0 vs. VTS ratio = 0.15; buildings 3 and 1, respectively). Building 2 obtained the lowest average scoring (see **Figure 7**). The type of stone might have had some influence, but the different pattern of arrangement of windows could have also been important. Windows in building 2 were arranged on the middle-left of the façade, which left a wide solid space on the right side that likely modified the perception of the building's volume.

4. Conclusions

A partial stone coating of the façade limited to the lower floor is the best option for both granite and limestone coatings, and is better accepted than nude façades. Arrangement of the stone must keep harmony between the scales of the elements and the esthetic result. Irregular arrangement is worse accepted than the traditional plinth of stone ($-0.54 < d < -0.43$). Full coating is risky, in special when the stone used does not account among the usual in the region. The structural and functional meaning of a building must also translate into the esthetic result, and the tradition teaches the way to follow. Half-timbering provides visually understandable and esthetically accepted results on a façade, but the orientation and arrangement of the beams must never be random. Optimal visual acceptance is reached by imitating the patterns evolved from the original function of the timber coats in traditional architecture.

With these considerations in mind, imitation of traditional half-timbering does not present significant visual advantages or disadvantages, over imitations of traditional plinth of stone (B). However, if half-timbering misses the traditional style, visual acceptance becomes worse than for a regular stone plinth ($d = -0.44$). Cost–benefit considerations suggest that avoiding timber-frames may result less risky and potentially more successful for visual acceptance. Both the amount and the arrangement of openings may likely influence the perception of façade complexity, and the issue will be taken into full consideration in future studies. Additional studies involving different types of stone claddings, alone or in combination with other materials like bricks or ceramics of different colors, could also enlighten better correspondence between façade's complexity and visual acceptance for sustainable environments. In the meantime, transferring the results of the present study to sustainable rural planning activities may help to improve the current guidelines and regulations for building design in the region studied, and perhaps in other Mediterranean areas.

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