THE BALANCED INTERVENTION THEORY: A CONSERVATIVE BUT ADAPTIVE SOLUTION FOR THE TRADITIONAL BASQUE ARCHITECTURAL MODEL

MATXALEN ETXEBARRIA MALLEA, LAUREN ETXEPARE IGIÑIZ & MARGARITA DE LUXÁN GARCÍA DE DIEGO
Department of Architecture, University of the Basque Country (UPV/EHU), Spain & Emeritus Professor, School of Architecture, Technical University of Madrid (UPM), Spain.

ABSTRACT
The *Balanced Intervention Theory* is a conservative but adaptive solution that takes into consideration both heritage construction values' conservation and hygrothermal behaviour improvement measures of the traditional Basque architectural model. The development of the theory is based on the valuation and intervention of the construction evolution of the traditional farmhouse architecture in the River Lea Valley, located in the Historical Territory of Bizkaia (Basque Country, Spain). On assumption that the combination of different conservation measures involves intervention limits and conflicts of interest, the theory may attempt to meet the answer to the problem concerning the conservation and continuous adaptive evolution of this heritage construction model. In that sense, an intermediate *conservative* but *adaptive* solution, which contributes to *preservation* and *renovation*, is developed in order to avoid choosing between *overprotection* (just preservation) or *no-valuation* (complete intervention) according to four gradual intervention degrees based on the combination of the heritage protection level, and on vertical and horizontal envelopes' hygrothermal improvement measures. As a result, the relationship between the protection and the hygrothermal intervention may determine different improvement and conservation solutions for each case study.
Keywords: balanced intervention, conservation, protection, hygrothermal improvement, intervention degrees, traditional Basque architecture.

1 INTRODUCTION

The architectural heritage conservation depends on sensitive intervention measures that enable the construction evolution, alongside the maintenance and promotion of the architectural values [1]–[3]. However, the valuable original construction characteristics should comprise not only the construction system, the load-bearing structure technique, the architectural aesthetic and composition, and the construction materials, but also the construction logic as related to indoor hygrothermal behaviour.

With regard to this framework, where the indoor hygrothermal balance is closely related to the local environment [4]–[6], there is an urgent need to develop a specific intervention theory to avoid the deterioration [7], the complete loss, or the abandonment, and to ensure the correct and sensitive conservation of the traditional Basque architectural model, considering both construction values and hygrothermal behaviour variables.

The result of the sensitive conservation [8], therefore, could be defined as the Balanced Intervention Theory, which involves the combination of different conservative but adaptive construction solutions for the traditional Basque architectural model.

Several studies [9]–[10] have defined it for the whole territory of the Basque Country, where more than 40,000 exemplars are still recognisable for their architectural characteristics, yet the development of this intervention theory is focused on the geographical area of the valley of River Lea (75.89 km^2), located at the north-eastern side of the Historical Territory of Bizkaia, due to its high percentage of still conserved exemplars.

It is worth mentioning that the traditional Basque architectural model is a type of large rural farmhouse whose origin dates back to the 15th Century. Despite the differences among

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authors with regard to its origin as a specific type of building [10]–[11], it could be said that the architectural model evolved with the classical periods in the history of architecture [10]. Hence, there would be a Gothic-Renaissance period model (mid-15th to mid-17th Century, including a Renaissance period, mid-16th to mid-17th), an intense Baroque period model (mid-17th to end 18th Century) and a final decline model during the Neoclassical period (19th Century). Within these four periods, therefore, the architectural evolution generated a great variety of subtypes, differentiated mainly by their volumetric proportions, construction materials and composition (Table 1, Fig. 1). However, all of them were created to combine

Table 1: State of the art of River Lea valley evolutionary subtypes. Author's own elaboration [12] based on Santana *et al*. [10].

Classical Period	Century	Evolutionary Subtype
1. Gothic-Renaissance	XV–XVII	Type 1.1. Biscay
2. Renaissance	XVI–XVII	Type 2.1. Stone made, without porch
		Type 2.2. Timber framework above central lintelled porch
3. Baroque	XVII–XVIII	Type 3.1. Half-timber framework above central lintelled porch
		Type 3.2. Stone made with central lintelled porch
		Type 3.3. Semicircular or segmented arched porch
		Type 3.4. Three-centred arched porch
		Type 3.7. Mixed with lintelled porch
		Type 3.8. Mixed with arched porch
4. Neoclassical	XIX	Type 4.1. Mixed

Source: *Etxebarria Mallea, 2017.*

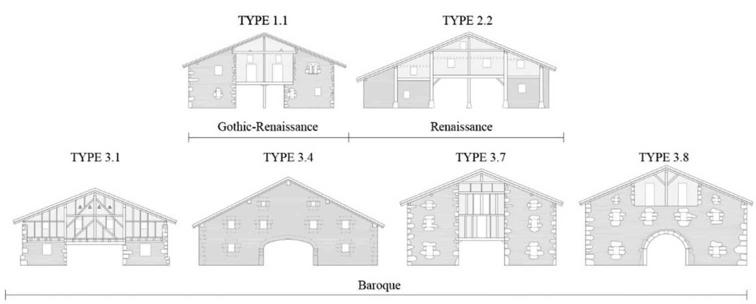


Figure 1: Local traditional architectural model: evolutionary subtypes' main façade graphic design. Type 1.1 Gerrikagoitia farmhouse; Type 2.2 Larrinaga zarra farmhouse; Type 3.1 Barrutieta farmhouse; Type 3.4 Esuneta farmhouse; Type 3.7 Itza farmhouse; Type 3.8 Ugarriza farmhouse.

Source: Etxebarria Mallea, 2017.

both agricultural and domestic functions within a single compact unit, including a stable, a cellar, and storage areas for straw and grain under the same pitched roof.

2 STATE OF THE ART

Recent studies about the indoor hygrothermal behaviour of the traditional Basque architectural model [13]–[14] demonstrate that they do not meet current society's habitability and comfort needs. Therefore, lots of them are being abandoned or demolished in order to construct new buildings, even if they still conserve their original architectural values. As a result, their sensitive adaptive evolution and conservation is at serious risk.

However, not only do owners' decisions influence, but also current building regulations' requirements. Heritage building protection and architectural intervention are considered to be independent disciplines, consequently, each of them has its own regulations* [15]–[18]. Therefore, conflicts of interest and limits come up when trying to combine both criteria. Within such framework, there is a need to develop a construction-criteria based theory to avoid choosing between *overprotection* (just preservation) or *no-valuation* (complete intervention) and ensure their conservation [19].

3 BALANCED INTERVENTION THEORY

The Balanced Intervention Theory is the one which advocates an intermediate *conservative* but *adaptive* solution that interrelates and combines the two most conflicting tendencies towards the conservation (Fig. 2), that is to say, the *preservation* and the *renovation*, as a function of the heritage protection level and the need for hygrothermal improvement.

3.1 Objectives

The main objective of the theory is to promote the conservation and avoid the abandonment or loss of the traditional architectural heritage of both the valley of River Lea and the Basque Country through a series of construction intervention measures, which balance the architectural values and the hygrothermal adaptation concerning their original construction logic.

3.2 Material and method

For this purpose a methodological procedure that contributes to the decision-making process has been developed.

The first step is focused on the knowledge of the state of the art and on the establishment of the characteristics to be studied, which should undertake the construction evolution and the associated features (construction materials, construction techniques, architectural composition and aesthetic), as well as the heritage protection level and the hygrothermal behaviour variables.

<table>
<tr><td colspan="8">ARCHITECTURAL INTERVENTION</td></tr>
<tr><td colspan="8">CONSERVATION</td></tr>
<tr><td colspan="2">PRESERVATION</td><td>ADAPTATION</td><td>RESTORATION</td><td colspan="4">RENOVATION</td></tr>
<tr><td>Maintenance</td><td>Consolidation</td><td>Reuse</td><td></td><td>Reconstruction</td><td>Regeneration</td><td colspan="2">Refurbishment</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Hygrothermal</td><td>Energetic</td></tr>
</table>

Figure 2: Architectural intervention as conservation.

* While developing this research paper Law 7/1990 on Basque Cultural Heritage was in force. Therefore, the considered requirements and the suggested intervention theory are based on it. However, it should be pointed out that it has been recently repealed by the current Law 6/2019 on Basque Cultural Heritage.

The second one, instead, includes the definition of all the applicable intervention measures towards the hygrothermal refurbishment, which are classified as *vertical* and *horizontal* construction intervention measures. Each of these measures involves a different hygrothermal improvement along with a different architectural value protection. Hence, depending on the construction subtype, the heritage protection level and the achievable hygrothermal improvement, there are different possible combinations. The result of the combinations, therefore, enables the definition of four gradual intervention levels [20].

3.2.1 Preliminary analysis

Despite the fact that the traditional Basque architectural model has different construction characteristics depending on the subtype and construction period, five valuation and protection criteria are defined for all of them, that is, the structural, the construction system, the architectural composition, the functional and the settlement valuation criteria. Moreover, each criteria is also distinguished according to the façade analysed (Table 2).

Regarding the regulation based valuation, however, no particular criteria are defined for such architectural model protection. Nevertheless, two current regulations (Basque Government law

Table 2: Baroque Type 3.1 valuation example.

Valuation Criteria	**Façade**		
	Main	**Laterals**	**Rear**
Structure	Massive stone made wall	Massive stone made wall	Massive stone made wall
	Timber framework	Lime mortar coating	Lime mortar coating
	Lime mortar coating	-	-
Construction System	Corner union of perpendicular stone made walls	Corner union of perpendicular stone made walls	Corner union of perpendicular stone made walls
	Framework light filling	Continuous air renewal system	Roof
	Continuous air renewal system	Roof	-
	Roof	-	-
Composition	Material use horizontal division	Openings' construction system	Openings' construction system
	Material composition	Ashlar work	Ashlar work
	Openings' construction system	-	-
	Ashlar work	-	-
	Dintelled porch	-	-
Functionality	Solar gains	External environment protection	External environment protection
Settlement	Solar orientation	-	-

[16] and local urban regulations) need to be considered in order to set their protection level (listed, listable, inventoried or inventoriable; A, B, C or D), and the resulting permitted interventions.

The hygrothermal variables (Operative Temperature and Relative Humidity), on the other hand, describe the indoor passive performance, so in order to understand thermal envelope's behaviour, construction logic and local environment's adaptation energy simulation software or monitoring equipment might be used.

3.2.2 Classification of interventions

Considering that the passive indoor hygrothermal behaviour depends on, and almost all valuable features correspond to the thermal envelope (Table 3), the construction intervention measures towards the hygrothermal refurbishment are classified as *vertical* and *horizontal*, depending on the intervened envelope. It should be pointed out that all measures are the result of an updated comprehension of their original construction logic. Hence, damp and condensation pathologies need to be taken under control ensuring their breathing performance with the use of vapour permeable materials.

Vertical interventions are defined as:

- V1: recovery of lime mortar internal and external plaster due to its vapour permeable and environmental moisture buffering capacity.
- V2: replacement of existing openings' (windows and doors) with double-glazed and insulated units for thermal performance improvement and air infiltration reduction.
- V3: indoor dividing massive stone-made wall improvement with lime mortar plaster and thermally improved openings.
- V4: rear façade's internal insulation with permeable materials and layers, such as air gap, wood fibreboard insulation and lime plaster.
- V5: lateral façades' internal permeable insulation.
- V6: main façade's internal permeable insulation avoiding thermal discontinuity problems caused by the use of different construction materials.

Horizontal interventions, instead, are defined as:

- H1: roof's external insulation with the addition of new permeable layers above the existing rafters.
- H2: ground floor improvement as a result of a little depth excavation and new layers (gravel, breathable geotextile, hydraulic lime screed, permeable floor finish) addition.
- H3: ground floor's permeable insulation based on a designed mixture of natural hydraulic lime binders and insulating aggregates [2].
- H4: external flooring's permeable insulation with wood fibreboard insulation and lime plaster.
- H5: internal floorings' permeable insulation with wood fibreboard insulation and lime plaster.

Not all interventions, however, are considered equally valid for all cases due to the existence of different subtypes, which have particular valuable characteristic, as well as different heritage protection levels. Therefore, the combination of these measures is regarded as a gradual scale, where the considered interventions respect both the particular architectural values and heritage protection levels.

3.2.3 Intervention levels

The balanced intervention, therefore, is defined as a four level gradual scale, in which each grade combines different vertical and horizontal measures according to the case study's architectural subtype, heritage protection level and hygrothermal adaptation aim.

Table 3: Existing vertical and horizontal envelope description. $S_{mason.s}$ = sandstone masonry; $S_{mason.l}$ = limestone masonry; $MOR._{lim}$ = lime mortar; SB = solid brick; W_{oak} = oak wood; T = tile; $S._{lim}$ = limestone; E_{comp} = compacted earth; G_{sg} = single glazing.

Envelope	Material	Composition	Av. Thick-ness (M)	R (M².K/W)	U (W/M².K)
Façade	sandstone masonry	$S_{mason.s}$	0.64	0.36	2.75
		$S_{mason.s}$ + $MOR._{lim}$	0.61	0.36	2.76
		$MOR._{lim}$ + $S_{mason.s}$	0.60	0.36	2.79
		$MOR._{lim}$ + $S_{mason.s}$ + $MOR._{lim}$	0.51	0.34	2.96
		E_{comp} + $S_{mason.s}$	0.58	0.34	2.91
	limestone masonry	$S_{mason.l}$	0.64	0.61	1.65
		$S_{mason.l}$ + $MOR._{lim}$	0.66	0.62	1.61
		$MOR._{lim}$ + $S_{mason.l}$	0.63	0.60	1.66
		$MOR._{lim}$ + $S_{mason.l}$ + $MOR._{lim}$	0.49	0.50	1.99
		E_{comp} + $S_{mason.l}$	0.71	0.66	1.52
	solid brick	$MOR._{lim}$ + SB + $MOR._{lim}$	0.17	0.39	2.72
	oak wood	W_{oak}	0.34	2.04	0.49
		W_{oak} + $MOR._{lim}$	0.26	1.50	0.67
		$MOR._{lim}$ + W_{oak} + $MOR._{lim}$	0.26	1.40	0.71
Interior Division	sandstone masonry	$S_{mason.s}$	0.56	0.45	2.24
		$S_{mason.s}$ + $MOR._{lim}$	0.54	0.45	2.23
	limestone masonry	$S_{mason.l}$	0.65	0.72	1.38
		$S_{mason.l}$ + $MOR._{lim}$	0.68	0.75	1.34
	solid brick	$MOR._{lim}$ + SB + $MOR._{lim}$	0.26	0.43	2.31
Roof	oak wood	T + W_{oak}	0.045	0.30	3.35
Ext. Floor	oak wood	W_{oak}	0.03	0.44	2.29
Int. Floor	oak wood	W_{oak}	0.03	0.29	3.49
Ground Floor	compact earth	E_{comp}	0.50	1.15	0.87
	limestone slab	E_{comp} + $S._{lim}$	0.62	1.24	0.81
Opening	window	G_{sg} + W_{fr}	0.004	-	5.87
	door	W_{oak} + W_{fr}	0.03	0.34	2.87

(Source: Etxebarria Mallea, 2018.)

- Grade I: preservation above refurbishment (Table 4). It comprises the models with major heritage protection, so the architectural values' preservation is the main objective and the hygrothermal improvement, instead, is slightly granted.
- Grade II: intermediate combination for preservation (Table 5). It covers the models with medium-high heritage protection, but even if preservation is mainly regarded, refurbishment strategies are also considered.
- Grade III: intermediate combination for refurbishment (Table 6). It includes the models with medium-low heritage protection, so the intervention goes for hygrothermal improvement, but taking into account the importance of the architectural values too.
- Grade IV: refurbishment above preservation (Table 7). It involves the major hygrothermal improvement, as it covers the models with the lowest heritage protection level.

Table 4: Grade I permitted interventions according to each model subtype.

	Gothic	**Renaissance**		**Baroque**				**Neo**
	1.1	2.1	2.2	3.1	3.2	3.3–3.6	3.7–3.8	4.1
Ver.	V1	V1	V1	V1	V1	V1	V1	V1
	V2	V2	V2	V2	V2	V2	V2	V2
	V3	V3	V3	-	V3	V3	V3	V3
Hor.	H1	H1	H1	H1	H1	H1	H1	H1
	H2	H2	H2	H2	H2	H2	H2	H2
	H4	-	H4	H4	H4	H4	H4	-

Table 5: Grade II permitted interventions according to each model subtype.

	Gothic	**Renaissance**		**Baroque**				**Neo**
	1.1	**2.1**	**2.2**	**3.1**	**3.2**	**3.3–3.6**	**3.7–3.8**	**4.1**
Ver.	V1	V1	V1	V1	V1	V1	V1	V1
	V2	V2	V2	V2	V2	V2	V2	V2
	V3	V3	V3	-	V3	V3	V3	V3
Hor.	H1	H1	H1	H1	H1	H1	H1	H1
	H2	H2	H2	H2	H2	H2	H2	H2
	H4	-	H4	H4	H4	H4	H4	-
	H5	H5	H5	H5	H5	H5	H5	H5

4 RESULTS AND DISCUSSION

The above described intervention methodology shows the possibility to define a relationship towards the conservation of the traditional Basque architectural heritage model and its adaptation to current hygrothermal habitability standards through four intervention levels concerning a detailed analysis of its construction logic and characteristics, heritage protection levels and intervention requirements (Fig. 3). Therefore, it could be said that the theory is based on a sensitive reflection.

Table 6: Grade III permitted interventions according to each model subtype.

	Gothic	Renaissance		Baroque				Neo
	1.1	**2.1**	**2.2**	**3.1**	**3.2**	**3.3–3.6**	**3.7–3.8**	**4.1**
Ver.	V1	V1	V1	V1	V1	V1	V1	V1
	V2	V2	V2	V2	V2	V2	V2	V2
	V3	V3	V3	-	V3	V3	V3	V3
	V4	V4	V4	V4	V4	V4	V4	V4
	V5	V5	V5	V5	V5	V5	V5	V5
Hor.	H1	H1	H1	H1	H1	H1	H1	H1
	H2	H2	H2	H2	H2	H2	H2	H2
	H4	-	H4	H4	H4	H4	H4	-
	H5	H5	H5	H5	H5	H5	H5	H5

Table 7: Grade IV permitted interventions according to each model subtype.

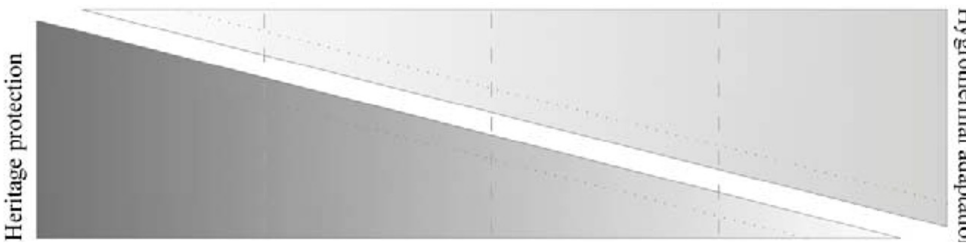
	Gothic	Renaissance		Baroque				Neo
	1.1	**2.1**	**2.2**	**3.1**	**3.2**	**3.3–3.6**	**3.7–3.8**	**4.1**
Ver.	V1	V1	V1	V1	V1	V1	V1	V1
	V2	V2	V2	V2	V2	V2	V2	V2
	V3	V3	V3	-	V3	V3	V3	V3
	V4	V4	V4	V4	V4	V4	V4	V4
	V5	V5	V5	V5	V5	V5	V5	V5
	V6	V6	V6	V6	V6	V6	V6	V6
Hor.	H1	H1	H1	H1	H1	H1	H1	H1
	H3	H3	H3	H3	H3	H3	H3	H3
	H4	-	H4	H4	H4	H4	H4	-
	H5	H5	H5	H5	H5	H5	H5	H5

Current regulations on heritage protection and refurbishment intervention, however, do not establish construction-based criteria to combine both disciplines' requirements, which unfortunately contribute to *overprotection* (just preservation) or *no-valuation* (complete intervention).

5 CONCLUSIONS

With regard to current regulations framework, the development of this theory has demonstrated there is a new field of study, in which both heritage protection and hygrothermal improvement disciplines are adopted, adapted, combined and applied, not only for the traditional Basque architectural model, but also for similar traditional construction-based architecture.

Hygrothermal Improvement Interventions			
V1,V2,V3 H1,H2,H4	V1,V2,V3 H1,H2,H4,H5	V1,V2,V3,V4,V5 H1,H2,H4,H5	V1,V2,V3,V4,V5,V6 H1,H3,H4,H5
GRADE I	**GRADE II**	**GRADE III**	**GRADE IV**



Listed A	Inventoried Listable B	Inventoriable C	D
Heritage Protection Level			

Figure 3: Graphic scale of the Balanced Intervention Theory.

Table 8: Amount of still conserved traditional Basque architectural model in the valley of River Lea.

Total Amount	**Basque Government Heritage Protection**			**Local Heritage Protection**			**No Heritage Protection**	
	Level	**Amount**	**%**	**Level**	**Amount**	**%**	**Amount**	**%**
271	Listed	6	2.2	A	3	1.1	35	13
	Listable	1	0.4	B	34	12.5		
	Inventoried	0	0	C	100	36.9		
	Inventoriable	39	14.4	D	99	36.5		
	Total	46	17	TOTAL	236	87		

Likewise, it seems reasonable to suggest there is a huge intervention potential towards the adaptive conservation of the traditional architectural heritage of the valley of River Lea in order to prevent it from its complete loss (Table 8). However, even if the development of the theory is focused on a specific region, its locally adapted application might be equally valid for both the close regions and the whole Basque territory.

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