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ACOUSTIC OUTCOME OF REFURBISHING AN ACCOMMODATION BUILDING TOWARD LEED AND WELL CERTIFICATIONS: GUIDELINES FOR EFFECTIVE INTERVENTIONS PRIORITIZATION

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ABSTRACT

In the recent years occupant comfort is becoming a prerogative in the building sector. This has led to the spread of rating systems to certificate the environmental performance of buildings and encourage building owners and operators to implement sustainable design, construction, and operations practices as LEED and WELL. In the framework of various criteria of these certification programs, including energy efficiency, water conservation, indoor environmental quality, materials selection, and sustainable site development, acoustic performance is increasing its relevance. In the present work the case study of an accommodation building subject to refurbishment is used to qualify the spaces according to the LEED and WELL certifications and assess the impact of planned interventions on parameters and credits of these protocols. Several simulations will be carried out on the building to evaluate background and impact noise, sound transmission and reverberation time pre and post renovation. The procedure here detailed is not limited to the identification of building areas that need to be acoustically improved, but also aims to identify actions which would produce the greatest effect. Moreover the work proposes a scoring system to highlight areas or elements for which interventions are priority, based on room use and occupancy.

Keywords: *acoustic simulation, LEED and WELL certifications, building acoustic parameters, intervention priority*

1. INTRODUCTION

The pursuit of meeting standards-based Indoor Environmental Quality (IEQ) requirements in existing buildings is growing [1]. However, achieving energy efficiency does not automatically ensure better IEQ, [2] [3]. Acoustic performances are often related to subjective parameters such as noise annoyance [4], and in the last period numerous regulations are emerging for offices and schools such as, ISO 22955:2021 [5], UNI 11367:2023 [6], UNI 11532-1:2018 [7]. Non-residential typologies are treated in [8], [9], [10]. In [11] a set of descriptors was proposed for acoustic insulation requirements. International unification and the consequent comparable rating is nowadays guaranteed by protocols such as LEED and WELL. The LEED focuses on the environmental sustainability of buildings and it based on eight categories. WELL is the first system focused on occupant comfort. Each of them contains a number of prerequisites and credits. The maximum score LEED is 110 points and the scoring system is divided into four levels of certification: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) and Platinum (>80 points). The protocol WELL is divided into ten features, including sound. The qualification levels are the same of LEED certification.

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In the existing literature index-based method are employed for the assessment of the acoustic quality [10, 12, 13].

A hotel subjected to refurbishment aimed at improving localized acoustic defects was used as a case study. Criteria of the LEED and WELL protocols were applied to it, with the intent to see how interventions focused on one aspect, such as reverberation time reduction, are reflected on parameters such as sound insulation power. Along the lines of what it is customary to do in environmental acoustic, a Priority Index was developed, to which to refer in order to identify, in case of building refurbishment, in which rooms the interventions are priority and major.

2. METHODOLOGY

In the present work benchmarks which do not take into account mechanical systems contributes, exterior noise intrusion or other noise sources which could impact occupant well-being, but only stratigraphies of the partitions and the material characteristics of the rooms are considered. The level of sound isolation and speech privacy between spaces thus represent the main aim.

The protocols provide for compliance with quality parameters related to the destination of the room in question and of those adjacent to it. The LEED rating system adopted in the present case is Interior Design and Construction (ID+C), for interior spaces that are a complete interior fit-out. In this case we consider the hospitality intended use. The score which can be reached for acoustic performance credit is equal to 1 point (Fig. 1), and is considered to be achieved only if at least two of the three acoustic performance points are respected. For a performance point to be achieved, all the occupied spaces under examination have to respect it. The WELL protocol instead assigns a partial score to each performance point (Fig.1). Regarding Reverberation Time, the LEED Protocol indicates that T60 values shall be respected at frequencies of 500 Hz, 1000Hz and 2000Hz. The WELL Protocol provides that the achievement of reverberation time thresholds (2 Points) covers only the projects in which the room types listed in it, cumulatively make up at least 10% of occupiable project area. The limit value has to be compared with the average room reverberation time, without reference to specific frequencies; per areas for learning, lectures and conferencing, areas for fitness and areas for music rehearsal optimal ranges are identifies. It also specifies that where room types include multiple use the limits is represented by the lower reverberation time or range. Regarding sound insulation the LEED protocol uses composite sound transmission class (STCc) index [14] The single-number ratings obtained can be used to compare the potential sound insulation of partitions or floors tested in laboratory conditions (STC) which does not consider flanking sound transmission paths. Otherwise the actual sound isolation between adjacent rooms in buildings (NNIC, NIC) can be used. WELL in S03-Sound Barriers is divided into two parts: Design for Sound Isolation at Walls and Doors, rated by STCc parameter, and Achieve Sound Isolation at Walls. This second part requires that walls separating regularly occupied spaces met alternatively minimum Noise Isolation Class (NIC) or Speech Privacy Potential (SPP). Being the latter the sum of Noise Isolation Class (NIC) and Noise Criteria Rating (NC) (eq.1), therefore involving the evaluation of mechanical systems not taken into account in this study, it was chosen to evaluate the rooms only through the NIC parameter.

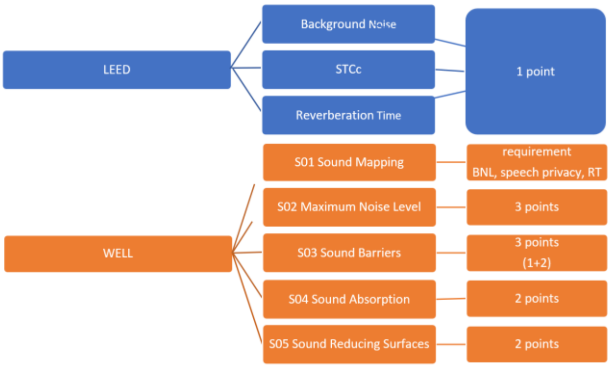

Figure 1. Structure of the acoustic credits for LEED and WELL protocols.

$$SPP = NIC + NC \tag{1}$$

In LEED protocol spaces are distinguished in: Confidential(CN), Private(PV), Collaborative(CL), Conferencing(CF), Occupied area(OA), Mechanical equipment(ME), Hallway/stairway(HS). In WELL spaces types are: Loud(L), Conferencing/Learning/Sleeping(C/L/S), Regularly occupied(R), Quiet(Q), Concentration(C), Circulation(D). (See section 4, Table 4).

2.1 In field campaign and model validation

The object of the present study is a hospitality facility located in Rome. This structure was subjected in 2023 to a renovation aimed at improving the internal acoustic comfort, with particular attention to the reverberation time and sound insulation of the walls. The analysis focused on five rooms (Fig. 2), representative of typological intended uses: Office (95 m^3), Bedroom (54 m^3), Breakfast room (108 m^3), Gymnasium (105 m^3) and Conference room (198 m^3). The rooms are of regular shape; it is worth to note the square shape of the bedroom, while peculiar are the elongated shape of the gym and the vaulted ceiling of the conference room. The ante- and post-operam acoustic performance of the rooms and the improvement of comfort following the renovation were evaluated through simulations by Odeon Software [15]. For the reconstruction of the spaces and the calibration of the model an experimental campaign was conducted in march 2023, during which the reverberation times of the current state were measured, in accordance with UNI EN ISO 16283-1:2018 [16] and UNI EN ISO 717-1:2013 [17] standards. To measure the reverberation time the impulse method with clapped blow was used. The measurements were repeated on three different measuring points, as shown in Fig. 2.

For the acoustic simulations the rooms the Odeon provisional software was used, which uses a hybrid geometric method based on pyramid ray tracing approach [15]. In the software it is possible attribute different materials with own absorption and surface acoustic properties. After positioning one or more virtual source, it is possible gather data outputs, such as Reverberation Time T60, Sound Pressure Level SPL, and Intelligibility STI as point response. For a better understanding according to the investigated geometry, the parameters could be visualized in color maps.

The model was validated with experimental data of the reverberation time, by comparing the measured values with the ones obtained from the simulations. The values related to at least 3 points in each room were averaged at the different frequencies and differences among 0.4 s and 0.9 s were found, for Office and Gymnasium respectively. The model was then used to simulate the configurations of the rooms before the intervention, mantaining the same receiver points. The calibration results in differences between simulated and measured values below 5% (see section 3.1), corresponding to the JND estimated for reverberation metrics [18]. The only exception is for breakfast room, for which the slightly higher value was considered acceptable taking into account the uncertainties associated with the absorbing coefficient and the scattering characteristics of the materials and surfaces. Due to the unavailability of technical data sheet for some of them, surface parameters were taken from the Odeon library [15].

Figure 2. Planimetric representation of source point plan measurement points for T60 in the investigated rooms.

Table 1. Absorption coefficient α of the surface materials in the investigated rooms.

Element	Material	Frequency [Hz]					
		125	250	500	1000	2000	4000
Suspended ceiling	Plasterboard	0.11	0.13	0.05	0.03	0.02	0.03
Floor	Marble	0.01	0.01	0.01	0.01	0.02	0.02
Floor	Parquet	0.1	0.07	0.05	0.06	0.06	0.06
Wall/ceiling	Plaster	0.01	0.01	0.01	0.02	0.02	0.02
Door	Wood	0.14	0.1	0.06	0.08	0.1	0.1
Window	Glass	0.35	0.25	0.18	0.12	0.07	0.04
Chairs/Bed	Fabric	0.07	0.31	0.49	0.81	0.66	0.54
Chairs	Wood	0.1	0.07	0.05	0.06	0.06	0.06
Table/desk	Wood	0.4	0.3	0.2	0.17	0.15	0.1
Projector canvas	Fabric	0.35	0.25	0.18	0.12	0.07	0.04
Mirror	Mirror	0.35	0.25	0.18	0.12	0.07	0.04
Suspended ceiling	**Fiberboard**	**0.35**	**0.2**	**0.15**	**0.15**	**0.2**	**0.2**
Wall	**Sound absorbing panel**	**0.55**	**0.7**	**0.8**	**0.95**	**1**	**0.95**
Wall	**Wallpaper**	**0.02**	**0.03**	**0.04**	**0.05**	**0.07**	**0.08**
Wall	**Sound absorbing plating**	**0.3**	**0.32**	**0.5**	**0.95**	**1**	**0.95**
Curtain	**Fabric**	**0.3**	**0.45**	**0.65**	**0.56**	**0.59**	**0.71**
Boiserie	**Sound absorbing wood**	**0.35**	**0.5**	**0.6**	**0.5**	**0.4**	**0.4**

**The bold type refers to improvement interventions*

2.2 Simulation of the original and after renovation scenarioes

Materials used in the simulation for the scenario Ante Operam and Post Operam are detailed in Table 1.

The renovation of the bedroom included the installation of a panel made of sound-absorbing material on the walls shared with other rooms and the introduction of heavy curtains in front of the windows. Inside the office the performance of the separation wall between it and the lobby was improved by a plating made of sound-absorbing material. In the breakfast room the walls were lined with wallpaper and a fiber suspended ceiling was inserted. To reduce the reverberation effect to the ideal values for the intended use, a boiserie with sound-absorbing material (h= 2 meters) was placed against the walls of the conference room and the wooden seats were replaced with fabric armchairs (60 seats) The renovation of the gym involved the installation of a plating made of sound-absorbing material on the long side.

3. RESULTS

3.1 Reverberation time

Maps of reverberation time (Fig. 3) were drawn for ante operam and post operam configurations in order to check if there are distant from the optimal conditions.

In Tab. 2 T_{60} measured and calculated before and after the interventions are reported and compared with the corresponding optimal values, depending on the use of the room.

Table 2. Values of the reverberation time measured and simulated in both the Ante Operam and Post Operam scenarios.

Room type	**$T60_{,ref}$ [s]**	**Measured T60 PO[s]**	**Calculated T60**		Δ_{valid}[1]
			AO [s]	**PO [s]**	
Office	≤0.60*	0.41	1.30	0.40	[s]
Bedroom	≤0.60*	0.42	0.90	0.40	-0.01
Breakfast room	≤1.00**	0.80	2.28	0.85	-0.02
Gym	0.70≤T≤0.80**	0.93	2.23	0.90	0.05
Conference room	≤0.60**	0.93	2.80	0.90	-0.03

**LEED reference values*
***WELL reference values*
[1] *Difference between measured and simulated reverberation time values in the Post Operam scenario, considered for model validation*

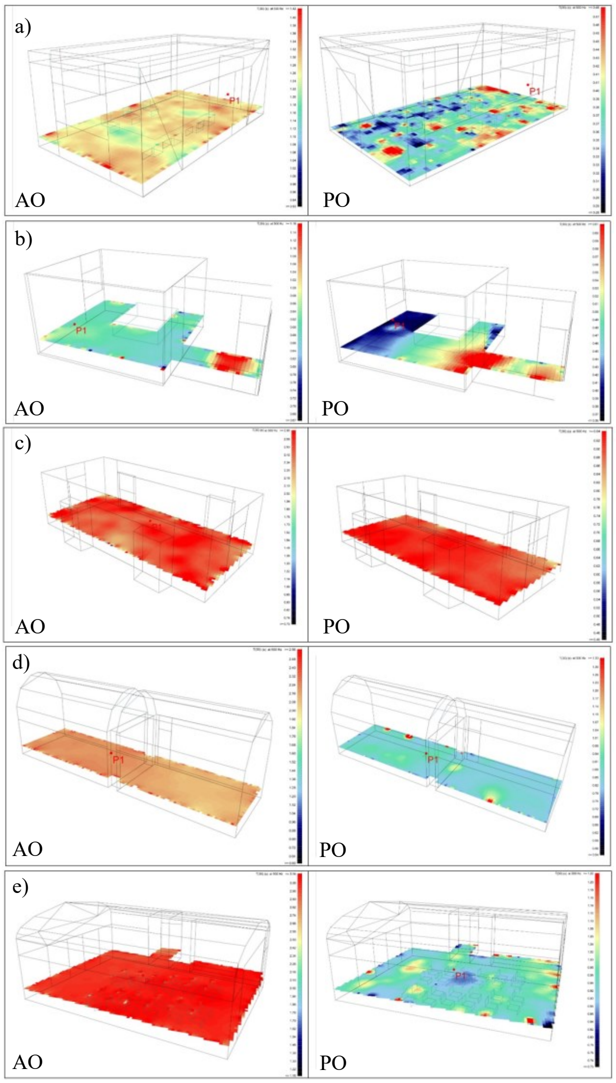

Figure 3. 3D distribution of the reverberation time in Ante Operam (AO) and Post Operam (PO) scenarios: (a) Office; (b) Bedroom; (c) Breakfast area; (d) Gym; (e) Conference room.

The above table and figures, show values of reverberation time far from optimal values, thus it became necessary to intervene to improve acoustic comfort. As a result of the refurbishment interventions, good values of the reverberation time were achieved. In particular, the most significant improvements concern the office. Even the bedroom, which started from a value less distant from the optimal one compared to the office, is now less than 0.2 s below the limit. Gymnasium and Conference room can't reach the limits.

Comparing the post operam of the office, the conference room and the breakfast area it emerges how asymmetrical interventions involve an uneven distribution of reverberation time in environments of regular shape. In the office, although an improvement is evident, the intervention on a single wall does not correct the unevenness of the T60 in the room, where values vary up to 0.16 s. A more constant trend was found in the conference room, although there are peaks of 1.2 s. Fig. 4d and 4e show how the concave configuration of the ceiling generates the perimeter localizations of the reverberation time, while in the center of the auditorium 0.8 dB are achieved, however above the optimal value. The combined intervention on the ceiling and walls implemented in the breakfast area led to the best results with values all around 0.85 s.

3.2 STCc and NIC

The minimum values to be considered as a benchmark for the STCc parameter, take into account the most stringent value among imposed by the LEED and WELL protocol Tab. 3. “A”,”B”,”C” are partitions’ ID as explained in Fig.2. Corridors have been classified as "Hallway" as required by the LEED protocol, being wide, therefore considerable as areas not only of passage but also of pause. The bedroom is evidently the most compromised room in the ante operam situation, where for each of the investigated walls has an average value below the threshold of about 15 dB. The anchoring of a sound-absorbing counterwall on each side of the partition in common with another chamber (the one in front of the bed) allows to reach an STCc of 65 dB. The intervention in the office involves an improvement of in-frequency STCc above 200hz of 0.1 dB, but it is not legible in the final single number STCc. The interventions in the breakfast room do not change the performance of the walls in terms of STCc compared to the original configuration: wall “C” 5 dB below the minimum value. The same applies to the gym, in which case the improvement element is introduced on a wall separating not significant spaces for the purposes of the protocols. Of the four walls of the conference room one is a retaining wall, two separate it from the external environment and the only one in common with other internal areas, an office and a lobby space, has a minimum thickness of 0.91 m: STCc is around 59 dB.
The gym, considered a "collaborative/multi use" space in Table 2, has a wall bordering two rooms with different

Table 3. Precautionary STCc limits from LEED and WELL protocols.

Room ID		Partition AO	Partition Post Operam	$STCc_{,ref}$	STCc AO	Δ	STCc PO	Δ	$NIC_{,ref}$	NIC AO	Δ	NIC PO	Δ
Bedroom	A	Wall (10cm)	Wall (10cm)	**50**	36	-14	36	-14	**45**	35.5	-9.5	35.5	-9.5
	B	Wall (45cm) Wooden door	Wall (45cm) Wooden door	**55****	39	-16	39	-16	**50**	46.5	-3.5	47.4	-2.6
	C	Wall (10cm)	**sap**+Wall (10cm)+**sap**	**50**	36	-14	65	15	**45**	35.5	-9.5	51.5	6.5
Office	A	Wall (45cm) Wooden door	Wall (45cm) Wooden door	**50****	40	-10	40	-10	**45**	48.2	3.2	48.3	3.3
	B	Wall (65cm) Wooden door	Wall (65cm)+**sap** Wooden door	**45****	40	-5	40	-5	**40**	48.4	8.4	51.9	11.9
	C	Wall (45cm) Glass door	Wall (45cm) Glass door	**45****	48	3	48	3	**40**	48.2	8.2	48.3	8.3
Breakfast room	A	Wall (45cm) Wooden door	Wall (45cm) Wooden door	**40****	40	0	-	-	**35**	48.2	13.2	49.0	14.0
	B	Wall (65cm) Glass door	Wall (65cm) Glass door	**40****	50	10	-	-	**35**	48.2	13.2	49.0	14.0
	C	Wall (10cm) Wooden door	Wall (10cm) Wooden door	**40****	35	-5	-	-	**35**	35.5	0.5	35.7	0.7
Conference room	A	Wall (65cm) Wooden door	Wall (65cm) Wooden door	**55**	59	4	-	-	**50**	50.2	0.2	50.2	0.2
Gym	A	Wall (45cm)	Wall (45cm)	**60****	51	-9	-	-	**55**	48.2	-6.8	48.2	-6.8
	B	Wall (65cm) Wooden door	Wall (65cm) Wooden door	**40****	44	4	-	-	**35**	48.7	13.7	48.7	13.7

*** sap=sound absorbing panel*
*** WELL reference values*

uses: another gym of smaller dimensions (A1) and lobby (A2) (Figure 2). Under this circumstance the most stringent of the corresponding LEED limits, respectively 35 dB(A) and 25 dB(A), has to be taken into account. The following table shows the stratigraphies of the partitions examined ante and post operam and the related findings. The sound isolation of the partitions as built (R'w), corresponding to Noise Isolation Class (NIC) in protocols, was evaluated taking into account both wall stratigraphies (Table 3) and surface interventions in Suonus models, both participating in flanking transmission.

4. IMPACT OF IMPROVEMENT MEASURES ON CREDITS AND EVALUATION OF THE MOST EFFECTIVE ACTIONS

The rooms were awarded scores in the various criteria provided by the LEED and WEEL protocols (Tab. 4). The only point of the LEED Acoustic Performance credit, is awarded only if all occupied spaces, meet two of the following: HVAC background noise, Sound Transmission, and/or Reverberation time. Having in this case neglected the effects of noise due to mechanical equipment we consider that for the achievement of credit should be meet both sound transmission and reverberation time performances.

Brekfast room meets all LEED requirements, but the fact that other environments have gaps on one of the two STCc or RC parameters, does not allow scoring. Gymnasium respects neither RT nor STCc.

None of the space under examination respond to the WELL protocol. Reverberation time is not satisfied by Conference room nor Gymnasium. Threshold values of STCc are only reached by Conference room. The results of NIC, not achieved only by the bedroom, show that the problem lies in the asymmetry of the intervention with sound-absorbing mattress and sheets of plasterboard, applied to a single wall. The same treatment on the opposite side would allow to reach the NIC score in this local and then to earn the three points corresponding to the S03 credit in the WELL protocol.

A first assessment of the distance separating the post-operam configuration from the achievement of LEED credit and WELL credits can be made by assigning to each parameter to be respected RT and STCc for LEED and RT, STCc and NIC for WELL one point; in the case of STCc and NIC, a point is attached to each wall under consideration. The maximum score thus achievable appears to be 16 points for LEED and 29 for WELL. Comparing the total parameters with those achieved we see that the LEED target is reached for 62%, the WELL target for 65%.

Table 4. Assessment of the post-operam scenario according to the different protocols.

		Main	Adj	PO	LEED Protocol		WELL Protocol	
					Ref	Score	Ref	Score
				Executive or private office				
RT				0.4	<0.6		-	
STCc	A	CN	CN	40	45	2/3 (-5pt)	50	1/3 (-15pt)
	B	CN	H/S	40	35		45	
	C	CF	CF	48	35		45	
NIC	A	Q	Q	48.3	-	-	45	3/3
	B	C/L/S	R	51.9			40	
	C	Q	Q	48.3			40	
				Bedroom				
RT				0.4	<0.6		-	
STCc	A	PV	PV	36	50	1/3 (-15pt)	50	1/3 (-30pt)
	B	PV	H/S	39	40		55	
	C	PV	H/S	65	50		50	
NIC	A	Q	Q	35.5	-	-	45	1/3 (-12.1pt)
	B	C	R	47.4			50	
	C	C	R	51.5			45	
				Breakfast room				
RT				0.85	-	-	≤ 1.0	
STCc	A	CL	H/S	40	25	3/3	40	2/3 (-5pt)
	B	CL	H/S	50	25		40	
	C	CL.	H/S	35	25		40	
NIC	A	R	D	49.0	-	-	35	3/3
	B	R	D	49.0			35	
	C	R	D	35.7			35	
				Conference room				
RT				0.9	< 0.8	(-1 pt)	≤ 0.6	(-3 pt)
STCc	A	CF	C	59	50	1/1	55	1/1
NIC	A	C/L/S	R	50.2	-	-	50	1/1
				Gymnasium				
RT				0.9	< 0.2	(-6 pt)	0.7 – 0.8	(-1 pt)
STCc	A	OA	ME	51	60	1/2 (-9pt)	60	1/2 (-9pt)
	B	CL	H/S	44	25		40	
NIC	A	R	L	48.2	-	-	55	2/2
	B	R	D	48.7			35	

**Adj=Adjacent*

Furthermore from Figure 4. distribution of gaps that prevent the achievement of the limits seems largely attributable to deficiencies in terms of STC (about 81% in LEED and about 79% in WELL).

It has therefore been suggested to strengthen the interventions in order to reach the minimum, for

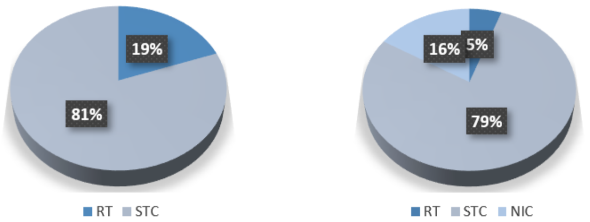

Figure 4. Distribution of gaps that prevent the achievement of the limits divided into the different criteria: (a) LEED, (b) WELL.

example by plating both walls of the bedroom, to introduce a ceiling treatment in the conference room. Since the values indicated by the protocols are threshold values a quality evaluation system of the proposed solution has been developed. This can also be helpful in early project choices to balance desired performance and economic commitment. Bands of performance were identified taking as a base level the most stringent value among those proposed by the LEED and WELL protocol and each band was awarded a score (Tab. 5).With score of 2.5 the environment is ranked standard, Above 3.25 Efficient, Above 4.5 High efficient. In addition, achieving a score of 3 the LEED protocol is certainly achieved, while with 4.5 points are considered satisfied both protocols.

5. PROPOSED SCORING SYSTEM FOR PRIORITY ASSESSMENT

To determine the hierarchy of the areas to be treated, starting from the most urgent or decisive, it is appropriate to use a Priority Index.

Each critical room is characterized by an Index of priority (IP_i) is calculated using the following equation:

$$IP_i = R \cdot a \cdot l \cdot (\Delta STCc + \Delta RT)$$

Where R represents the ratio:

$$R = \frac{N}{P}$$

Nj is the number of the occupants of the room under consideration; Pj is the perimeter of the room under consideration; lj is the length of the wall which separates sensitive occupied environments (i.e. bedroom and corridor); $\Delta STCc$ is the maximum difference from the minimum value imposed by the regulations for STC, comparing the values of all the walls of the same room being evaluated. The same reasoning applies to ΔRT, the maximum difference from the minimum value imposed by the regulations for reverberation time. The aj parameter depends on the room use and are used to pay more attention on noise sensitive buildings; it is considered equal to 1 for breakfast room and gymnasium, 2 for offices, 3 for bedrooms, and 4 for conference rooms. With the willing to proceed with interventions aimed at improving environments falling within the same intended use, it is possible to evaluate the criticality of a type of rooms as follows:

Table 5. Example of scoring system for the bedroom intended use.

	Value		Points
STC room/room	>45	Standard	0.5
	>50	Efficient	0.75
	>55	High eff	1
STC room/hallway	=35	Standard	0.5
	>42.5	Efficient	0.75
	>50	High eff	1
RT	>0.6	Standard	0.5
	>0.65	Efficient	0.75
	>0.7	High eff	1
NIC room/room	>40	Standard	0.5
	>45	Efficient	0.75
	>50	High eff	1
NIC room/hallway	>30	Standard	0.5
	>37.5	Efficient	0.75
	>45	High eff	1

$$IP_{use} = \sum_{i}^{n} IP_i$$

where: n is the number of critical rooms included in the critical typology under consideration. The use refers to the types of rooms commonly present in the accommodation facilities, as those above treated: Bedroom, Executive or private office, Breakfast room, Conference room, Gymnasium.

6. CONCLUSIONS

This study presents a case study of a hotel refurbished addressing localized acoustic issues. Five rooms, typological for intended use, were analyzed: Office, Bedroom, Breakfast room, Gymnasium and Conference room. A post-operam measurement campaign allowed to evaluate the RT and the effects of the improvements, as well as to validate 3D models on Odeon software. The spaces were studied in terms of RT through Odeon, sound transmission by an analytical method and R'w by Suonus software in both ante operam and post operam scenarios. The LEED and WELL protocols were applied to assess the interventions with respect to their scoring systems, taking into account partitions' stratigraphies and materials' characteristics of the rooms, whilst neglecting mechanical systems and exterior noise contributes. Furthermore a preliminary evaluation system is suggested for the widespread typologies in tertiary and hospitality facilities, as offices and bedrooms. This allows to assign a performance level to individual premises, whereas the protocols' acoustic credits typically apply to the entire building. This approach is useful for establishing a ranking among different rooms with the same purpose, such as offices or hotel bedrooms. It will represent a tool for clients, and designers to balance expected performance and economic considerations in relation to the planned acoustic solutions, aiming at the achievement of acoustic credits for certification. Finally a Priority Index is developed to identify priority areas for interventions during building refurbishment. As a result of the refurbishment interventions, good values of the reverberation time were achieved. In particular, the most significant improvements concern the office (from 1.30 s, to 0.40 s), but this does not guarantee the achievement of STC and NIC thresholds. In rooms with vaulted ceilings such as the conference room, interventions affecting only part of the walls'height are not enough to comply with the LEED and WELL limits. The breakfast room meets all LEED requirements, but the fact other environments have gaps on one of the two STCc or RC parameters, does not allow scoring. With interventions not properly targeted at the achievement of LEED and WELL, distribution of gaps that prevent the achievement of the limits divided into the different acoustic criteria are largely attributable to deficiencies in terms of STC (about 81% in LEED and about 79% in WELL).

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