To justify the current ceiling strategy proposed throughout the Atrium serviced apartments and public areas, this documents presents the acoustic requirements which have been considered during the design process.

Building regulations

Approved Document E of the Building Regulations classifies serviced apartments as *"rooms for residential purposes"* and with regards to the issue of protecting against sound from other parts of a building states:

> *"Requirement E1*
>
> *Rooms for residential purposes shall be designed and constructed in such a way that they provide reasonable resistance to sound from other parts of the same building and from adjoining buildings"*

In the Secretary of State's view, the normal way of satisfying Requirement E1 is for all floors and associated ceilings which separate apartments to achieve the sound insulation performance criteria set down in Table 1.

	Airborne sound insulation	Impact sound insulation
Floors	≥ 43dB $D_{nT,w} + C_{tr}$	≤ 64dB $L'_{nT,w}$

Table 1 Sound insulation performance standards for internal floors, ceilings and stairs between apartments

It is acknowledged that in the case of some historic buildings undergoing a material change of use, it may not be practical to improve the sound insulation to the standards in Table 1. However, works should be carried out to improve the sound insulation to the extent that is practically possible.

Where apartments adjoin public areas on the ground floor and basement, the Building Regulations do not specify a performance but state that "*specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level"*.

SACO brand standards

In addition to the Building Regulations, SACO have also established acoustic performance standards for properties operating under their brand. The minimum airborne sound insulation performances and maximum impact sound insulation for constructions separating apartments are presented below.

Adjacency	Sound insulation performance
Apartment – apartment	
Floors	≥ 43dB $D_{nT,w} + C_{tr}$ ≤ 64dB $L'_{nT,w}$
Apartment - public areas/WC/changing areas	
Floors	≥ 60dB $D_{nT,w}$ ≤ 60dB $L'_{nT,w}$
Apartment – Back of house/office/meeting rooms	
Floors	≥ 43dB $D_{nT,w} + C_{tr}$ ≤ 60dB $L'_{nT,w}$
Apartment – plant room	
Floors	≥ 60dB $D_{nT,w}$

Table 2 SACO brand standards for internal sound insulation criteria for apartments

Discussion of ceiling strategy

Ceilings throughout the development currently comprise suspended plasterboard ceilings which have been inherited from the previous hotel operator. To expose the historic character of the building, it has been proposed that the dropped ceilings within some apartments be replaced with a raised ceiling set between the timber beams comprising 2 layers of dense plasterboard backed with mineral wool. Sound insulation tests of the two ceiling types were carried out in October 2017 and Table 3 presents the measured airborne sound insulation performances against the required performance standards. It should be noted that both ceiling types readily achieved the required impact sound insulation performances.

Adjacency	Ceiling type	Tested airborne sound insulation performance	Building Regulations / SACO performance standard
Apartment - Apartment	Existing dropped ceilings	51dB $D_{nT,w} + C_{tr}$	≥ 43dB $D_{nT,w} + C_{tr}$
	Raised plasterboard ceiling	43dB $D_{nT,w} + C_{tr}$	
Apartment - Public areas	Existing dropped ceilings	59dB $D_{nT,w}$	≥ 60dB $D_{nT,w}$
	Raised plasterboard ceiling	50dB $D_{nT,w}$	

Table 3 Comparison of the airborne sound insulation performances of the proposed ceiling types

The results of the tests demonstrate that existing dropped ceilings and any like-for-like replacement can be expected to readily satisfy the Building Regulations and, with the addition of mineral wool insulation in the air cavity, the SACO brand standards for all adjacencies with apartments.

Raised plasterboard ceilings can be expected to only just satisfy the airborne sound insulation performances between apartments, but they fall short of the required performances between apartments and public spaces by some 10dB. Consequently, it has been recommended that raised ceilings should only be installed between apartments and dropped ceilings be retained/installed within public spaces below apartments to protect the amenity of guests.

Within the apartments of Central House raised ceilings have been omitted as historic lath and plaster ceilings have been discovered behind the existing dropped ceilings. Due to the relatively lightweight construction of lath and plaster in comparison to newly proposed raised plasterboard ceilings, the lath and plaster ceilings are not expected to meet the requirements of the Building Regulations and serve to worsen the status quo rather than improve it. This lowered acoustic performance could also be expected to have a negative impact upon the hotel's reputation as guests are likely to be disturbed by noise. It has, therefore, been recommended that dropped ceilings be retained within these apartments to protect the amenity of guests.