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High Environmental Quality (HQE), the GIAc/ADEME approach

Eric Gaucher

Acoustique & Conseil, 17-19 rue des Grandes Terres, 92508 Rueil-Malmaison, France
eg@acoustique-conseil.com

The "Haute Qualité Environnementale" HQE concept is increasingly important for French building projects. The French acoustics consultants association, GIAc, has been working, with the ADEME's support in order to define acoustically a building that aims to obtain the HQE Certificate. This method developed since 1999 presents many qualities compared to the classical approach based only on experience. In particular, acoustical objectives are here linked one to the other. This introduces and controls equilibrium between different values, which is in itself very important considering the acoustic quality of a room. It is also very easy to define correct objectives adapted to any activity as soon as the acoustical analysis of the activity itself is correct.

1 GIAc

The GIAc (Groupement de l'Ingénierie Acoustique) represent most French independent acoustic consultancy agencies.

Today, the GIAc includes 100 agencies throughout France.

Many groups are working on subjects concerning our profession:

- insurance,
- Economy evolution
- communication,
- uncertainty in acoustical calculations and measurements,
- sustainable development (Grenelle de l'environnement),
- HQE,
- ...

2 HQE Concept

The Kyoto congress in 1997 has popularized the idea of sustainable development. It has been developed in France through different ideas such as Agenda 21 (which means we always have to think about the 21th century) or the Environment Chart added to French constitutional chart. Concerning buildings, the answer is called HQE, "Haute Qualité Environnementale". An association called "Association HQE" has been developing these ideas for 15 years.

3 HQE Acoustique

We include acoustics in the HEQ concept because the concept of being « sustainable » is related to adequacy between activity and acoustic properties of buildings: if sound performance is insufficient, then the activity is less sustainable, if it is over designed, then it's surplus to use.

Many reflections have been carried out with

ADEME : Agence de Développement de l'Environnement et de la Maîtrise de l'Energie

CERTIVEA : CSTB agency in charge of writing and managing

- 1999 With the contribution of ADEME for
  - o student buildings (schools, colleges, universities)
  - o sports and leisure rooms
  - o offices
- 2002 With the contribution of ADEME for
  - o music schools
  - o multipurpose halls
- 2004 With the contribution of ADEME for
  - o catering
  - o health buildings
- 2007 - 2008 new working group in coordination with CERTIVEA
  - o exploiting buildings
  - o commercial buildings
  - o Hotels

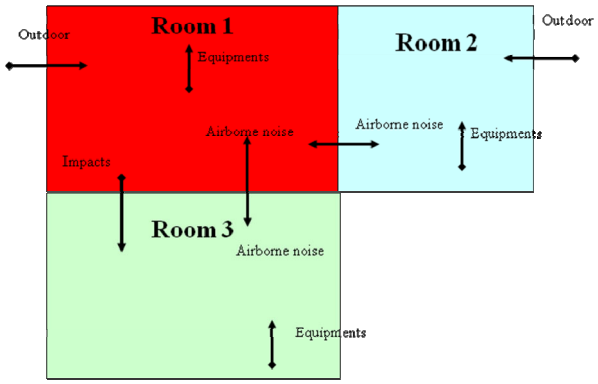
4 GIAc/ADEME HQE Acoustique principe

One of the main objectives concerning acoustics is to adjust as precisely as possible the acoustic performance of the building to the activities held within it.

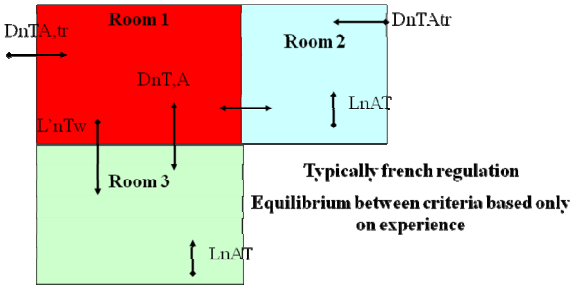
The approach is to come back to the analysis of a building acoustics situation: the activity developed in a room generates a sound (aggressiveness) which can disturb activities held in surrounding rooms. In return, this very activity requires quietness (sensitivity) to be held in adequate conditions. If we define rules allowing quantification of this aggression and sensitivity, we can deduce the insulation criteria corresponding to the quality we are looking for

4.1 General situation

Each activity in each room emits airborne noise, Equipment noise, Impact noise that propagates to any other room :



4.2 Classical approach: independent definition of criteria

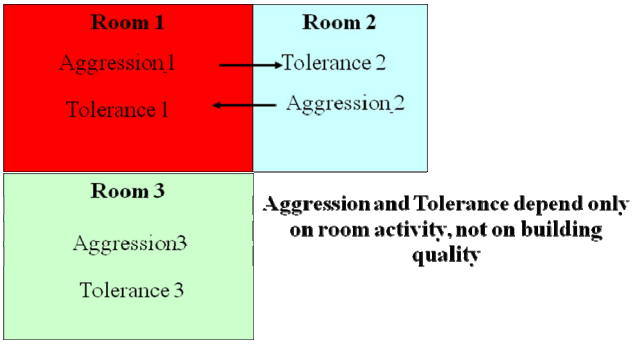


French regulation has defined such values for commonplace situations. Qualification companies such as QUALITEL also use this approach.

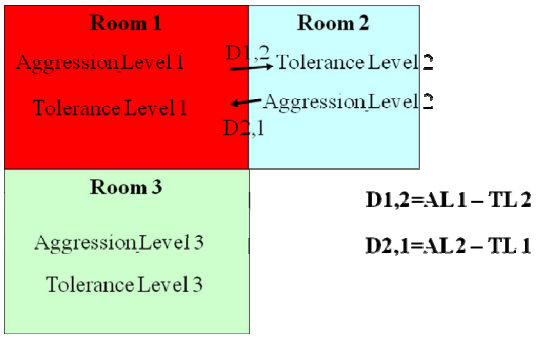
Even if regulation deals with most types of buildings, many specific rooms and situations cannot be defined in regulation texts and most of those values are defined by the acoustic consultant based upon his experience and his analysis of the situation.

4.3 GIAc/ADEME approach: noise situation analysis

The idea was to come back to the minimal analysis of any situation in a building: each room is associated with a human, technical (or animal) activity. This activity can generate noise and vibration with a variable intensity, we shall call this notion "noise aggression". Meanwhile, it has a noise tolerance level.



The idea is to find a pertinent means to quantify aggression and noise tolerance level for each room. The difference between aggression level of room 1 and noise tolerance level of room 2 will then define the insulation level required in this situation.

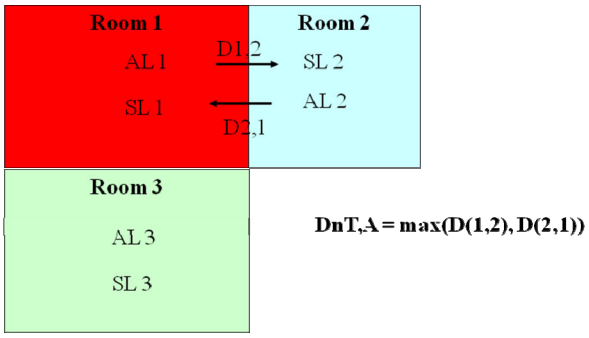


D1,2=AL 1 – SL 2

D2,1=AL 2 – SL 1

And the same from room 2 to room 1.

The insulation criteria required for building quality can then be deduced by keeping the highest of the two values:



4.4 GIAc/ADEME approach: quantification

Both aggression levels and noise tolerance levels can be analyzed and quantified using decomposition between an energy part and a qualitative part.

4.4.1 Energy part of criteria

This part can be measured with a sound-level-meter.

To quantify background noise, we nowadays often use statistical criteria such as L_{A90}, which is the noise over passed 90% of time. Typical values are:

- Office : L_{A90}=35 dB(A)
- Bedroom : L_{A90}=25 dB(A)
- Swimming pool : L_{A90}=45 dB(A)

To quantify activity noise, we nowadays often use statistical criteria such as L_{A10}, which is the noise over passed only 10% of time. Typical values are:

- Office : L_{A10}=65 dB(A)
- Bedroom (with music) : L_{A10}=75 dB(A)
- Swimming pool : L_{A10}=80 dB(A)

This criterion is nevertheless insufficient to define aggression and tolerance level: we have to take into account

other aspects such as semantics, color of signal or the actual nature of the activity.

4.4.2 Correction parameters

The aggression of noise will depend on its level L_{A10} but also of the nature of noise: a highly semantic or colored noise is much more aggressive than a neutral noise. A positive noise (such as helicopters turning around a hospital) is more accepted than a negative one (the same helicopter transporting a wealthy businessman).

We have therefore defined a "nature correction" (NC) parameter. Typical values are:

- Continuous and neutral noise : 0
- Quiet voices : 5
- Loud voices : 10
- Very loud voices : 15
- Colored signal (music) : 20
- Confidential conversation : 25

On the other hand the tolerance level will also depend on specific aspects connected with activity. We'll call it "Sensibility Correction" (SC):

- Good intelligibility, very quiet room : -5
- Quiet room (personal office) : 0
- Average tolerant room (common office) : 5
- Tolerant room (corridor) : 10
- Mainly unoccupied room : 20

4.4.3 Aggression and tolerance levels

With those parameters defined, we can now quantify aggression level (AL) and tolerance level (TL) in any location:

$AL = L_{A10} + NC$

$TL = L_{A90} + SC$

4.4.4 Classical acoustic criteria deduced

Considering two rooms 1 and 2, once we have quantified AL_1, TL1, AL2, TL2, we can deduce classical building acoustic objectives:

- Insulation between room 1 and 2 : $Dn_{TA1/2} = MAX((AL_2-TL_1),(AL_1-TL_2))$
- Stable equipment noise: $L_{nA} = TL-5$
- Intermittent equipment noise: $L_{nA} = TL$
- Impact noise level : $L'_{nTw} = TL + 25$
- Façade insulation: quantify Exterior Aggression Level as $EAL = MAX (L_{Aeq}, L_{A10})$ with L_{Aeq} and L_{A10} defined in front of building façade. $Dn_{TA,tr} = EAL-TL$
- Reverberation criteria: defined independently as usual.

5 Case of Music rooms

If a major part of the activity held in a room is music, then its richness in low frequencies has to be taken into account. It is possible to develop exactly the same logic, but confined to 125 Hz octave band to define a complementary criterion:

$D_{125,1/2} = MAX((AL_{125,2}-TL_{125,1}),(AL_{125,1}-TL_{125,2}))$

6 Practical example

This method is easy to implement in any spreadsheet. Here is an example Acoustique & Conseil developed for its internal quality.

One sheet presents data, leaving the acoustic consultant master of nature correction and sensibility correction:

Nom du projet :
Référence :
Date (JJ/MM/AA) :

Ajouter / modifier une salle | Supprimer une salle | Edition du tableau de résultats

Entrée des Données

Dénomination de la salle du projet	Dénomination réglementaire	Dénomination HQE (GIAc)	Agression			Réception		
			L10	Correction de nature	Niveau d'agression	L90	Correction de sensibilité	Niveau d'exigence
salles d'opération, d	Salle d'opération, d'c	Bloc opératoire	70	17	**87**	45	-5	**40**
locaux d'hébergeme	Locaux d'hébergeme	Idem réservés au somm	75	2	**77**	30	5	**35**
locaux de soins : sal	Salles d'examens et	Traitement patients	60	22	**82**	40	0	**40**
locaux de repos du p	Autres...	Vestiaires	65	22	**87**	40	5	**45**
Circulations, halls	Circulations internes	Couloirs circulations	65	2	**67**	50	5	**55**
salles de formation,	Autres...	Bureau cloisonné	65	10	**75**	35	5	**40**
laboratoires, pharma	Autres...	Salle informatique	75	12	**87**	40	3	**43**
cuisine	Autres...	Cafétéria	75	20	**95**	40	5	**45**
ateliers	Autres...	Ateliers	80	15	**95**	50	5	**55**
locaux techniques: b	Autres...	Locaux techniques	90	10	**100**	85	5	**90**

Another sheet presents in a compact manner the results. The left part of the sheet show insulation objective. The two values (Line i / Col j) and (Line j / Col i) are compared and the most important value is reported in the upper part of the sheet:

Salles du projet	Etage	locaux de repos du personnel	salles de formation, bureau administratifs	laboratoires, pharmacie, préparations soins	ateliers	locaux techniques: bâtiment Chaufferie,	L'nTw	Bruit de fond dû aux équipements techniques (fonctionnement continu)	Bruit de fond dû aux équipements techniques (fonctionnement intermittent)
locaux de repos du personnel		**42**	**47**	**44**	**50**	**55**	70	40	45
salles de formation, bureau administratifs			**35**	**47**	**55**	**60**	65	35	40
laboratoires, pharmacie, préparations soins				**44**	**52**	**57**	68	38	43
ateliers					**40**	**45**	80	50	55
locaux techniques: bâtiment Chaufferie, locaux techniques div						**10**	115	85	90

7 Conclusion

The method developed by the GIAc with ADEME's help permits to explain the quantification of classical building acoustic criteria. Following this method presents some major interesting aspects:

- Objectives are automatically coherent, and if we want to change a parameter, then we'll have to modify a primary criterion (such as Nature correction or Sensibility correction) which modifies all secondary criteria simultaneously.
- It's easy to introduce a new room: Analysis of its activity is sufficient to define its relationship with any other room previously defined: It's not necessary to quantify any combination of rooms' couples.
- Most acousticians believe that equilibrium between criteria is often more important than the absolute value itself. This method answers this preoccupation.

These points show that this method is a new way to improve and control objective definition, preserving the liberty of the acoustician to adapt values to each situation. This can improve the environmental acoustical quality of a building and is therefore a good answer to the HQE acoustic problem.

Even though this approach has not been included in extensor in French QEB reference book, it can be used to validate the absolute values, to extend the qualification to other kinds of rooms, and also to adapt objective criteria to different situations.

Acknowledgments

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