ARCHITECTURAL TRANSLATION OF THE ACOUSTICAL RESULTS

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1 INTRODUCTION

One of the main protagonists influencing the acoustical quality of one hall is undoubtedly the architect and sometimes without even knowing it. The architectural conception of one hall and all that this involves, for example its utilisation, the geometry, the volume, the disposition of the architectural elements, the construction etc., play a decisive role in the elaboration of some acoustical quality with the help of an expert acoustician. Sometimes unfortunately the conception and the realisation of the hall from an architect who does not have the acoustical knowledge and the aid of an acoustician can be a disaster and require an acoustical correction.

The architectural translation of the acoustical results attempted here does not have the purpose to replace neither the acoustician consultant nor the necessary acoustical knowledge to realise an acoustically correct hall. The final purpose of this architectural translation is first of all to give the architect the means to appreciate and evaluate the acoustical results. After that, the purpose is to have a basic help during the architectural conception of the hall in order to obtain a more “exploitable” result with the collaboration of an architect-acoustician. Finally, the purpose is to construct a base of dialog, a more tangible language for the architect in order to better communicate with the acoustician.

One part of the acoustical translation can be used in the acoustical pedagogy through presentations and explications of the architectural elements (halls – forms – diagrams) in relation to the acoustical behaviour (ray tracing – reflections – comparisons of the results etc). The other part is meant to be used more as a tool of evaluation / translation and presentation of the results through curves of comparison, illustrated objective criteria etc, being also a calculation tool.

2 PRESENTATION OF THE MODULE OF THE ARCHITECTURAL TRANSLATION OF THE ACOUSTICAL RESULTS

The module of the architectural translation of the acoustical results is at the same time an estimation, presentation and calculation tool of the acoustical results. This module is also a platform of integration of the external motors of the acoustical calculation and of the recuperation of external rates to be evaluated. At the same time it can be used as an educational tool. The acoustical results are presented in relation to the aptitude of the integrated or adapted calculation motor to calculate some of these results.

This module attempts first of all to recuperate the calculation results of the acoustical criteria and compare them with the optimal rates in relation to some architectural elements and present them in a graphical form of "rose of the acoustical results". At the same time another use of this module concerns also the input of non-calculated rates of different objective criteria per frequency in order to evaluate them and place them in relation to the optimal rates. This module is a part of a globally proposed platform of architectural acoustical simulation adaptable in a CAD system [1], developed in a Visual LISP [2],[3] and Visual BASIC [4].

2.1 Calculation with evaluation of the rates of the objective criteria

The calculation with evaluation of the objective criteria rates is made up of three types. Inside every type the calculated objective criteria are presented under graphical form of comparison with the optimal rates filtered from the architectural elements used. From all the calculation types, without exception, we can evaluate the different affected rates with the objective criteria without inevitably calculating them. The three calculation and evaluation types of the acoustical results concern:

- one objective criterion of one hall under all frequencies (fig.1-left)
- one objective criterion of several halls under one frequency (1000 Hz) (fig.1-center) and
- several objective criteria of one hall under one frequency (1000 Hz) (fig.1-right).

The module presented here has its own calculated acoustical motor generating its rates of objective criteria. Nevertheless, the major importance is that every sophisticated, powerful and efficient calculated acoustical motor can be adaptable to this proposed module through a global platform of acoustical simulation where the present module belongs to.

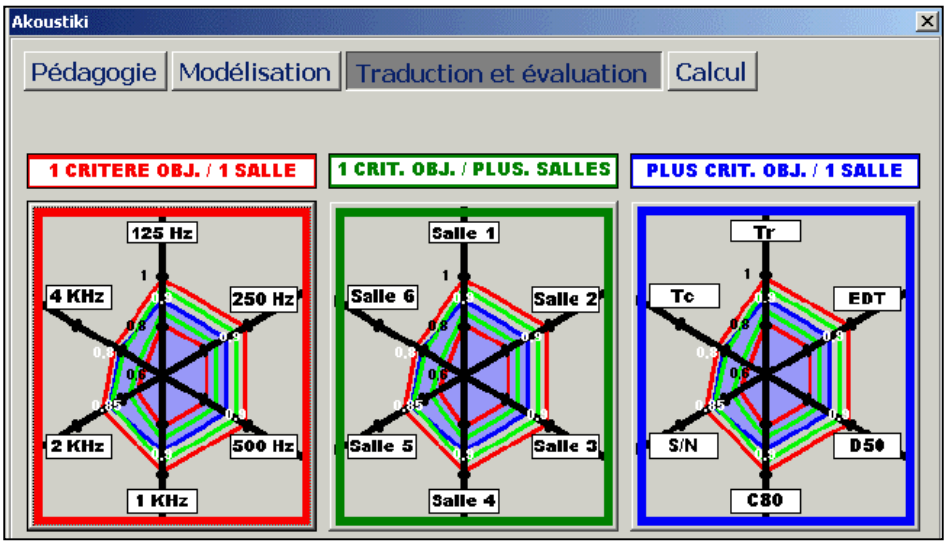


Fig. 1 - The module of the translation of the rates of the objective criteria in dialog box form and integrated in the global platform of acoustical simulation.

2.1.1 Calculation with evaluation of one objective criterion of one hall in all frequencies

The calculation with evaluation of every objective criterion of one hall passes through the principal dialog box of the translation and evaluation of the acoustical results and the choice of the window access “1 objective criterion / 1 hall” (fig 1 – left window). The calculated rates of either the internal calculation of the module here presented or the external adapted calculation motor, are generated in ASCII format per frequency through the dialog box following the principal window. Through this dialog box we have the ability to define some architectural elements that affect considerably the objective criteria to be calculated from one hall (fig.2).

On the first zone we can define some characteristics of the hall, such as its volume and its name. On the second zone, concerning the configuration of the hall we can select:

- the objective criterion to calculate
- the type of the hall (organ, symphonic music, opera, jazz and chamber, speech, variety), and
- the type of the spectacle into the hall (concert, recording, speech).

On the third zone, concerning the evaluation of the rates in all frequencies, we have the ability to input the rates to be evaluated with one objective criterion without the rates coming from the calculation. The input of these rates forces the system to take into its account the input rates and not the calculated rates of the acoustical motor. In this way, the system doesn’t take into account the rates coming from the calculation and it turns from a calculation motor into a translation and evaluation motor of rates. In the case of no input of this evaluation zone, the system continues to function its calculation motor of the wished objective criteria. On the fourth zone, concerning the saving path of the results, we have the ability to indicate this path of the calculated rates or the input rates to be evaluated with generated graphics of Excel format.

The rates, the types of the hall as well as the spectral appearance of the optimal objective criteria for the different types of spectacle are taken from the literature [5] and they are integrated, adapted and taken into account in the computerized calculation of the results. All the input data of all the zones of the dialog box as well as the generated rates will export automatically into Excel sheets that feed the graphical acoustical results (“acoustical roses”).

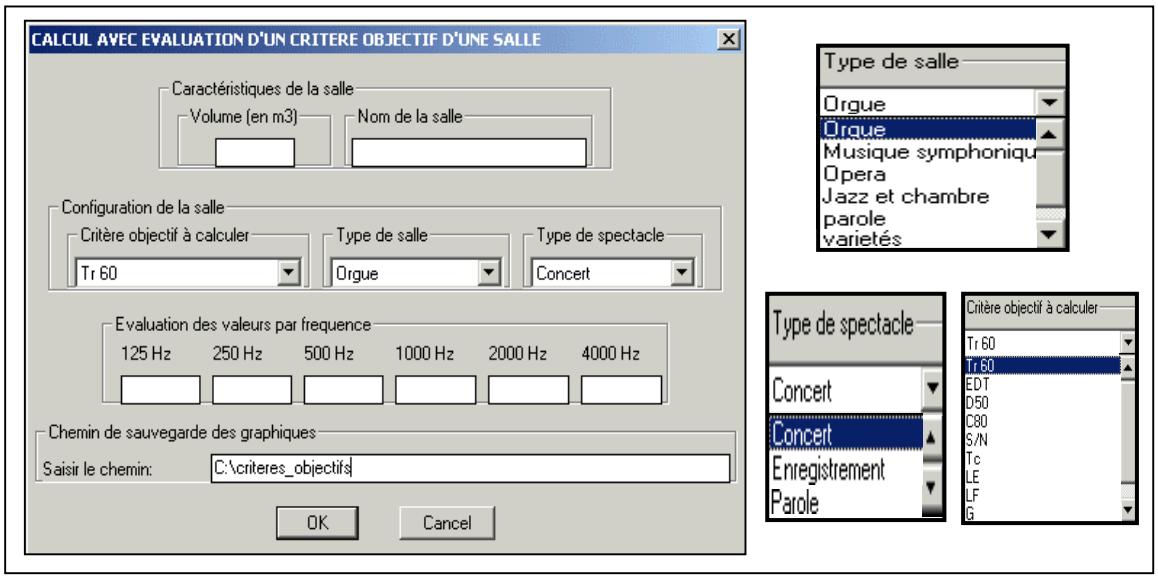


Fig. 2 - Definition of the architectural elements into the calculation with evaluation of one objective criterion of one hall.

2.1.2 Evaluation of one objective criterion of several halls in one frequency

This evaluation concerns the same objective criterion of several halls at the same time through a simultaneous comparison under the frequency of 1000 Hz. The acoustical results must be taken from other external calculation and recuperated in this module of the translation results and that because there isn't internal acoustical simultaneous calculation to more than one hall.

The principle of the access, the input and the saving of the data as well as the subsequent treatment of the calculated rates is the same as in the first type (§ 3.1.1). This evaluation of one selected objective criterion concerns 1 to 6 halls at the same time. The choice and the input of the characteristics of every hall (name and volume of hall, type of hall and spectacle) are realized through specific window boxes (fig. 3).

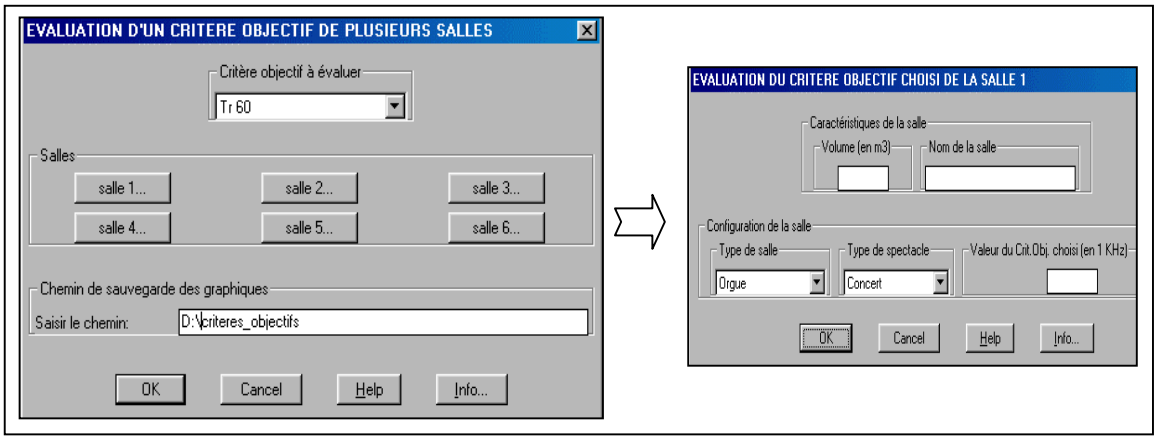


Fig. 3 - Definition of the architectural elements through the evaluation of one objective criterion of several halls in one frequency

2.1.3 Calculation with evaluation of several objective criteria of one hall in one frequency

This last type of calculation with evaluation concerns several objective criteria of the same hall under the same frequency of 1000 Hz. Different comparisons of 1 to 6 objective criteria at the same time are possible during this evaluation (fig.4). All the other principles of functioning are the same as the other presented types.

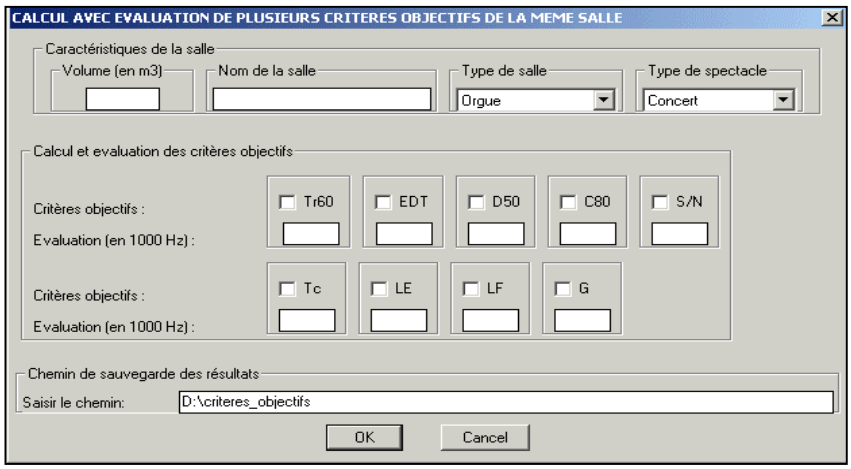


Fig. 4 - Definition of the architectural elements and the objective criteria of one hall in the frequency of 1000 Hz.

2.2 Recuperation of the rates of the objective criteria

The calculated rates are automatically saved into sheets of Excel files that include connections between them in order to treat and display the results correctly. The module of translation of the acoustical results generates through the dialog boxes, on the one hand, the file including all the input data of the hall (characteristics, configuration, type of calculation etc.) and on the other hand, the file including the obtained or recuperated calculation rates. The integrated calculation code into the module generates the file including the optimal rates taking into account the architectural elements described above (§ 3.1.1). The connections of all these generated files update the final file that presents the final acoustical results in graphical form (fig.5).

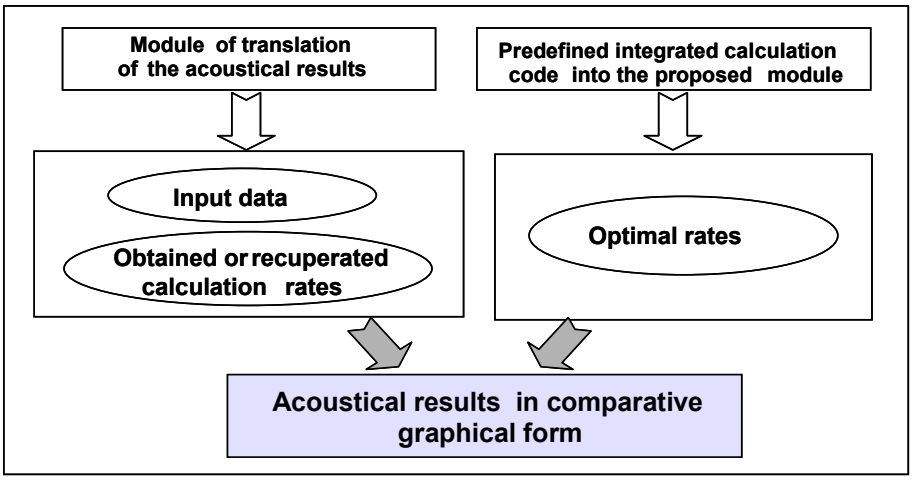


Fig. 5 - Diagram of recuperation of the objective criteria rates

2.3 Final presentation of the rates of the objective criteria

The final Excel file includes in its first sheet named “graphical results,” the acoustical results (obtained or recuperated rates) in comparison with the optimal rates (fig.6).

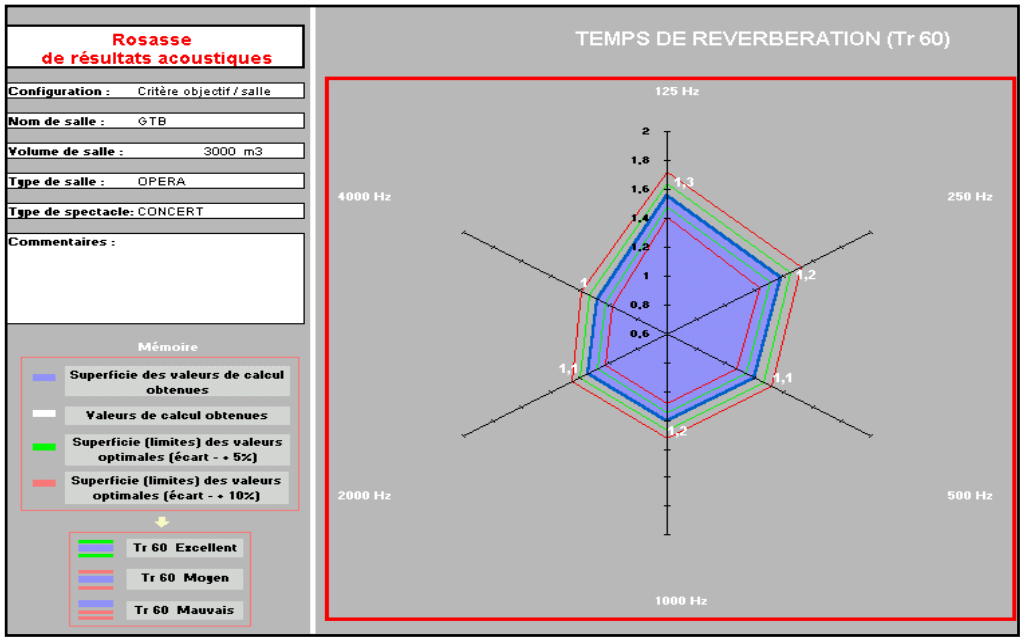


fig. 6 - Rose of the acoustical results of one objective criterion of one hall in all frequencies

On the right side of the results diagram, the calculated rates form one area (here filled in blue color) in the center of the diagram ("acoustical rose") where each of the six axes that corresponds to one frequency, intersects with the others. This filled area is first of all compared with the limits of the first empty area (the two green lines in the center of four lines) corresponding to the rates close to the optimal rates (deviation: - + 5%). When this filled area is placed between the green lines, the rate of the objective criterion is excellent (fig.7a), when it is placed between the red lines (deviation: - + 10%) the objective criterion is mediocre (fig.7b), and finally when it is placed outside the final limits of the red lines either towards the outside or towards the inside, the objective criterion is bad (fig.7c).

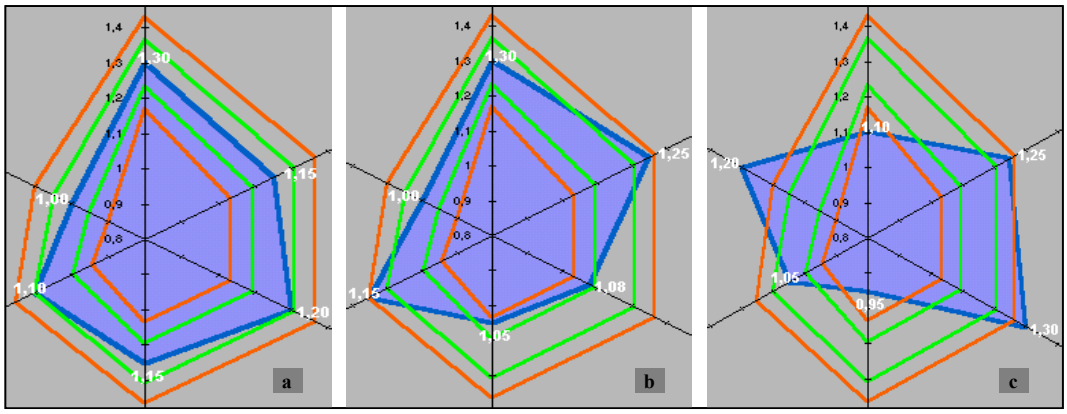
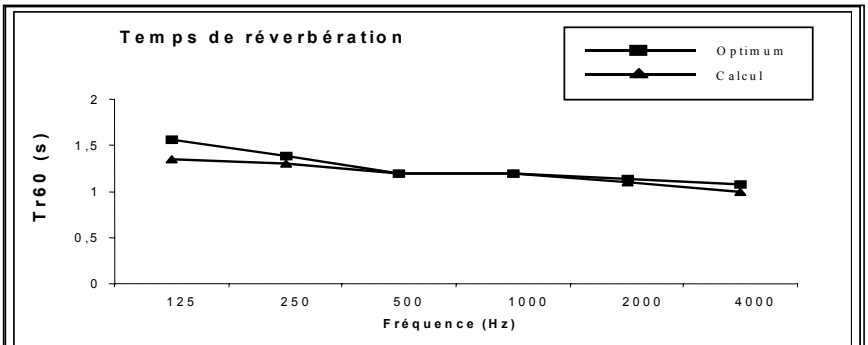


fig. 7 - From the positive (left) to the negative (right) evaluation of the "acoustical roses".

On the left side of the results in the same Excel sheet, all the input data through the dialog boxes are automatically updated and they correspond to the characteristics of the hall (name, volume, type of hall and spectacle), the selected type of the calculation and one comments zone. Below the comments zone there is an explanatory table that places and evaluates the objective criterion in relation to the comparison of the obtained and optimal acoustical rates (fig.6).

The second sheet of the same file of the acoustical results includes automatically all the obtained and optimal rates as well as a "traditional" presentation of the same results in graphical curves (fig.8). This traditional presentation doesn't include all the "deviation rates" close to the optimal rates for clarity reasons.



Valeurs obtenues	Valeurs optimales	Valeurs optimales -5%	Valeurs optimales 5%	Valeurs optimales -10%	Valeurs optimales 10%
1,35	1,56	1,48	1,64	1,40	1,72
1,3	1,38	1,31	1,45	1,24	1,52
1,2	1,2	1,14	1,26	1,08	1,32
1,2	1,2	1,14	1,26	1,08	1,32
1,1	1,14	1,08	1,20	1,03	1,25
1	1,08	1,03	1,13	0,97	1,19

fig. 8 - Comparison in « traditional » form of the obtained and optimal rates (curves with absolute rates).

In the fist case of presentation of the acoustical rates (one objective criterion of one hall in all frequencies) each axe corresponds to each frequency (from 125 Hz to 4000 Hz). In the second case of presentation (one objective criterion of several halls in one frequency) each axe corresponds to each hall (max. 6 halls) (fig. 9-left) and in the third case (several objectives criteria of one hall in one frequency) each axe corresponds to each objective criterion selected (max. 6 obj. crit.) (fig.9-right).

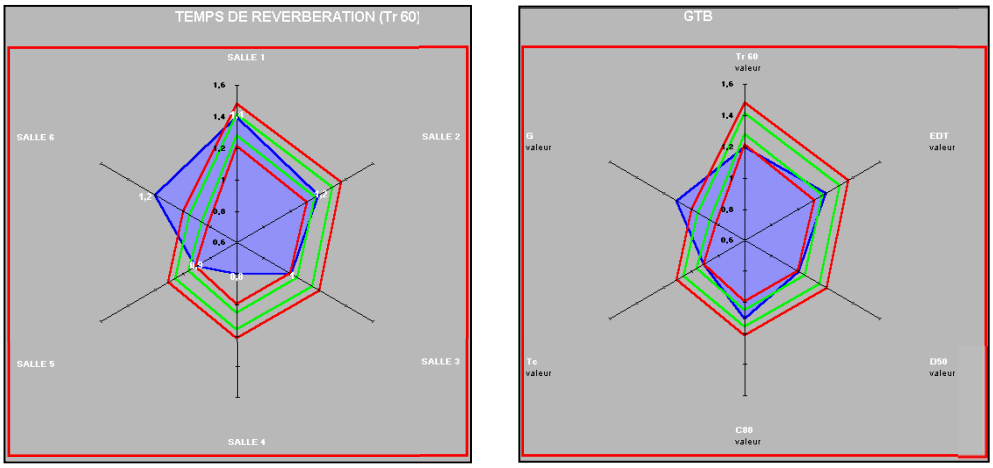


fig. 9 - Presentation in “acoustical rose form” of one objective criterion of several halls in one frequency (left) and several objective criteria of one hall in one frequency (right).

In the third case of presentation of several objective criteria of the same hall in one frequency, it is evident that the rates of each objective criterion correspond to a different scale (for example the scale of the D50 (from 0% to 100%) is different from the scale of C80 etc.). For this reason, the scale on which the full area is drawn representing the obtained rates, is homogeneous. This means that the scale of each objective criterion is adjusted to a unique scale to make the presentation easier and particularly the evaluation of the results. The obtained rates from the calculation corresponding to each criterion are displayed also in absolute numbers in the same graphic.

In the second Excel sheet named “Data” the adjusted rates to a unique scale are displayed in comparison with the optimal rates with graphical traditional curves. This type of graphic doesn’t present the obtained absolute rates of the calculation but permits us to evaluate and compare these rates with the optimal adjusted rates on the same scale (fig.10).

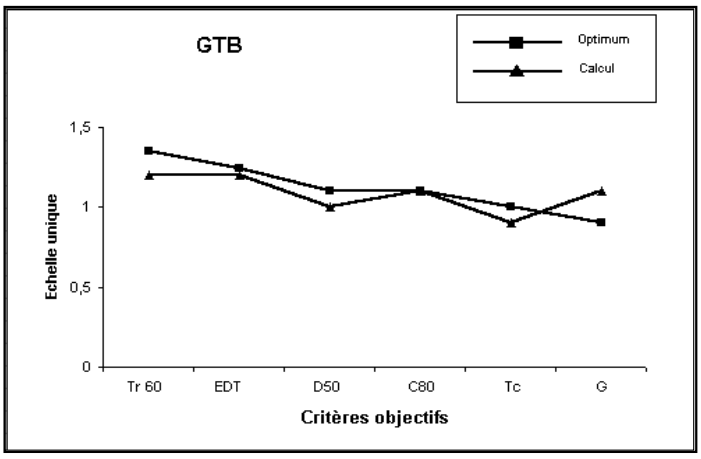


fig. 10 - Traditional presentation form of adjusted rates of several obj.crit. to a unique scale. Here the rates are ajusted to the scale of the reverberation time.

3 CONCLUSION

The architectural translation of the acoustical results is realized through their evaluation and comparison with optimal rates taken from the literature in relation with architectural elements. This evaluation is illustrated in “acoustical roses” and concerns the following:

- one objective criterion of one hall in all frequencies
- one objective criterion of several halls in one frequency (1000 Hz) and
- several objectives criteria of one hall in one frequency (1000 Hz).

The purposes of this architectural translation are:

- To provide the architect with the means to appreciate and evaluate the acoustical results,
- To have a basic help during the architectural conception of the hall in order to obtain a more “exploitable” result than that from the collaboration between the architect and the acoustician and
- To construct a base of dialog, a more tangible language for the architect in order to better communicate with the acoustician.

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