

RESEARCH ON CEILING OF ACOUSTICS IN CONCERT HALL

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ABSTRACT

Lighting and stage facilities in concert hall are not as complicated as opera house, but the acoustics quality is most the crucial among all kinds of hall design which can not be evaluated with single acoustical parameter. Acoustical design usually presents an overall effect only. Difficult to predict the result of acoustical design in combining many acoustical parameters. Here suggests criterion method by the area coefficient counted with multi-dimension rose graph, each dimension in the graph denoting an individual acoustic parameter, as the technique rule of the combined acoustical criterion. Therefore area has shown in the rose graph needs to larger the better acoustics in the hall.

Measurement of the concert hall usually takes with international standard (ISO 3382) processing the minimum test points by scale. It just take account of few selected positions only. Now through digital simulation predict the acoustics parameters even at every seat position. And can get the percentage of the optimum positions as criteria of acoustics. From there statistical data, not only can make compares with different acoustical design, and also know how to improve the acoustical design. This method has been used to optimize a medium-size hall project design from five different ceiling configurations.

FOREWORD

Acoustics design of concert hall is subjected to room shape, dimensions, capacity of the hall, the glint of the surfaces inside and pew layout, hall and absorb to handle with proliferation, the whole shape and various architecture facilities, mutual and connected each others. Generally speaking, the ceiling of concert hall design handles the freedom degree that acoustics design is the biggest, and the ceiling also has very important of influence for concert hall acoustics, for example the design of the ceiling involves to mix reverberation time control highly, the ceiling shape involve the early reflect sound of the auditorium receiver, distribute even degree in hall and proliferation degree...etc.

BEST VALUE RATE

This thesis choice the ceiling design of concert hall is the particular case example takes into analytical. First reason is the ceiling of concert hall with under the yoke of ceiling and stage setting compare lighter than opera house. Second reason is most variety with the shape of concert hall ceiling.

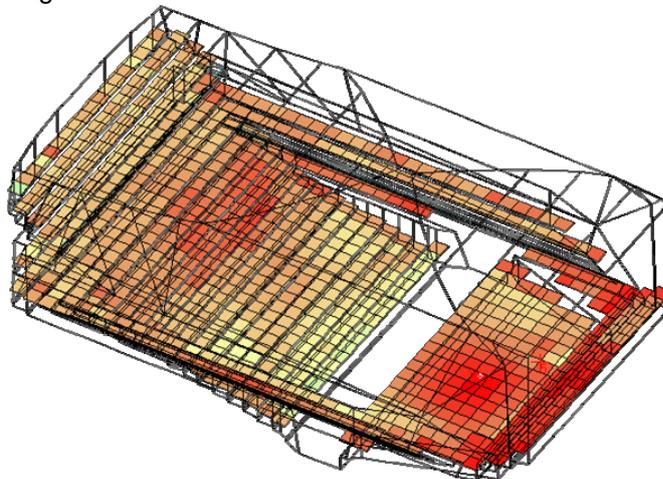


Fig.1 Acoustics parameters of all seats in concert hall (C80)

Acoustical quality request of concert hall is most strict and fastidious in each kind of hall, not just single acoustical parameters can decide. On the way if seats of the hall attain 1,000 to 2,000, areas reach several hundred or near thousand square meters, the acoustics condition also doesn't fulfill homology everywhere. Therefore assess acoustical quality of concert hall, usually just generally from total result, but usually can't with "good" and "bad" to express in brief either. Also need to provide the more meticulous thorough acoustical quality result analysis while choose other case comparison or adjustment to make optimization in design of the hall process particularly.

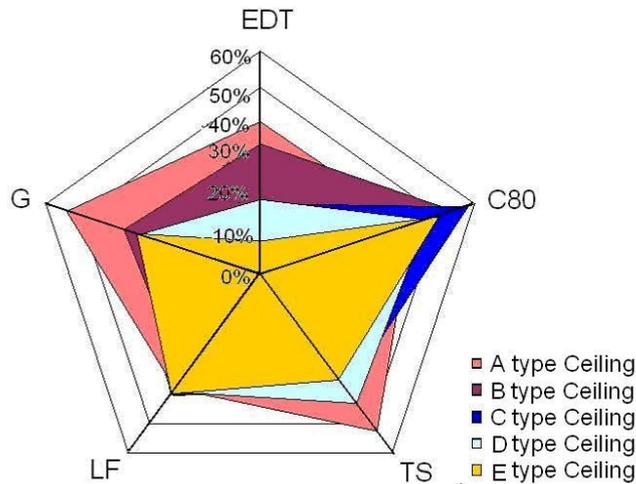


Fig.2 Rose graph of acoustic parameters with 5 ceiling type in concert hall

MINUTENESS

For sense of hearing result that each seats in concert hall currently limited to measurement, so just with the valuation of acoustical quality by the acoustical parameter of the parts of sampling measure position, and representative whole acoustical equally of the hall, have apparently to be partial all whole of shortage. Measurement work from the hall acoustical quality by international standard ISO 3382:1997 (Acoustics—Measurement of the reverberation time of room with reference to other acoustical parameters) had recommended different scale hall inside examine the number of the lowest limit examination point, after being used as valuation hall completion of basis work. But in design period, particularly the calculator emulation has become the importance assistance means nowadays. We also need to exanimate the acoustics characteristic of all the audience seats probably. The author puts forward a kind of consideration way that is thinner to turn(for example thin turn the 1 meter x 1 meter sampling unit) to the audiences area here, to each acoustics parameters increase covariance data as result, further can make thorough analysis comparison to the different acoustical design thus, showing may also to the architecture design to each measure result(for example sit an area to the dissimilarity of influence, the whole concert hall of average value index sign increment the covariance meaning). For improvement or optimization design as more reference practically.

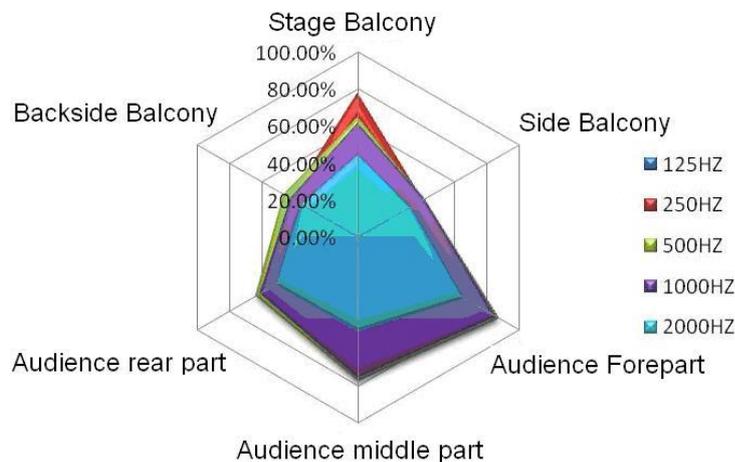


Fig.3 Comparison of the best acoustics area by zone in concert hall (EDT)

STATISTICS

Another crux of concert hall acoustics design is that how to take into comprehensive evaluation in numerous acoustical parameters. The author puts forward a kind of area coefficient method that is called the rose diagram here, may become the technique rule of the comprehensive examination. Different concert hall usage property contain the different acoustical parameter basis, speech requesting the optimization satisfaction degree of the clear degree should be best, the acoustics quality request of concert hall then is reverberation time or early decay time has to satisfy great majority of the sense of hearing enjoy, so take into quantity to turn in the rose diagram area standard calculation of the different acoustical quality parameter, in addition to emphasize the total area extends to increase full degree as far as possible, needing reverberation time stalk segment increase more higher.

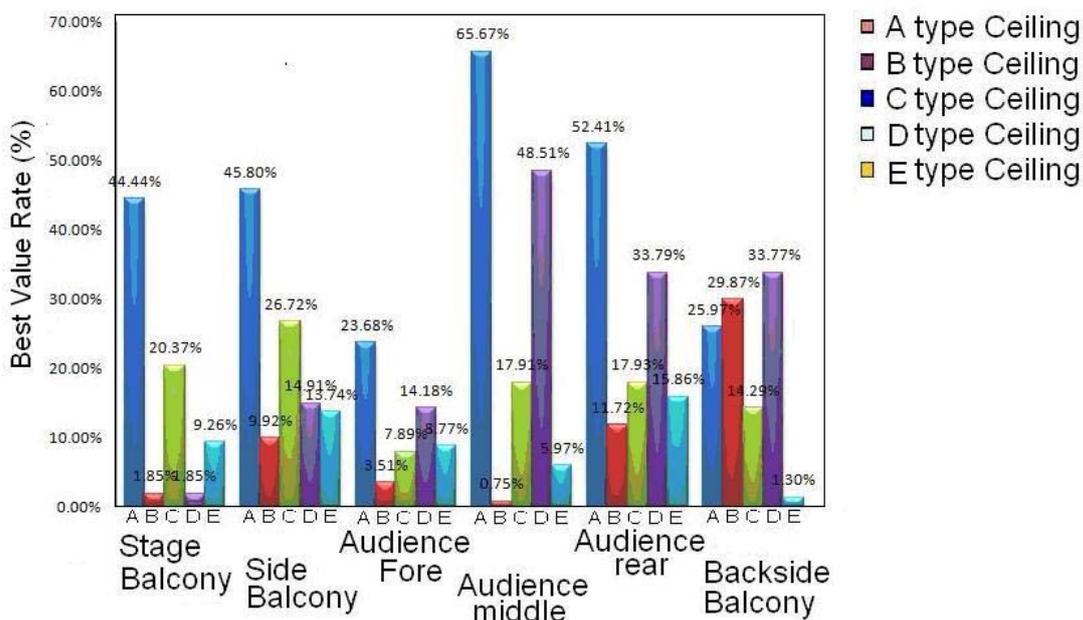


Fig.4 Comparison of best EDT rate among zones with change ceiling

This paper with medium-sized concert hall in Her-fei city for example and adopt an above mentioned method. Then compare five kinds of ceiling designs on decided flat and surface decoration foundation. The medium-sized concert hall ceiling variety through calculator imitate operation result and statistics find out the excellent degree of the medium frequency in sound field then compare curve ceiling better than others. For each acoustics parameter, energy and reflect time are even arrive whole fields seat then receiver get more well-balanced. But the all seats of the curve style ceiling express whole superior quality more excellent at part of the low frequency and high frequency. However for the flat panel ceiling, inclined ceiling and the arch ceiling, express whole superior quality then appear obviously in the low frequency part to compare for. For the strength felling of concert hall ceiling design, many ceilings have keeping with whole and well-balanced acoustics result. The curve ceiling can dome crest the strength of the ceiling then is higher. Acoustics design can make reference to combine the adequacy avoid producing the acoustical quality of minor faults.

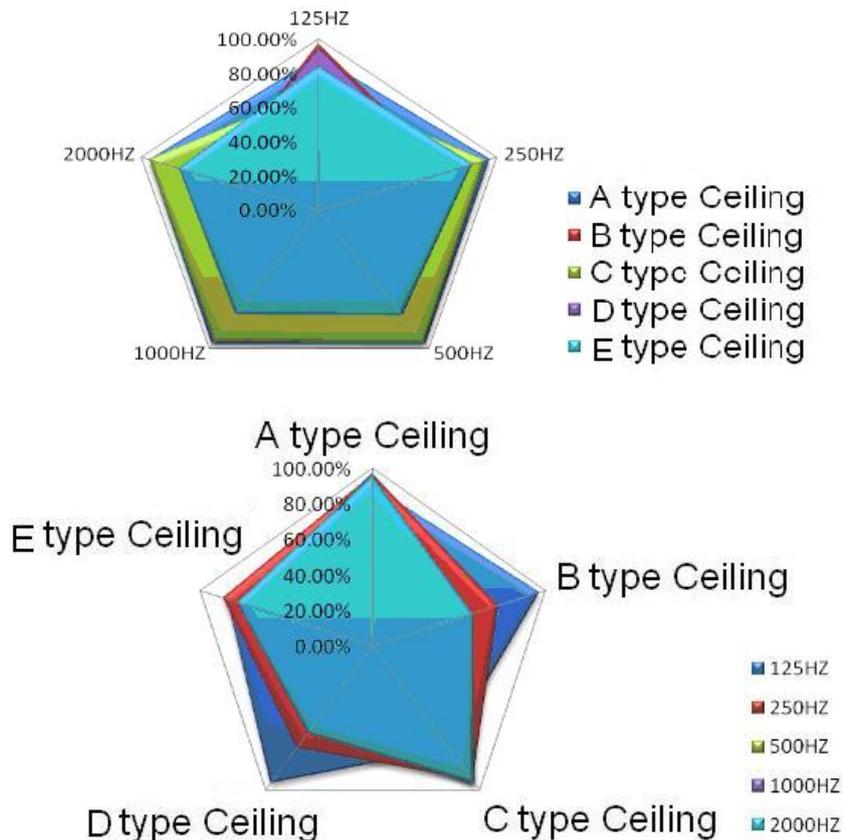


Fig.5 Comparison of C80 between ceiling type and frequency

CONCLUSIONS

For concert hall ceiling of musical usage appearance, concert hall ceiling design want to satisfy all auditoriums to attain the best acoustics result is extremely and rare. But if can promote the high-quality ratio that the ideal seats as far as possible, for the ceiling of concert hall be design of the beginning start to examine for the ability before the event. Therefore it can avoid the whole acoustics parameter excessiveness deviation after set up. Acoustics design come out black box an operation predicament to provide more lend support to means effectively.

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