# THE FORD AUDITORIUM

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(using freely the teachings of William Allen and Peter Parkin)

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The Henry and Edsel Ford Auditorium is the home of the Detroit Symphony Orchestra, which has been a dominant influence in Detroit's cultural development for more than 50 years. The auditorium, situated in Detroit's riverfront Civic Center, is owned and operated by the City of Detroit. It is used not only for individual or group artistic performances but for lectures, television and radio broadcasts, motion picture screenings, a variety of assemblies, and for displaying the very latest of the Ford automotive products.

The auditorium has a seating capacity of about 2900 - 1800 seats on the main floor, 1100 in the balcony. There are no pillars on either the main floor or the balcony, so all seats have an unobstructed view of the stage. The Proscenium Arch is approximately 75 ft wide and 35 ft high. The stage is about 35 ft deep and 120 ft wide, with an orchestra pit capacity of 65 musicians. When not in use, the pit can be elevated to the level of the stage.

When the auditorium first opened, its performance left much to be desired, and caused a great deal of criticism by the news media, the artists and concertgoers. Finally, in about 1971, the management decided to completely redesign the interior. Lewis M. Dimenco was appointed Architect and Vern O. Knudsen the Acoustic Consultant. At Dr. Knudsen's request, William Allen and Peter Parkin were brought in to advise - particularly in the lower frequency range - following their experience with the Royal Festival Hall and other noted auditoria.

The criticisms of the auditorium made by other observers in previous years, and by Vern Knudsen and Bill Allen in April 1972 are generally consistent and can be summarized:

a) Drums and brass easily overpowered and masked the violins. Stray resonance was sometimes experienced,

b) Reeds and woodwinds were not sufficiently evident on the ground floor to make their contribution to musical texture,

c) The balance and quality varied too much from place to place in the auditorium. In some areas the sound was confused,

d) The liveliness and general strength of sound was not commensurate with the quality and large size of the Detroit Symphony Orchestra.

Stage staff told Bill Allen also that players on each of the extreme wings of the orchestra had complained that players on the opposite wing did not keep time well, and they said also that the musicians did not always hear one another as well as they ought for a well integrated performance.

The auditorium as it stood had design defects which could explain all these criticisms. It was suggested that:

a) The platform and stage enclosure were acoustically disadvantageous for the orchestra and for the propagation of sound,

b) The hall was unable to diffuse this sound when it received it, and this prejudiced the quality of the reverberation,

c) It suffered from echoes in some places,

d) Its reverberation as a whole was deficient at low frequencies.

While there was no doubt that the auditorium was acoustically faulty, the opinion was offered that the architectural character of the interior left something to be desired and that it contributed consciously or sub-consciously to the pervasive, acoustical criticism. The finishes and general quality of the design fell well short of the excellence of the orchestra, and it seemed to both Vern Knudsen and Bill Allen that it did not provide the environment needed to give a desirable sense of occasion.

Orchestras comprise a great variety of instruments, all of which have distinctive character. Composers combine them in all sorts of ways, and have images in their minds of the textures they are thereby creating. They assume that when an orchestra makes the intended sounds, the audience will hear them in the imagined manner. This does not necessarily happen however. The distinctive character and the tonal quality of the musical instruments depends upon their harmonies or overtones. These are short sound waves and are easily shadowed by the bodies of players, music stands, etc. It then follows that if an orchestra platform and the audience area are so related that the different musical departments are very differently exposed, those which can be seen well will be heard well, and those which are poorly visible will lose their distinctive character, their quality of one, and some of their strength. This applies particularly to violins, violas, reeds and woodwind, but not to brass or percussion. Sir Henry Wood had the dictum that "all listeners should be able to see all the f holes n the fiddles". We now know this makes good sense acoustically.

One other fact that was evident was that the hall was very sensitive to singers turning their heads, and intelligibility and loudness increased and decreased disconcertingly depending on which direction was faced. The cause of the trouble was the directionality of the human voice and the lack, then, of useful side reflectors and diffusers at the front of the hall to reflect the artists voices when they turn away.

Tests of the reverberation made it clear beyond doubt that better diffusion was necessary. In general, this is best developed from areas on the walls and ceiling near the stage opening. In this case it was the lower frequency sound that most urgently needed diffusion and the size of these sound waves - up to 10 or 20 ft - necessitated large slopes to cause effective diffusion.

Traditionally this diffusion was a by-product of box seats and ornamental features near the proscenium on each side wall. These provided the acoustical roughness needed. In the Ford auditorium the best location was occupied instead by a vertical lighting recess, open and lined with sound absorbents - in this way actually weakening what should be a point of strength for reflection. This absorbent opening is as bad a feature to have in this position as could be imagined.

<u>New Design Considerations</u>

Reverberation is necessary to give strength, liveliness, fullness and richness of tone. It comprises mainly a rapid succession of inter-reflections which lose energy more or less rapidly as they encounter various surfaces. Normally the audience is by far the greatest absorbent. Ideally the decay of individual sounds should take place uniformly and be prolonged for a time of the order 2.2 to 2.5 seconds at mid frequencies (250 to 500 Hz), and rather longer (about 3.0 seconds) at the lower frequencies (60 to 100 Hz).

If inter-reflections are to take a long enough time, obviously a hall must have a satisfactory value for the amount of absorption present. As a rough approximation, one allows 300 cubic ft per seat. The Ford Auditorium has only about 200 cubic ft per seat. Automatically, one's expectation is that reverberation will be too short. By definition, the reverberation time is the time it takes for a decay of 60 dB to occur, but whether a listener feels he is hearing the full reverberation depends a lot upon the shape of the decay curve, for if it departs substantially from a smooth fall, the length as defined technically will not correspond to the listener's impression, which is the only real criterion in the end.

It used to be assumed that the larger the hall, the larger the reverberation time should be, but now it is generally agreed that for any substantial hall a reverberation time of 2 seconds at mid frequencies is about right with a slight prolongation at lower frequencies. Much of this line of thought is due to Leo Beranek in the United States and C. W. Kosten in Holland, who has devised further simplifications which seem to give even more realistic predictions. These simplifications are so drastic that they seem to suggest that all halls could be turned out more alike than they are - supposing that to be desirable. In fact, it means that some of the traditional arithmetic is pointless with this new perspective, and always had less bearing than was supposed.

Reverberation is important, but the fact that it can be computed and measured more easily than any other aspect has given it undue prominence. What is equally important is the sound that reaches the ears initially. That is why, above, emphasis was laid on the value of a direct visual, and hence aural, view of all the sources of sound in a performance. The initial pulse of every individual sound makes our minds decide its direction and character, and its subsequent decay comes as a sort of savouring or appreciation period in which something in the nature of an aural aesthetic of the space is created.

Beranek, after an in-situ study of numerous concert halls over a period of years, came to the conclusion that a quality he called "intimacy" was desirable, and could be attained by ensuring that the initial part of the sound reaching a listener was followed quickly by a sideways reflection. Unhappily the initial application of this idea was to the Philharmonic Hall in New York where a misfortune diverted attention from assessing its value, and, so far, it has had no widespread effect upon acoustical practice.

However, Howard Marshall a New Zealand architect, working at the Institute of Sound and Vibration Research in Southampton, produced a more general theory of the same ilk, which indicates Beranek had a valid point: Marshall was able to postulate that an acoustical impression of a hall depends largely on what happens to reflections in the first one-tenth of a second after the initial sound is heard, i.e., reflections whose paths are not more than 100 ft. longer then the direct path. Marshall's "room response" seems to be an extension of what Beranek conceived as "intimacy".

Briefly, Marshall's argument was this: There is a moment lasting about one-fortieth of a second after hearing a strong pulse of sound, during which one is "blinded acoustically" to what follows - like the momentary effect of a flash of light-and there is no point then in receiving any more information at this time. If the reflection is from the same direction it adds to the "blinding" effect and, if from some other direction, it will not be registered. In this case "the same direction" includes a reflection from above the source of sound because as our ears are horizontally arranged we cannot distinguish easily the direction of sounds vertically related. Instead we need some strong information next from another direction after the necessary interval, which should be reflections from the side walls, and, as Beranek observed, they should have paths about 25 or 30 ft longer than the direct sound. An overhead reflection from the ceiling is then more or less inevitable - in fact desirable - and the last reflection likely to be obtainable in this critical period is from the junction between ceiling and walls. In this way, it seems, the shape of the room is appreciated acoustically, and one's sense of being enveloped by sound is enhanced.

Marshall's idea is still too new in our thoughts for us to have evaluated our listening experience in relation to it. But it seems likely that it goes some way towards explaining why we feel differences in the acoustical character of rooms.

It is generally reckoned that diffusion is a good thing. In particular it is accepted that it is valuable to have at least some areas of a hall's boundaries acoustically rough, which means the use of irregularities large enough to modify the reflection of waves of 10 ft in size or larger.

There is no doubt that the use of great flat planes for walls and ceiling introduces the risk that the reflections, which continue to take place after the initial one-tenth of a second, will cause irregularities in the reverberation that may prove to be unpleasant. On the other hand, large irregularities over the whole ceiling and wall surfaces may not be altogether good either. Bill Allen and Peter Parkin's preference is for moderation in the use of roughness, which should be on walls rather than ceiling, and should not entirely cover the walls. But, as so often is the case in acoustics, there are exceptions such as the Concertgebouw in Amsterdam - a great simple rectangular box in which some lovely sound is heard.

Finally in these design considerations we come to two psychological parameters that are no less important than the acoustical ones. First there must be concern for what happens on, around, and behind the stage - i.e., all the factors that make for a good performance and for a good initial shaping of what the audience will hear a moment later. It has been assumed too easily that nothing a designer does has any influence on the quality of performance, and too little attention has been given to the way the design of the performance end of the house influences what the audience hears - and of course what the performers themselves hear.

It should be self-evident that performers should be put into as good a frame of mind as possible to make their music, but musical people have had only fragmented opportunities to discuss their needs: proper lavatories and showers, comfortable rooms for the principals, a 'green room' with a view to provide space in which to warm up out of 'earshot' of the audience and a cheerful space in which to meet friends afterwards for the emotional run-down - a space incidentally which friends can easily reach. All this should be instinctive to the good designer in the provision of backstage facilities.

Then care must be taken in choosing the path along which the performers come to meet their audience. This is especially critical for the principals who have a particular rapport to establish for a successful performance. It is generally accepted that entry should be from the left as the audience sees the stage. This is not just a convention: It is the natural approach to keyboard instruments. Also it is the side of the first violins - the hardcore of most performances. It does not follow from this that entry must be on the extreme left. There is a strong backing for an entry just to the left of centre. Then that part of the path within view of the audience should be so laid out that the performer is always exposed to his or her best advantage. There is something to be said for an entry slightly above the platform, with a slight descent to the place of performance. Basically the principal performers must be given advantageous entry to etablish the 'rapport' with the audience which they will need from that moment on.

The performers must be placed in a situation that, as Sir Malcolm Sargent put it, "demands excellence". And they should be able to hear themselves together with others that may be performing or accompanying also. Among the surfaces that can surround an orchestra, the overhead canopy or reflector has become almost inevitable. Its purpose, however, is often misunderstood. When it is termed a reflector, it is often because it is believed the sound from the stage needs help in reaching distant seats, and it is angled accordingly. This is a mistaken belief. The sound should only need help if the basic design is not doing its job, and the help such a reflector can give can never fully correct a basic fault. The chief function of this element is usually to be part of the existing system for the orchestra, for which purpose it must be low enough to feed back quite quickly, preferably from no more than 30 ft above the instrument line. It could, of course, be part of the ceiling of the hall, but one must have big volumes to get long reverberation, and this generally results in ceilings much higher than 30 ft over the stage. The canopy therefore is normally to be regarded as a lowered section of the ceiling. But it must be aesthetic enough to draw the attention of the audience towards, and not away from, the performer.

Having mentioned "rapport" it must be remembered that the listeners too have a part in this. They must be in the best receptive mood possible. Rows should not be straight, for they have no focus and diminish concentration - one cannot see other faces and, without visual contact, it is difficult to share emotional experience. As the esteemed Hope Bagenal once put it, "There must not be a conflict of the optic and the acoustic". In a place where people face inward, the sense of sharing an experience can be tremendous.

Also the seats should not be too spacious and relaxing 'like an armchair at home' because this tempts individuals to retreat from the tension of participation. One should be helped to keep alert and to follow the performance.

Finally, to be truly successful, the whole building must give people a 'sense of occasion'. The Royal Festival Hall is the best example we know. There foyers are quiet, luxuriously absorbent places, and from these one passes through a very "deadened" sound lock to enter the hall itself where, in strong contrast, one at once senses a large and lively acoustic space, unexpectedly possessing (we believe) a quality of acoustic tension and excitement.

<u>The New Interior Design of the Ford Auditorium</u>

All the above factors were included in the considerations for a new interior design, but inevitably, economics severely restricted what could be done. The shell of the auditorium and stage had to be retained, of course, as did the floor, and its rake, both on the main floor and in the balcony. New carpeting and seats were installed, but these were a choice of a committee and any acoustic considerations were completely 'forgotten'. After installation it was found that the steel seat pans 'rang' and damping - with heavy building felt - was necessary.

The auditorium has a large pipe organ above the stage with, originally, four large openings into the main space of the hall. Organ louvres have been fitted to close up these openings when the organ is not in use. The ceiling - a very low one of only 35 ft maximum height - otherwise remains unchanged.

Large radius diffusion shapes, proposed by Vern

Knudsen, now form the side walls and the rear wall below the balcony - a position where a curved wall has long been known to be a potent source of acoustical problems because of the way it concentrates reflected sound. Strangely (to us that is) it seems to work very well. The front of the balcony has been curved also and given a slight downward tilt. Whereas the wall diffusers are of heavy plaster, with a surface of two browning coats, and one gloss finishing coat, the balcony facade is of one half inch plywood panelling. The sidewall lighting alcoves are covered except for two parts on the left and one on the right for necessary side lighting. If more side lighting is needed a hidden cupboard in the main box - the Christine Ford Box - can be opened to reveal a number of mountings.

On stage in the concert shell the original BBN-designed two-piece ceiling made up of tetrahedral shapes is all that remains of the original acoustic fabric of the auditorium. The sides and back of the shell are formed of convex diffusion shapes - moveable 2 inch to 2 1/2 inch plaster panels on a steel frame with rollers. Except on the front rail of the balcony, all the convex diffusers are of heavy plaster weighing more than 6 lb per square ft - to minimize vibration.

Finally the canopy (in front of the fire curtain), again of convex shape is new. It is made of fibreglass and at 80 ft by 25 ft is, we believe, the largest structural fibreglass panel ever made. It is held in place by twelve hoists which can raise, lower, tilt or bend it according to desires.

Back stage only a little decorating was possible.

## The Present Situation

After these design configurations were put into effect, the character of the hall was changed significantly. No longer does one have to shout to be able to converse between the stage and parts of the body of the auditorium. A conversation in a normal voice is now quite possible. The sound now received by the audience is clear and 'brilliant'. The entrance - which indeed is very tastefully done - and the seating go some way to creating an atmosphere of "excited tension". But the lower notes still need some correction. Initially, it was proposed that assisted resonance - which was, of course, originated by Peter Parkin - be installed to do just this. But cost considerations, so far, have not allowed this, which, we believe, would bring the performance of this auditorium as close to perfection, from an acoustical point of view, as possible.

In its present state, the auditorium has had glowing commentaries. The critics have applauded its acoustical response. The concertgoers too have been unanimous about their appreciation of its performance.

But all is not well. The Detroit Symphony Orchestra has a new Director, Antal Dorati and he, to whom most of all the auditorium must appeal in order to get truly great performances, is not entirely happy with it. It is our understanding that he believes the auditorium is a little too harsh at the lower frequencies for his music, and needs mellowing - which of course would be the effect of our proposed assisted resonance. And as a new director - like all others before him - he would like a brand new home for the Symphony, as is quite understandable. But it is suggested that the problem is not so much mechanical as psychological. Economics did not permit our ideas for backstage to be put into effect, and the existing facilities I consider inadequate for the needs of the performers. Indeed I have likened part of the backstage decor to that of a subway station.

It is here, backstage, that I believe some serious refurbishing is urgently needed. Until this hidden, non-acoustic, parameter is corrected the auditorium wil never be considered one of the greats. Only when the performers are one in accord with the auditorium will it reach the heights we believe its acoustics deserve.