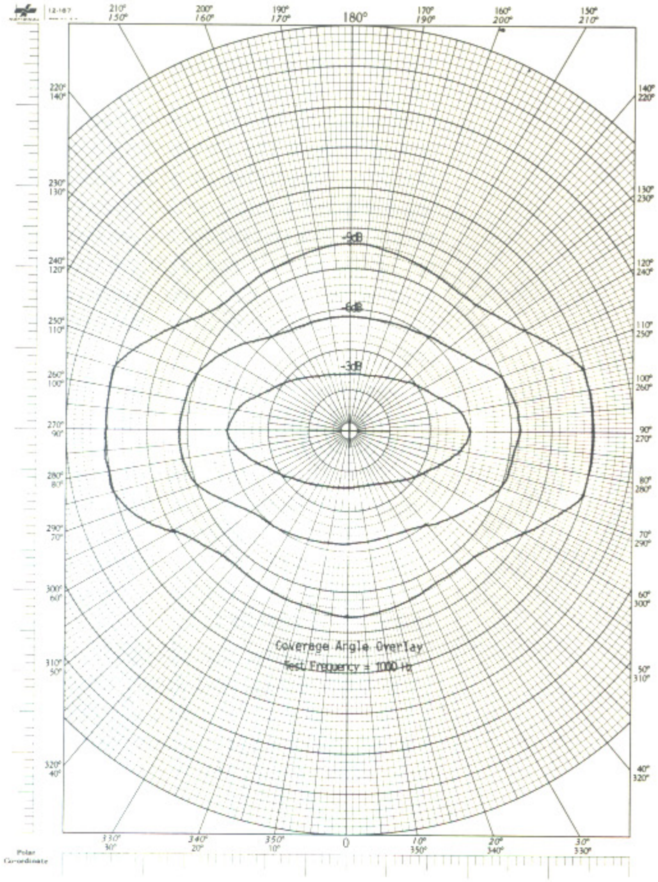

Figure 2.

and the bottom two horns and the woofers were aimed directly at the center of the floor seating section.

After the sound system had been connected with the power amplification and the various signal processing and program mixing equipment, the designer began what is always the final performance test: he began to listen to the system he had worked so hard to manufacture. As he walked around the church, he noticed that in many locations he could not understand what the speaker on the intelligibility test tapes was saying. He also noticed that the sound pressure level in the front and at the center of the seating areas were drastically higher than at the rear and the edges of the audience seating areas. The designer also found that the fidelity of the sound system was appreciably worse in the balcony than on the floor level. In desperation, the designer began to modify the equalization he had previously adjusted so precisely in the hopes of improving the fidelity of the sound system, but it was to no avail, the sound system could not be corrected with equalization.

Unbeknownst to Super Neeto Sound Company's designer was the significance of sound source dispersion and directivity factor. It may be helpful at this time to explain these two concepts in further depth.

Sound source dispersion, also known as coverage angle, is easily understood by viewing either polar charts or 3-D plots of the acoustic output of the sound source at a specified frequency. Usually the 6 dB down points are used to designate the dispersion angles in degrees, as shown in *Figure 1*. This measurement is made for both the horizontal axis and the vertical axis. With this information the designer is able to choose the sound source which will cover the audience maximally, but reduce the reflections of the sound source energy in the room to a minimum; thereby increasing the intelligibility of the program significantly. To further aid the designer, many manufacturers publish coverage angle overlays which outline the dispersion characteristics of the sound source as they would affect the audience area, as seen in *Figure 2*. There are now many price effective computer software programs which will simulate the dispersion of a sound source in a computer-generated replica of the environment the loudspeaker is to be installed in.

Directivity factor, also known as Q, is the ratio of the sound pressure squared, at a specific distance and fixed direction, to the mean squared sound pressure level at the same distance; then averaged over all directions from the sound source. Therefore, the directivity factor of a sound source is not an average measurement, but rather an average of all the individual Q measurements. Hence, an omnidirectional sound source would have a Q=1, and a hemispherical sound source would have a Q=2, and so on. What this means in practicality is that a sound source with a Q=1 would be half as directive as a sound source with a Q=2, and a sound source with a Q=4 would be twice as directive as the sound source with a Q=2. As seen in *Figure 3*, it is apparent that an increasing Q is directly proportionate to increasing sound source power, as long as the input power to the sound source remains the same. This is due to the horn's ability to take the acoustic energy of the sound source and tighten the dispersive pattern, thereby creating a more directive and concentrated output. As a result, utilizing higher Q loudspeakers make more efficient sound systems if the higher Q sound source conforms with the dispersion requirements of the system. But use extreme caution when installing high Q devices, for if they are not installed properly the adversity of the sound system can be as extreme as the profit. Additionally, not all manufacturers include the directivity factor measurement (Q) in their specifications sheet, but most will supply the information if it is requested.

So, applying the two concepts of sound source dispersion and directivity factor to Super Neeto Sound Company's installation, it is clear that some modifications need to take place.

Firstly, the balcony seating section would require a horn with a 70 degree by 40 degree dispersion and a Q of about 9. This sound source would considerably cut down the unwanted room reflections, and also increase the efficiency of the balcony horn and compression driver combination. In addition to changing the horn, its center axis should be aimed toward the seats in the center-rear of the balcony. By doing this, the sound pressure will remain more constant for the entire balcony audience due to the inverse square law; see appendix 1-0.