

### 3.0 Sound System (Design and Installation by Chuck Gehrman)

#### 3.1 Hauptwerk and Sound Production

The Hauptwerk program generates a digital audio stream which requires an audio interface to convert it to analog signals for amplification. The built-in audio of the Mac computer, while very good, is limited to two channels of audio out. Since Hauptwerk is capable of multiple output channels, and it was our intent to add voices to each division of the organ, the PreSonus Firestudio Project was chosen for our audio interface. This unit is moderately priced, and gives eight channels of output. Communication between the interface and the computer is by Firewire.

#### 3.2 Audio Channels

In order to have the digital voices blend with the actual pipes, it was necessary to have the speakers for each division physically located in that division. This has the additional effect of letting the organ's swell boxes provide a realistic crescendo and decrescendo for all voices in the division. It was decided to use the eight channels of output as four stereo pairs. The pipe organ consists of four divisions, Swell, Great, Choir and Pedal. Since we were adding a fifth division, the Antiphonal, the digital pedal voices were split between the Swell and Great speakers to place them near similar voices. The 32' Pedal Contra Posaune speaks from and is expressive with the Swell. This puts it in the same chamber as the 16' Pedal Contra Trompette pipes. The remaining Pedal voices speak with the Great, which puts them outside of expression and on the right side of the instrument in the same area as the rest of the Pedal pipes.

#### 3.3 Amplification and Speaker Selection

From the beginning of this project, it was our intention to add voices to the Moller organ that would be difficult or impossible to identify as non-winded. To this end, the decision was made to place most speakers inside the organ chambers so their output would mix normally with that of the pipes. The chamber placement meant that the directional characteristics of the speakers were not an issue. Horn speakers, which are efficient, but tend to beam their output, could be used since the chamber behaved as a mixing space. The decision was made to go with JBL Control 29-AV speakers as they combine relatively smooth frequency response with high efficiency and the ability (common to most speakers designed for PA use) to play quite loudly with little distortion. Once in place, the frequency response of each division was measured using white noise and a spectrum analyzer and appropriate correction applied to all samples intended for use in that division. The result was startlingly believable pipe sounds.

One stereo pair of speakers is used in each of the Choir and Great divisions. The Swell organ, which contains a number of powerful reed voices, including the 32' Pedal Contra Posaune, contains four speakers. To provide the copious amounts of clean power needed, it was decided to use Crown XLS 1500 amplifiers. These units have switching power supplies and are quite efficient and lightweight for their output. Each amp also has the ability to provide a loop-through output to mix for the subwoofers and a flexible crossover system with peak limiters built in.

In the Antiphonal Division, the speakers are four Bose 802 full range units. They are driven in stereo and equalized. Since they are not in a swell box, these voices are not expressive. They are mounted in boxes in the rear balcony openings. As such, they are the only clearly visible speakers in the organ, except for the subwoofers, which are not readily visible from the congregation.

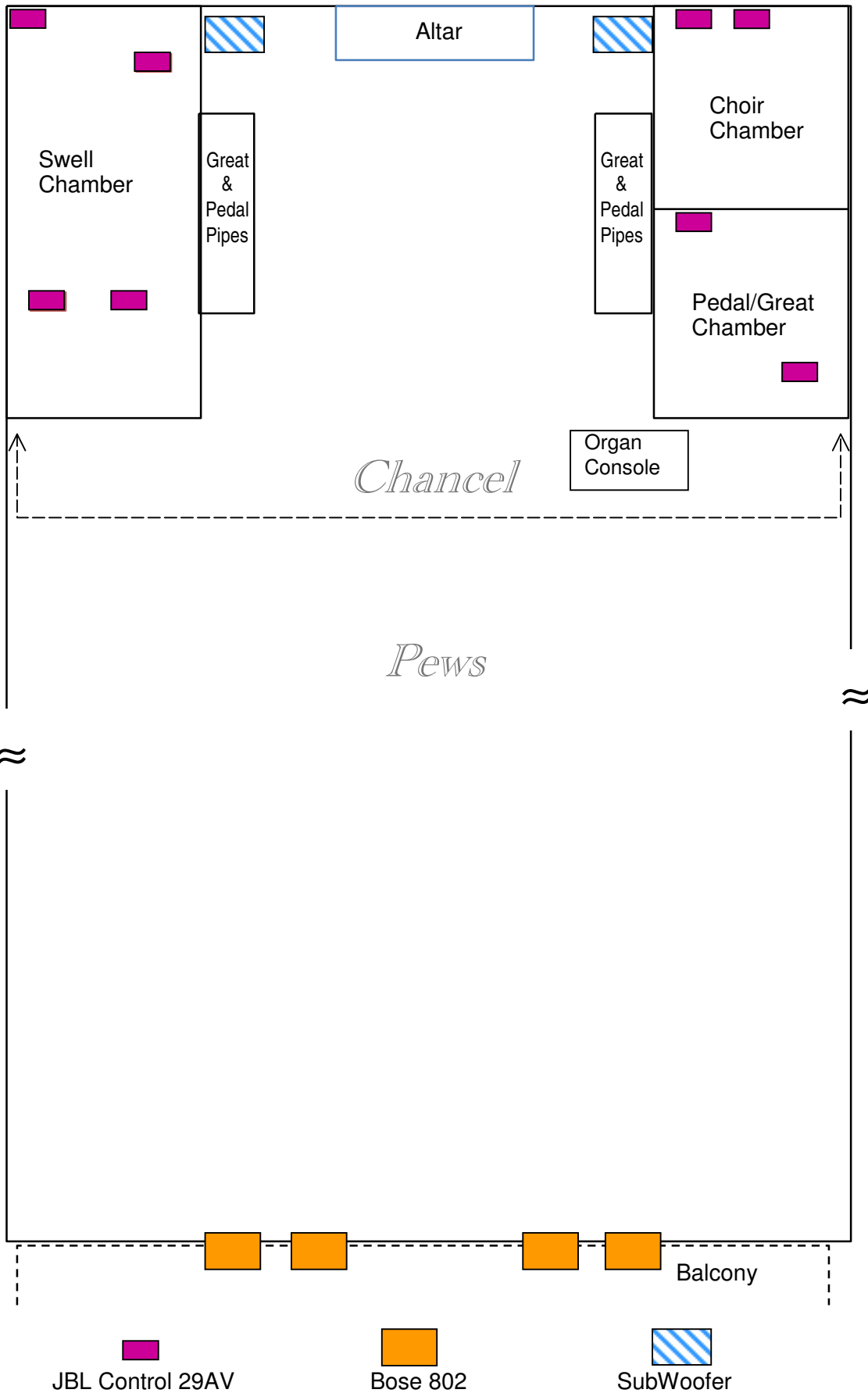


Figure 3.3. Speaker Placement

### 3.4 Routing of Channels and Audio Equipment Layout

The audio signals produced by the Presonus Firestudio located in the organ console are sent over an eight channel shielded and balanced snake to the Control Room beneath the Swell Organ chamber. The signals pass through the Audio Interlock and are distributed to four stereo amplifiers. The Choir Organ voices and the Antiphonal Organ voices are treated as full range signals and sent to the speakers in those locations. The Swell and Great voices include pitches below 8', including the various pedal stops. These amplifiers are set in Hi Pass mode, with the crossover frequency at 53 Hz. This sends all frequencies above 53 Hz to the speakers in the chambers. The unfiltered signal from each of these amplifiers is also passed-thru to the SubWoofers mixer. The signals from all four channels are summed and sent to the power amplifier for the subwoofers. This amplifier is set in Low Pass mode with the crossover frequency at 53 Hz. Thus all frequencies below 53 Hz are routed to the two SubWoofers cabinets. The physical layout of the equipment is shown in figure 3.4.1 below.



Audio Interlock

2 Power Distribution Units

Sub Woofer Amplifier

Great Amplifier

Sub Woofer Mixer

Antiphonal Amplifier

Choir Amplifier

Swell Amplifier

Figure 3.4. Audio Equipment Rack