PRACTICAL DESIGN AND CONSTRUCTION OF PIPE ORGAN CHAMBERS

by Lee Haggart

It must be understood that the suggestions contained herein are the result of many years of experience and are of necessity empirical. No exact formula for design can be given, since the variable factors of even a simple chamber are many and their effect decidedly complex. The usefulness of this article is that of a guide in design, based virtually in its entirety upon the actual tone chamber construction of satisfactory installations, past and present. Organ tone reflection rooms must meet the following requirements:

1. Unusually rigid supporting structure for walls, ceilings and floors.
2. Exceptionally smooth plaster finish, resembling glass as nearly as possible.
3. Rectangular shape, approximate ideal ratio 2:3:5, with avoidance of anything approaching a square form.
4. Grill openings as near to 100% of the largest side of the tone reflection chamber as possible.
5. Adequate cable conduits and power sources.

Now let's examine the above five requirements in detail.

1. Due to the intense sound pressure changes in the enclosure containing a pipe organ, a strain is placed upon the structure of the room itself. Medium or light construction will most likely result in sympathetic vibration of the supporting members and the walls, ceiling and floor. This condition will reduce necessary reflections by absorption of the frequencies causing the unwanted sympathetic vibration. Construction should, therefore, be of solid concrete, heavy hollow tile, or crossbraced wooden studding.

Concrete or concrete and steel construction, in almost any thickness is sufficiently rigid for chamber use. This is not meant to apply to concrete pre-fabricated slabs that are sometimes used as wall partitions between rooms. These slabs will not vibrate in sympathy with the higher frequencies, but will go into motion as whole units at low frequencies.

Hollow tile blocks when used should be of at least 4" width. Tile is probably the best material for the construction of the tone room. It is easily plastered, forms an extremely rigid wall and offers less transmission of vibration mechanically.

Wooden construction should use studding of at least 2" x 4" stock, strongly crossbraced, spaced on 16" centers as a maximum. The crossbracing is required to limit the possibility of the entire wall vibrating as a unit at a low frequency.

Plasterboards such as "Sheetrock," "Gyplath" and "Buttonboard" make excellent tone chamber wall, ceiling and floor construction. It is heavy enough in itself to resist vibration at middle and high frequencies, but it will respond at low frequencies if not well secured to studding and bracing. When used on floors of tone chambers it is, of course, necessary to install a rough finish floor first.

Metal lath should be securely fixed. In metal lath and plaster rooms, care must be used to support the open centers between the studding by means of wire or wooden bracing. Sympathetic vibration of metal lath often produces a low-pitched, penetrating "buzzing" sound.

Brick construction in any thickness from one brick width is satisfactory.

In all specifications for contractors or builders make it plain that solid, rigid, vibration-proof construction must be used; including one or more of the previously-mentioned materials or equivalents.

Doors or hatches when used must be of heavy construction, preferably with an "ice box" type of lock. The jambs should be lined with felt to limit vibration, and if a key-type lock is necessary, a padlock and felted hasp is recommended instead of a bolt or spring-type lock. The doorway must have at least a 42" clear opening to allow the passage of the pipe chests.

2. All pipe organ chamber surfaces should resemble glass surfaces as nearly as possible. Surfaces such as would be presented by glass would be nearly 100% reflective and would therefore be near perfection for tone rooms. A finish known to the trade as "Keen's Cement" is recommended for coating the interior surfaces, walls, ceiling, and where possible, the floor. Keen's Cement presents a surface not unlike that of marble or slate. If this particular plaster is not available, the material used should be of the "hard plaster" type and must be trowelled smooth. The plaster mixture must not contain large-grain sand or any of the many acoustic materials.

Under no circumstances should acoustical tile, acoustic plaster, Celotex or rock wool be used as a pipe organ chamber interior finish. These materials are designed to eliminate reflections and therefore defeat the purpose of the tone reflection chamber. Wooden walls, ceilings and floors may be used, provided care is exercised in making the construction solid. Here again, a smooth finish is essential. Finished tongue-and-groove (T&G) boards with a coating of "hard" Duco or some similar varnish or enamel will contribute to the reflective properties of the wooden surfaces. A hard varnish or enamel upon plaster finishes also aids reflection. "Masonite" and similar board may be used as interior finish. However, it is difficult to keep materials of this type from vibration unless extreme care is exercised in installation.

3. Organ chambers of rectangular form, in a ratio of width, height and length of 2:3:5 have proven most satisfactory. It is realized that each building presents both construction and acoustic problems and often it is not practical to build a rectangular chamber. In such cases, make the design as close to the rectangular as layout will permit. Avoid anything approaching the square in form. The square shape presents extremely difficult acoustic problems and is rarely satisfactory in tonal results. Triangu-

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lar forms work moderately well, particularly if the three sides are of rectangular shape, that is, the walls of a triangular chamber should approximate a rectangle in form. Ventilator ducts, water pipes or heating conductors must be vibration-proofed with hair felt or asbestos [not in 1982! -ed.] and should be covered where possible with a finish corresponding to that of the surface of the tone room. Where added cost will permit, it is beneficial, although not essential, that the corners of the tone chamber be "coved."

In particular, it is excellent practice to have the ceiling and wall corners on the grill side of the tone chamber coved. That is, a smooth curved surface extending from all adjacent surfaces to the edge of the grill opening itself.

4. In a tone reflection chamber based on the 2:3:5 ratio, a practical example would be, width 7'0", height 10'6", length 17'6". The largest side 10'6" x 17'6" should not be limited by the grill structure to less than 80% of this value, or approximately 8'3" x 14'0". A tone room limited by a grill of less than the optimum dimensions indicated acts like a Helmholtz Resonator and the opening itself becomes the virtual sound source. This causes severe unevenness in intensity throughout the complete frequency range of the organ.

Consideration must be given also, in calculating the grill opening, to the amount of blocking of the area that will be caused by the ornamental grillwork itself. It is not uncommon for grills to cut down the possible tone area by 50%.

To grillwork, also, applies the "must" rule regarding solid, rigid construction, with emphasis upon watching for possible vibration of the grillwork as a whole at the low frequencies. Ornamental or display pipework may be used if due care is observed in the use of heavy metal (or wood) in their construction. In considering this, remember that display pipes can easily cover all but 20% of the opening.

It is customary to cover the back of organ grills with some form of screening cloth. Usually, if not warned, the architect or builder will allow the drapery specification to be drawn by the interior decorator. This procedure usually finishes with the openings covered with heavy canvas or velvet drapes. Instances have been noted where, "for acoustic reasons," the decorator has put in hair felt backing upon heavy velour drapes!!! These materials are highly detrimental, as they absorb a wide range of the higher frequencies and cause the organ to sound "tubby" or "overbassed." Light net cloths or "metal cloth" drapes are recommended, as they cause but little loss of any of the organ tones.

Nylon or rayon cloth make excellent grill coverings. They are reasonably opaque to light, yet offer little impediment to sound.

5. All conduit runs for the organ cable; all wind conveyances (plumbing), all convenience outlets, lights and switches for either the console or organ chamber, should be installed by a competent electrician or metalsmith in accordance with local wiring codes.

In each chamber a duplex 115 volt AC outlet is required. The conduit and outlet can be placed anywhere except on the floor. It is preferable to have the entire floor clear. Of course, provision should be made for one or more ceiling lights.

It will be necessary to install a conduit (or Greenfield flex) between the console location and the organ chamber. A 3" conduit with a bend radius of not less than 36" will be required.

In any of the conduits intended for the organ cable the electrician should leave in the conduit run a pull-wire of about #14 AWG galvanized iron, or equivalent.

The wind lines must have all lengthwise seams soldered. All adjustable elbow joints and seams must be soldered completely around the pipe. All "joins" of pipe lengths must be completely soldered. Tinners and sheet-metal men are notorious for the use of "gunk" plastic to close seams and joints because they make wind conveyances for ventilation systems at low pressure wind. Organ-supply wind at almost any pressure will promptly blow out all of the "gunk" and paper tape and the wind lines will leak like a colander.

The material presented in this article has been condensed from a longer pamphlet written about 25 years ago for distribution to architects and builders. Many successful organ installations have used the principles outlined. Following these suggestions is good insurance for proper sound from your pipe organ. □

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