Phase I (Lobby E) | 1989 | 25,000 square feet
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Phase II (Lobbies C &D) | 1991 | 75,000 square feet
Expansion (Lobby B) | 2001 | 38,000 square feet
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**Total** | | **138,000 square feet**

**History (How did we get here?)**

Phase I terrazzo was installed by Advance Terrazzo and completed in 1989. Phase II installation was performed by the same contractor and completed in 1991. We had 100,000 square feet of terrazzo at that time.

Shortly into its lifecycle (around 1993), terrazzo issues and accelerated deterioration were noted. The installation was reviewed by the installation contractors and was believed to be caused by high point-loads resulting from small and hard wheeled carts and the high loads generated by forklifts. A sand cushion terrazzo floor is designed for 30 pounds per square foot loading. Exhibit Hall floors which are expected to bear forklift traffic on a daily basis along with significant loading due to displays and displayed machinery, are designed for a load of 350 pounds per square foot – a difference of a factor of 10.

To the dismay of many clients, fork-lift traffic was banned from the Terrazzo surface. Steel wheeled carts, very common in the local convention business up until then, were banned and decorators replaced the casters on all their equipment with polyurethane coated casters and acquired soft wheeled pallet jacks.

The rate of deterioration slowed slightly, but continued at a pace that was obvious would lead to this floor surface becoming undesirable in much less than the expected 40-50 yrs. During the very early planning stages for the expansion, this issue was brought to the attention of the Project Office by MCC management. Our desire was to have the original installation examined for defects as well as proposing solutions for the additional lobby space that were suitable for the convention trade.

The Expansion Project Office directed the study of the existing floor late in 1998. Sequencing of the fast-track construction process ultimately led to the results of the testing and final recommendations from the independent testing lab (American Engineering and Testing) to arrive on the project scene early in the year 2000. By that point in time, the bid documents for significant portions of the project were completed and on the street and the steel was already in place on the foundations.
At that point, it was not possible to incorporate some of the significant recommendations for the terrazzo floor. Among these changes for example was a thicker protective 'sand cushion' bed that would have necessitated changes to the elevations of 100’s of elements of the facility structure, many of which were already in-place. As a result, only some of the minor corrections could be made; such as an adjustment of the aggregate mix to include different ratios of fines (particle sizes in the mix).

The contractor winning the bid for the terrazzo installation in the expansion ended up being Advance Terrazzo, the same installer as Phases I & II. With a very similar design to the original and the same installer, it should come as no surprise that we have the same issues of deterioration on the expansion terrazzo as we have in Phases I & II. Based on our learning with the earlier terrazzo, there has been almost no heavy traffic on the expansion surfaces from the date of completion. As with Phase I & II, this has prevented the type of damage that you will see in the attached photo file.

The construction contracts for the terrazzo installations did not include any warranty beyond acceptance by the owner at substantial completion.

**Present Condition (What have we got?)**

The attached photos show typical examples of the major issues we face with the floor. Conditions include:
- Pitting of the surface - generally due to impacts
- Broken sections - particularly at corners and intersections in the design with tight angles
- Spalling – damage to the edges of a section as the corner surfaces erode away due to impacts and increased forces at joints
- Cracks – some are related to structural shifting, others to shrinkage
- Shrinkage – cementitious material shrinks for some years after installation and controlling and accommodating this shrinkage is somewhat of an art

Of our 138,000 square feet of floor, we have about 400 square feet that we consider to be acceptable for a world class facility. That would be the section that we had done 1 year ago to the final specs in this report. Of the remainder of the floor about 80% (or 110,000 square feet) contains sufficient cracks and spalling that cursory inspection will readily yield a comment of “What happened here?” and perhaps 20% (or 27,000 square feet) contains minimal enough deterioration that it could pass a casual viewing.
Investigative Efforts (What we have done)

The original MCC floor maintenance process (1989 – 2001) consisted of traditional Waxing and Stripping along with spray-buff to keep up the shine. This is the same process one would use for commercial vinyl tile floor and is not recommended for the maintenance of terrazzo. Stripping chemicals and waxes are hazardous and are high in VOCs (Volatile Organic Compounds). Wax products age to yellow and look dirty very easily.

Following our steep learning curve as we explored the issues with Phase I and Phase II terrazzo and in concert with recommendations from the terrazzo installers, our current maintenance consists of buffing the high polish areas with neutral cleaner and no sealing chemicals. We are slowly removing built-up wax seal layers in Phase I and Phase II areas as we do annual maintenance. These measures will address the appearance but not the structural integrity of the floor surface.

We received and experimented with a variety of long-term maintenance plans and methods over recent years. These are highlighted here:

Recommendation from Advance Tile & Terrazzo installers during the Expansion completion (2001)
  Strip wax, grind, buff with neutral solution
  Does not address structural integrity issues
  Does not address inevitable staining due to food service

Urethane Coating
  Strip wax, grind floor surface, urethane coat
  Scuff and re-apply urethane as needed to maintain finish
  Does not address structural integrity issues
  Wear-through was quick and entails frequent use of high VOC chemicals

Acrylic Coating
  Strip wax, grind floor surface, acrylic coat
  Scuff and re-apply acrylic as needed
  Does not address structural integrity issues
  Wear-through similar to urethane, also requires frequent use of high VOC chemicals

Epoxy 2-part Coating Option
  Yellows with age
  Extremely difficult to work with
  Does not address structural integrity issues
  Most toxic chemical use of all methods
Conclusions (How are we going forward?)

Following multiple vendor contacts, information from industry sources, recommendations and the experience of local suppliers, confirmation from independent testing agents and our own experience; we can identify 2 major parts to this solution: 1) structural issues of the floor surface itself and 2) long term custodial maintenance and cleaning procedures.

To address the long-term structural integrity of the terrazzo floor surface, we need to correct the effects of shrinkage. The repair regimen will be aimed at restoring the monolithic nature of the terrazzo surface. This will eliminate the damage caused by traffic at the current gaps and openings. With the areas of the floor being 18, 16 and 6 years old now, the vast majority of shrinkage has occurred and the floor surface can be addressed to repair the gaps and cracks that resulted.

Shrinkage in every one of the thousands of terrazzo sections has allowed gaps to form near the edges and at the divider strips. The resultant spalling along all those edges has generated the wide-spread pattern of damage that is clearly visible with only a quick tour of the floor.

What is spalling? Gaps at the joints leads to increased stress at these points as rolling loads “drop” just slightly “off the edge” and impact the other side. Our terrazzo is a cementitious product and is friable and subject to fracture under these minor impacts. With the large amount of exhibitor and public traffic in addition to normal show activity, our floor is subjected to millions of individual journeys by wheeled loads of all sorts. Each of these journeys impacts the joints of a hundred or more sections on our floor. It is the combined effects of 100’s of millions of impacts at the joints (with the gaps) that generates the overall pattern of damage and wear concerns that you see in our pictures.

There are a variety of additional concerns of a lesser nature related to building shifts, installation errors and construction sequencing that will be addressed at the same time we repair the floor, but these are not the primary cause of concern.

Consensus opinion is that our shrinkage issue is repairable without replacement of the terrazzo. We need to restore the monolithic nature of the floor surface to avoid the edge impact issues that create the spalling. Because we can repair the existing floor without demolition and replacement, we have reduced our original 2-year capital request from a total of $5 Million to $3 Million to recognize the savings of repair in-place. This work will take place primarily at night from now until shortly before the RNC in the Fall of 2008.
MCC staff developed an RFP to accommodate all the lessons learned from our investigations and history. This RFP includes a provision for warranty of the floor repair along with the requirement for vendor service following the repair work. The RFP is currently under review by the PRC and SUBP prior to its publication.

The repair process will consist of steps similar to these:

- Remove and re-grind all loose divider strips
- Reinstall appropriate dimensioned metal divider strips
- Patch spalled edges at all divider strips
- Epoxy inject all new and remaining divider strip areas to achieve monolithic floor surface
- Repair or replace all damaged (cracked and pitted) sections
- Replace all temporary repairs
- Using polishing stones and hardeners, bring the terrazzo surface to a gem-like level of polish.
- This surface does not require chemical coating or sealing (very much like a polished gemstone)

Our final test patch has withstood a calendar year of wear without chemical coatings. It has not stained nor shown visible wear. The polished surface looks fantastic and maintains a slip-coefficient well within guidelines for safety.

The second major concern was daily maintenance of the floor finish. Our new procedures will comply with the requirements of the new highly polished finish. The nature of the repair, which leaves the floor in a permanent state of high polish alleviates the need for sealing chemicals and chemical stripping solutions. Daily custodial upkeep will consist of buffing with a neutral cleaner. Quarterly inspections will be made by the terrazzo service contractor to catch any developing issues as a very early stage.

Some localized damage will inevitably occur as the result of normal show activity. Things get dropped and pallets with exposed hardware get dragged across the surface. The contractor will provide on-call re-polishing of those areas. Essentially, the Convention Center custodial staff will maintain the cleanliness of the floor and the contractor will maintain the polished stone surface and structural integrity of the floor.
Midfield crack with shrinkage visible at metal divider strips
Typical mid-field cracking
Effects of spalling at midfield crack
Shrinkage with visible temporary repair
Shrinkage at metal divider strip with resultant spalling

Metal divider

Resultant Spalling
Shrinkage and Spalling
Terrazzo from oldest sections shrinkage with extensive spalling