CASE STUDIES OF HMA CONSTRUCTION PROJECTS

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ABSTRACT

One of the best ways to improve performance of HMA or any other material is to look at past projects and identify things that have worked well and things that have not worked well. Several projects will be discussed that had experienced performance problems or that had exceptional performance. Some of the problems include premature cracking in longitudinal joints, potential FOD issues due to segregation of materials during construction, clay balls in HMA, organic materials in HMA, and percolation of water from underneath the pavement. The causes for these problems along with steps that can be taken to minimize these problems in the future will be identified.

One good performing project that will be discussed is a project in Alaska that was overlaid in 1976 that has continued to perform well to this day. It was the first project constructed by the military that used a specification having reduction in pay clauses for in-place density. The mixture properties and construction methods used for this project will be discussed along with a discussion of the observed performance to date.

1. INTRODUCTION

There is a need to provide good quality control during mix design and construction of hot mix asphalt to ensure that good performance is obtained. Many pavements have been observed over the last few years where early repairs were needed to solve a problem that was the direct result of construction deficiencies. The first item that will be discussed will be the good performance of an HMA pavement overlay in Shemya Alaska where an existing runway pavement was overlaid in 1976 and has not been overlaid since. Some maintenance is now done yearly to seal cracks and to patch areas that need patching but no overlay has yet been required. The performance of this overlay to date has been outstanding.

The second case study involves projects that have had segregation during construction which leads to raveling and potentially FOD issues. Visual observations should identify this segregation problem during construction thus giving the contractor an opportunity to solve the problem. So the first step is to identify that there is a problem and the second step is to solve the problem once it has been identified. There are a number of things that can be done to solve segregation problems if the problem is identified but if it is not identified, continued segregation can lead to performance issues.

The third study involves pavements where clayballs appeared in an overlay shortly after construction and after some rainfall had occurred. The clayballs are sometimes not obvious during the construction process but appear shortly after rainfall resulting in swelling of the clay particles sometimes resulting in some material popping out causing FOD issues. Clayballs are often identified when the construction is still underway resulting in a need to solve the problem before additional work can continue.

The fourth project to be discussed involves seepage of water up through an asphalt pavement surface. This seepage is not normally expected but it is something that occurs fairly often. For the water to seep up through the pavement one generally needs three things to occur. The mixture needs a significant amount of voids in it (at least 6 to 8 percent or more), water needs to be near the pavement surface, and hot weather needs to occur. If the asphalt surface is fairly dense resulting in low voids and low permeability then it is not uncommon for blisters to occur in the pavement during hot weather since the water vapor can not escape through the voids in the mixture and hence the build up of pressure resulting in blisters.

2. LONG LASTING PAVEMENT IN SHEMYA, ALASKA

The long lasting pavement was constructed in Shemya, Alaska in 1976. The old pavement was originally completely reconstructed in 1967. Then in 1976 a new overlay had to be placed over the existing surface primarily due to cracking and raveling at the longitudinal joints (Figure 1).

Figure 1. Cracking and Raveling of Longitudinal Joint.

The repair specified that some high spots be removed with a heater planer and that some low spots be patched with a leveling course of HMA. After the planing and the leveling course was placed, the entire surface was overlaid with a two inch layer of hot mix asphalt (Figure 2).

Figure 2. Placement and Compaction of 2-inch overlay.

It can be seen from Figure 2 that a significant amount of compactive effort was provided to the hot mix asphalt. The primary reason for this high effort was that this was the first airfield pavement project that had a reduction in pay clause for density not meeting the specification requirements. The density of the mixture was measured in the mat and in the joint and the results were evaluated separately. When the density was slightly below the specification requirements a reduction in pay was applied based on the density but the material was accepted at this reduced cost. When the material was significantly below the specifications then the material would have to be removed and replaced. Of course this type of specification encouraged the contractor to apply additional compactive effort to ensure that adequate density was obtained.

Some facts about the construction and testing results are provided below:

1. Temp during construction ranged from 40 to 55 degrees F.
2. Winds generally ranged from 10 to 30 mph.
3. It was overcast, foggy, and windy about 90% of the time.
4. Paved width used was 25 ft.
5. Average lot density in mat ranged from 97.7 to 99.1% of lab density except 1 lot when average density was 96.1%
6. Average joint density ranged from 95.2 to 98.0% of lab density except for 1 lot when joint density was 94.1% of lab.
7. There were a total of 14 lots and the lowest average joint density and lowest average mat density occurred in the same lot.
8. Standard deviation of mat density results was 1.07 and the standard deviation of the joint density results was 1.43.

The gradation results are provided in Table 1.

Table 1. Average Gradation Results for the Project.

Sieve Size	Average	Standard Dev.
3/8 inch	96.8	1.2
No. 4	72.2	2.1
No. 8	51.7	1.4
No. 16	38.3	1.2
No. 30	28.4	1.5
No. 50	16.7	1.2
No. 100	9,4	1.3
No. 200	6.9	1.0

Testing showed that the density results and the gradation results had very low variability and that the average was very close to the desired amount. For example, typically on an HMA construction project the standard deviation of density results is approximately 1.5%. On this project the standard deviation was approximately 1.0%, indicating that the overall compaction results were very good.

The gradation results were also very good. Typically the standard deviation for the middle sieves for the gradation is 2.5 to 3.0 percent but for this project the standard deviation for these sieves was generally 1.5 percent or less.

At the time this report was prepared this pavement surface had performed well for over 30 years with only minor maintenance. The level of annual maintenance required for this pavement has significantly increased during the last few years. Figures 3 and 4 show some of the maintenance that has been performed in recent years.

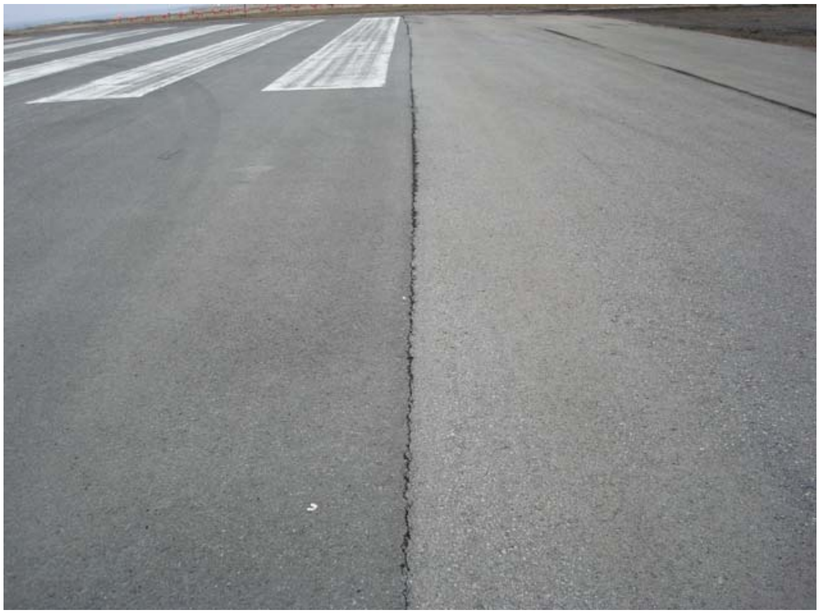

Figure 3. Longitudinal joints that have cracked and been sealed

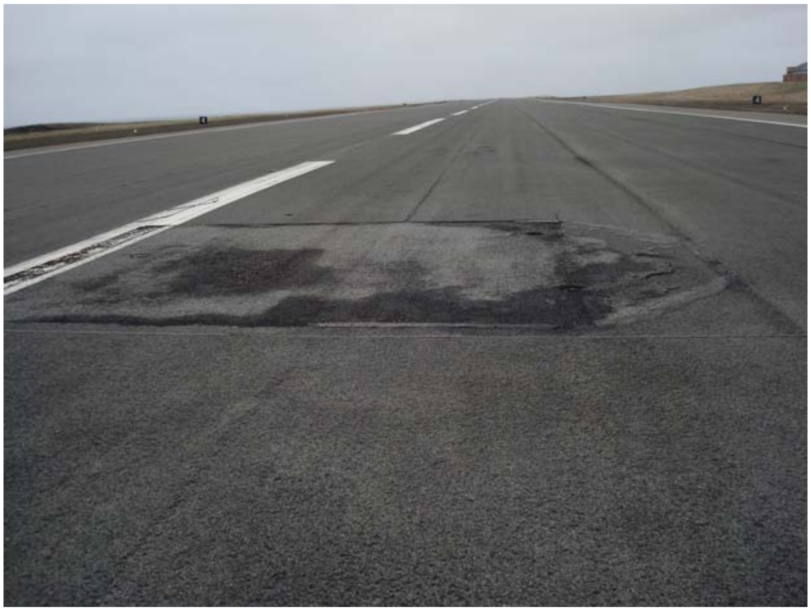

Figure 4. Patching that exists on the 31 year old pavement.

Figure 3 shows that much of the pavement surface is still in good condition even though some sealing of the longitudinal joint has been required. Figure 4 shows that an old patch has deteriorated to the point that it will have to be patched again in the near future. In general, most of the pavement is still in very good condition especially considering that it is over 30 years old. The conclusion from this project is that good control of materials and good compaction will help ensure a long pavement life.

3. EXPERIENCE WITH SEGREGATION

Segregation of the aggregate in hot mix asphalt has been a problem on many projects. While segregation is sometimes a difficult problem to solve, it can almost always be minimized so that it is not a significant issue. Steps to minimize segregation include controlling the stockpiles, proper loading of the storage silo, proper loading of the trucks from the silo, using a material transfer vehicle, proper operation of the paver, and minimizing handwork.

A typical project that has significant segregation is shown in Figures 5 and 6. The areas shown in Figure 6 will most likely ravel with time resulting in FOD

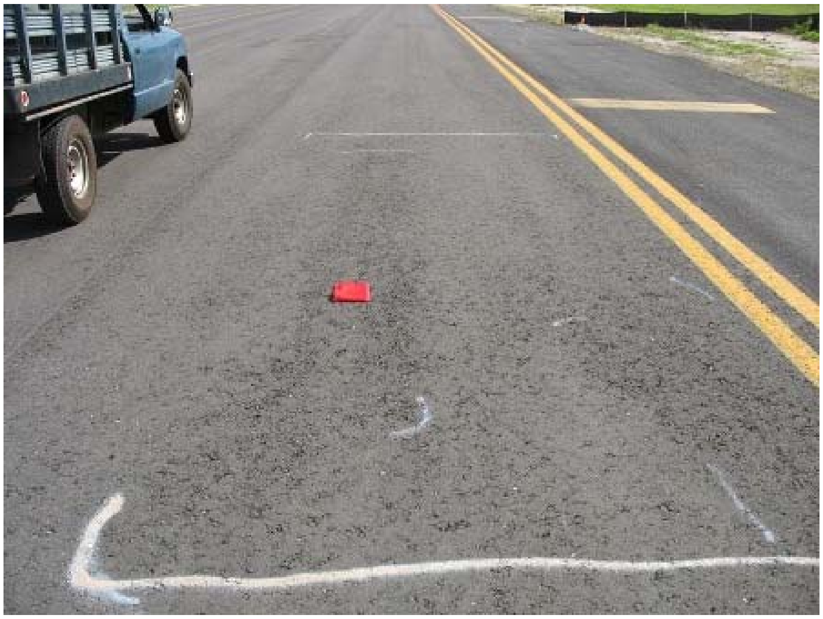

Figure 5. Surface of Pavement showing Segregation.

issues and the need to patch the area. Segregation happens on too many projects and in most cases this can be prevented. The problem must first be identified and then steps made to correct the problem. Without correcting segregation issues, the pavement life will be significantly reduced.

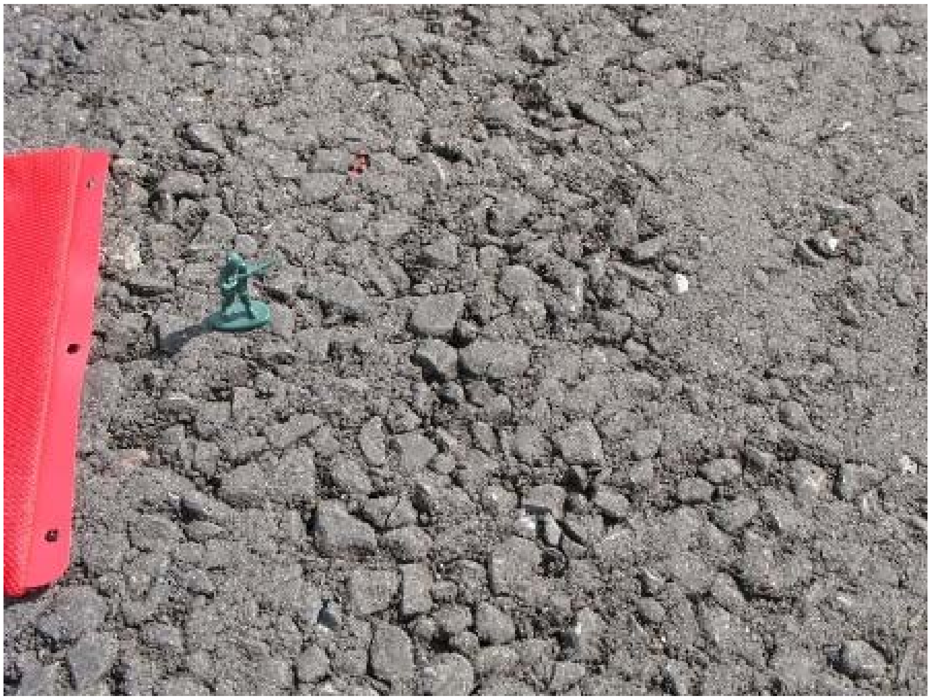

Figure 6 - Close-up of Segregated area showing porous surface.

4. EXPERIENCE WITH CLAYBALLS OR ORGANICS IN HOT MIX ASPHALT PAVEMENTS.

It is important that the production of asphalt pavements ensure that no contamination from clayballs or organics occurs. When contamination does occur this can result in significant pavement issues such as pop outs and may lead to FOD problems.

Clayballs can be found in many natural sand stockpiles and are sometimes found in seams in a quarry that may end up in the crushed material. Also, there has been at least one instance where the clayballs were found in the settling pond where the fines were wasted. A front end loader was used to clean out the settling pond and then used to load the crushed aggregate into the cold feeders. The clayballs were inadvertently transported from the settling pond into the stockpiles with the loader and thus resulted in contamination that caused the clayball problems. A picture of one of the clayballs is shown in Figure 7. Close inspection should be made during construction to ensure that clayballs are not used in HMA. If clayballs do exist some popouts and likely some FOD problems may occur.

Figure 7. Removed sample of HMA showing clayball.

There have been a number of problems where contamination with wood chips has occurred. One project was constructed where wood chips were observed in the pavement surface (Figure 8) shortly after construction was completed. Generally the wood chips will not cause a significant problem if they are not excessive or if they are not too large. The wood chips are likely to swell and cause FOD problems if not controlled. The wood chips normally come from natural sand stockpiles.

Figure 8 - Contamination of HMA with wood chips.

5. EXPERIENCE WITH MOISTURE FLOWING OUT THE SURFACE OF A PAVEMENT

It is important to provide a way for moisture to be drained from underneath an HMA pavement. This has been done in several ways including using porous mixtures, subsurface drainage, etc. However, there are many pavements that are built where the moisture causes some problem with performance. One problem that occurs when there is moisture near the surface of the pavement is drainage of the moisture up through the surface. This generally occurs when moisture is near the surface, the temperature is hot, and the surface has enough porosity to allow the moisture to vaporize and rise through the surface.

A typical example of the water draining out the surface of a pavement is shown in Figure 9. Typically this does not result in long term performance issues but it does have the potential to be a problem. Often the water gets underneath the pavement surface due to rainfall during construction. For this type of problem the water underneath the pavement may evaporate with time and not continue to be a problem. Sometimes water gets into the pavement from underneath. In this case it is more likely to result in performance issues since the moisture will continue to be a problem during the life of the pavement.

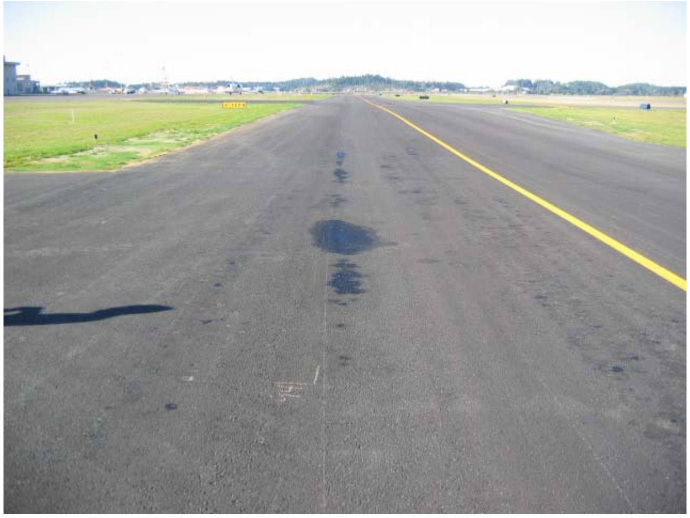

Figure 9. Water flowing out the surface of a pavement.

When the moisture is trapped underneath the pavement due to the surface mixture not being permeable blisters may occur (Figure 10). These blisters are caused by the water vapor. It is important that these blisters be punctured so that the water vapor can escape and the HMA can rebond to the underlying layer. If the water is not allowed to drain out of the blister, debonding around the blister may occur eventually possibly in a pothole.

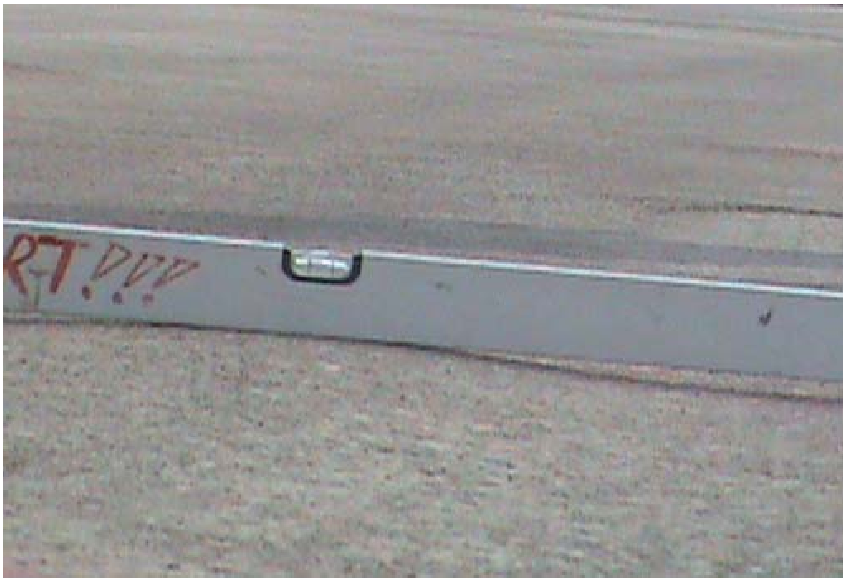

Figure 10. Blister caused by Water Vapor underneath the Pavement Surface.

6. SUMMARY

One project was discussed that had performed well for 31 years. It is essential that construction problems be minimized in order to ensure that good performance results.
There are many problems that may result during the construction of an HMA project. It is important that these problems be solved during the construction process to ensure good performance.