Engineering
UPDATE©

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From Research to Practice

Having different geotechnical design and field engineering firms is not an uncommon practice. However, this may result in the architect or civil engineer being forced to be the intermediator and play an active role in directing the geotechnical aspects of the work.

Many times, this does not present a problem, but because this is not the architect's or civil engineer's expertise, misduplication of what is required can be significant on more difficult projects.

If, however, the geotechnical designer and/or inspector are one and the same, the architect or civil engineer plays more of a supporting role, and any animosity which may exist between the geotechnical designer and inspector is removed.

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HANGAR SLAB ASSESSMENT FOR POOR, AS-BUILT SUBBASE/SUBGRADE CONDITIONS

After construction, concern existed over the as-built conditions of a hangar slab at an international airport. Upon investigation by MEA, it was found that neither the subbase nor subgrade met the engineering properties assumed in the design. In fact, the slab thickness was locally below the minimum specified. The specified hangar slab system is provided in Figure 1.

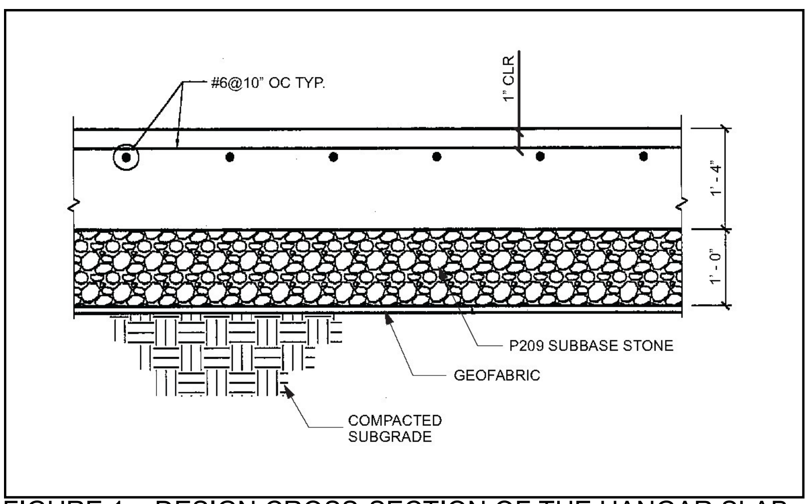

FIGURE 1: DESIGN CROSS-SECTION OF THE HANGAR SLAB

Based on field and laboratory testing of the subgrade soils, the reaction modulus was estimated to typically range from 25 to 100 pci. Considering the as-built subbase thickness, the combined modulus would be on the order of 40 to 150 pci, which is far below the slab design value of 200 pci. In other words, the constructed slab had much less support than what the design called for. Fortunately, lower aircraft loads were planned than what was considered during design. The hangar floor was tested under the above as-built conditions to see if these lower loads could be handled. The concrete joints and slab panels were field loaded using a heavy-weight deflectometer (HWD). A photo of the HWD is shown in Figure 2.

When modeling the HWD deflection characteristics of the slab

FIGURE 2: HWD PERFORMING TEST OF HANGAR SLAB

and the range of combined reaction modulus conditions, it was found that the slab had sufficient capacity, thus avoiding very significant rehabilitation costs. Now, after several years in operation, the slab has performed well, validating the conclusion reached by MEA.

On this project, a complex web of contract specifications resulted from various input from civil, structural, geotechnical, and architectural engineering firms. Although a detailed and careful analysis would have unraveled these confusing contract specifications, they resulted in the misapplication of the intended specifications was exacerbated by the use of a different company for slab construction, rater than the geotechnical designer. To further complicate the matter, the geotechnical designer provided recommendations when it was virtually impossible to achieve the intended as-built conditions given the subgrade soils.

Laboratory testing had shown that the specified soil subgrade would not hold up and would swell with moisture (see Figure 3). In addition to the subgrade softening, the associated, but inconspicuous, swelling also becomes problematic upon exposure to moisture as it raises the grade which in turn requires the stone and/or concrete thickness to be cut in order to meet the specified floor surface elevation.

Problems arose when it was recognized that the as-built hangar slab/soil support system was not installed as per the design. The concern was that severe slab damage would possibly result once the support system was loaded with aircrafts.

The potential soil support problems were discovered late, as the geotechnical designer was not involved in the day-to-day slab construction activities in order to ensure that the design intent was being followed. Moreover, the specifications developed were not practical for the subgrade soils present. Despite this sub-standard construction, MEA found through HWD and other testing that the as-built slab could sustain the anticipated aircraft loads.

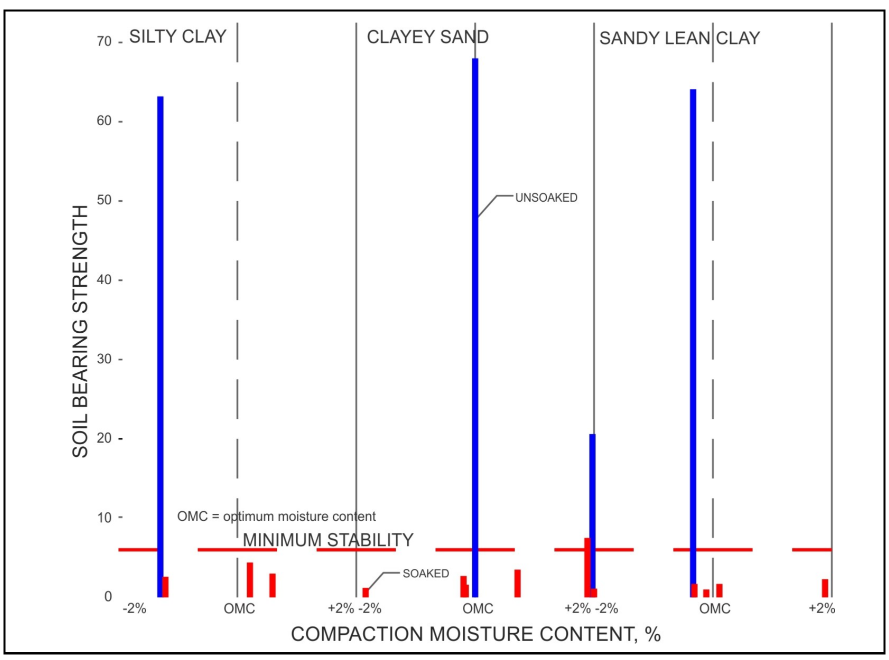

FIGURE 3: SOIL SUBGRADE STRENGTH COMPACTED TO SPECIFICATIONS BEFORE AND AFTER SOAKING

Other Engineering UPDATES of Interest:

UPDATE 28: Airport Pavement Subbase and Subgrade Preparation Difficulties

UPDATE 7: Soil Provides Poor Road Construction Support

UPDATE 12: Investigation of a Roadway Failure

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 24 states in the U.S. Our projects primarily have an emphasis on Geotechnical Engineering, however, we also have significant experience in projects involving transportation, subsidence engineering, laboratory testing, training, and geophysical exploration. Gennaro G. Marino, Ph.D., P.E., D.GE is president and principal engineer of Marino Engineering Associates, Inc., and has been a licensed professional engineer since 1984. To obtain additional information on MEA, one can also visit our website at www.meacorporation.com.

FOR MORE INFORMATION: There is a significant amount of additional information that is available on the above subject. For more information, please contact Dr. Marino at the address listed below.

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