Sustainable Road Construction Product Technology

EMC SQUARED®

Advanced Stabilization Technology

MAJOR COST SAVINGS
HIGH STRENGTH
BIG GREEN BENEFITS

EMC SQUARED System Specified by U.S. Army Corps of Engineers For Over 116 Miles/187 Kilometers of Main Supply Routes

Advanced Stabilization Technology Reduces Construction Costs and Environmental Impacts on $60 Million U.S. Army Corps of Engineers Projects at Fort Bliss.

Strong Roads That Retain Full Strength Under Heavy Loading at Both Low and High Temperatures – Field and Laboratory Test Results

Stabilization Products LLC

Stabilization Products LLC

Cost-saving Clean Technology for Stabilization of Aggregate, Soil and Recycled Pavement Materials

INCLUDES FIELD AND LABORATORY EVALUATIONS

Advanced Stabilization Technology Reduces Construction Costs and Environmental Impacts on U.S. Army Corps of Engineers Projects at Fort Bliss

Projects: **Fort Bliss Tank Trail Repairs, Phases 1,2 & 3**
Total Value of Construction Contracts: **$60 Million**
Project Owner: **U.S. Army**
Project Engineer: **U.S. Army Corps of Engineers**
Construction Management: **U.S. Army Corps of Engineers**
Stabilization Product Technology: **EMC SQUARED® System**

Convoy of Heavy Equipment Transporters (M-1070 HET) with GCWR's of 243,400 Pounds Moving Abrams M1A2 Tanks on High Strength Stabilized Aggregate Surfaced Roads

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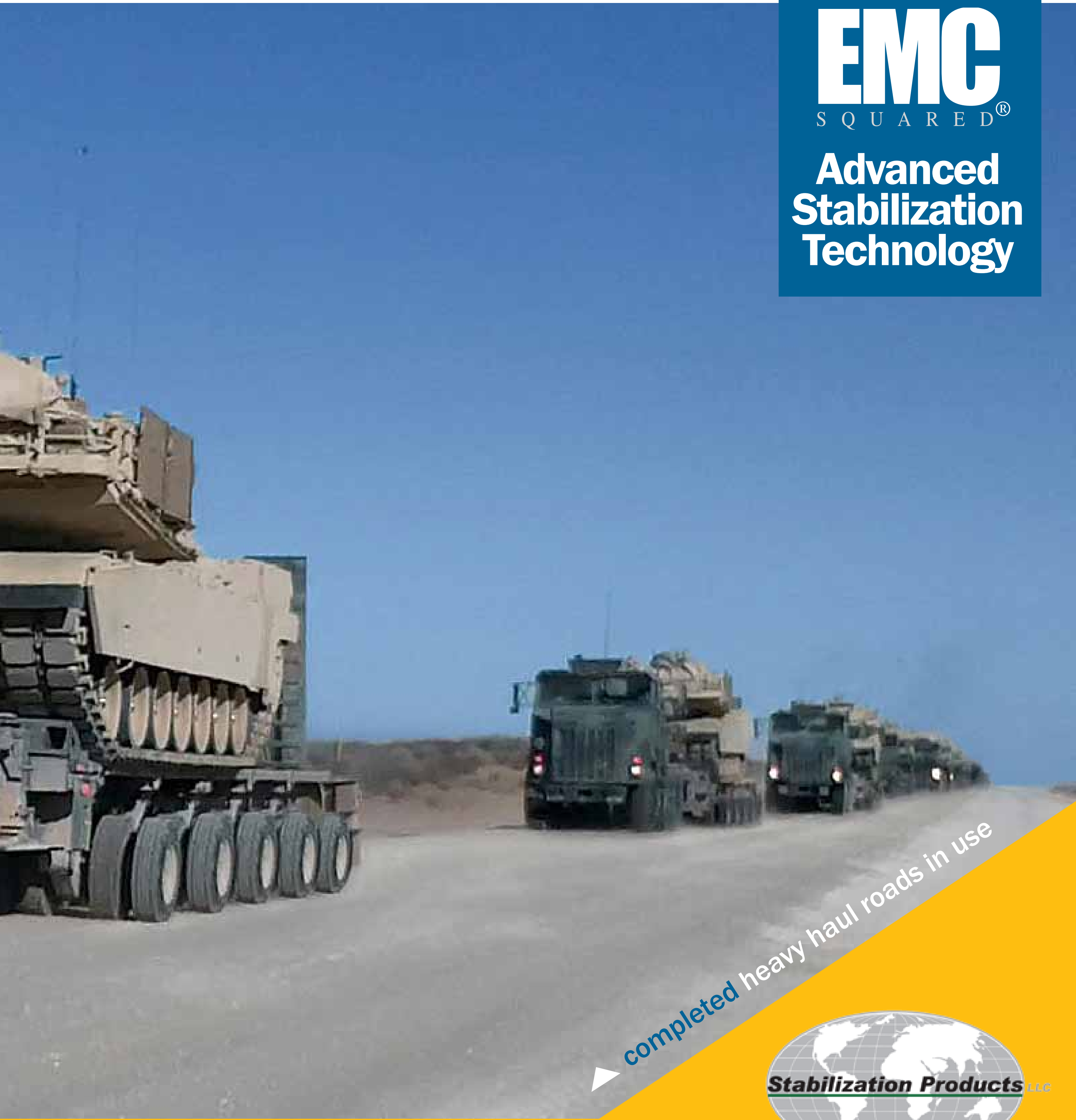

► completed heavy haul roads in use

Stabilization Products LLC

Advanced Stabilization Technology Reduces Construction Costs and Environmental Impacts on U.S. Army Corps of Engineers Projects at Fort Bliss

Subgrade Stabilization with Disc Mixing of Stabilizer Treatment

Fort Bliss Location and Environment

Fort Bliss is the Army's second largest installation following the adjacent White Sands Missile Range, and the Army's second largest Maneuver Area for heavy armor training activities. Fort Bliss headquarters are located within the city limits of El Paso, Texas, with most of the training area and practice ranges located to the north in southern New Mexico. The area has an annual average of twenty days over 100°F and sixty nights below freezing. It has also experienced as much as two feet of snowfall in a single storm. While rainfall averages 9.4 inches per year, extremely heavy summer monsoonal thunderstorms can create severe flash flooding and have generated as much as 15 inches of rainfall in a single week. The area is subject to high winds and blowing dust for extended periods during the spring months. Fort Bliss has hundreds of miles of unpaved heavy haul roads, also known as tank trails, main supply routes, or MSR's. These roads service convoys of heavy military equipment including M1A2 Abrams Tanks, Bradley Infantry Fighting Vehicles and M-1070 Transporter units approaching their GCWR's of 243,400 pounds when moving Abrams Tanks around the base on heavy duty semi-trailers. The old rough running road system at Fort Bliss had historically taken its toll on the fuel consumption and maintenance costs for the military equipment operating on these main supply routes.

U.S. Army Corps of Engineers

Three contracts were awarded by the U.S. Army Corps of Engineers through the MATOC program to remedy these problems on eight heavy haul road routes. The work included raising the road profiles to improve drainage conditions, construction of concrete low water crossings and placement of culvert structures and construction of an unpaved road structural section capable of supporting the extremely heavy loads. These heavy haul roads were constructed over more than 116 miles of varying soil types and drainage conditions to support frequent heavy loading, even through episodes of extended heavy rainfall. On just one of the heavy haul road construction phases, the contractor reported 22 distinct soil types over the length of their project. The new Fort Bliss heavy haul roads support loads far heavier than those allowed on the Interstate Highway System through all the region's extreme weather conditions, and do so without the need for protective asphalt or concrete pavement surfaces.

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Delivery of Stabilized Aggregate Mix from Pugmill Mixing Plant

Bid Options Provided to Contractors

Faced with a limited repair budget but still with the need to stretch available funds to cover the reconstruction of as many miles as possible at Fort Bliss, the Army Corps of Engineers design staff gave bidding contractors two options. Contractors could provide bids based upon constructing the heavy haul roads with two layers of crushed aggregate, each layer being eight inches thick, or the second option specifying the EMC SQUARED Stabilizer product. The stabilized design required construction of a twelve inch layer of stabilized native soil covered by an eight inch layer of stabilized aggregate surface course material.

Stabilized Road Design Saves Big Money

Faced with the high cost of manufacturing crushed aggregate materials and long round trip trucking hauls, it is no surprise that contractors selected the stabilized design option for the construction of all three phases. **The need for manufacturing over one million tons of crushed aggregate was eliminated (over 40,000 truck loads at 25 tons per load), along with the related long distance trucking hauls. Using an average of $20.00 per ton as the delivered cost for untreated crushed aggregate materials, for sake of cost estimating purposes, a $20 million dollar material requirement for these projects was eliminated as a direct result of implementing the use of an advanced product technology that could cost-effectively stabilize the wide variety of locally available soils. In comparison to the estimated construction budget and miles of heavy haul roads submitted in the original request for funding the haul road improvements, the stabilized design cut construction costs by approximately 40% and stretched the available $60 million budget from building just 70 miles to over 116 miles of main supply routes .**

Selection of Stabilization Technology

The EMC SQUARED System stabilization technology was specified by the U.S. Army Corps of Engineers because of its historically proven capability to improve the strength and moisture resistance of aggregate materials and a wide variety of soil types ranging from sandy silts and silty sands to caliche and clay soils. Equally important in the selection of the EMC SQUARED Stabilizer product was the fact that it is a proven performer for over two decades

Advanced Stabilization Technology Reduces Construction Costs and Builds More Miles of Roads for U.S. Army Corps of Engineers at Fort Bliss

Placement of Stabilized Aggregate Mix by Asphalt Paving Machine

in stabilizing select aggregate and soil materials for service as road running surfaces supporting frequent truck and heavy equipment traffic. Stabilized running surfaces are challenging applications that have not been cost-effectively addressed by earlier generation stabilizer products such as asphalt emulsions, foamed asphalts, cements, fly ash materials and lime products. SP LLC has worked closely with the Army Corps of Engineers and contractors to help them take advantage of the full range of benefits available from this innovative stabilization technology. As well demonstrated in the stabilized heavy haul roads at Fort Bliss, the EMC SQUARED System provides entirely new capabilities and opportunities for improving the performance of constructed aggregate and soil structures.

Superior Performance

Aggregate trucking hauls and military equipment convoys used the stabilized subgrades and stabilized aggregate surfaces in all weather conditions during construction operations. Once construction of each heavy haul road route was completed, the intense level of traffic from convoys of track equipment, such as the Abrams M1A2 Tanks and Bradley Infantry Fighting Vehicles, surprised even the Range Management staff at Fort Bliss. The surfaces of the stabilized heavy haul roads adjacent to state highways were treated with a dust control product during construction, as recommended by SP LLC, and are providing the most effective retention of rock materials in the running surface. SP LLC recommended that a dust control product be applied on all stabilized heavy haul road surfaces, but project managers made the decision to spend available funds on upgraded concrete low water crossings, rather than on dust control product for the rest of the new heavy haul road routes. The performance of the stabilized heavy haul roads without dust control treatment has also been excellent, even under the traffic of Abrams M1A2 Tanks (track equipment weighing almost 70 tons), but the light scattering of small rock on these haul road surfaces is evidence that the retention of fine particle materials in the stabilized surface is improved by application of the dust control product. It is clear in viewing all of these heavy haul roads that the stabilizer is effectively shedding water and maintaining stiff and solid running surfaces that are far superior to untreated aggregate surfaces. The only problem project and range managers are experiencing with the stabilized running surfaces placed by asphalt paving machines is enforcing speed limits for the trucking hauls and other traffic that are driving on these smooth running roads.

Falling Weight Deflectometer (FWD) testing conducted by Fugro Consultants, Inc., Austin, Texas.

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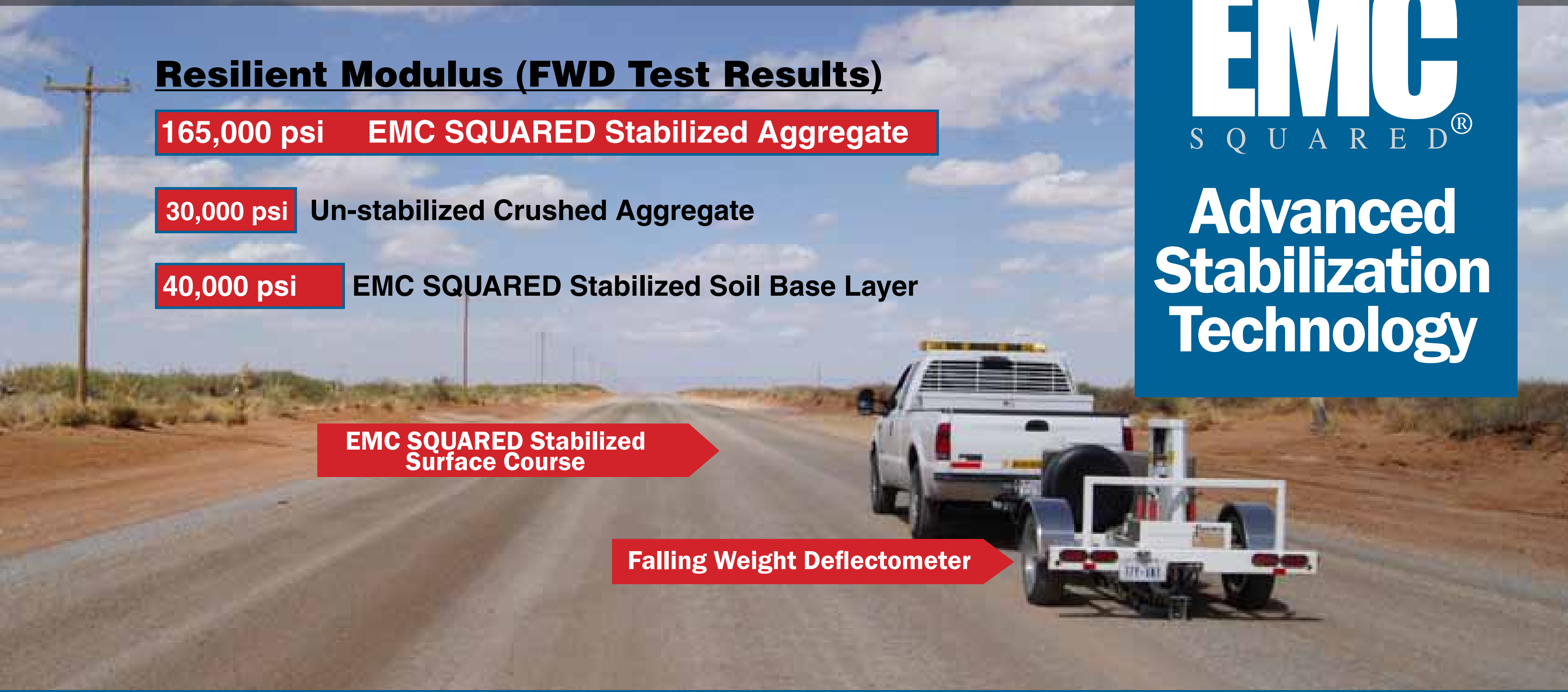


Engineering Field Evaluation of Stabilized Road in Progress

Field and Laboratory Evaluation

The results of field and laboratory engineering evaluations of the stabilized soil and aggregate materials are summarized in the four pages that follow. Note the effectiveness of the economical EMC SQUARED Stabilizer treatment, strengthening native soils to a performance level equivalent to crushed aggregate base rock materials. Even more interesting are the results of engineering tests conducted in a nationally recognized pavement materials testing laboratory to evaluate the performance of the stabilized aggregate surface course material and its relationship to Hot Mix Asphalt (HMA). While HMA is a viscoelastic material that weakens dramatically as temperatures increase, the stabilized aggregate retained consistent strength and demonstrated a high level of resistance to rutting and deformation in testing temperatures that include 130º F. These are excellent engineering properties for any layer in a pavement structural section. The consistent strength of the stabilized aggregate is ideal for worst case design requirements, such as Fort Bliss heavy haul roads where extremely heavy loads move at slow speeds during weather conditions ranging from below freezing to high temperatures and for other severe service applications such as mine haul roads, airport runway and taxiways, and pavement systems for port and intermodal facilities. The consistent strength of the stabilized aggregate is also an excellent match for viscoelastic HMA surface course materials that benefit from the support of strong flexible base course layers that retain their stability independent of changes in temperature and loading frequency.

Stabilized Surface Course FWD Test Results

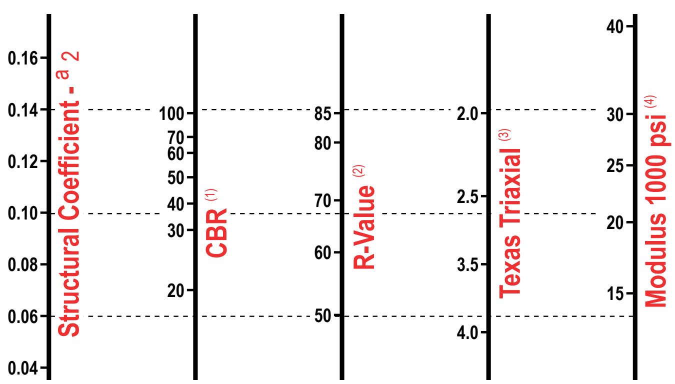
Falling Weight Deflectometer (FWD) testing is known as a Non-destructive Test, or NDT, meaning that the testing equipment can measure the resilient modulus of the surface course and lower layers while working on the surface without disturbing or coring through the pavement structural section. Pictured above is a trailer-mounted Dynatest FWD testing apparatus. This NDT field testing conducted on the stabilized MSR road at Fort Bliss evaluated the Resilient Modulus of the EMC SQUARED Stabilized Aggregate as 165,000 psi, over five times the 30,000 psi typically used as the resilient modulus, or stiffness, assigned to un-stabilized crushed aggregate materials of average quality (30,000 psi is equivalent to CBR 100, or R-Value 85, according to the Base Chart developed by the American Association of State Highway and Transportation Officials, or AASHTO).

Field and Laboratory Evaluations of Stabilized Materials

Stabilized Soil Subgrade - 40,000 psi

Pictured on top of page 7 is a Falling Weight Deflectometer (FWD) testing appartus evaluating the strength of a stabilized heavy haul road at Fort Bliss after several months in service under heavy haul trucks and tracked military equipment. The FWD equipment is capable of simultaneously providing Resilient Modulus measurement of both the Stabilized Aggregate Surface Course layer and the Stabilized Soil Subgrade layer below in a non-destructive manner while testing the performance of many miles of road in a single day. The analysis of the FWD field testing data resulted in an average layer moduli for the stabilized soil subgrade layer of 40,000 psi[1], equivalent to the strength of crushed aggregate base course materials which typically have layer moduli in the range of 30,000 psi. Using the chart below provided by the American Association of State Highway Transportation Officials (AASHTO) for correlation with other standard index tests for additional perspective, the FWD testing demonstrated that the stabilized subgrade soil was significantly stronger than 30,000 psi, the Resilient Modulus value that correlates with a CBR of 100, an R-Value of 85, a Texas Triaxial of 2.0 and a Structural Coefficient of 0.14. These test values from this group of five standard highway industry test methods are all representative of good quality crushed aggregate base course materials. The higher moduli of the native soil materials stabilized with the EMC SQUARED Stabilizer treatment (40,000 psi) at Fort Bliss demonstrates in materials engineering measurements the effectiveness of this advanced broad spectrum stabilization technology.

AASHTO Guide for Design of Pavement Structures
Base Course



(1) Scale derived by averaging correlations obtained from Illinois.
(2) Scale derived by averaging correlations obtained from California, New Mexico and Wyoming.
(3) Scale derived by averaging correlations obtained from Texas
(4) Scale derived on NCHRP project *(3)*

[1]FWD data analysis by Peter Sebaaly, Ph.D., P.E., Director of the Western Regional Superpave Center, Professor, Civil and Environmental Engineering Department, University of Nevada Reno.

Stabilized Aggregate vs Asphalt Pavement

Select aggregate base course materials treated with the EMC SQUARED Stabilizer are typically many times stronger than untreated aggregate and most closely resemble Hot Mix Asphalt (HMA) pavement materials in modulus properties. Historically compared with flexible asphalt pavement materials in resilient modulus testing, the EMC SQUARED stabilized layers are flexible, in contrast to cement treated layers, which exhibit rigid, slab-like behavior and a strong tendency to layer cracking. As illustrated in the table below with diametral resilient modulus test results conducted at 77º F in the pavement materials lab at University of Nevada Reno (UNR), the stabilized aggregate material from a Southern Nevada project provided a layer coefficient equivalent to the local HMA pavement materials.

Resilient Modulus Results and Layer Equivalency Factors

Sample ID	Average Resilient Modulus (psi)*	Layer Equivalency Factor**
Aggregate Base with EMC SQUARED	272,500	0.35***
Untreated Aggregate Base	51,000	0.10

* Resilient Modulus results reported by University of Nevada Reno
** Analysis and reporting by Dan Ridolfi, P.E., Professional Service Industries (PSI), 1/16/04
*** Per PSI report, Standard practice in Southern Nevada is to assign a layer coefficient of 0.35 for dense graded hot mix asphalt.

Transition from Resilient to Dynamic Modulus Tests

The evaluation of asphalt pavement materials is in transition from Resilient Modulus to Dynamic Modulus testing, the test method specified by the nationally recognized AASHTO Mechanistic-Empirical Pavement Design Guide (MEPDG) for evaluation of Hot Mix Asphalt (HMA) pavement. HMA pavement materials are viscoelastic in nature, exhibiting lower modulus values (strength loss) as pavement temperatures increase. Dynamic Modulus testing evaluates the impacts of temperature and frequency of loading on the pavement material. Given the similarities between aggregates treated with EMC SQUARED Stabilizer and HMA pavement, the laboratory evaluation of the stabilized aggregate surface course materials from Fort Bliss is also based upon current state of the art test methods for HMA pavement, the Dynamic Modulus and Repeated Load Triaxial (RLT) tests.

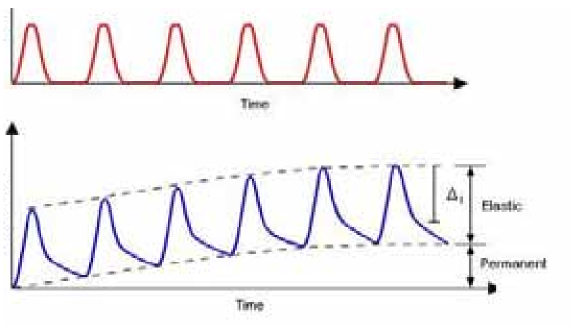
Laboratory Evaluation of Stabilized Aggregate Materials

Repeated Load Triaxial (RLT) Test - Resistance to Permanent Deformation

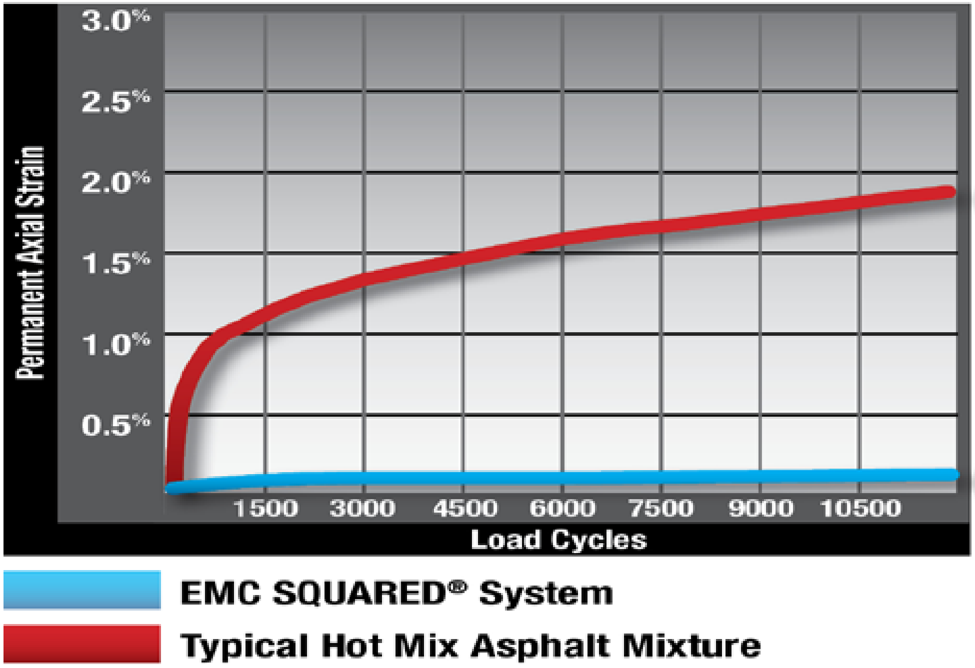
In the interest of referencing the performance of Hot Mix Asphalt (HMA) materials as a base line for evaluating the stabilized aggregate mixture sampled from the heavy haul road projects at Fort Bliss, Repeated Load Triaxial (RLT) and Dynamic Modulus (E*) testing was conducted in the Pavement/Materials Testing Laboratory at the Western Regional Superpave Center. The results of the RLT tests, which measure resistance to rutting and permanent deformation, are provided below. Quoting from the final report, **"The RLT data generated in this evaluation indicated that the stabilized aggregate material from the Fort Bliss facility is not anticipated to generate any permanent deformation under a wide range of loading conditions. It should be noted that the worst loading condition on flexible pavements is slow moving loads in hot environments. The elastic behavior of the stabilized aggregate material from the Fort Bliss facility coupled with its relatively good level of E* makes it a good candidate for pavements loaded under such severe conditions. In addition, the stabilized aggregate material is expected to perform as well in pavements subjected to standard loading conditions."**

Repeated Load Triaxial Set-Up

Loading and Response



Permanent Deformation Characteristics of the EMC SQUARED Stabilized Aggregate Cured for 72 hrs at 104° F in Comparison to Typical Hot Mix Asphalt Materials



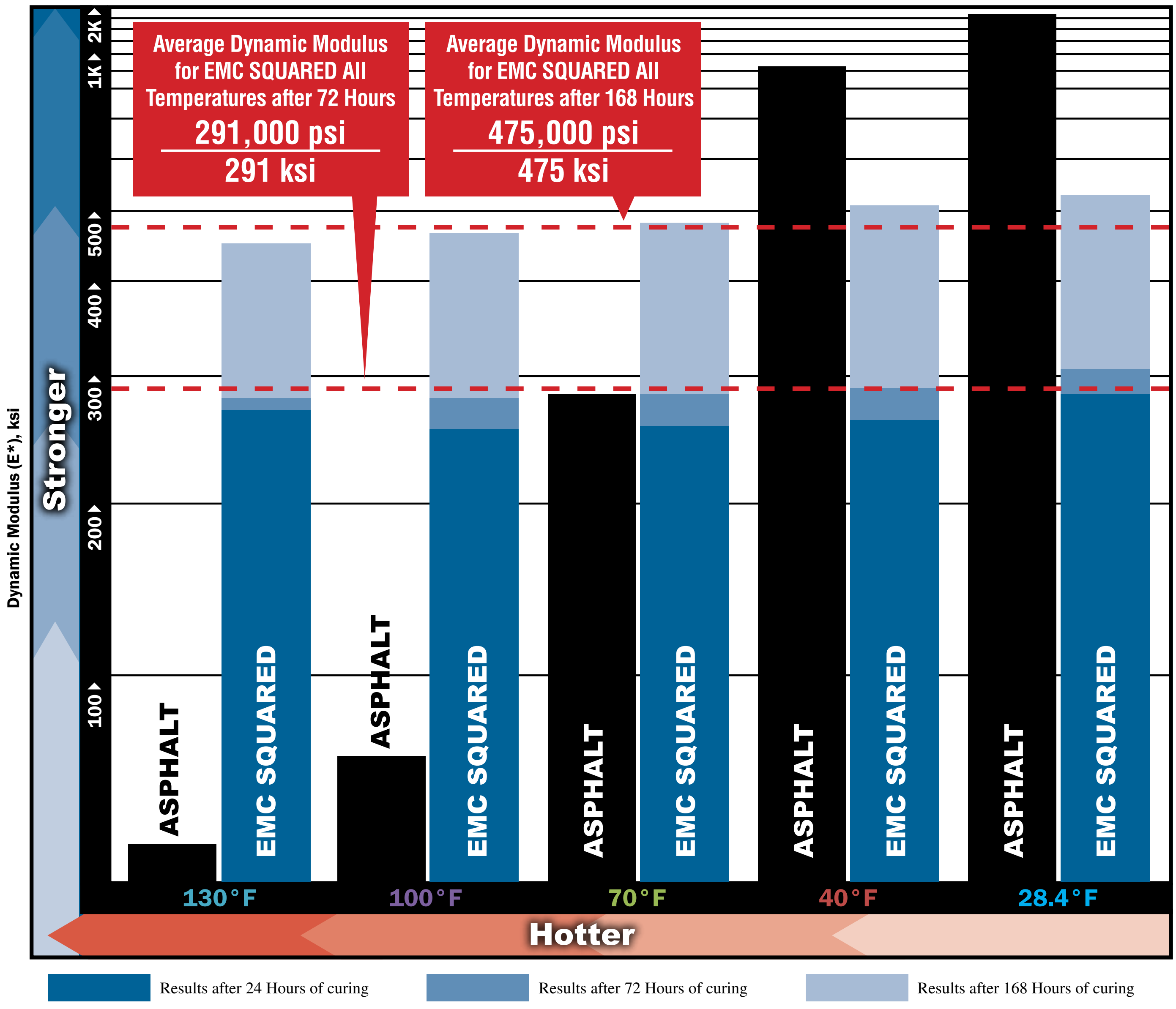
WESTERN REGIONAL SUPERPAVE CENTER

The engineering evaluation of the stabilized aggregate materials sampled from the U.S. Army Corps of Engineers project at Fort Bliss was conducted under the direction of Peter Sebaaly, Ph.D., P.E., Director of the Western Regional Superpave Center, one of five centers established by the Federal Highway Administration (FHWA) to support the implementation of the Superpave Technology for hot mix asphalt materials, Director of the Nevada Technology Transfer Center (funded by FHWA and Nevada DOT), and Professor of Civil Engineering in the Civil and Environmental Engineering Department at University of Nevada Reno where the Pavement/ Materials Program and materials testing laboratory are located. Peter Sebaaly also provided the analysis and review of the Falling Weight Deflectometer (FWD) field testing at Fort Bliss conducted by Fugro Consultants, Inc.

COMPARISON OF DYNAMIC MODULUS AND REPEATED LOAD TRIAXIAL TEST RESULTS FOR TYPICAL HOT MIX ASPHALT (HMA) MIXTURE AND EMC SQUARED® STABILIZED AGGREGATE

Dynamic modulus is the main input required for design of Hot Mix Asphalt (HMA) pavements using the nationally recognized AASHTO Mechanistic-Emperical Pavement Design Guide (MEPDG). HMA pavement materials are viscoelastic in nature and their dynamic modulus values vary dramatically in response to changes in loading rate and temperature. For example, HMA materials exhibit much lower modulus values (significant strength loss) as pavement temperatures increase. In contrast, dynamic modulus testing shows that EMC SQUARED Stabilized Aggregate materials retain a relatively consistent dynamic modulus (consistent strength) through the full range of loading rates and temperature changes, indicating elastic rather than viscoelastic behavior. Cold-mixed EMC SQUARED Stabilized Aggregate materials have the further advantage of gaining strength with additional curing time.

Dynamic Modulus Data for Typical HMA Mixture and EMC SQUARED Stabilized Aggregate Mixture



The above chart references data from a report by Peter Sebaaly, Ph.D., P.E. University of Nevada, Reno, Director of the Western Regional Superpave Center.

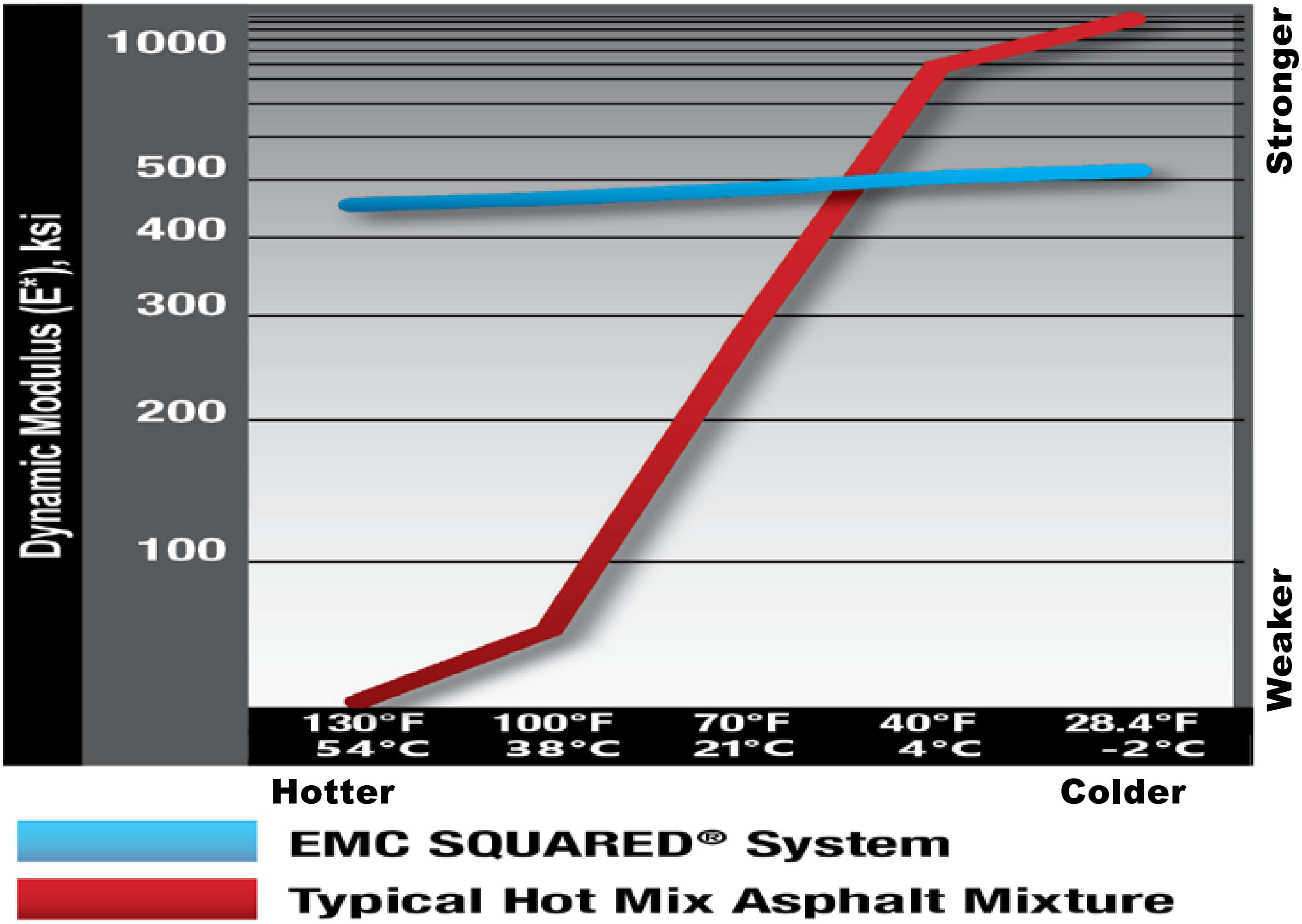
Laboratory Evaluation of Stabilized Aggregate Materials

Dynamic Modulus Properties of EMC SQUARED Stabilized Aggregate Compared to Performance of Typical Hot Mix Asphalt (HMA) Materials

The fundamental definition of modulus is the relationship between the stress and strain of an engineering material. Dynamic Modulus measurements are the most up to date method for evaluation of Hot Mix Asphalt (HMA). HMA materials are viscoelastic in nature and their modulus values change with variations in both temperature and loading rate, a well known example being the tendency of asphalt pavement to lose strength and resistance to rutting as temperatures increase. The Dynamic Modulus (E*) of HMA materials declines by a Factor of approximately 100 times when temperatures are increased from below freezing (28.4º F) up to 130º F. This is not a positive aspect of HMA materials, but rather a problematic characteristic of HMA material that pavement material engineers and pavement design engineers must work around.

Stabilized Aggregate Sample in Dynamic Modulus testing Set-up

The Dynamic Modulus measurements of the EMC SQUARED stabilized aggregate material have a modulus that is within the same range as the modulus of typical Hot Mix Asphalt (HMA) materials, but as illustrated in the graph below, the stabilized material essentially retains a consistent strength through the full range of temperatures and loading rates, which is in distinct contrast to viscoelastic HMA materials that undergo dramatic modifications in their behavior as a function of changes in temperature and loading rates. As a result, the Dynamic Modulus (E*) for the EMC SQUARED stabilized aggregate can be represented as a constant, rather than the curve (E* master curve) as necessitated by the variability of HMA materials.



Post-construction Survey of Stabilized Main Supply Route (MSR) Tank Trail System at Fort Bliss in New Mexico and Texas

Introduction: This brief summarizes the results of a post-construction survey of the condition of a system of Stabilized MSR Tank Trails at Fort Bliss that stretch across the border between the states of New Mexico and Texas. This heavy duty stabilized road system was built by a sequence of three construction contracts administered by the U.S. Army Corps of Engineers (USACE). The Tank Trails were designed by the USACE Fort Worth District Office to service caravans of tracked Abrams M1A2 Battle Tanks and wheeled tactical equipment that accessed the Maneuver Training Areas. M-1070 Heavy Equipment Transporters weighing as much as 243,400 pounds when fully loaded transport the Abrams Tanks on the MSR Tank Trails to areas more remote.

The survey was conducted by a Professional Geoscientist (P.G.) who was on staff at Fort Bliss serving as the Land Rehabilitation and Maintenance (LRAM) Coordinator for the Integrated Training Area Management (ITAM) program with responsibility for the Maneuver Training Areas and the Maneuver Trails. As the Maneuver Trails intersect the MSR Tank Trail system throughout their length, he had the daily opportunity during the three construction contracts to observe the soil stabilization work and the production and placement of the EMC SQUARED Stabilized Aggregate running surfaces.

While a total of over 116 miles of stabilized Tank Trails were constructed as a result of the three construction contracts, this survey concentrated on two of the construction projects that built 87.5 miles as the EMC SQUARED Stabilized Aggregate running surfaces were placed by asphalt paving machine equipment that produced the smoothest possible running surface, rather than conventional motor grader blade placement that it typically used for lower-standard gravel roads. These stabilized tank trails were regularly subjected to the traffic of tactical equipment during construction and had been in daily use by convoys of heavy transporter trucks and military tactical equipment for twelve to eighteen months prior to the time this survey was conducted.

The EMC SQUARED Stabilized Aggregate material used for surfacing the Tank Trails at Fort Bliss was evaluated in the asphalt pavement materials testing laboratory of the Western

Regional Superpave Center (WRSC) and its performance was compared with that of typical Hot Mix Asphalt materials. Under Repeated Loading Triaxial (RLT) testing the EMC SQUARED Stabilized Aggregate remained resilient and free of damage while the asphalt materials were subject to permanent deformation. In Dynamic Modulus testing, the EMC SQUARED Stabilized Aggregate materials outperformed asphalt pavement in retaining their high modulus under the worst of conditions - slow moving heavy loading and warmer temperatures. Field testing was also conducted with Falling Weight Deflectometer (FWD) testing equipment, confirming the high modulus of the stabilized aggregate surfacing and modulus values for the stabilized soil subbase layer that were higher than the modulus of the subbase aggregate material specified in the original conventional road design.

Tank Trails Surveyed

The MSR Tank Trail system at Fort Bliss uses Color Codes and a numbering system to identify the different Routes and the Training Ranges where they are located (see map on page 5). For sake of clarity, that information is provided below for all of the Stabilized MSR Tank Trails that were surveyed:

TANK TRAIL NAME & TRAINING RANGE LOCATION	TANK TRAIL NUMBER
Route Gray South Range	Route #1
Route Green South & McGregor Ranges	Route #2
Route Black Dona Ana Range	Route #3
Route Alvarado Dona Ana Range	Route #3
Route Red Dona Ana Range	Route #4
Route Blue Dona Ana Range	Route #5
Route Orange Dona Ana Range	Route #8

Survey Observations ROUTE GREEN (ROUTE 2)

“The entire length of approximately 19 miles of this trail was observed while driving from north to south along its course. Most of the trail was in excellent condition. It was constructed over a basin floor soil composed of sheet and dune sands and spotty caliche. Throughout a 7 mile stretch of this trail located in the northern half of this route, a very slight wash-boarding effect was observed on the north-bound lane. It appeared as though the blow sand had collected on the trail surface and formed a wind rippling effect in this section. Vehicle stability at higher speeds might be compromised throughout this area. It was observed throughout the entire length of this trail that a large trailing plume of dust with about 60% visibility occlusion exists when speeds above the 20 MPH speed limit are maintained. A signficant amount of the dust kicked up off the tank trails by traffic exceeding the 20 MPH speed limit is comprised of wind deposited blow sand that is deposited on the surface of the tank trails by the frequently windy conditions typical for this area. Four concrete low water crossings were observed in the northern half of this trail. Speeds should be reduced to 30 to 40 MPH or lower to safely navigate across the lips on both ends of these low water crossings. It is estimated but not recommended that speeds up to 70 MPH can be safely maintained by a normal sized passenger vehicle throughout most of the length of this trail.”

Note - the report above on Route Green (Route #2) is nearly identical to the reports on the other seven trail segments that were surveyed. For the sake of avoiding redundancy, the report on this one MSR Tank Trail route is presented as representative of the typical condition of all eight surveyed tank trails that were constructed at Fort Bliss with both subgrade soils and aggregate running surfaces stabilized with the EMC SQUARED Stabilizer treatment. The only differences reported among the routes was the type of native subgrade soils that they traversed and the amount of blow sand that has accumulated on the trail surfaces. Some amount of natural wind deposited blow sand accumulation is typical on all eight tank trails.

Post-construction Survey of Stabilized Main Supply Route (MSR) Tank Trail System at Fort Bliss in New Mexico and Texas

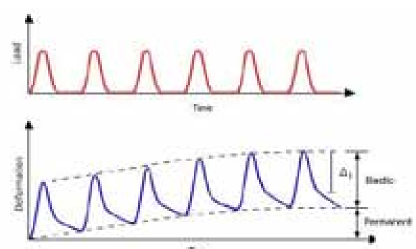
Pavement Materials Testing of Stabilized Aggregate Pavements at Fort Bliss

It was important to measure the performance of the EMC SQUARED Stabilized Aggregate Pavement materials, as produced for the MSR Tank Trails at Fort Bliss, for a number of reasons. First, to validate the engineering basis supporting the fact that the innovative stabilized MSR Tank Trail design, using eight inches of EMC SQUARED Stabilized Aggregate materials placed by paving machine on a twelve inch stabilized soil subgrade, was equivalent or better in strength (Modulus) than the far more expensive conventional gravel road. The conventional gravel road design for tracked military equipment and heavy equipment transporter trucks weighing as much as 240,000 pounds, called for 16 inches of crushed aggregate materials. Secondly, to verify that the Stabilized Aggregate Pavement would have the increased strength to resist abrasion by convoys of tracked tactical equipment and excessive gravel loss from the trail surfaces. Third, and most relevant to the subject of reducing the fuel consumption of the tactical and operational fleets using the MSR Tank Trails at Fort Bliss, it was important to verify that the stabilized MSR Tank Trail design provided similar or better stiffness values as paved road systems, since stiffness and smoothness are the combination that provides the road that most effectively reduces fuel consumption.

Non-destructive field testing on a stabilized MSR Tank Trail at Fort Bliss was performed with Falling Weight Deflectometer equipment, and testing of the stabilized aggregate material was conducted in the asphalt pavement materials laboratory of the Western Regional Superpave Center (WRSC) located at the University of Nevada, Reno campus. As reported by Dr. Peter Sebaaly, Director of the WRSC facility, the results of both the field testing and pavement laboratory testing indicated that the stabilized tank trail had far higher strength (Modulus) than what could be anticipated from sixteen inches of gravel material. The lab testing also confirmed that the EMC SQUARED Stabilized Aggregate material from the Fort Bliss MSR Tank Trail projects retained higher average modulus than a typical asphalt pavement, and that it could be expected to resist permanent deformation more effectively than asphalt pavement, "even in worst case conditions which are slow moving loads in hot environments," as stated by Dr. Sebaaly.

Repeated Load Triaxial Set-Up

Loading and Response



Based on the follow up field and laboratory testing, the economical stabilized design has been proven stronger than the conventional gravel road design, and the EMC SQUARED Stabilized Aggregate tested as a high strength pavement material with higher average modulus and better resistance to permanent deformation than asphalt pavement materials, providing a stiff and resilient layer capable of maintaining a smooth running alignment and supporting slow moving heavy loads without permanent deformation, even in the hottest weather conditions.

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E-mail: info@stabilizationproducts.net
Website: http://www.stabilizationproducts.net

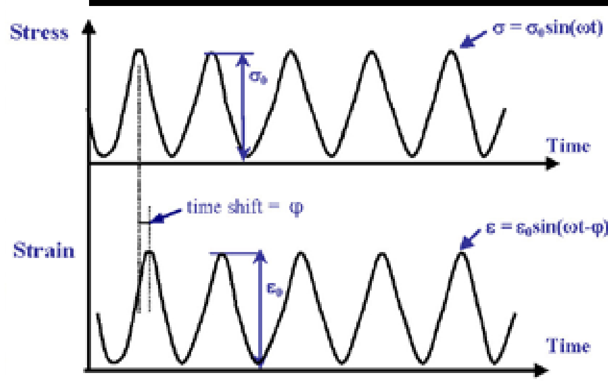
Canadian Sales - Milieu Road Technologies Ltd.
(780) 875-9159

Post-construction Survey of Stabilized Main Supply Route (MSR) Tank Trail System at Fort Bliss in New Mexico and Texas

Engineering Field Evaluation of Stabilized MSR Tank Trail in Progress

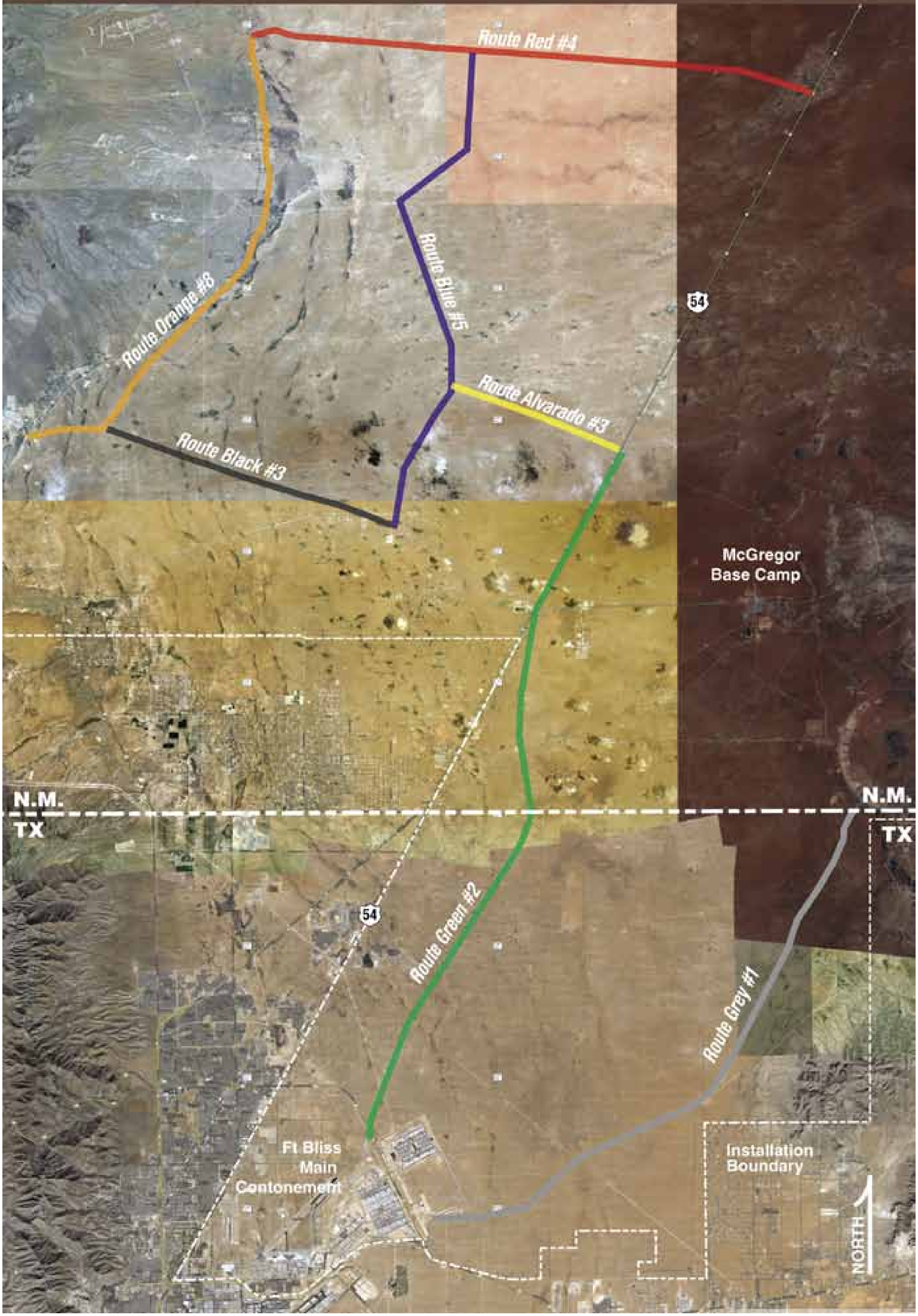
Dynamic Modulus Setup

Applied Stress and Measured Strain



Dynamic Modulus $|E^*| = \frac{\sigma_0}{\varepsilon_0}$

Fort Bliss Stabilized Tank Trails



The EMC SQUARED® System

RANGE OF APPLICATIONS: The high performance EMC SQUARED System products are economical, sustainable and highly versatile. These concentrated liquid treatments have proven effective in stabilizing non-plastic (granular) and cohesive, highly plastic (expansive) soils, non-plastic and plastic aggregate materials, recycled asphalt pavement millings (RAP), and recycled pavement aggregates manufactured with pulverized asphalt and crushed concrete content. A partial list of EMC SQUARED applications includes subgrade soil stabilization for major interstate freeway, highway, and city expressway projects; stabilized soil layers directly exposed to traffic, such as military tank trails, solar array sites, construction sites, industrial sites, and landfill closures; stabilized base courses under streets and roads; Full Depth Reclamation (FDR) and Cold In-place Recycling (CIR); and stabilized aggregate running surfaces for a wide variety of public agency and industrial applications. EMC SQUARED stabilized aggregate and stabilized soil installations continue to provide effective performance after more than twenty years of service in direct exposure to traffic and the environment.

STABILIZED RUNNING SURFACES: Where EMC SQUARED System products stand head and shoulders above other stabilizing agents is in treatment of aggregate materials for road running surface applications. Aggregate materials treated with asphalt emulsion, foamed asphalt, cement, fly ash and lime products are traditionally covered by protective hot mix asphalt or concrete pavements because the treated materials are unable to stand up to the repeated pounding of high speed automobile and truck tires and direct exposure to wet weather and freezing conditions. On the other hand, when matched with aggregate base course and recycled aggregate materials that have suitable gradation and adequate binder content, as exemplified by the performance of the U.S. Army Corps of Engineers heavy haul road projects at Fort Bliss, EMC SQUARED System stabilization treatments can facilitate the construction of bound aggregate layers that most closely resemble hot mix asphalt pavement in layer equivalency evaluation.

COMPARATIVE ECONOMICS: The EMC SQUARED System stabilizer products are significantly less expensive and faster to apply than cement and lime based treatments, and more effective with a wider range of soil and aggregate materials. EMC SQUARED System treatments improve the flexible and elastic behavior of bound aggregate materials, in contrast to cement and lime treated materials, which exhibit rigid, slab-like behavior, susceptibility to layer cracking and contribution to reflective cracking in pavement layers above. EMC SQUARED System treatments are far less expensive than asphalt cement, asphalt emulsion and foamed asphalt treatments which can be five to twenty times more expensive on a cost per ton of aggregate or FDR material treated. These are big cost savings from a clean product technology that is safer for workers and the environment.

$E=MC^2$: Given all the broad spectrum stabilizing power of this highly concentrated and environmentally friendly product technology, the similarity in name with Einstein's famous energy equation ($E=MC^2$) is no accident. The EMC SQUARED System is a breakthrough product technology that improves strength and moisture resistance at very low cost. Stabilization is now an affordable option that can be considered wherever soil, aggregate or recycled pavement materials are being processed and compacted for load bearing or wear resistant surfaces.

EMC SQUARED System products have completed over three decades as the leading edge of stabilization technology, setting the standard for economic improvement of soil, aggregate and recycled pavement materials in construction applications. The people at SP LLC have pioneered the implementation of green products in the highway industry. We have proven that clean technology can provide far more sophisticated, effective and environmentally appropriate answers than bulk application of asphalt, cement, fly ash and lime products. As former general engineering contractors and suppliers of aggregate and pavement materials, our staff are conversant with the engineers who specify our products, the installing contractors, and the quality control personnel responsible for monitoring the essential engineering controls during construction processes. Our industry background and technical support services are essential to the success of a product technology that is reliant upon construction processes that must be conducted according to rigorous engineering quality controls. The cost-savings and performance advantages of the EMC SQUARED System are contingent upon thorough preliminary engineering reviews, competent designs and specifications, and proper installation. Contact us for assistance on your next design or construction project.

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