

Mechanically Stabilized Earth Wall

Kang Mi Kim

Analysis of Full-scale Mechanically Stabilized Earth (mse) Wall Using Crimped Steel Wire Reinforcement Joshua Aaron Jensen, 2014 Mechanically Stabilized Earth (MSE) walls have provided an effective solution to constructing retaining walls. The engineering and construction industry is continually striving to provide more cost-effective and design-efficient means to building MSE walls. Hilfiker Retaining Walls has developed a new semi-extensible metal mat reinforcement technology which does not fit into the current extensible or inextensible categories as defined by regulating authorities. The objective of this project was to construct and observe the behavior collect quantitative data for a 20-foot tall MSE wall using the prototype semi-extensible reinforcement technology. The results were compared to expected American Association of State Highway and Transportation Officials Load Reduction Factored Design values and was also compared to another case study, Prediction of Reinforcement Loads in Reinforced Soil Walls as conducted by Tony M. Allen, P.E., and Richard J. Bathurst, Ph. D., P. Eng. Comparing the behavior of the 20-foot prototype MSE wall to these design regulations and case studies allowed for proper classification and will facilitate future industry design efforts.

Assessing the Long-term Performance of Mechanically Stabilized Earth Walls Travis M. Gerber, 2012 Mechanically stabilized earth (MSE) walls are an important class of infrastructure assets whose long-term performance depends on various factors. As with most all other classes of assets, MSE walls need periodic inspection and assessment of performance. To date, some agencies have established MSE wall monitoring programs, whereas others are looking for guidance, tools, and funding to establish their own monitoring programs. The objective of this synthesis project is to determine how transportation agencies monitor, assess, and predict the long-term performance of MSE walls. The information used to develop this synthesis came from a literature review together with a survey and interviews. Of the 52 U.S. and 12 Canadian targeted survey recipients, 39 and five, respectively, responded. This synthesis reveals that unlike bridges and pavements, MSE walls and retaining walls in general are often overlooked as assets. Fewer than one-quarter of state-level transportation agencies in the United States have developed some type of MSE wall inventory beyond that which may be captured as part of their bridge inventories. Fewer still have the methods and means to populate their inventories with data from ongoing inspections from which assessments of wall performance can be made. In the United States, there is no widely used, consistently applied system for managing MSE walls. Wall inventory and monitoring practices vary between

agencies. This synthesis examines existing practices concerning the nature, scope, and extent of existing MSE wall inventories. It also examines the collection of MSE wall data, including the types of performance data collected, how they are maintained in wall inventories and databases, the frequency of inventory activities, and assessment practices relevant to reinforcement corrosion and degradation. Later parts of this synthesis discuss how MSE wall performance data are assessed, interpreted, and used in asset management decisions. This synthesis finds that the most well-implemented wall inventory and assessment system in the United States is the Wall Inventory Program developed by FHWA for the National Park Service. However, this system, like some others, uses 'condition narratives' in a process that can be somewhat cumbersome and subjective. Other systems use more direct numeric scales to describe wall conditions, and an advantage of such systems is that they are often compatible with those used in assessments of bridges. As experience with MSE walls accumulates, agencies will likely continue to develop, refine, and better calibrate procedures affecting design, construction, condition assessment, and asset management decisions. One portion of this synthesis is dedicated to summarizing the actions taken thus far by survey respondents to improve the long-term performance of their MSE walls. Many agencies prescribe the use of a pre-approved wall design and/or wall supplier. Other actions or policies frequently focus on drainage-related issues.--
Summary.

Mechanically Stabilized Earth Wall Abutments for Bridge Support Ioannis Zevgolts,Philippe L. Bourdeau,2007-04-15

Evaluation of Mechanically Stabilized Earth (MSE) Walls for Bridge Ends in Kentucky Charlie Sun,Clark Graves,2013 This report summarizes the nationwide survey results on Mechanically Stabilized Earth (MSE) wall abutment status. Many of the handy features in MSE Wall Abutment Inspection/Rating In KY web application are highlighted, and various graphical user interfaces of the web application are illustrated and described. The inspection/rating for 56 existing MSE wall abutments are presented and discussed.

Shored Mechanically Stabilized Earth (SMSE) Wall Systems Design Guidelines Kimberly Finke Morrison,2006 As a Federal Highway Administration design reference for highway projects, this report was prepared to enable the engineer to identify and evaluate potential applications of shored mechanically stabilized earth (SMSE) walls. Included in this design guideline are a literature review on similar construction and the results and interpretation of field-scale testing, centrifuge modeling, and numerical modeling of an SMSE wall system. Results of the centrifuge modeling and field-scale testing show that reduction of the reinforcement length to as little as 25 percent of the wall height (0.25H) provides sufficient wall stability, even under a considerably high degree of surcharge loading. Using the results of the modeling and field testing research, this design guideline recommends a minimum reinforcement length equivalent to as little as 30 percent of the wall height (0.3H) for the MSE wall component, provided that the MSE reinforcement length is greater than 1.5 m. The benefit of attaching reinforcement to the shoring wall is found to be small and is generally not recommended except by way of the

upper two layers of reinforcement. If possible, these layers of reinforcement should overlap the shoring wall and have a total length of $0.6H$. If this is not possible, then these layers should be attached to the shoring wall. Internal design requirements of the MSE wall component for an SMSE wall system differ from that of a traditional MSE wall. Equations presented in this design guideline have been developed specifically to address these requirements. The benefits of increased retaining abilities provided by the shoring wall, such as reduction in lateral load acting on the MSE wall component and contribution to global stability, are considered in the design process.

Assessment and Rating of Mechanically Stabilized Earth Walls Noel Janacek, 2012 Mechanically stabilized earth (MSE) walls have been increasingly utilized in the United States since 1972 and in Texas since 1979. MSE walls provide earth retention for commercial, industrial and transportation projects throughout Texas. Within the transportation industry, the traditional design life of MSE walls is 75 years, with new projects requiring 100 year design life. The millions of square feet of existing MSE walls are generally less than half of the anticipated design life, making identifying and assessing the existing wall inventory a significant asset management component for optimizing maintenance expenditures. This thesis proposes and applies a system that assesses and rates MSE walls based on as-built design assessment, physical condition, safety impacts, and owner defined elements. The program developed in this thesis has been generally tailored to application in transportation infrastructure with MSE walls having greater than two years of service, founded in and retaining both cohesive and cohesionless soils.

A Field Study of Construction Deformations in a Mechanically Stabilized Earth Wall Nathan Daniel Abele, 2006 Mechanically stabilized earth (MSE) has been used for over thirty years in the United States. The advantages of MSE, including economics, often outweigh their disadvantages. MSE structures are built with a growing frequency and are not likely to disappear in the foreseeable future. Complete understanding of the system has not yet been widely achieved. This thesis is a study of the movement and deformation during construction of a mechanically stabilized earth structure built as a bridge abutment. The MSE wall studied for this research was constructed as part of an ODOT bridge replacement and widening project located in northwest Ohio. The studied MSE system for this project was a Reinforced Earth Company product. The subsurface conditions under the main MSE wall face include an approximate twenty foot thick clay layer over limestone bedrock. Phased construction was used along with both cast in place and precast leveling pads. Some wall facing deformations presented are expected, while others are more difficult to explain. Results of this research provide information that can be used to better understand deformation during the construction process of similar walls constructed in the future. Comparison of these results to performance of other MSE walls may ease concerns of possible larger problems. Further similar work is likely needed to explain some of the trends presented here.

Design of Roadside Barrier Systems Placed on Mechanically Stabilized Earth (MSE) Retaining Walls Kang Mi Kim, 2010

Millions of square feet of mechanically stabilized earth retaining wall are constructed annually in the United States. When used in highway fill applications in conjunction with bridges, these MSE walls are typically constructed with a roadside barrier system supported on the edge of the wall. This barrier system generally consists of a traffic barrier or bridge rail placed on a continuous footing or structural slab. The footing is intended to reduce the influence of barrier impact loads on the retaining wall system by distributing the load over a wide area and to provide stability for the barrier against sliding or overturning. The proper design of the roadside barrier, the structural slab, and the MSE wall system requires a good understanding of relevant failure modes, how barrier impact loads are transferred into the wall system, and the magnitude and distribution of these loads. In this study, a procedure is developed that provides guidance for designing: 1. the barrier-moment slab, 2. the wall reinforcement, and 3. the wall panels. These design guidelines are developed in terms of AASHTO LRFD procedures. The research approach consisted of engineering analyses, finite element analyses, static load tests, full-scale dynamic impact tests, and a full-scale vehicle crash test. It was concluded that a 44.5 kN (10 kips) equivalent static load is appropriate for the stability design of the barrier-moment slab system. This will result in much more economical design than systems developed using the 240 kN (54 kips) load that some user agencies are using. Design loads for the wall reinforcement and wall panels are also presented.

An Experimental and Numerical Investigation of Tall Mechanically Stabilized Earth Walls Andrew W. Strahler, 2016 The implementation and construction of Mechanically Stabilized Earth (MSE) walls has undergone substantial expansions in recent years, owing to its relatively low cost, ease of construction, and high efficiency compared to conventional retaining methods. As a result, MSE walls are being constructed to greater heights with complex features (e.g. multiple tiers, equivalent batter angles, close reinforcement spacing) even though impacts on wall response associated with these characteristics are not well understood. Available methods to predict wall responses are limited to empirical databases of single tiered walls less than 20 m and designers are left to complex finite element modelling to estimate the behavior of tall walls (walls with heights greater than 20 m). The current study aims to provide practitioners with a better understanding of the working stress behavior of tall MSE walls during and after construction through the use of a calibrated numerical model that incorporates pressure dependent soil, panel-soil interaction, non-linear soil reinforcement interaction, facing rigidity, foundation stiffness, and compaction stresses. First, an extensive laboratory investigation is conducted to characterize the plane strain and three dimensional stress-strain and stress-dilatancy response of a well-graded gravelly soil. Laboratory pullout tests are performed to characterize the influence of reinforcement spacing on load-displacement response. Results from the high quality laboratory investigations are used to calibrate specific numerical elements in FLAC (e.g. reinforcement-soil interface, facing-soil interface, soil constitutive response) incorporating pressure dependent constitutive responses. A numerical model representing a 46 m tall MSE wall is developed in FLAC, incorporating calibrated

element parameters. Measurements made during the construction of a 46 m tall MSE wall are used to establish those factors within the model that most accurately simulate the observed wall performance. Results from a geometric parametric study conducted to assess the influence of boundary conditions on wall response are presented, focusing on impacts associated with tier height, tier offset, and wall height. The synthesis of the results from the geometric parametric study are used to establish a more thorough understanding of wall response, with specific emphasis on wall displacements and reinforcement strains.

Developing More Efficient Mechanically Stabilized Earth (MSE) Wall Reinforcements Matthew J. Rahmeyer, 2016
Creating a more efficient reinforcement for Mechanically Stabilized Earth (MSE) Walls is important because it will reduce the amount of material needed to construct MSE walls, and will reduce overall construction costs for companies and contractors. This thesis explores four main geometries of metallic crimped and metallic crossbar type reinforcement constructed with both, smooth steel and #4 rebar steel. Metal round bar was chosen because, compared to metallic rectangular strip reinforcements, there is less surface area in contact with the soil which will then reduce the amount of corrosion losses. Throughout testing, it was found that crimped metal round bar was able to produce the required pullout resistance but created too much extensibility (the amount of length the crimps straightened). The reinforcement made with crossbars and metal round bar were found to produce the required amount of pullout resistance with little to no extensibility.

Internal Design of Mechanically Stabilized Earth (MSE) Retaining Walls Using Crimped Bars Bernardo A. Castellanos, 2010
Current design codes of Mechanically Stabilized Earth (MSE) Walls allow the use lower lateral earth pressure coefficient (K value) for designing geosynthetic walls than those used to design steel walls. The reason of this is because geosynthetic walls are less rigid permitting the wall to deform enough to work under active pressures instead of at rest pressures as in steel walls. A new concept of crimped steel bars was recently introduced. This new type of bar was tested for tension and pullout behavior. Results on tests made on crimped bars show that putting those crimps in the steel bar will give us a better pullout behavior and a more flexible tensile behavior. This new type of steel bar will behave more like geosynthetics, allowing the wall to deform sufficiently to reach the necessary deflection to reach the active condition. The use of steel by current design codes is pushing MSE walls to be designed with more steel than needed. Measurements of the force in different walls showed that the steel is not being used even close to the maximum stress allowed by the code which is 50%. The proposed design methodology using crimped bars will help us save around 52% of steel volume compared to the actual design procedures. This means a huge improvement in the usage of steel versus actual designs. This improvement is obtained because of the efficient behavior of rounded bars under corrosion and because of the flexibility in the bars obtained with the crimps that will allow us to reach the active condition.

DESIGN OF EMBANKMENT WIDENING AND MECHANICALLY STABILIZED EARTH WALL Dr. Suresh Kommu &

Dr. SS. Asadi,2021-06-11 The embankment is the most ancient form of civil engineering structures which refers to a volume of earthen material that is placed and compacted to raise the grade of a road way above the level of the existing surrounding ground surface. The design and performance of the embankment mainly depend upon the purpose of construction. In the in field of hydraulics, the embankment is designed for field control and seepage control in the field of transportation, the design of the embankment is concern about differential settlement due to external loads. Based on the type of material used for construction Embankment is classified into several categories like a reinforced embankment, earth fill, and rock fill embankment. In the roadway based on the requirement and design, the existing embankment is extended to serve the purpose.

Evaluation of the Stabilized Earth Wall System by TandB Structural Systems ,2012-03-01

Field Monitoring of Mechanically Stabilized Earth Walls to Investigate Secondary Reinforcement Effects Yan Jiang,2015 Mechanically stabilized earth (MSE) walls have been commonly used in highway construction. AASHTO (2007) has detailed design procedures for such a wall system. In the current AASHTO design, only primary reinforcements are used in relatively large spacing (commonly 2 feet), which requires higher connection strength between reinforcements and wall facing. Large spacing between reinforcements may also increase the chances of wall facing bulging and construction-related problems. To alleviate such problems, the use of secondary reinforcements installed between primary reinforcements was proposed. The use of secondary reinforcements could (1) reduce the required connection load for primary reinforcement, (2) increase the internal stability by secondary reinforcement, (3) improve the compaction near the wall facing, and (4) mitigate the down-drag behind the wall facing. However, this idea was not verified in practice. To improve the understanding of the performance of MSE walls with secondary reinforcement and verify its benefits in practice, three MSE wall sections reinforced with geogrids were constructed and monitored in the field: (1) an MSE wall section with uniaxial geogrids as primary and secondary reinforcements, (2) an MSE wall section with uniaxial geogrids as primary reinforcements and with biaxial geogrids as secondary reinforcements, and (3) an MSE wall section with uniaxial geogrids as primary reinforcements only (i.e., the control section). Earth pressure cells, inclinometer pipes and a probe, and foil-type strain gauges were used in these three test wall sections to measure the vertical and lateral earth pressures, lateral wall facing deflections, and strains of primary and secondary geogrids, respectively. The measured results (i.e., the wall facing deflections, the vertical and horizontal earth pressures, and the strains of geogrids) were compared with those calculated using AASHTO (2007). Based on the analysis of the field test results, major conclusions can be drawn in the following: (1) the secondary reinforcements reduced the wall facing deflections as compared with those in the control section; (2) the measured vertical earth pressures were close to the computed trapezoid stresses and increased with the construction of the wall; (3) the distribution of the measured lateral earth pressures in the control section linearly increased with depth, while the distributions of the measured

lateral earth pressures in the sections with secondary reinforcements were approximately uniform with depth; (4) the measured tensile strains at the connection in all sections were small; and (5) secondary reinforcements reduced the maximum tensile strains in the primary geogrids.

Reliability Analysis of Mechanically Stabilized Earth (MSE) Walls Tanit Chalermyanont,2002

Mechanically Stabilized Earth (MSE) Wall Backfill Water Infiltration Ali Soleimanbeigi,Keli Bohrer,William Likos,Greg Siemans,2021

Design Parameters and Methodology for Mechanically Stabilized Earth (MSE) Walls Charles Aubeny,Giovanna Biscontin,Texas. Department of Transportation,Jie Huang,United States. Federal Highway Administration,Vishal S. Dantal,Sazzad Bin-Shafique,Texas A & M Transportation Institute,Rafat Sadat,2014

Interaction Between Drilled Shaft and Mechanically Stabilized Earth (MSE) Wall J.-L. Briaud,Marcelo Sanchez (Research Engineer),Mohammad Aghahadi,Gang Bi,Jie Huang (Research Engineer),2017 Drilled shafts are being constructed within the reinforced zone of mechanically stabilized earth (MSE) walls especially in the case of overpass bridges where the drilled shafts carry the bridge deck or traffic signs. The interaction between the drilled shaft and the MSE wall is not well known and not typically incorporated into the design. As part of the research project, a full-scale test was conducted in 2012 at Texas A&M University. The test was performed on an MSE wall where the backfill material was clean sand and the soil reinforcement was made of metal strips. Also two real projects were instrumented during construction, and data were gathered for one year. A numerical model was used and calibrated against the results of the three full-scale cases. Then a sensitivity analysis was performed and 64 numerical cases were modeled to understand the effect of different parameters on the interaction between the MSE wall and the drilled shaft. The data from the simulations, the full-scale test results, and the monitoring of the real site were processed, and a modification of the current guidelines was proposed for the case where there is a drilled shaft subjected to a horizontal load in the reinforced zone of the MSE wall. A design chart is presented to take into account the additional pressure on the wall created by the drilled shaft.

Asset Management Practices for Mechanically Stabilized Earth Walls Aine Mines,Darren Beckstrand,2025 Mechanically stabilized earth (MSE) walls are widely used in transportation projects due to their cost-saving, time-efficient, and resilient nature. However, most of the walls constructed so far have been built too recently to allow assessment of whether or not they would meet the desired design life. Additionally, design guidelines, construction materials, and protocols have evolved greatly since the technology was first adopted. NCHRP Synthesis 644: Asset Management Practices for Mechanically Stabilized Earth Walls, from TRB's National Cooperative Highway Research Program, documents state departments of transportation asset management practices for MSE walls in their inventories. Relevant practices include those related to maintenance and rehabilitation of deteriorated walls, inventory and assessment, and development of risk and life-cycle costs.

-- Publisher's website.

Prediction of Soil Reinforcement Loads in Mechanically Stabilized Earth (MSE) Walls Tony M. Allen, Richard J. Bathurst, 2001

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