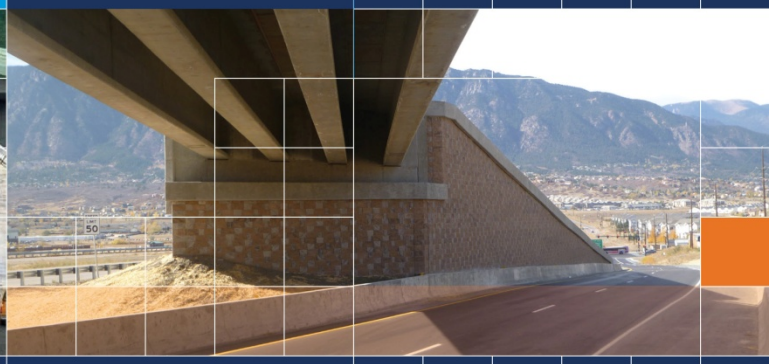
U.S. Department of Transportation
Federal Highway Administration

HIGHWAY INNOVATIONS, DEVELOPMENTS, ENHANCEMENTS, AND ADVANCEMENTS (IDEA)

– Protocol for Technical Evaluation of Earth Retention Systems

SEPTEMBER 2016



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16. Abstract

The Highway Innovative Technology Evaluation Center (HITEC) program was initiated over 20 years ago to facilitate the introduction of new and innovative technologies into highway construction. HITEC evaluations have been used by state agencies to improve their transportation infrastructures and by manufacturers to improve their products.

Earth retention is now a mature technology. Over the last two decades techniques to retain earth have evolved, particularly those that are based on mechanically stabilized earth (MSE) concepts. The viability of MSE structures in state transportation applications is no longer in question and other ERS methods have been developed. Rather, the goal of the Highway Innovations, Developments, Enhancements and Advancements (IDEA) program is to foster further innovation with proven ERS technology, encourage the development of new technologies, and improve the methods by which the technologies are delivered to projects on the ground. The IDEA program is intended to provide a consistent framework to propose changes to standard practice that owners may take advantage of by expanding ERS innovations in their projects. Towards this goal, this IDEA Protocol has been developed to provide guidance for three tasks: 1) the technical evaluation of earth retaining systems; 2) the use of reports of evaluations by transportation agencies; and 3) archiving and maintenance of reports of evaluations.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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GLOSSARY OF TERMS

Agreement for Technical Evaluation: The written agreement between the Applicant and the Review Team Entity to conduct an evaluation.

Applicant: A manufacturer or holder of a patented earth retaining system that wishes to undertake a technical evaluation under the IDEA program.

Final Submittal Review Phase: The last phase of the technical evaluation process in the IDEA program.

Initial Submittal Review Phase: The first phase of the technical evaluation process in the IDEA program.

Initial Technical Evaluation: The first technical evaluation performed for a given earth retaining system performed in either the HITEC or IDEA programs.

Manufacturer: The company or entity that fabricates ERS components and/or systems

Pre-Submittal Review Phase: The initial step of preparing an application and developing an Agreement for Technical Evaluation.

Report of Initial Technical Evaluation: The final report that presents the findings of the Initial Technical Review.

Submittal Check Phase: A completeness review of the original submittal for technical evaluation.

System Review: A periodic review of an ERS that has previously received a complete Technical Evaluation.

Update Technical Evaluation: A Technical Evaluation performed on an ERS with a prior complete Technical Evaluation that has had a significant change or innovation since the initial Technical Evaluation was performed.

LIST OF ABBREVIATIONS AND SYMBOLS

AASHTO	American Association of State Highway and Transportation Officials
ASCE	American Society of Civil Engineers
ASD	Allowable stress design
CERF	Civil Engineering Research Foundation
ERS	Earth retaining system
FHWA	Federal Highway Administration
HITEC	Highway Innovative Technology Evaluation Center
IDEA	Highway Innovations, Developments, Enhancements and Advancements
LRFD	Load and resistance factor design
MSE	Mechanically stabilized earth
NTPEP	National Transportation Product Evaluation Program
TRB	Transportation Research Board

1.0 INTRODUCTION

1.1 History of the HITEC Program

The Highway Innovative Technology Evaluation Center (HITEC) was established in 1994 as a collaborative effort by the Federal Highway Administration (FHWA), American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB) to accelerate the process by which technological advances are introduced for use in highway infrastructure (HITEC, 1998). The HITEC Program has been administered through the Civil Engineering Research Foundation (CERF) of The American Society of Civil Engineers (ASCE). The structure of HITEC was designed to facilitate comprehensive consensus-based nationally accepted performance evaluations of new or innovative technologies for the highway community.

Until 1994, many of the state transportation agencies had no formal process to evaluate earth retention systems and often lacked the technical resources that such evaluations require. Some agencies had protocols for technical evaluations, but the protocols were far from uniform. Consequently, the transfer of innovative earth retention technology from the private to the public sector was decidedly impeded.

The HITEC earth retaining system (ERS) program was created to evaluate the performance of proprietary ERS technologies. It was designed based on information and recommendations from federal, state and local highway officials, as well as the manufacturers of earth retention systems. The goal of the program was to provide transportation agencies ERS evaluations, thereby increasing the efficiency of agency approval processes.

Over a period of about 20 years, 18 complete earth retention systems were evaluated and each documented with a final report. These evaluations compelled critical thinking by both transportation officials and manufacturers on challenging earth retention issues. Now, many of those issues have been resolved and MSE retention has become a commonly accepted component of transportation infrastructure. To advance innovation in ERSs and help disseminate new technologies into practice with public transportation agencies FHWA has prepared this protocol for Innovations, Developments, Enhancements, Advancements (IDEA) for ERSs.

1.2 Objectives of the Highway IDEA Program

The IDEA program has three objectives:

- Update and improve the existing HITEC Technical Evaluation Protocol for new and modified earth retention systems and ERS components to provide a timely, transparent and cost-effective evaluation process.

- Develop guidance for use of Technical Evaluations by project owners and/or transportation agencies.
- Develop guidance for administration and maintenance of Technical Evaluations, including periodic system reviews.

The emphasis on innovation is not limited to MSE systems. It is anticipated that ERS innovations will include new technologies and modifications of existing ones. Areas where innovations are expected to develop include: corrosion/durability; spacing of reinforcement; connections; facing details; extensibility; and drainage. These are some of the technically challenging issues that are excellent candidates for innovation that will ultimately benefit the state Departments of Transportation, their highway projects, and the public as well as future development of ERSs.

2.0 GUIDANCE FOR THE TECHNICAL EVALUATION OF EARTH RETENTION SYSTEMS

2.1 Focus of the Protocol

Guidance for the technical evaluation of earth retention systems is provided in the form of a protocol. The focus of the IDEA protocol differs from that of the HITEC protocol in that HITEC was used specifically to evaluate the relatively new technology of mechanically stabilized earth (MSE) walls. Over time, the HITEC process helped to identify issues that are indeed critical for the proper performance of MSE structures, as well as some that are less relevant than previously thought. The IDEA program recognizes that MSE is a mature technology and the protocol has been updated to reflect the state of knowledge and state of practice.

The IDEA protocol addresses many MSE system details that are included in the HITEC protocol. However, it is assumed that applicants for an ERS evaluation are experienced with respect to the requirements of the standard of practice and should have little difficulty completing most of the items in the IDEA protocol checklist (see Section 2.7). The emphasis of the IDEA program is on *innovation*. The protocol is designed to check ERS compliance with the standard of practice, but also to evaluate aspects of the system that advance the state of the practice.

2.2 Definition of a "System"

To define a "system" it is helpful to first consider the types of earth retention systems that are presently in use. These systems are listed below and outlined in Figure 2-1 (Tanyu et al., 2001):

- Rigid gravity and semi-gravity systems.
- Prefabricated modular gravity systems.
- MSE systems.
- Non-gravity cantilevered and anchored systems (i.e. sheet pile, soldier pile and lagging, slurry, tangent and secant pile, master/king pile).
- In-situ reinforced systems (e.g. soil nail, micro-pile).
- Chemically stabilized earth systems (e.g. jet grout, soil mix).

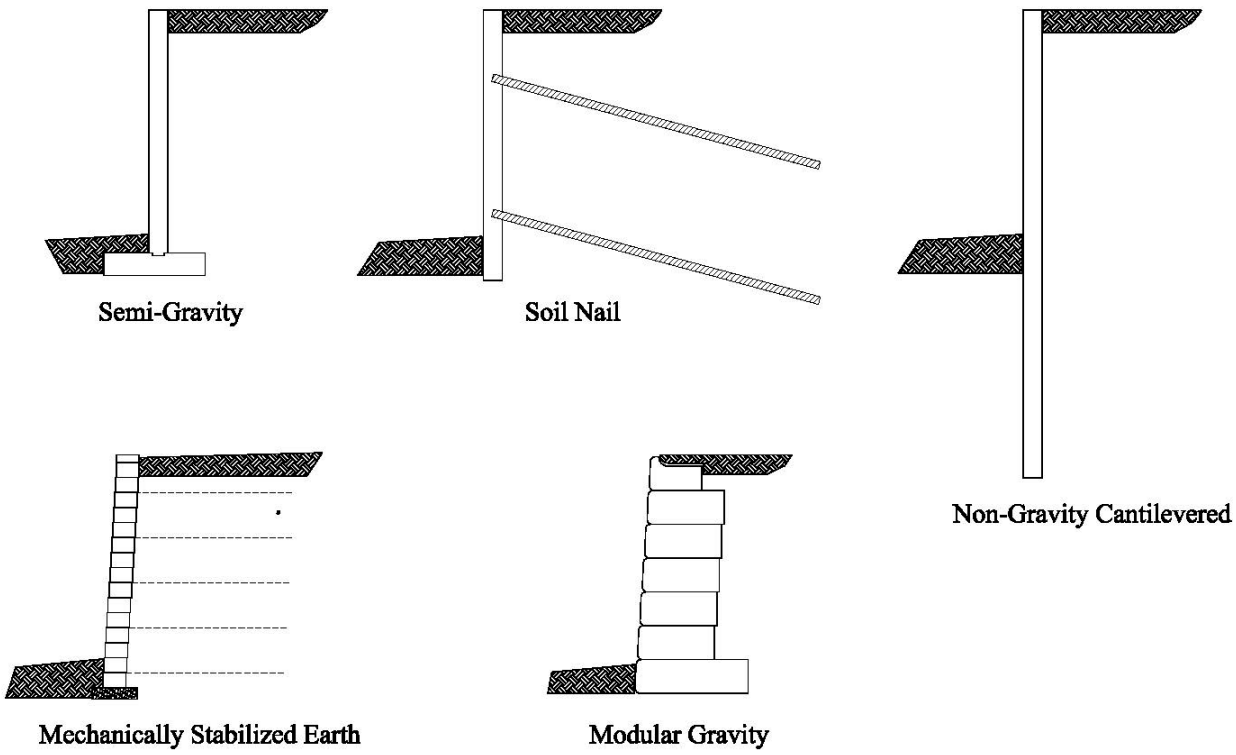

Figure 2-1: Types of Earth Retaining Systems

These systems rely on the fabrication of application-specific components using diverse materials. The properties of components are linked together by a design methodology that is based on theories of earth pressure and soil-structure interaction to produce an earth retention model. That model is transformed into reality through techniques of construction that are specific to the design theories, system components and field conditions. At each step of fabrication, design and construction, specific measures are required to control overall quality.

Accordingly, the IDEA protocol defines an earth retaining system as a unit that comprises the following elements:

- Specific components and the materials used for their manufacture.
- Design methodologies.
- Construction procedures.
- Quality control measures.

The relationship of each of these to an earth retaining system is discussed in this section.

2.2.1 Components

Earth retaining system (ERS) components are manufactured for different purposes using different materials and different techniques. Components can be specific to a particular system and can be characterized by the following functions:

- Components can be temporary or permanent.
- Components can function as facing, to anchor facing, support facing and/or align facing.
- Components can reinforce soil, restrain soil and/or drain soil.
- Components can be fabricated from steel, concrete, cement grout, geosynthetics, polymeric composites, soil, rock, recycled construction materials or a combination of these materials.
- Components have evolved from those made in traditional steel and concrete plants and that resisted soil pressure by relative brute-force methods. Now components are also made using injection molds, lasers, looms and extruders to provide tensile strength to the soil structure and resist aggressive electrochemical soil processes.

2.2.2 Design

The selection of a design methodology for an ERS is based on many factors including the structure type, system stiffness, the material that is retained, site conditions and deflection limits (Tanyu et al. 2001). These factors dictate the earth pressures used for design of the ERS, as noted in the following examples:

- Traditional Rankine or Coulomb earth pressure models remain appropriate for gravity and semi-gravity systems; however, modifications of such models may be advantageous and justifiable for modular gravity systems or systems with different types of reinforcement[1].
- A Coulomb earth pressure model may be appropriate for the soil retained by a cantilevered pile system but P-Y curves or numerical analyses may be needed to adequately estimate total pile deflection.
- The earth pressure diagram that is used for a system that is restrained by tiebacks depends on the strength and physical properties of the soil that is retained and whether a single level or multiple levels of anchors are used. Also, the selected earth pressure acting on the system must consider each stage of construction.

[1] FHWA guidance (FHWA NHI-10-024) acknowledges that the reinforcement stiffness can influence the ability of the wall to mobilize fully active conditions; and further, the actual earth pressure coefficient can vary with depth behind the wall.

- MSE structures are typically designed using conventional earth pressure theory. The resulting models can be modified to better account for different ERS component stiffnesses. Limit equilibrium models are constructed using either allowable stress design (ASD) or load and resistance factor design (LRFD).

- Numerical methods are being used with increasing frequency to better account for stress-strain relationships between components and loads.

- The design methodology must consider both internal stresses on system components and external (i.e. global) stability of the entire ERS.

2.2.3 Construction

Construction procedures that are indicated for a specific ERS depend on a variety of factors.

- Perhaps the most fundamental factor that determines construction procedures is whether the ERS will be cut or fill. A cut wall may often dictate the use of top-down construction techniques, thereby limiting construction options to those associated with non-gravity cantilevered, anchored, soil nail or chemically stabilized systems. Deflection limits or structure height may require the use of anchored wall systems with tiebacks. Each of these top-down systems has a unique set of construction requirements.

- Fill ERS construction proceeds from the bottom up. The many systems available for this method of earth retention have similar procedures for construction, but also important distinctions. For example, modular block facing systems are typically dry stacked, but some require the installation of components to align blocks and secure them to earth reinforcement. Similarly, panel systems for ERSs are typically attached to earth reinforcement using an array of techniques, many of which are described by detailed installation specifications. Panels also typically require bracing to assure stability and alignment.

2.2.4 Quality Control

An ERS comes with a set of quality control measures that it often shares in common with other systems as well as particular measures that are unique. Such measures should be taken during system design, as well as during component fabrication and ERS construction.

- Examples of two common quality control requirements during fabrication of concrete modular blocks are 1) periodic testing of compressive strength and 2) dimensional tolerances. However, some modular block systems require the insertion of alignment, shear or reinforcement connection devices that are fabricated from different materials and that entail a unique set of measures to assure the devices' strength and dimensional integrity.

- Quality control measures that should be common between the designs of different earth retention systems include: 1) determination of soil shear strength parameters; 2) Earth

retaining structure section geometries; 3) surcharge loads; and 4) factors of safety against overall stability failure. However, other design parameters are unique to individual systems. Examples of these include: 1) stresses in MSE reinforcement elements; 2) stresses in anchor tendons; 3) stresses at the connection between the system facing and earth reinforcement or anchor tendons; 4) stresses in steel reinforcement of precast concrete facing panels; and 5) bending stresses in cantilevered or anchored non-gravity system elements.

- There are numerous ways to connect earth reinforcement to precast concrete facing panels. However, the details of the connection are usually unique to a given system. Similarly, the requirements for inspection of a connection are thus usually system-dependent.

As illustrated in the discussion above, the four elements addressed in the IDEA protocols (components, design methodology, construction procedures, and quality control measures) apply to all systems, but the specific details and requirements of each will vary widely for the different ERSs. Innovative improvement to any of these elements is a focus of the IDEA program.

2.3 Types of Technical Evaluations

There are two types of Technical Evaluations to assess earth retaining systems:

- An Initial Technical Evaluation.
- An Update Technical Evaluation.

2.3.1 Initial Technical Evaluation

An Initial Technical Evaluation is performed to assess an ERS that has not been previously reviewed under the IDEA program's protocol, the HITEC program, or other similar process. Given the objective of innovation in the IDEA program, ERSs that have had previously obtained a Technical Evaluation through the HITEC Program do not need to undergo an Initial Technical Evaluation under the IDEA program, but an Update Technical Evaluation may be appropriate.

2.3.1.1 The Initial Technical Evaluation Process

An Initial Technical Evaluation consists of a four-phase process as summarized in tabular form in Appendix A and described below. The four phases include:

- Pre-Submittal Review Phase.
- Submittal Check Phase.
- Initial Submittal Review Phase.
- Final Submittal Review Phase.

Pre-Submittal Review Phase

The Pre-Submittal Review Phase is initiated when the Applicant provides its request for a Technical Evaluation (see Appendix B) to the agency or entity that has been assigned the responsibility for the IDEA program administration (to be determined). The request is accompanied by a brief description of the Applicant's ERS and designation of the checklist the Applicant believes to be appropriate. Checklists for various types of ERSs are presented in Appendix C.

The IDEA program Administrator forwards the application to the Evaluation Review Team and its Review Consultant (see Section 2.5). The Review Team comprises individuals knowledgeable of the ERS being proposed. Upon authorization of the Review Team, the Review Consultant considers the request and determines the cost for each of the next three phases of review. This cost estimate is provided to the Review Panel for use in developing an Agreement for Technical Evaluation.

An important determination at this stage is whether a custom checklist should be developed by the Review Team. If a custom checklist is needed, then the time and cost to prepare it must be determined and included in the schedule and cost for the Submittal Check Phase. If the proposed schedule and cost are acceptable to the Applicant, then an Agreement for Technical Evaluation is executed.

Submittal Check Phase

Following execution of the Agreement for Technical Evaluation, the Applicant prepares its submittal. The importance of adherence to the submittal format and completeness should be emphasized to the Applicant, and it should be cautioned that formatting errors will result in a delay of this phase of the review.

The Applicant should also be advised that if the proposed ERS contains an innovation or change to a previously-evaluated system, then it is the Applicant's responsibility to thoroughly document the innovation in terms of complete descriptions, test data, and design methodology. Essentially, the Applicant must "prove" the innovation using sound engineering, particularly if the innovation does not conform to current reference standards. The Applicant should also address the patent status of the innovation and provide documentation of technology ownership.

Experience demonstrates that a technically sophisticated Applicant can have reasonable questions regarding the submittal requirements. If the Applicant has no prior experience with HITEC or a comparable transportation agency review process, or if a custom checklist must be used, then the Applicant's uncertainty will be increased. If the Applicant need for clarification is not satisfied, then the submittal will possibly contain errors and omissions. Resolution of these can take several iterations of reviewer comments and applicant responses. Therefore, the Applicant and the Review Team should use clear and direct communication to avoid multiple

submittals and reviews. Failure to do so may create frustration, increase costs and delay review completion.

To encourage clear communication, this protocol permits the Applicant to request a meeting with the Review Consultant and the Review Team before the Applicant completes its submittal. During the meeting the Applicant should request any clarifications needed to help comply with IDEA program requirements.

Upon receipt of the submittal, the Review Consultant evaluates it for completeness and format. The Consultant's Report of Submittal Check presents the findings of this phase of review. If additional information or changes are required, the Consultant will summarize them in the report using bulleted items that specifically describe how and which sections of the submittal should be changed to satisfy format requirements or clarify additional information that is needed. Then the submittal and a draft version of the report are provided to the Review Team. Upon approval of the report by the Review Team, a final version is sent to the Applicant.

If the report indicates the submittal is deficient, the Applicant may request a second meeting with the Consultant and Review Team member to discuss and clarify how the deficiencies can be resolved.

The Applicant might at this point elect to withdraw from the review process, particularly if it finds that it is unable to provide a sufficiently complete submittal. In the event of a withdrawal, the Review Administrator will document the withdrawal by the Applicant. However, if the Applicant provides a complete and properly formatted submittal, the Initial Submittal Review Phase may begin.

Submittal Review Phase

The Consultant now evaluates the technical content of the submittal for conformance to the applicable references, as discussed in Section 2.5. For submittals that describe an innovation, the adequacy of the submittal with respect to "proof" of the innovation are a focus of the Consultant's effort. The Consultant's Preliminary Report of Technical Evaluation presents findings factually and succinctly. A draft version of this report and the submittal are then provided to the Evaluation Review Team. Upon approval of the report by the Review Team, a final version is sent to the Applicant.

If the report indicates deficiencies with the ERS, the Applicant may request a meeting with the Review Consultant and a Panel member to discuss and clarify methods by which the deficiencies can be resolved.

The Applicant might determine that its interests are not best served by a Final Report of Review and elect to withdraw before starting the final phase. However, if the Applicant provides a response to the Preliminary Report of Review, then the Final Submittal Review Phase may begin.

Final Submittal Review Phase

The Applicant's response is used to complete the review. The Consultant's Report of Initial Technical Evaluation includes a discussion of the following:

- ERS Type.
- Components.
- Design Methodology.
- Construction.
- Quality Control.
- Performance History.

The innovation will be the emphasis of the report, and the report will state whether the technical evaluation is an initial or an update. In the case of an initial evaluation, the report will note that an update evaluation may be required if any element of the ERS is significantly changed.

2.3.1.2 Initial Technical Evaluation Schedule

The time that is required to perform each phase of the review will depend on a number of factors, some of which are beyond the control of the Review Consultant and the Review Team. In particular, the ERS type and complexity of the potential innovations of the ERS may significantly affect the time that is required for its review. However, the time for this work can be estimated. The turnaround time that the Applicant requires to respond to or prepare revisions in response to the panel evaluations described in the previous section cannot be estimated.

The Applicant is given an estimate for the time the Consultant and Review Team require to perform their work during the Submittal Check Phase after the Consultant has had the opportunity to review the submittal and assess its complexity. The Applicant is reminded that the total time required to complete the Submittal Check Phase depends on the Applicant's timely response to the Report of Submittal Check.

A meaningful estimate of the time required for the Consultant and Panel to perform their work for the initial and final review phases probably cannot be provided to the Applicant until the Report of Submittal Check is completed. However, if the ERS comprises an MSE or gravity system consistent with one of the existing checklists, the time required for the Consultant's and Panel's work would typically be as follows:

- Pre-Submittal Review Phase—2 weeks
- Submittal Check Phase—2 weeks
- Initial Submittal Review Phase—3 weeks
- Final Submittal Review Phase—5 weeks

The schedule may be significantly affected by a need to use a custom checklist or if the proposed ERS includes an innovation requiring significant documentation and review.

2.3.2 Update Technical Evaluation

The Initial Technical Evaluation is updated every 5 years or when a significant modification to the system has been made. Update Evaluations are important to assure users that the information about an ERS is current and remains accurate. The decision to perform an Update Technical Evaluation is based on the results of a System Review, as described below.

2.3.3 System Review

A System Review is performed to determine if a "significant" change has been made by the Applicant to an ERS element or if a change has been made to one of the relevant references defined in Section 2.5. A System Review is indicated by one of the following:

- Notification from the Applicant of a change in an element of the ERS.
- Significant change in one of the references for review (i.e. revision of an AASHTO specification or FHWA guideline).
- Finding by a state transportation agency that a system is significantly changed compared to a prior system evaluation. This may occur for example, if an agency notices a difference in the system's description in a Report of Initial Technical Evaluation compared to a design submittal for the ERS for a specific project.
- Passage of a period of 5 years following the publication of the Report of Initial Technical Evaluation.

2.3.4 Update Technical Evaluation

The scope of an Update Technical Evaluation depends on what has indicated its need. For example, if it is in response to notification of a change in an element of the system from the Applicant or an agency, the review scope can be fairly focused on the ERS element at issue. If the evaluation is triggered by the passing of a period of 5 years since then the publication of the Report of Initial Technical Evaluation, then the scope may be broader. The results of this work are presented in the Report of Update Technical Evaluation prepared by the review team and issued by the panel. The Update Technical Evaluation may be as simple as a letter verifying that no significant changes have been made to a previously evaluated system.

2.4 Evaluation Cost Structure

The Applicant will finance the cost of the ERS evaluations performed by the Review Panel, the Review Team and the Team's Consultant. The cost for the Initial Technical Evaluation and the

Update Technical Evaluation are different. As described below, it is structured to provide the Applicant with flexibility in financing the evaluation process. Partial payment for each evaluation stage is scheduled at each review phase and is made before work for the respective phase begins. Therefore, separate payments are to be made for the cost items described below.

2.4.1 Initial Technical Evaluation Cost Structure

- Cost item 1—Pre-Submittal Review Phase (i.e. an application fee).
- Cost item 2—Submittal Check Phase.
- Cost item 3—Initial Submittal Review Phase.
- Cost Item 4—Final Submittal Review Phase.

The rationale for this structure is to reduce the financial risk to the applicant by providing a structure that allows the applicant to withdraw its evaluation request at the end of any phase. Distribution of the total cost across the four review phases is beneficial if the Applicant decides during the Submittal Check Phase or the Initial Submittal Review Phase that it is not in the Applicant's interest to continue with a Final Submittal Review Report.

The System Review and Update Technical Evaluations are intended to be structured as an update of Cost Item 4—The Final Submittal Review Report, described above. The extent of the System or Update Technical Review and its associated cost also depend on the specific scope of the review. For the purpose of these types of evaluation, it is envisioned that the System Review cost will be less than the Update Technical Review that it may trigger. This is because the least expensive System Review would be an affirmation that no significant changes are needed to an ERS, while the Update Technical Review does not involve additional technical evaluation. Similar to the Initial Technical Evaluation, the estimated cost for each of these review phases is determined prior to the review such that the Applicant can understand the financial commitment with each review phase.

2.5 Evaluation Review Panel and Review Team

2.5.1 Evaluation Review Panel

The evaluations for the IDEA Program are performed under the authority of the Evaluation Review Panel. The Evaluation Review Panel comprises leaders in the field of ERSs and are drawn from public agencies, academia, ERS manufacturers, and practitioners familiar with ERSs. The Evaluation Review Panel has approximately 20 to 30 members and serve on a volunteer basis with interest in the overall development and advancement of ERS technology, and operate under the auspices of the program Administrator (TBD). The role of the Evaluation Review Panel is to provide governance for the administration of the IDEA program rather than perform specific evaluations. The Panel is responsible for developing a Charter to specify the details of the evaluation process.

2.5.2 Review Team

Members of the Review Team are drawn from the Evaluation Review Panel for the purpose of overseeing the process of technical evaluations and to review the findings and recommendations of its Review Consultant. The Review Team should comprise the following personnel:

- One employee of FHWA or a state transportation agency.
- A researcher or academic expert in the ERS type proposed in an application.
- An engineering practitioner from the private sector that is experienced in the type of ERS proposed in the application to serve as the point person for technical evaluations.

Personnel who are considered for service on the Review Team should possess general expertise in earth retention as it relates to design, specifications, research, testing and manufacturing. However, if a candidate for the Review Team has a professional or commercial conflict of interest with the proposed evaluation, she may be replaced at the discretion of the Review Panel. The private sector consultant should have expertise with the specific type of system that is under review as well as with the relevant design standards (see Section 2.3). Given that there are technical evaluations of ERSs of different types, the composition of the Review Team may be different for separate evaluations depending on the specific expertise needed for a particular system type. Members of the Review Team are selected from members of the Review Panel, with the addition of the engineering practitioner.

Because the bulk of the technical and administrative work associated with an evaluation is conducted by the engineering practitioner, this service is compensated by a portion of the fees derived from the IDEA program Review fees.

2.6 References for Technical Evaluations

Technical Evaluations are based upon information that is submitted by the party that has applied for a review of its ERS (i.e. the Applicant) and existing guidelines and standards that apply to the ERS type. For example, if the Applicant's ERS classifies as an MSE retention structure then applicable references may include:

- The Applicant's technical submittal for its system.
- *AASHTO LRFD Bridge Design Specifications* (AASHTO, 2015 or more recent as available).
- FHWA Publication FHWA-NHI-10-024 / 025 *Design and Construction of Mechanically Stabilized Earth Walls—Volumes I and II* (Berg et al., 2009).
- FHWA Publication FHWA-NHI-09-087 *Corrosion / Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Slopes* (Elias et al., 2009).

- Current ASTM Standards

Other types of ERSs may indicate the use of other references. For example, if the system involves the use of ground anchors, then *Geotechnical Engineering Circular No. 7 Ground Anchors and Anchors and Anchored Systems* (Sabatini et al., 1999) is likely relevant. If the system involves the use of soil nails, then *Geotechnical Engineering Circular No. 7 Soil Nail Wall-Reference Manual* (Lazarte et al., 2015) is likely relevant. Some local agencies may have established guidance or technical procedures that may also be appropriate references. Local conditions are also be important considerations. For example methods for addressing seismicity are treated differently in different references and it is important to consider the best way to incorporate this in a submittal. Allowable Stress Design methods may also provide an appropriate design approach. In addition, ERSs that have been developed internationally and have been developed using other technical standards or references (e.g. Eurocode) may refer to these standards or references; however, FHWA and AASHTO references will typically be primary references, as appropriate.

The references serve as a baseline to assess a system's conformance with current engineering practices. In fact, an innovative system likely does not conform to current practices and would not necessarily be judged deficient. Rather, the nonconformance may be an innovation and an opportunity to advance the state of practice, provided that sufficient information is included in the application as a basis for completion of the technical evaluation. It is important to demonstrate that the design method for an innovation is consistent with an applicable guidance document, or that the innovation is an appropriate adjustment to an established design methodology.

2.7 Technical Evaluation Application Organization

The Technical Evaluation is designed to assess all types of earth retaining systems. It is anticipated that in the near term, most Applicants will request an evaluation of MSE and modular gravity systems. For this reason, the protocol and the current checklists are oriented toward these structures.

Given that innovation is a focus of the IDEA program, it is hoped that requests for reviews of other types of ERSs will be received and that modifications to the protocol and/or checklists will be required. In these cases the protocol are be modified as necessary on a case-by-case basis in coordination with the Applicant. However, all Technical Evaluations consider the ERS elements and performance history as described below.

2.7.1 Components

Drawings, specifications and test results for components are required. For example, consider an ERS that includes a reinforced precast concrete facing panel with embedded steel connectors that attach to earth reinforcement. The panel, reinforcement and connectors should be drawn in

elevation, plan and section views with dimensions and descriptions. Panel specifications should address its dimensional tolerances, constitutive materials, and compressive strength. Test results should document the pullout capacity of the embedment from the panel. Similar drawings and technical specifications are needed for the many essential components that an ERS may require for proper performance.

In the case of geosynthetic earth reinforcement, drawings that illustrate its location in a system are needed as are the material's property specifications. However, if the geosynthetic has been assessed by the National Transportation Product Evaluation Program (NTPEP), the NTPEP report may be submitted in lieu of some geosynthetic test data. Additional technical information regarding the geosynthetic material should be submitted, as needed to provide a comprehensive description of the component and the specification required for proper performance.

2.7.2 Design Methodology

Each ERS submittal should describe the design methodology that is used to model earth pressures, evaluate system performance (e.g. deflection and design life), and provide calculations for a typical structure. In many cases the methodology may be consistent with currently accepted standards. However, in other cases the methodology may be largely consistent with an accepted standard, but deviate in one or more important respects, or the methodology may depart completely from current practice.

If the design methodology is consistent with an accepted standard, then the description of the methodology can be brief, acknowledging the standards that are applicable. However, if the methodology departs from current practice then additional details of the governing design theories and their application are likely be required.

To illustrate, consider an example of a potentially minor deviation from AASHTO standards where the Applicant posits that its steel reinforcement behaves like an extensible rather than an inextensible material. Accordingly, for the Simplified Method the coefficient of lateral stress ratio (K/K_a) should be 1.0 (Berg et al., 2009). If such an assertion can be justified with appropriate data, it would represent the type of innovation that the IDEA program is intended to foster. This issue is discussed further in Section 2.7.

Each ERS submittal is required to include examples that illustrate how traffic surcharge loads, traffic barrier impact loads and crest slopes (sloping crest configurations) are addressed where applicable.

2.7.3 Construction

The procedures that should be used to construct the ERS should be thoroughly described such that they are clear to both installers and inspectors. The procedures should be provided with the submittal in a stand-alone document. If certain aspects of the construction procedure deviate

from conventional practices, then such a potential innovation will likely require in-depth explanation.

2.7.4 Quality Control Measures

A description of the quality control measures that apply to the structure design, component fabrication and ERS construction is required.

2.7.5 ERS Performance History

The relevant performance case histories of the ERS should be provided using the form provided at Appendix B. The form includes questions that help to illustrate potential limitations of the system's application and equally important, how the system has overcome the limitations of other systems.

2.8 Submittal Checklists

As previously mentioned, this protocol includes submittal checklists for several ERSs. They explain the information the Applicant should provide and include a detailed format for submittal organization. The checklists also include "commentaries" that describe information required for each item certain.

This protocol provides a checklist for the following MSE and gravity systems:

- Concrete modular block unit paired with extensible reinforcement.
- Concrete modular block unit paired with inextensible reinforcement.
- Precast concrete panel paired with extensible reinforcement.
- Precast concrete panel paired with inextensible reinforcement.
- Steel facing paired with extensible reinforcement.
- Steel facing paired with inextensible reinforcement.
- Precast concrete modular gravity system.

For the instances where a checklist asks if a feature of the ERS conforms to AASHTO guidelines, actual confirmation of claimed conformance is necessary. In the case of the example of a deviation from AASHTO design guidelines in Section 2.7.2, the calculations for the design examples are to be provided to verify conformance. If the checklists included in this protocol are not appropriate for a new or innovative system evaluation, or if the system is different from those listed above, a custom checklist is developed to provide a systematic way to prepare an application that is sufficiently developed for the Review Team to consider.

3.0 GUIDANCE FOR USE OF TECHNICAL EVALUATIONS BY TRANSPORTATION AGENCIES

HITEC's *Guidelines for Evaluating Earth Retaining Systems* (HITEC, 1998) state that the HITEC report of evaluation does not approve, recommend, or endorse earth retention systems, but rather provides findings that can inform the product selection decisions made by transportation agencies. Despite this provision, the reports have been mistakenly interpreted to be blanket approvals or rejections of specific earth retention systems. The same policies hold true for the IDEA Program as well. Therefore, these guidelines are provided to assist transportation agencies to make effective use of Final Reports of Technical Evaluations. Each transportation agency should establish a means for considering IDEA program reports and approving use of any particular ERS on projects within its jurisdiction. These measures are necessary because highway construction conditions and policies and procedures for ERS approvals vary considerably between individual state DOTs and transportation agencies.

As with the HITEC program, the evaluation of ERSs and component innovations under the IDEA program consists of a technical review of the system and/or components. The report presents a summary of the technical review in the final report. The final report helps state or local agencies to evaluate the ERS more efficiently and advance the dissemination of ERS technology to construction projects. State or local agencies should update existing ERSs catalog descriptions such that their project can benefit from the innovation. The state or local transportation agencies are still responsible for the overall approval to employ a particular system. The extent to which an agency chooses to approve a specific ERS is completely left to the agency. It is also important to note that no particular ERS is suitable for all conditions because as site-specific factors can influence ERS selection, as described below.

3.1 Consideration of the Elements of an ERS

The elements of an ERS (i.e. components, design, construction and quality control) are specific to each system and must be considered in the determination of whether an ERS is suitable for the performance conditions for each project. No ERS is superior to all others under all performance conditions, despite what some manufacturers claim. For example, two criteria that indicate the use of one type of ERS over another are deformation limitations and corrosion resistance.

Deformation Limitations

Polymeric geosynthetic reinforcements exhibit lower tensile strength moduli than steel reinforcements. Consequently, an MSE ERS constructed with steel reinforcement will displace less than an MSE system constructed with geosynthetic reinforcement to support a given load if all other conditions are equivalent. For most wall applications, the difference in the displacements of two such walls is not an important consideration. However, if the ERS supports a structure that is especially sensitive to movement, then the use of an ERS that is based on steel reinforcement may be indicated.

Corrosion Limitations

Steel reinforcements are subject to corrosion under environmental conditions that are benign for geosynthetic reinforcements. The limits recommended by FHWA for three of these conditions are shown in Table 3-1.

Table 3-1: Recommended limits of electrochemical properties for reinforced fill with steel reinforcements (Berg et al., 2009).

3.2 Property	3.3 Limit
Resistivity	>3000 ohm-cm
Chlorides	<100 ppm
Sulfates	<200 ppm

The limits shown in Table 3-1may proscribe the use of steel reinforcement in walls that are subject to water runoff from coal mines or inundation by seawater. These conditions may be better accommodated by the use of geosynthetic reinforcement.

In addition to the two examples presented above, there are numerous other examples that demonstrate that a variety of site-specific considerations can affect the performance of an ERS. These conditions may include other environmental conditions (extreme temperature impacts to specific components and drainage conditions) as well as constructability considerations. These examples illustrate two important points about earth retention systems and how they are employed:

- Not all systems are appropriate for all performance conditions.
- The design of an ERS and selection of wall elements must be based on the site conditions, performance requirements, and the properties of the system's elements.

3.4 Guidelines for Approval of an ERS

As previously stated, the IDEA Review Report evaluates the technical aspects of a given ERS or component. Local or State transportation agencies still need to approve, disapprove or provide limited acceptance of the ERSs or components based on their own policies and procedures.

The elements of an ERS are specific to each system and must be considered to determine if an ERS is suitable for the performance conditions for a given project. During this process, the Report of Technical Evaluation is the best tool an Agency has to identify the capabilities and limitations of an ERS. But before the report can be used, the Agency must first determine the relevant performance conditions.

An Agency's submittal procedures for each earth retention project should account for each of the four ERS elements:

- Components.
- Design.
- Construction Procedures.
- Quality Control Measures.
- System Performance History

During the Agency's review, it should check that the information for each element is consistent with the current report of technical evaluation. Again, if a change has been made to an element of the ERS, then the Agency should review the reported change to assess its significance.

3.4.1 Performance Conditions

The performance conditions that determine the suitability of an ERS for a given project or types of projects generally fall into five categories: ERS geometry, loads, environmental factors, geotechnical factors, and constructability factors. Each is briefly discussed below. Additionally the performance of an ERS may also be affected by the degree of cut or fill at a particular location. A more extensive discussion of performance conditions can be found in *Design and Construction of Mechanically Stabilized Earth Walls—Volumes I* (Berg et al., 2009).

3.4.1.1 ERS Geometry

A description of an ERS's geometry includes height, layout, batter, tiers, toe slopes, crest slopes, three-dimensional considerations (outside corners or curves), and top-of-structure details. The first three are the most likely to limit the number of suitable systems. For example, tall ERSs demand a greater structural capacity from an ERS than a comparatively short structure does. If the batter of an ERS is relatively large, then the design engineer must determine if the horizontal distance required between the structure toe and the structure crest will leave enough room for guard rails, fence and curbs behind the structure crest.

If the layout of an ERS includes outside corners or curves, then potential three-dimensional effects should be considered. Research and field inspections shows that outside corner and curve configurations require special attention to internal and external stability analyses, design detailing, construction procedures, backfill specifications, and soil compaction to obtain satisfactory structure performance.

3.4.1.2 ERS Loads

The design of an ERS requires consideration of loads created by structure height, traffic, crest slopes, adjacent structures, ERS stiffness, and excess soil pore water pressures. Obviously some

loads are transient and others are relatively permanent. All cause displacement of the structure and the magnitude of the displacements depend in part on the properties of the ERS elements.

3.4.1.3 Environmental Factors

Environmental factors can severely restrict the suitability of different ERSs. The potential effect of the electro-chemical properties of fill soil on steel reinforcement was previously discussed, but such properties must also be considered for geosynthetics. Freeze-thaw durability can be a significant concern for concrete, and spray from deicing salt solutions can have a corrosive effect on both dry-cast and wet-cast concrete facing units, as well as steel facing and reinforcement components. Typical and potential site and ERS drainage conditions must be considered to ensure that ERS performance will remain acceptable.

3.4.1.4 Geotechnical Factors

There are many geotechnical factors that influence the design of an ERS, but only a relative few have important implications for the type of ERS that should be selected. Of these few factors, foundation settlement and global stability are perhaps the most important. This is because flexible ERSs accommodate differential settlement more effectively than rigid ERSs. MSE structures are generally regarded as being flexible, but even among the different MSE systems there is a wide range of tolerances for differential settlement. The tolerances are mostly a function of the facing system. For example, consider that precast full-height panel facing systems are limited to a differential settlement ratio of about 1:500 and welded-wire facing systems to about 1:50 (NHI, 2009).

3.4.1.5 Constructability Factors

Construction details and procedures are key considerations for an ERS. Perhaps the most common constructability factor for MSE structures is the availability of right-of-way behind the ERS face to install reinforcement. The distance between the structure face and the right-of-way must be sufficient for the full reinforcement design length. If construction of the reinforced soil zone requires excavation into an existing hillside, the stability of the temporary slope must be assured. If the distance available for reinforcement is inadequate, or if the stability of a temporary excavation is inadequate, then another type of ERS should be considered (e.g. semi-gravity, modular gravity, and top-down construction).

Another condition that requires consideration of ERS constructability is water. MSE structures should typically be constructed “in the dry”. If an ERS is required at the edge of an existing body of water, then the use of cofferdams and dewatering measures may be necessary. Given such conditions, a non-gravity cantilever system may be more appropriate (e.g. sheet piles).

A site condition that is often unanticipated and that can induce complete failure during ERS construction is surface water runoff. If surface water drains towards an ERS, it is imperative that

measures be taken to divert the runoff away from the structure during its construction. Otherwise, the water can erode soil from behind the ERS face and undermine the base. One study of the causes of failure of 45 MSE ERSs found that uncontrolled surface water runoff was a significant factor in seven of the failures (Valentine, 2013).

3.4.1.6 Other Factors

In addition to the performance conditions described above, an Agency may have considerations that are specific to its geographical region or result from legislation. Such considerations may include seismic loads, scour, soil liquefaction and building setbacks. A discussion of these considerations is beyond the scope of this evaluation protocol.

3.5 Specifications for ERS evaluations

Project specifications should address the appropriate use of ERSs that have had an IDEA Technical Evaluation such that the State or local agency recognizes that the Technical Evaluation is limited to the technical performance of the system and its construction and QA/QC methodology. Some State or local agencies may have their own technical evaluation process for ERSs that would be required in addition to or in lieu of an IDEA Program Technical Evaluation. On the other hand, there may be some agencies that do not have the technical resources to perform its own evaluation and thus may rely on the IDEA Technical Evaluation. In each case, it is important to recognize that the FHWA IDEA Technical Evaluation is not an Approval for a particular ERS. Rather, it is an assessment of the ERS components, design methodology, construction, quality control and performance history.

4.0 GUIDANCE FOR ADMINISTRATION AND MAINTENANCE OF FINAL REPORTS OF TECHNICAL EVALUATIONS

To make efficient use of the reports of technical evaluations, the IDEA Program administrator should design a process by which it can track and disseminate reports it has received and ensure that the reports remain current. Toward these goals, guidance is provided for report administration and maintenance.

4.1 Administration

The IDEA Program Coordinator's administration of technical evaluation reports should provide for the following:

- Coordination.
- Distribution.
- Archiving.

4.1.1 Report Coordination

A process should be developed to coordinate receipt of reports of technical evaluation from the Evaluation Review Panel and Review Team and to keep track of the reports that have been issued. The department should also initiate the Agency's requests for System Reviews when they are needed and track the status of responses to those requests. A specific numbering system can be developed to display the type of ERS, year it was evaluated, and version number. For example, referring to Figure 2-1, a technical evaluation report number for a soil nail wall system could be SN-15-001. This number indicates that it is a soil nail wall evaluated in 2015 and that this is the first version of that technical evaluation.

4.1.2 Report Distribution

The process should also provide for the distribution of reports of technical evaluations to the Agency's departments that will use the reports. These departments may include:

- Earth retention structure design.
- Materials testing.
- Construction inspection.
- Geotechnical engineering.
- Structural Engineering.

4.1.3 Report Archiving

Reports of evaluation should be archived in a manner that not only allows them to be readily located and disseminated, but makes it easy to determine if they are current. A key element to

ensure that the most current reports are distributed is to develop a version control identification system that will be maintained as reports or updated or modified.

4.2 Report Maintenance

Reports of technical evaluation are useful to a state or local transportation agency only to the degree that they contain the most current evaluation information. As discussed in Section 2.3.2, an Update Technical Evaluation will need to be performed to ensure that the information they contain remains current. The decision to perform an update evaluation is based on the results of a System Review. One of the four triggers that can initiate a System Review is a request by a transportation agency.

If an Applicant has changed an element of its ERS, it should request a System Review. However, local vendors (e.g. contractors or licensed system distributors) of an ERS may propose the system for use on an Agency's project, unaware that an ERS element has been modified. Therefore, the Agency should include the current Technical Evaluation Report and a Statement of Technical Evaluation Report Currency in its list of submittal requirements for each earth retention project, as described below.

4.2.1 Statement of Technical Evaluation Report Currency

The submittal from a vendor of an ERS for each project should include a statement by the vendor that it has asked the Applicant if the Applicant has changed an element of the ERS since the last report of technical evaluation (i.e. Report of Initial Technical Evaluation or Report of Update Technical Evaluation), as well as the Applicant's response. If a change has been made to an element of the ERS, then the Agency should review the reported change to assess its significance.

5.0 REFERENCES

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APPENDIX A

Highway Innovation Developments, Enhancements and Advancements (IDEA)

Initial Technical Evaluation Process

The Innovations, Developments, Enhancement and Advancements (IDEA) Program - Review Process and Activities

Definitions:

1. Applicant – A manufacturer or holder of a patented earth retaining system that wishes to undertake a technical evaluation under the IDEA program.
2. Administrator – IDEA Administrator coordinates system review activities and the exchange of information and requests with Applicant and Reviewers.
3. Review Consultant (RC) – Private sector subject matter expert consultant responsible for the system evaluation, draft and finalize review phase reports (see Section 2.5.2).
4. Review Team (RT) – Provide consultation with the RC when required and review the findings and recommendations of the Review Consultant (see Section 2.5.2).
5. IDEA Evaluation Committee: GI board level committee responsible for the overall IDEA program.

			Evaluation Team Action	
Review Phase[1]	**Applicant Action**	**Administrator Action**	**Review Consultant**	**Review Team**
Milestone 1: Pre-Submittal Review Phase Time estimate – 2 weeks	• Apply for Technical Evaluation • Pay application fee	• assign review consultant and review team • Acknowledge application and send onto Review Consultant • Forward RC approval to applicant	• Review request and approve for technical evaluation – *two weeks to review request and respond to applicant.*	No action
Milestone 2: Submittal Check and Applicant Response Time estimate – 3 weeks	• Prepare submittal • Pay fee for next action • Response to RC comments • Finalize comments or withdraw application – *two*	• Acknowledge submittal and send onto Review Consultant • Coordinate communications between applicant and RC	• Review submittal and checklists for completeness • Issue Initial Report of Submittal Checklist – *two weeks to draft Initial Report* • Review Applicant response to Initial Report – *one week to review response*	No action

			Evaluation Team Action	
Review Phase[1]	**Applicant Action**	**Administrator Action**	**Review Consultant**	**Review Team**
	weeks to respond to Initial Report • Suspend application after 4 weeks of no response		• Report Initial Report complete decision	
Milestone 3: Submittal Review Time estimate – 11 weeks	• Pay fee for next action	• Provide applicant with updates when warranted • Coordinate activities of RC and RT to resolve comments and finalize Draft Preliminary Report of Technical Evaluation	• Evaluate the technical content of the submittal • Draft Preliminary Report of Technical Evaluation – *four weeks to review and draft report*	• Review Preliminary Report of Technical Evaluation – *two weeks to review report*
			• Respond to RT comments – *one week to respond to RT comments and/or revise* • Issue to Administrator Preliminary report to Applicant	
		• Deliver Draft Preliminary Report of Technical Evaluation to applicant		
	• Respond to Preliminary Report of Technical Evaluation - *two weeks to respond to Preliminary Report*			

			Evaluation Team Action	
Review Phase[(1)]	**Applicant Action**	**Administrator Action**	**Review Consultant**	**Review Team**
		• Coordinate report comments with applicant and RC	• Respond to Applicant comments; if needed – *one week to respond to applicant*	
Milestone 4: Final Report Phase Time estimate – 5 weeks	• Pay fee • Approve publication of Technical Evaluation at GI Website	• Deliver Final Technical Evaluation	• Complete Final Technical Evaluation - *five weeks to review and draft report*	No action

Notes: 1) Review phases defined within "*Highway Innovations, Developments, Enhancements and Advancements (IDEA)—Protocol for Technical Evaluation of Earth Retention Systems*"

Commentary

1) Pre-Submittal Review Phase – The first phase of the technical evaluation process in the IDEA program.
   - Applicant provides its request for a Technical Evaluation to Administrator; Brief description of the Applicant's ERS and designation of the checklist the Applicant believes to be appropriate.
   - Administrator forwards the application to the Review Consultant. The Review Consultant considers the request and informs Administrator the a review is authorized
   - Review Consultant determines whether a custom checklist should be developed. If a custom checklist is needed, then the time and cost to prepare it must be determined and sent onto the Administrator.

2) Submittal Check Phase – A completeness review of the original submittal for technical evaluation.
   - Applicant prepares its submittal (Applicant advised that if ERS contains an innovation or change to a previously evaluated system, then it is the Applicant's responsibility to thoroughly document the innovation in terms of complete descriptions, test data, and design methodology)
   - Upon approval of the report by the Review Team, a final version is sent to the Applicant.
   - Applicant may elect to withdraw from the review process.

3) Submittal Review Phase – A completeness review of the applicant submittal for technical evaluation.
   • Evaluate the technical content of the submittal for conformance to the applicable references
   • RC Preliminary Report of Technical Evaluation presents findings factually and succinctly.
   • Draft version of report then provided to the RT.
   • Approval of report by Review Team
   • Final version is sent to the Applicant.

- Applicant may elect to withdraw from the review process.

4) Final Submittal Review Phase – The last phase of the technical evaluation process in the IDEA program.
   - Applicant's response is used to complete the review.
   - Publish

APPENDIX B

Highway Innovation Developments, Enhancements and Advancements (IDEA)

Application for Initial Technical Evaluation

Appendix B
Highway Innovation, Developments, Enhancements and Advancements (IDEA)
Application for Initial Technical Evaluation

A. Applicant Information

Company name: _____
Company address: _____
Telephone: _____

Name and title of employee authorized to contract on behalf of company:
Name: _____
Telephone: _____
Email:_____
Signature:_____
Date:_____

Name and of employee who will be contact for communications with IDEA Review Panel:
Name: _____
Telephone: _____
Email: _____

B. IDEA Program Policies

Have you read the IDEA Protocol for Technical Evaluation of Earth Retention Systems, including Appendix B and Appendix C? _____

C. Earth Retention System (ERS) Identification

Product or trade name: _____

Describe the ERS type based on Section 2.2: _____
_____
_____
_____
_____

D. Describe the ERS elements:

_____
_____
_____
_____
_____
_____

E. Describe any of the ERS innovations:

F. Which of the checklists at Appendix C should be used for the evaluation of the ERS? If none are applicable, then indicate whether a custom checklist should be developed.

G. Has a HITEC evaluation been completed on the ERS or on a previous version? _____

If yes, please provide the HITEC report and describe any changes that have been made to the ERS since that evaluation.

H. Please write a brief history of the system's development.

I. Please list the public and private agencies that have accepted the system for use on their projects.

Appendix B
Highway Innovation, Developments, Enhancements and Advancements (IDEA)
Application for Initial Technical Evaluation

J. Document case histories where the system was used on projects, including design procedures, details, drawings, specification, photos and system performance records:_____
_____
_____
_____
_____
_____
_____

K. Please list any patents that apply to elements or components of the system and briefly describe each: _____
_____
_____
_____
_____

L. Please describe any information that should be treated confidentially:_____
_____
_____
_____
_____

M. Please describe any limitations or restrictions for using the system:_____
_____
_____
_____
_____

APPENDIX C

Highway Innovation Developments, Enhancements and Advancements (IDEA)

Checklists for Different ERS Types

Appendix C1
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Extensible Reinforcement

Guidelines for the Applicant to use this checklist:

1. The submittal should be provided in an electronic format (i.e. portable document format—PDF) with three hardcopies. Please include any other electronic files for computer program calculations that are requested.

2. Organize your submittal in as strict accordance with this checklist as is possible using tabbed sheets to separate the sections. For example, the first section of the submittal should comprise information related to the facing unit under "Tab 1.1 Facing Unit".

3. If a report or drawing is requested for a section, provide it in that section even if it is requested again elsewhere in the submittal, unless noted otherwise. For example, if a drawing of the facing unit-reinforcement connection is requested in both Section 1.1 and Section 2.3, include the requested drawing at both locations. Please do not "refer" the reviewer to another section unless noted otherwise. Failure to comply with this requirement will almost certainly delay the review of the submittal.

4. Mark the checklist at each item to indicate "yes" you have included the relevant information. If you must check "no", please provide a brief explanation if appropriate.

Section 1: ERS Components

Tab 1.1		Facing Unit
Yes	No	Item
☐	☐	Does the system contain what you consider to be an innovation that is related to the facing unit? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Report who manufacturers the units and describe manufacturer and licensee / licensor arrangement.
☐	☐	Provide specifications for each facing component.
☐	☐	List the types of facing units (e.g. standard, cap, corner, base, etc.).
☐	☐	Provide description of Connection Details
☐	☐	Provide standard dimensions and tolerances for each type of unit (e.g. standard, cap, corner, base, etc.) in plan and section drawings.
☐	☐	Describe wet- or dry-cast fabrication process.
☐	☐	Provide the target 28-day minimum compressive strength.
☐	☐	For dry-cast units, provide the target concrete density and maximum water absorption.
☐	☐	For wet-cast units, provide the target percent air range.
☐	☐	Discuss whether producers use mix designs to improve durability in areas subject to freeze/thaw or salt scaling.
☐	☐	Provide inter-unit shear test results and design shear capacity envelopes.
☐	☐	Describe with text any unit shear, alignment or bearing devices. Provide specifications and detail drawings. List the manufacturer of the devices.
☐	☐	Describe with text any filter which is used to prevent migration of fill soil through ERS face. Provide specifications.
☐	☐	Describe with text the aesthetic facing options that are available. Provide photos, drawings

Appendix C1
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Extensible Reinforcement

Tab 1.1		Facing Unit
		and brochures as appropriate.
☐	☐	Describe any limits on the facing units that are created by curved ERS sections and corners.

Tab 1.2		Extensible Reinforcement
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the reinforcement? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Who manufactures the reinforcement?
☐	☐	List each style or type that is to be used with the facing system.
☐	☐	Provide specifications for each style or type that is to be used with the facing system.
☐	☐	Provide the current NTPEP report (if a NTPEP report is not available, then a custom checklist is required).
☐	☐	Describe the facing unit-reinforcement connection with text and drawings and provide specifications for any connection devices.
☐	☐	List short- and long-term facing unit-reinforcement connection strength tests performed, provide test results and strength envelopes the Applicant recommends for design.
☐	☐	List reinforcement pullout (ASTM D6706) tests performed and provide results. Provide test soil properties, corresponding pullout friction factors (F*) and scale effect correction factors (α) Applicant recommends for design. Discuss how test results support these recommendations based on Appendix B at FHWA-NHI-10-025. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.
☐	☐	List soil-geosynthetic interface shear (ASTM D5321) tests performed and provide results. List interface friction angle (ρ) Applicant recommends for design. Discuss how test results support these recommendations. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.

Tab 1.3		Other Components
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to a system component? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Reinforced Soil - Provide the recommended soil classifications (per ASTM D2487), Atterberg Limits range, grain-sized distribution range, minimum effective internal angle of friction and limiting electrochemical properties. Are these soil parameters consistent with current AASHTO requirements?
☐	☐	Drainage - Describe with text any internal and external drainage measures that are inherent in the system. That is, they are not optional measures such as blanket and chimney drains or drainage swales, but are built-into ERS components.
☐	☐	Coping—Describe with text coping that may be used with the ERS, not including the previously described cap units. Provide specifications, dimensions, dimensional tolerances and plan and section view drawings.
☐	☐	Traffic Barriers—describe with text traffic barriers (i.e. moment slab, post and beam or

Appendix C1
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Extensible Reinforcement

Tab 1.3		Other Components
		other) that may be used with the system and any limitations that may apply. Provide typical plan and section view drawings.
☐	☐	ERS-Structure Abutments—Describe with text how the structure is abutted to a reinforced concrete semi-gravity retaining wall with a stem and footing. Provide typical plan and section view details.
☐	☐	Slip Joints—describe with text how slip joints are made to accommodate potential differential settlement. Provide applicable typical plan and elevation view drawings.

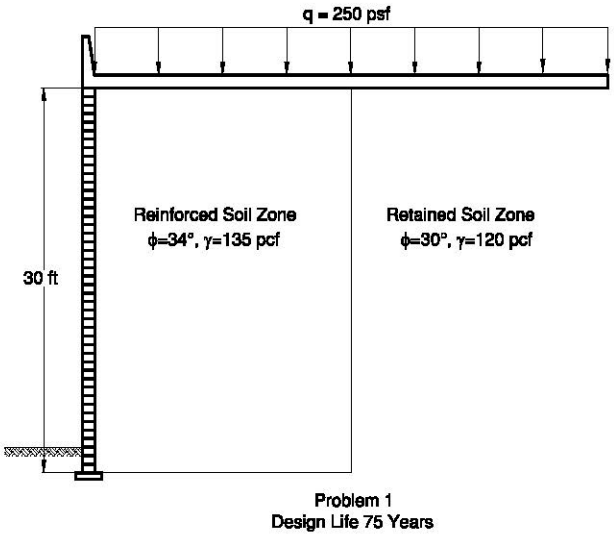
Section 2: ERS Design

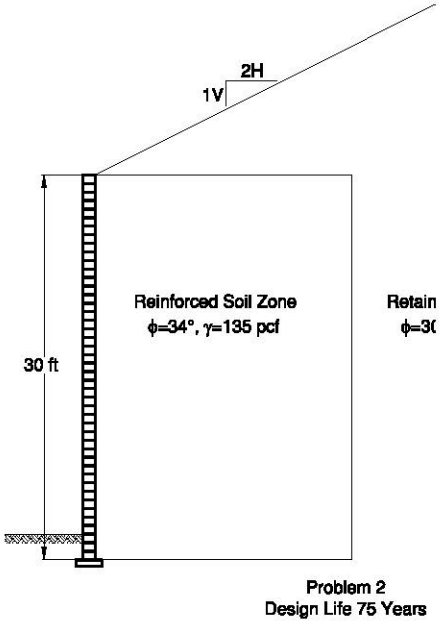
Tab 2.1		Design Methodology
Yes	No	Item
☐	☐	Does the system contain what you consider to be an innovation that is related to the design methodology? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Is the design methodology used for the ERS consistent with current *AASHTO LRFD Bridge Design Specifications*?
☐	☐	If the design methodology for the system is not consistent with current *AASHTO LRFD Bridge Design Specifications*, describe the methodology thoroughly, and provide references to supporting literature as appropriate.
☐	☐	Describe how the design addresses skewed reinforcement elements (i.e. those which are not installed perpendicular to the structure face). If this does not apply, check “no”.
☐	☐	Describe with text what design measures and calculations are required to account for a vertical utility manhole that is located 5 ft. behind the structure face and has an outside diameter of 5 ft. Provide plan and section detail drawings.
☐	☐	Describe with text what design measures and calculations are required to account for a horizontal utility pipe that is located 5 ft. behind the structure face and has an outside diameter of 3 ft. Provide plan and section detail drawings.

Tab 2.2		Design Drawings
Yes	No	Item
☐	☐	Provide a typical set of plans for an actual project that has been constructed. Include (add if necessary) a front elevation view, a typical ERS cross section and details of the ERS components.

Tab 2.3		Design Example
Yes	No	Item
☐	☐	Problems 1 and 2—provide complete hand calculations for both problems. If a computer program other than *MSEW* [11] is used, provide a working copy of the program for review as well as the file used for Problems 1 and 2. If the computer program *MSEW* can be used for the ERS, omit the hand calculations and provide the *MSEW* results as well as the electronic *MSEW* file.

Appendix C1
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Extensible Reinforcement





Section 3: Construction

Tab 3.1		Construction Procedures
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the construction procedures? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Describe foundation and leveling pad preparation.
☐	☐	Describe special tools that are required for ERS installation
☐	☐	Describe facing unit installation both at straight and curved sections of the structure and at corners as well as any modifications that are required to be made to the facing unit.
☐	☐	Describe procedures to install earth reinforcement at straight and curved sections of the ERS and at corners. Specifically address any measures that are to be taken at intersection or overlapping panels of reinforcement.
☐	☐	Describe measures that are required to maintain the design vertical and horizontal alignment of the ERS face.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Describe measures that are required to prevent erosion behind and in front of the structure during construction.
☐	☐	Describe experience or other special qualifications that are required of the ERS construction contractor.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Provide the construction manual for the ERS.

Appendix C1
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Extensible Reinforcement

Section 4: Quality Control

Tab 4.1		Manufacturing
Yes	No	Item
☐	☐	Describe the quality control measures that are required for the manufacturing of facing units. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of earth reinforcement components. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of any shear, alignment, bearing or connection devices. You may do this by providing a manufacturing QC manual.

Tab 4.2		Construction
Yes	No	Item
☐	☐	Describe the quality control measures that are required during construction of the system. If these measures are described in the system's construction manual then state that they are so included and refer the reviewer to the appropriate section of the submittal.

Section 5: Performance

Tab 5.1		Warranties and Disclaimers
Yes	No	Item
☐	☐	Provide warranties and disclaimers for ERS components to include facing units and earth reinforcement.

Tab 5.2		Testing
Yes	No	Item
☐	☐	Provide descriptions and the results of any laboratory testing not previously address in the checklist. Also provide descriptions and the results of any field tests, instrumented full- or reduced-scale models and numerical models of the full system or of specific components that has been performed.

Tab 5.3		Performance History
Yes	No	Item
Describe the performance history of the system to include:		
☐	☐	The oldest three structures.
☐	☐	The tallest three structures.
☐	☐	The three structures that experienced the most horizontal displacement at the face.
☐	☐	The three structures that experienced the most differential vertical displacement at the face.
☐	☐	The three structures to which the greatest surcharge load was applied by other than a crest slope.
☐	☐	Provide a list of private- and public sector users who have approved the use of the system. Also provide the contact information for a person at the user agency who may be contacted regarding the ERS's performance.

Appendix C1
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Extensible Reinforcement

Tab 6.0	Other Information
	In this section, please include anything you think will better help a reviewer understand your ERS that has not been adequately address in the previous questions. Here, you may elaborate on particular innovations, advantages that your system has with respect to other systems or anything about your system you want the reviewer and future users to know. Here is your chance to promote any benefits of the system, but please provide technical justifications.

Tab 6.1	Describe any limitations or restrictions for using the system or innovation

Tab 6.2	Provide photographs of the ERS to document details of the innovation

Appendix C2
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Inextensible Reinforcement

Guidelines for the Applicant to use this checklist:

1. The submittal should be provided in an electronic format (i.e. portable document format—PDF) with three hardcopies. Please include any other electronic files for computer program calculations that are requested.

2. Organize your submittal in as strict accordance with this checklist as is possible using tabbed sheets to separate the sections. For example, the first section of the submittal should comprise information related to the facing unit under "Tab 1.1 Facing Unit".

3. If a report or drawing is requested for a section, provide it in that section even if it is requested again elsewhere in the submittal, unless noted otherwise. For example, if a drawing of the facing unit-reinforcement connection is requested in both Section 1.1 and Section 2.3, include the requested drawing at both locations. Please do not "refer" the reviewer to another section unless noted otherwise. Failure to comply with this requirement will almost certainly delay the review of the submittal.

4. Mark the checklist at each item to indicate "yes" you have included the relevant information. If you must check "no", please provide a brief explanation if appropriate.

Section 1: ERS Components

Tab 1.1		Facing Unit
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the facing unit? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Report who manufacturers the units and describe manufacturer and licensee / licensor arrangement.
☐	☐	Provide specifications for each facing component.
☐	☐	List the types of facing units (e.g. standard, cap, corner, base, etc.).
☐	☐	Provide standard dimensions and tolerances for each type of unit (e.g. standard, cap, corner, base, etc.) in plan and section drawings.
☐	☐	Describe wet- or dry-cast fabrication process.
☐	☐	Provide the target 28-day minimum compressive strength.
☐	☐	For dry-cast units, provide the target concrete density and maximum water absorption.
☐	☐	For wet-cast units, provide the target percent air range.
☐	☐	Discuss whether producers use mix designs to improve durability in areas subject to freeze/thaw or salt scaling.
☐	☐	Provide inter-unit shear test results and design shear capacity envelopes.
☐	☐	Describe with text any unit shear, alignment or bearing devices. Provide specifications and detail drawings. List the manufacturer of the devices.
☐	☐	Describe with text any filter which is used to prevent migration of fill soil through the ERS's face. Provide specifications.

Appendix C2
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Inextensible Reinforcement

Tab 1.1		Facing Unit
☐	☐	Describe with text the aesthetic facing options that are available. Provide photos, drawings and brochures as appropriate.
☐	☐	Describe any limits on the facing units that are created by curved structure sections and corners.

Tab 1.2		Inextensible Reinforcement
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the reinforcement? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Who manufactures the reinforcement?
☐	☐	List each reinforcement type that is to be used with the facing system.
☐	☐	For each type provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each reinforcement type describe corrosion protection measures. If coatings or galvanization are used, provide minimum thickness for 75-year design life.
☐	☐	For each reinforcement type provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each reinforcement type provide the results of any corrosion tests that have been performed.
☐	☐	For each reinforcement type provide detail drawings that show dimensional tolerances.
☐	☐	Describe with text and drawing details how the reinforcement connects to facing units.
☐	☐	List each connection device that is used to connect the facing unit and reinforcement.
☐	☐	Who manufactures each connection device?
☐	☐	For each connection device provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each connection device describe corrosion protection measures and provide specifications. If coatings or galvanization are used, provide minimum thickness for 75-year design life
☐	☐	For each connection device provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each connection device provide the results of any corrosion tests that have been performed.
☐	☐	For each connection device provide detail drawings that show dimensional tolerances.
☐	☐	List facing unit-reinforcement connection strength tests performed, provide test results and strength envelopes the Applicant recommends for design.
☐	☐	List reinforcement pullout (ASTM D6706) tests performed and provide results. Provide test soil properties, corresponding pullout friction factors (F*) and scale effect correction factors (α) Applicant recommends for design (it is recognized that for inextensible reinforcement the value of α may be 1.0). Discuss how test results support these recommendations based on Appendix B at FHWA-NHI-10-025. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.
☐	☐	List soil-reinforcement interface shear (ASTM D5321) tests performed and provide results.

Appendix C2
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Inextensible Reinforcement

Tab 1.2	Inextensible Reinforcement
	List interface friction angle (ρ) Applicant recommends for design. Discuss how test results support these recommendations. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.

Tab 1.3		Other Components
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to a structure component? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Reinforced Soil - Provide the recommended soil classifications (per ASTM D2487), Atterberg Limits range, grain-sized distribution range, minimum effective internal angle of friction and limiting electrochemical properties. Are these soil parameters consistent with current AASHTO requirements?
☐	☐	Drainage - Describe with text any internal and external drainage measures that are inherent in the ERS. That is, they are not optional measures such as blanket and chimney drains or drainage swales, but are built-into structure components.
☐	☐	Coping—Describe with text coping that may be used with the ERS, not including the previously described cap units. Provide specifications, dimensions, dimensional tolerances and plan and section view drawings.
☐	☐	Traffic Barriers—describe with text traffic barriers (i.e. moment slab, post and beam or other) that may be used with the system and any limitations that may apply. Provide typical plan and section view drawings.
☐	☐	ERS-Structure Abutments—Describe with text how the structure is abutted to a reinforced concrete semi-gravity retaining structure with a stem and footing. Provide typical plan and section view details.
☐	☐	Slip Joints—describe with text how slip joints are made to accommodate potential differential settlement. Provide applicable typical plan and elevation view drawings.

Section 2: ERS Design

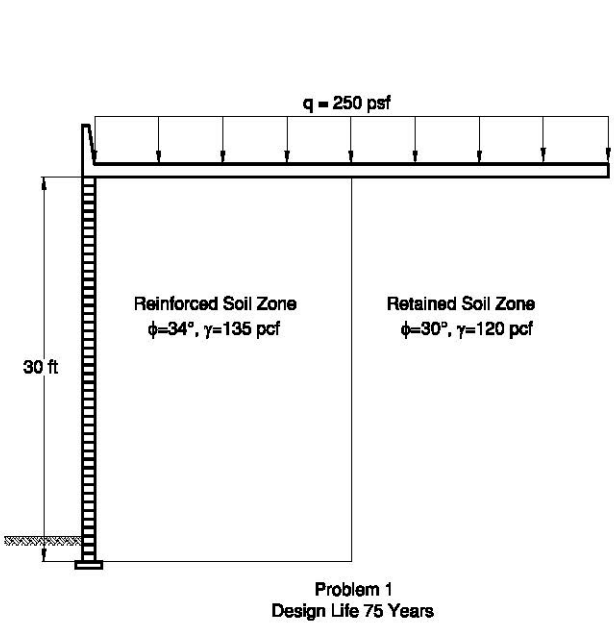
Tab 2.1		Design Methodology
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the design methodology? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Is the design methodology used for the ERS consistent with current *AASHTO LRFD Bridge Design Specifications*?
☐	☐	If the design methodology for the system is not consistent with current *AASHTO LRFD Bridge Design Specifications*, describe the methodology thoroughly, and provide references to supporting literature as appropriate.
☐	☐	Describe how the design addresses skewed reinforcement elements (i.e. those which are not installed perpendicular to the ERS face). If this does not apply, check “no”.
☐	☐	Describe with text what design measures and calculations are required to account for a vertical utility manhole that is located 5 ft. behind the ERS face and has an outside diameter

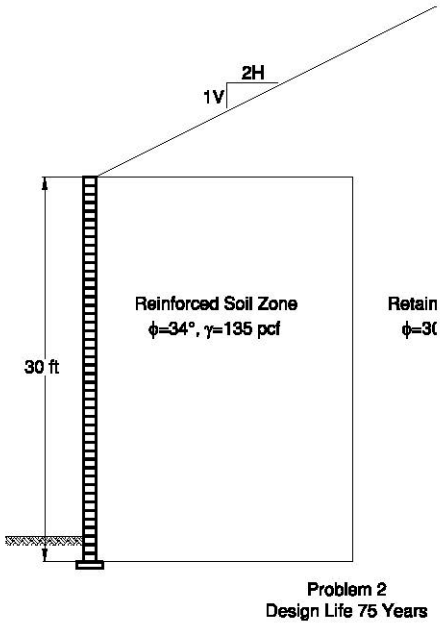
Appendix C2
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Inextensible Reinforcement

Tab 2.1		Design Methodology
		of 5 ft. Provide plan and section detail drawings.
☐	☐	Describe with text what design measures and calculations are required to account for a horizontal utility pipe that is located 5 ft. behind the ERS face and has an outside diameter of 3 ft. Provide plan and section detail drawings.

Tab 2.2		Design Drawings
Yes	No	Item
☐	☐	Provide a typical set of plans for an actual project that has been constructed. Include (add if necessary) a front elevation view, a typical ERS cross section and details of the ERS components.

Tab 2.3		Design Example
Yes	No	Item
☐	☐	Problems 1 and 2—provide complete hand calculations for both problems. If a computer program other than *MSEW* [11] is used, provide a working copy of the program for review as well as the file used for Problems 1 and 2. If the computer program *MSEW* can be used for the ERS, omit the hand calculations and provide the *MSEW* results as well as the electronic *MSEW* file.





Section 3: Construction

Tab 3.1		Construction Procedures
Yes	No	Item

Appendix C2
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Inextensible Reinforcement

Tab 3.1		Construction Procedures
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the construction procedures? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Describe foundation and leveling pad preparation.
☐	☐	Describe special tools that are required for ERS installation
☐	☐	Describe facing unit installation both at straight and curved sections of the structure and at corners as well as any modifications that are required to be made to the facing unit.
☐	☐	Describe procedures to install earth reinforcement at straight and curved sections of the structure and at corners. Specifically address any measures that are to be taken at intersection or overlapping panels of reinforcement.
☐	☐	Describe measures that are required to maintain the design vertical and horizontal alignment of the ERS face.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Describe measures that are required to prevent erosion behind and in front of the ERS during construction.
☐	☐	Describe experience or other special qualifications that are required of the ERS construction contractor.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Provide the construction manual for the ERS.

Section 4: Quality Control

Tab 4.1		Manufacturing
Yes	No	Item
☐	☐	Describe the quality control measures that are required for the manufacturing of facing units. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of earth reinforcement components. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of any shear, alignment, bearing or connection devices. You may do this by providing a manufacturing QC manual.

Tab 4.2		Construction
Yes	No	Item
☐	☐	Describe the quality control measures that are required during construction of the ERS. If these measures are described in the system's construction manual then state that they are so included and refer the reviewer to the appropriate section of the submittal.

Section 5: Performance

Tab 5.1		Warranties and Disclaimers
Yes	No	Item
☐	☐	Provide warranties and disclaimers for ERS components to include facing units and earth reinforcement.

Appendix C2
Initial Technical Evaluation Checklist for Concrete Modular Block Unit Paired with Inextensible Reinforcement

Tab 5.2		Testing
Yes	No	Item
☐	☐	Provide descriptions and the results of any laboratory testing not previously address in the checklist. Also provide descriptions and the results of any field tests, instrumented full- or reduced-scale models and numerical models of the full system or of specific components that has been performed.

Tab 5.3		Performance History
Yes	No	Item
		Describe the performance history of the system to include:
☐	☐	The oldest three structures.
☐	☐	The tallest three structures.
☐	☐	The three structures that experienced the most horizontal displacement at the face.
☐	☐	The three structures that experienced the most differential vertical displacement at the face.
☐	☐	The three structures to which the greatest surcharge load was applied by other than a crest slope.
☐	☐	Provide a list of private- and public sector users who have approved the use of the system. Also provide the contact information for a person at the user agency who may be contacted regarding the ERS's performance.

Tab 6.0	Other Information
	In this section, please include anything you think will better help a reviewer understand your ERS that has not been adequately address in the previous questions. Here, you may elaborate on particular innovations, advantages that your system has with respect to other systems or anything about your system you want the reviewer and future users to know. Here is your chance to promote any benefits of the system, but please provide technical justifications.

Appendix C3
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Extensible Reinforcement

Guidelines for the Applicant to use this checklist:

1. The submittal should be provided in an electronic format (i.e. portable document format—PDF) with three hardcopies. Please include any other electronic files for computer program calculations that are requested.

2. Organize your submittal in as strict accordance with this checklist as is possible using tabbed sheets to separate the sections. For example, the first section of the submittal should comprise information related to the facing unit under "Tab 1.1 Facing Unit".

3. If a report or drawing is requested for a section, provide it in that section even if it is requested again elsewhere in the submittal, unless noted otherwise. For example, if a drawing of the facing unit-reinforcement connection is requested in both Section 1.1 and Section 2.3, include the requested drawing at both locations. Please do not "refer" the reviewer to another section unless noted otherwise. Failure to comply with this requirement will almost certainly delay the review of the submittal.

4. Mark the checklist at each item to indicate "yes" you have included the relevant information. If you must check "no", please provide a brief explanation if appropriate.

Section 1: ERS Components

Tab 1.1		Facing Unit
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the facing unit? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	List each type of facing unit.
☐	☐	Report who fabricates the units and describe the fabrication process.
☐	☐	Provide specifications for each facing unit.
☐	☐	Provide standard dimensions, tolerances and typical steel reinforcement schedule (if any is used) for each type of unit (e.g. standard, crest, corner, base, etc.) in plan and section drawings.
☐	☐	Provide the target 28-day minimum compressive strength.
☐	☐	Provide the target percent air range.
☐	☐	Discuss whether producers use mix designs to improve durability in areas subject to freeze/thaw or salt scaling.
☐	☐	Provide inter-unit shear test results and design shear capacity envelopes.
☐	☐	Describe with text any unit shear, alignment or bearing devices. Provide specifications and detail drawings. List the manufacturer of the devices.
☐	☐	Describe with text any filter which is used to prevent migration of fill soil through ERS face. Provide specifications.
☐	☐	Describe with text the aesthetic facing options that are available. Provide photos, drawings and brochures as appropriate.
☐	☐	Describe any limits on the facing units that are created by curved structure sections and corners.

Appendix C3
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Extensible Reinforcement

Tab 1.2		Extensible Reinforcement
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the reinforcement? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Who manufactures the reinforcement?
☐	☐	List each style or type that is to be used with the facing system.
☐	☐	Provide specifications for each style or type that is to be used with the facing system.
☐	☐	Provide the current NTPEP report (if a NTPEP report is not available, then a custom checklist is required).
☐	☐	Describe the facing unit-reinforcement connection with text and drawings and provide specifications for any connection devices.
☐	☐	List short- and long-term facing unit-reinforcement connection strength tests performed, provide test results and strength envelopes the Applicant recommends for design.
☐	☐	List reinforcement pullout (ASTM D6706) tests performed and provide results. Provide test soil properties, corresponding pullout friction factors (F*) and scale effect correction factors (α) Applicant recommends for design. Discuss how test results support these recommendations based on Appendix B at FHWA-NHI-10-025. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.
☐	☐	List soil-geosynthetic interface shear (ASTM D5321) tests performed and provide results. List interface friction angle (ρ) Applicant recommends for design. Discuss how test results support these recommendations. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.

Tab 1.3		Other Components
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to a system component? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Reinforced Soil - Provide the recommended soil classifications (per ASTM D2487), Atterberg Limits range, grain-sized distribution range, minimum effective internal angle of friction and limiting electrochemical properties. Are these soil parameters consistent with current AASHTO requirements?
☐	☐	Drainage - Describe with text any internal and external drainage measures that are inherent in the system. That is, they are not optional measures such as blanket and chimney drains or drainage swales, but are built-into system components.
☐	☐	Coping—Describe with text coping that may be used with the ERS, not including the previously described cap units. Provide specifications, dimensions, dimensional tolerances and plan and section view drawings.
☐	☐	Traffic Barriers—describe with text traffic barriers (i.e. moment slab, post and beam or other) that may be used with the system and any limitations that may apply. Provide typical plan and section view drawings.

Appendix C3
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Extensible Reinforcement

Tab 1.3		Other Components
☐	☐	ERS-Structure Abutments—Describe with text how the structure is abutted to a reinforced concrete semi-gravity retaining ERS with a stem and footing. Provide typical plan and section view details.
☐	☐	Slip Joints—describe with text how slip joints are made to accommodate potential differential settlement. Provide applicable typical plan and elevation view drawings.

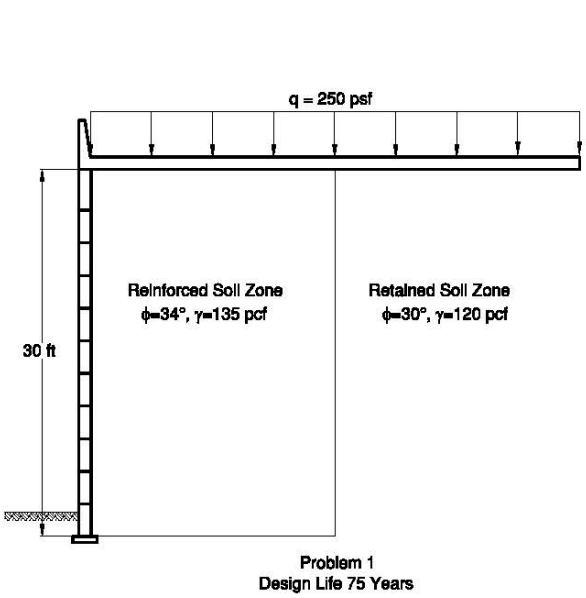
Section 2: ERS Design

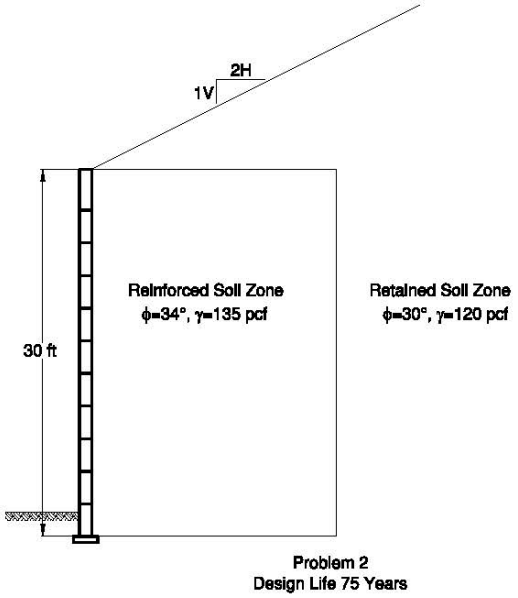
Tab 2.1		Design Methodology
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the design methodology? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Is the design methodology used for the ERS consistent with current *AASHTO LRFD Bridge Design Specifications*?
☐	☐	If the design methodology for the system is not consistent with current *AASHTO LRFD Bridge Design Specifications*, describe the methodology thoroughly, and provide references to supporting literature as appropriate.
☐	☐	Describe with text what design measures and calculations are required to design each type of reinforcement panel, including the steel reinforcement (if any is used).
☐	☐	Describe how the design addresses skewed reinforcement elements (i.e. those which are not installed perpendicular to the structure face). If this does not apply, check “no”.
☐	☐	Describe with text what design measures and calculations are required to account for a vertical utility manhole that is located 5 ft. behind the structure face and has an outside diameter of 5 ft. Provide plan and section detail drawings.
☐	☐	Describe with text what design measures and calculations are required to account for a horizontal utility pipe that is located 5 ft. behind the structure face and has an outside diameter of 3 ft. Provide plan and section detail drawings.

Tab 2.2		Design Drawings
Yes	No	Item
☐	☐	Provide a typical set of plans for an actual project that has been constructed. Include (add if necessary) a front elevation view, a typical ERS cross section and details of the ERS components.

Tab 2.3		Design Example
Yes	No	Item
☐	☐	Problems 1 and 2—provide complete hand calculations for both problems. If a computer program other than *MSEW* [11] is used, provide a working copy of the program for review as well as the file used for Problems 1 and 2. If the computer program *MSEW* can be used for the ERS, omit the hand calculations and provide the *MSEW* results as well as the electronic *MSEW* file.

Appendix C3
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Extensible Reinforcement





Section 3: Construction

Tab 3.1		Construction Procedures
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the construction procedures? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Describe foundation and leveling pad preparation.
☐	☐	Describe special tools that are required for ERS installation
☐	☐	Describe facing unit installation both at straight and curved sections of the structure and at corners as well as any modifications that are required to be made to the facing unit.
☐	☐	Describe procedures to install earth reinforcement at straight and curved sections of the structure and at corners. Specifically address any measures that are to be taken at intersection or overlapping panels of reinforcement.
☐	☐	Describe measures that are required to maintain the design vertical and horizontal alignment of the ERS face.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Describe measures that are required to prevent erosion behind and in front of the ERS during construction.
☐	☐	Describe experience or other special qualifications that are required of the ERS construction contractor.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Provide the construction manual for the ERS.

Appendix C3
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Extensible Reinforcement

Section 4: Quality Control

Tab 4.1		Manufacturing
Yes	No	Item
☐	☐	Describe the quality control measures that are required for the manufacturing of facing units. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of earth reinforcement components. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of any shear, alignment, bearing or connection devices. You may do this by providing a manufacturing QC manual.

Tab 4.2		Construction
Yes	No	Item
☐	☐	Describe the quality control measures that are required during construction of the ERS. If these measures are described in the system's construction manual then state that they are so included and refer the reviewer to the appropriate section of the submittal.

Section 5: Performance

Tab 5.1		Warranties and Disclaimers
Yes	No	Item
☐	☐	Provide warranties and disclaimers for ERS components to include facing units and earth reinforcement.

Tab 5.2		Testing
Yes	No	Item
☐	☐	Provide descriptions and the results of any laboratory testing not previously address in the checklist. Also provide descriptions and the results of any field tests, instrumented full- or reduced-scale models and numerical models of the full system or of specific components that has been performed.

Tab 5.3		Performance History
Yes	No	Item
Describe the performance history of the system to include:		
☐	☐	The oldest three structures.
☐	☐	The tallest three structures.
☐	☐	The three structures that experienced the most horizontal displacement at the face.
☐	☐	The three structures that experienced the most differential vertical displacement at the face.
☐	☐	The three structures to which the greatest surcharge load was applied by other than a crest slope.
☐	☐	Provide a list of private- and public sector users who have approved the use of the system. Also provide the contact information for a person at the user agency who may be contacted regarding the ERS's performance.

Appendix C3
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Extensible Reinforcement

Tab 6.0	Other Information
	In this section, please include anything you think will better help a reviewer understand your ERS that has not been adequately address in the previous questions. Here, you may elaborate on particular innovations, advantages that your system has with respect to other systems or anything about your system you want the reviewer and future users to know. Here is your chance to promote any benefits of the system, but please provide technical justifications.

Appendix C4
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Inextensible Reinforcement

Guidelines for the Applicant to use this checklist:

1. The submittal should be provided in an electronic format (i.e. portable document format—PDF) with three hardcopies. Please include any other electronic files for computer program calculations that are requested.

2. Organize your submittal in as strict accordance with this checklist as is possible using tabbed sheets to separate the sections. For example, the first section of the submittal should comprise information related to the facing unit under "Tab 1.1 Facing Unit".

3. If a report or drawing is requested for a section, provide it in that section even if it is requested again elsewhere in the submittal, unless noted otherwise. For example, if a drawing of the facing unit-reinforcement connection is requested in both Section 1.1 and Section 2.3, include the requested drawing at both locations. Please do not "refer" the reviewer to another section unless noted otherwise. Failure to comply with this requirement will almost certainly delay the review of the submittal.

4. Mark the checklist at each item to indicate "yes" you have included the relevant information. If you must check "no", please provide a brief explanation if appropriate.

Section 1: ERS Components

Tab 1.1		Facing Unit
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the facing unit? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	List each type of facing unit.
☐	☐	Report who fabricates the units and describe the fabrication process.
☐	☐	Provide specifications for each facing unit.
☐	☐	Provide standard dimensions, tolerances and typical steel reinforcement schedule (if any is used) for each type of unit (e.g. standard, crest, corner, base, etc.) in plan and section drawings.
☐	☐	Provide the target 28-day minimum compressive strength.
☐	☐	Provide the target percent air range.
☐	☐	Discuss whether producers use mix designs to improve durability in areas subject to freeze/thaw or salt scaling.
☐	☐	Provide inter-unit shear test results and design shear capacity envelopes.
☐	☐	Describe with text any unit shear, alignment or bearing devices. Provide specifications and detail drawings. List the manufacturer of the devices.
☐	☐	Describe with text any filter which is used to prevent migration of fill soil through structure face. Provide specifications.
☐	☐	Describe with text the aesthetic facing options that are available. Provide photos, drawings and brochures as appropriate.

Appendix C4
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Inextensible Reinforcement

Tab 1.1		Facing Unit
☐	☐	Describe any limits on the facing units that are created by curved structure sections and corners.

Tab 1.2		Inextensible Reinforcement
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the reinforcement? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Who manufactures the reinforcement?
☐	☐	List each reinforcement type that is to be used with the facing system.
☐	☐	For each type provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each reinforcement type describe corrosion protection measures. If coatings or galvanization are used, provide minimum thickness for 75-year design life.
☐	☐	For each reinforcement type provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each reinforcement type provide the results of any corrosion tests that have been performed.
☐	☐	For each reinforcement type provide detail drawings that show dimensional tolerances.
☐	☐	Describe with text and drawing details how the reinforcement connects to facing units.
☐	☐	List each connection device that is used to connect the facing unit and reinforcement.
☐	☐	Who manufactures each connection device?
☐	☐	For each connection device provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each connection device describe corrosion protection measures and provide specifications. If coatings or galvanization are used, provide minimum thickness for 75-year design life
☐	☐	For each connection device provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each connection device provide the results of any corrosion tests that have been performed.
☐	☐	For each connection device provide detail drawings that show dimensional tolerances.
☐	☐	List facing unit-reinforcement connection strength tests performed, provide test results and strength envelopes the Applicant recommends for design.
☐	☐	List reinforcement pullout (ASTM D6706) tests performed and provide results. Provide test soil properties, corresponding pullout friction factors (F*) and scale effect correction factors (α) Applicant recommends for design (it is recognized that for inextensible reinforcement the value of α may be 1.0). Discuss how test results support these recommendations based on Appendix B at FHWA-NHI-10-025. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.
☐	☐	List soil-reinforcement interface shear (ASTM D5321) tests performed and provide results. List interface friction angle (ρ) Applicant recommends for design. Discuss how test results support these recommendations. If no tests have been performed, list the default values that

Appendix C4
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Inextensible Reinforcement

Tab 1.2	Inextensible Reinforcement
	should be used based on FHWA-NHI-10-024/025.

Tab 1.3		Other Components
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to a system component? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Reinforced Soil - Provide the recommended soil classifications (per ASTM D2487), Atterberg Limits range, grain-sized distribution range, minimum effective internal angle of friction and limiting electrochemical properties. Are these soil parameters consistent with current AASHTO requirements?
☐	☐	Drainage - Describe with text any internal and external drainage measures that are inherent in the system. That is, they are not optional measures such as blanket and chimney drains or drainage swales, but are built-into structure components.
☐	☐	Coping—Describe with text coping that may be used with the ERS, not including the previously described cap units. Provide specifications, dimensions, dimensional tolerances and plan and section view drawings.
☐	☐	Traffic Barriers—describe with text traffic barriers (i.e. moment slab, post and beam or other) that may be used with the system and any limitations that may apply. Provide typical plan and section view drawings.
☐	☐	ERS-Structure Abutments—Describe with text how the ERS is abutted to a reinforced concrete semi-gravity retaining system with a stem and footing. Provide typical plan and section view details.
☐	☐	Slip Joints—describe with text how slip joints are made to accommodate potential differential settlement. Provide applicable typical plan and elevation view drawings.

Section 2: ERS Design

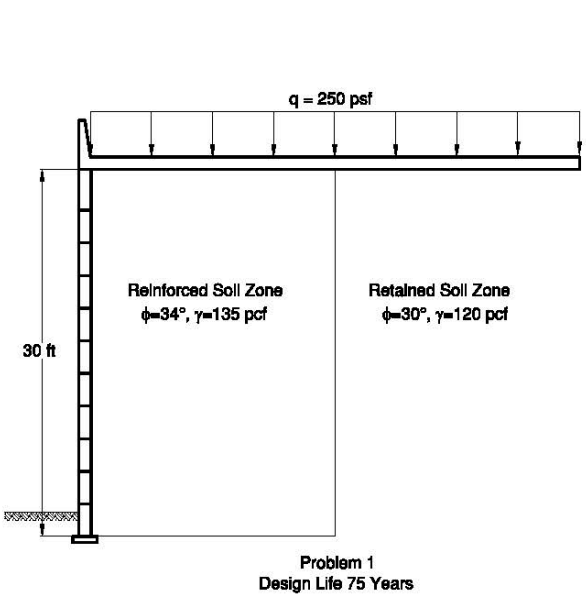
Tab 2.1		Design Methodology
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the design methodology? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Is the design methodology used for the ERS consistent with current *AASHTO LRFD Bridge Design Specifications*?
☐	☐	If the design methodology for the system is not consistent with current *AASHTO LRFD Bridge Design Specifications*, describe the methodology thoroughly, and provide references to supporting literature as appropriate.
☐	☐	Describe with text what design measures and calculations are required to design each type of reinforcement panel, including the steel reinforcement (if any is used).
☐	☐	Describe how the design addresses skewed reinforcement elements (i.e. those which are not installed perpendicular to the structure face). If this does not apply, check “no”.
☐	☐	Describe with text what design measures and calculations are required to account for a vertical utility manhole that is located 5 ft. behind the ERS face and has an outside diameter

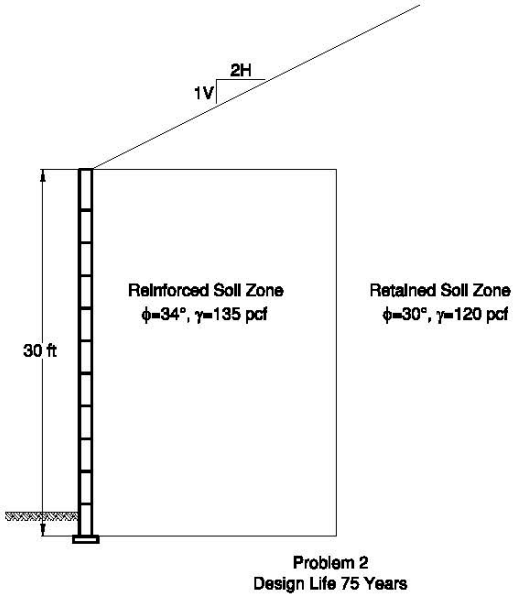
Appendix C4
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Inextensible Reinforcement

Tab 2.1		Design Methodology
		of 5 ft. Provide plan and section detail drawings.
☐	☐	Describe with text what design measures and calculations are required to account for a horizontal utility pipe that is located 5 ft. behind the structure face and has an outside diameter of 3 ft. Provide plan and section detail drawings.

Tab 2.2		Design Drawings
Yes	No	Item
☐	☐	Provide a typical set of plans for an actual project that has been constructed. Include (add if necessary) a front elevation view, a typical ERS cross section and details of the ERS components.

Tab 2.3		Design Example
Yes	No	Item
☐	☐	Problems 1 and 2—provide complete hand calculations for both problems. If a computer program other than *MSEW* [11] is used, provide a working copy of the program for review as well as the file used for Problems 1 and 2. If the computer program *MSEW* can be used for the ERS, omit the hand calculations and provide the *MSEW* results as well as the electronic *MSEW* file.





Section 3: Construction

Tab 3.1		Construction Procedures
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the

Appendix C4
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Inextensible Reinforcement

Tab 3.1		Construction Procedures
		construction procedures? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Describe foundation and leveling pad preparation.
☐	☐	Describe special tools that are required for ERS installation
☐	☐	Describe facing unit installation both at straight and curved sections of the ERS and at corners as well as any modifications that are required to be made to the facing unit.
☐	☐	Describe procedures to install earth reinforcement at straight and curved sections of the structure and at corners. Specifically address any measures that are to be taken at intersection or overlapping panels of reinforcement.
☐	☐	Describe measures that are required to maintain the design vertical and horizontal alignment of the ERS face.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Describe measures that are required to prevent erosion behind and in front of the ERS during construction.
☐	☐	Describe experience or other special qualifications that are required of the ERS construction contractor.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Provide the construction manual for the ERS.

Section 4: Quality Control

Tab 4.1		Manufacturing
Yes	No	Item
☐	☐	Describe the quality control measures that are required for the manufacturing of facing units. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of earth reinforcement components. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of any shear, alignment, bearing or connection devices. You may do this by providing a manufacturing QC manual.

Tab 4.2		Construction
Yes	No	Item
☐	☐	Describe the quality control measures that are required during construction of the ERS. If these measures are described in the system's construction manual then state that they are so included and refer the reviewer to the appropriate section of the submittal.

Section 5: Performance

Tab 5.1		Warranties and Disclaimers
Yes	No	Item
☐	☐	Provide warranties and disclaimers for ERS components to include facing units and earth reinforcement.

Appendix C4
Initial Technical Evaluation Checklist for Precast Concrete Panel Paired with Inextensible Reinforcement

Tab 5.2		Testing
Yes	No	Item
☐	☐	Provide descriptions and the results of any laboratory testing not previously address in the checklist. Also provide descriptions and the results of any field tests, instrumented full- or reduced-scale models and numerical models of the full system or of specific components that has been performed.

Tab 5.3		Performance History
Yes	No	Item
Describe the performance history of the system to include:		
☐	☐	The oldest three structures.
☐	☐	The tallest three structures.
☐	☐	The three structures that experienced the most horizontal displacement at the face.
☐	☐	The three structures that experienced the most differential vertical displacement at the face.
☐	☐	The three structures to which the greatest surcharge load was applied by other than a crest slope.
☐	☐	Provide a list of private- and public sector users who have approved the use of the system. Also provide the contact information for a person at the user agency who may be contacted regarding the system's performance.

Tab 6.0	Other Information
	In this section, please include anything you think will better help a reviewer understand your ERS that has not been adequately address in the previous questions. Here, you may elaborate on particular innovations, advantages that your system has with respect to other systems or anything about your system you want the reviewer and future users to know. Here is your chance to promote any benefits of the system, but please provide technical justifications.

Appendix C5
Initial Technical Evaluation Checklist for Steel Facing Paired with Extensible Reinforcement

Guidelines for the Applicant to use this checklist:

1. The submittal should be provided in an electronic format (i.e. portable document format—PDF) with three hardcopies. Please include any other electronic files for computer program calculations that are requested.

2. Organize your submittal in as strict accordance with this checklist as is possible using tabbed sheets to separate the sections. For example, the first section of the submittal should comprise information related to the facing unit under "Tab 1.1 Facing Unit".

3. If a report or drawing is requested for a section, provide it in that section even if it is requested again elsewhere in the submittal, unless noted otherwise. For example, if a drawing of the facing unit-reinforcement connection is requested in both Section 1.1 and Section 2.3, include the requested drawing at both locations. Please do not "refer" the reviewer to another section unless noted otherwise. Failure to comply with this requirement will almost certainly delay the review of the submittal.

4. Mark the checklist at each item to indicate "yes" you have included the relevant information. If you must check "no", please provide a brief explanation if appropriate.

Section 1: ERS Components

Tab 1.1		Facing Unit
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the facing unit? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	List each type of facing unit and provide a brief description.
☐	☐	Report who fabricates the units and describe the fabrication process.
☐	☐	Provide specifications for each type of facing unit.
☐	☐	Provide standard dimensions and tolerances for each type of unit (e.g. standard, crest, corner, base, etc.) in plan and section drawings.
☐	☐	For each type of facing unit, provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each type of facing unit, describe corrosion protection measures. If coatings or galvanization are used, provide minimum thickness for 75-year design life.
☐	☐	For each type of facing unit, provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each type of facing unit, provide the results of any corrosion tests that have been performed
☐	☐	Provide inter-unit shear test results and design shear capacity envelopes. If inter-unit shear is not applicable, briefly describe why.
☐	☐	Describe with text any unit shear, alignment or bearing devices. Provide specifications and detail drawings. List the manufacturer of the devices.
☐	☐	Describe with text any filter which is used to prevent migration of fill soil through ERS

Appendix C5
Initial Technical Evaluation Checklist for Steel Facing Paired with Extensible Reinforcement

Tab 1.1		Facing Unit
		face. Provide specifications.
☐	☐	Describe with text the aesthetic facing options that are available. Provide photos, drawings and brochures as appropriate.
☐	☐	Describe any limits on the facing units that are created by curved structure sections and corners.

Tab 1.2		Extensible Reinforcement
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the reinforcement? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Who manufactures the reinforcement?
☐	☐	List each style or type that is to be used with the facing system.
☐	☐	Provide specifications for each style or type that is to be used with the facing system.
☐	☐	Provide the current NTPEP report (if a NTPEP report is not available, then a custom checklist is required).
☐	☐	Describe the facing unit-reinforcement connection with text and drawings and provide specifications for any connection devices.
☐	☐	List short- and long-term facing unit-reinforcement connection strength tests performed, provide test results and strength envelopes the Applicant recommends for design.
☐	☐	List reinforcement pullout (ASTM D6706) tests performed and provide results. Provide test soil properties, corresponding pullout friction factors (F*) and scale effect correction factors (α) Applicant recommends for design. Discuss how test results support these recommendations based on Appendix B at FHWA-NHI-10-025. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.
☐	☐	List soil-geosynthetic interface shear (ASTM D5321) tests performed and provide results. List interface friction angle (ρ) Applicant recommends for design. Discuss how test results support these recommendations. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.

Tab 1.3		Other Components
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to a system component? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Reinforced Soil - Provide the recommended soil classifications (per ASTM D2487), Atterberg Limits range, grain-sized distribution range, minimum effective internal angle of friction and limiting electrochemical properties. Are these soil parameters consistent with current AASHTO requirements?
☐	☐	Drainage - Describe with text any internal and external drainage measures that are inherent in the ERS. That is, they are not optional measures such as blanket and chimney drains or drainage swales, but are built-into structure components.
☐	☐	Coping—Describe with text coping that may be used with the ERS, not including the previously described cap units. Provide specifications, dimensions, dimensional tolerances

Tab 1.3		Other Components
		and plan and section view drawings.
☐	☐	Traffic Barriers—describe with text traffic barriers (i.e. moment slab, post and beam or other) that may be used with the system and any limitations that may apply. Provide typical plan and section view drawings.
☐	☐	ERS-Structure Abutments—Describe with text how the structure is abutted to a reinforced concrete semi-gravity retaining structure with a stem and footing. Provide typical plan and section view details.
☐	☐	Slip Joints—describe with text how slip joints are made to accommodate potential differential settlement. Provide applicable typical plan and elevation view drawings.

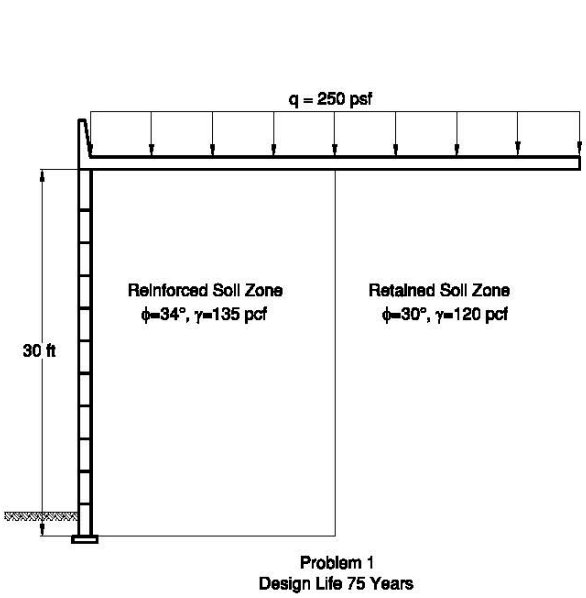
Section 2: ERS Design

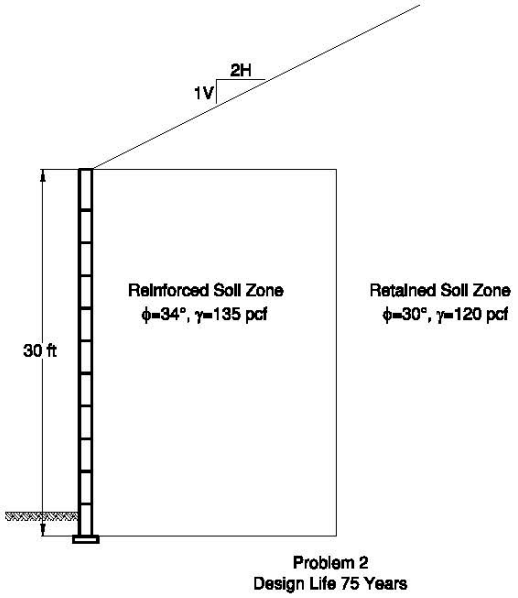
Tab 2.1		Design Methodology
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the design methodology? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Is the design methodology used for the ERS consistent with current *AASHTO LRFD Bridge Design Specifications*?
☐	☐	If the design methodology for the system is not consistent with current *AASHTO LRFD Bridge Design Specifications*, describe the methodology thoroughly, and provide references to supporting literature as appropriate.
☐	☐	Describe with text what design measures and calculations are required to design each type of reinforcement panel, including the steel reinforcement (if any is used).
☐	☐	Describe how the design addresses skewed reinforcement elements (i.e. those which are not installed perpendicular to the structure face). If this does not apply, check “no”.
☐	☐	Describe with text what design measures and calculations are required to account for a vertical utility manhole that is located 5 ft. behind the ERS face and has an outside diameter of 5 ft. Provide plan and section detail drawings.
☐	☐	Describe with text what design measures and calculations are required to account for a horizontal utility pipe that is located 5 ft. behind the structure face and has an outside diameter of 3 ft. Provide plan and section detail drawings.

Tab 2.2		Design Drawings
Yes	No	Item
☐	☐	Provide a typical set of plans for an actual project that has been constructed. Include (add if necessary) a front elevation view, a typical ERS cross section and details of the system components.

Appendix C5
Initial Technical Evaluation Checklist for Steel Facing Paired with Extensible Reinforcement

Tab 2.3		Design Example
Yes	No	Item
☐	☐	Problems 1 and 2—provide complete hand calculations for both problems. If a computer program other than *MSEW* [11] is used, provide a working copy of the program for review as well as the file used for Problems 1 and 2. If the computer program *MSEW* can be used for the ERS, omit the hand calculations and provide the *MSEW* results as well as the electronic *MSEW* file.





Section 3: Construction

Tab 3.1		Construction Procedures
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the construction procedures? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Describe foundation and leveling pad preparation.
☐	☐	Describe special tools that are required for ERS installation
☐	☐	Describe facing unit installation both at straight and curved sections of the ERS and at corners as well as any modifications that are required to be made to the facing unit.
☐	☐	Describe procedures to install earth reinforcement at straight and curved sections of the structure and at corners. Specifically address any measures that are to be taken at intersection or overlapping panels of reinforcement.
☐	☐	Describe measures that are required to maintain the design vertical and horizontal alignment of the structure face.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.

Appendix C5
Initial Technical Evaluation Checklist for Steel Facing Paired with Extensible Reinforcement

Tab 3.1		Construction Procedures
☐	☐	Describe measures that are required to prevent erosion behind and in front of the ERS during construction.
☐	☐	Describe experience or other special qualifications that are required of the ERS construction contractor.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Provide the construction manual for the ERS.

Section 4: Quality Control

Tab 4.1		Manufacturing
Yes	No	Item
☐	☐	Describe the quality control measures that are required for the manufacturing of facing units. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of earth reinforcement components. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of any shear, alignment, bearing or connection devices. You may do this by providing a manufacturing QC manual.

Tab 4.2		Construction
Yes	No	Item
☐	☐	Describe the quality control measures that are required during construction of the ERS. If these measures are described in the system's construction manual then state that they are so included and refer the reviewer to the appropriate section of the submittal.

Section 5: Performance

Tab 5.1		Warranties and Disclaimers
Yes	No	Item
☐	☐	Provide warranties and disclaimers for ERS components to include facing units and earth reinforcement.

Tab 5.2		Testing
Yes	No	Item
☐	☐	Provide descriptions and the results of any laboratory testing not previously address in the checklist. Also provide descriptions and the results of any field tests, instrumented full- or reduced-scale models and numerical models of the full system or of specific components that has been performed.

Tab 5.3		Performance History
Yes	No	Item
Describe the performance history of the system to include:		
☐	☐	The oldest three structures.
☐	☐	The tallest three structures.
☐	☐	The three structures that experienced the most horizontal displacement at the face.
☐	☐	The three structures that experienced the most differential vertical displacement at the face.

Appendix C5
Initial Technical Evaluation Checklist for Steel Facing Paired with Extensible Reinforcement

Tab 5.3		Performance History
☐	☐	The three structures to which the greatest surcharge load was applied by other than a crest slope.
☐	☐	Provide a list of private- and public sector users who have approved the use of the system. Also provide the contact information for a person at the user agency who may be contacted regarding the ERS's performance.

Tab 6.0	Other Information
	In this section, please include anything you think will better help a reviewer understand your ERS that has not been adequately address in the previous questions. Here, you may elaborate on particular innovations, advantages that your system has with respect to other systems or anything about your system you want the reviewer and future users to know. Here is your chance to promote any benefits of the system, but please provide technical justifications.

Appendix C6
Initial Technical Evaluation Checklist for Steel Facing Paired with Inextensible Reinforcement

Guidelines for the Applicant to use this checklist:

1. The submittal should be provided in an electronic format (i.e. portable document format—PDF) with three hardcopies. Please include any other electronic files for computer program calculations that are requested.

2. Organize your submittal in as strict accordance with this checklist as is possible using tabbed sheets to separate the sections. For example, the first section of the submittal should comprise information related to the facing unit under "Tab 1.1 Facing Unit".

3. If a report or drawing is requested for a section, provide it in that section even if it is requested again elsewhere in the submittal, unless noted otherwise. For example, if a drawing of the facing unit-reinforcement connection is requested in both Section 1.1 and Section 2.3, include the requested drawing at both locations. Please do not "refer" the reviewer to another section unless noted otherwise. Failure to comply with this requirement will almost certainly delay the review of the submittal.

4. Mark the checklist at each item to indicate "yes" you have included the relevant information. If you must check "no", please provide a brief explanation if appropriate.

Section 1: ERS Components

Tab 1.1		Facing Unit
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the facing unit? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	List each type of facing unit and provide a brief description.
☐	☐	Report who fabricates the units and describe the fabrication process.
☐	☐	Provide specifications for each type of facing unit.
☐	☐	Provide standard dimensions and tolerances for each type of unit (e.g. standard, crest, corner, base, etc.) in plan and section drawings.
☐	☐	For each type of facing unit, provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each type of facing unit, describe corrosion protection measures. If coatings or galvanization are used, provide minimum thickness for 75-year design life.
☐	☐	For each type of facing unit, provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each type of facing unit, provide the results of any corrosion tests that have been performed
☐	☐	Provide inter-unit shear test results and design shear capacity envelopes. If inter-unit shear is not applicable, briefly describe why.
☐	☐	Describe with text any unit shear, alignment or bearing devices. Provide specifications and detail drawings. List the manufacturer of the devices.
☐	☐	Describe with text any filter which is used to prevent migration of fill soil through ERS

Appendix C6
Initial Technical Evaluation Checklist for Steel Facing Paired with Inextensible Reinforcement

Tab 1.1		Facing Unit
		face. Provide specifications.
☐	☐	Describe with text the aesthetic facing options that are available. Provide photos, drawings and brochures as appropriate.
☐	☐	Describe any limits on the facing units that are created by curved structure sections and corners.

Tab 1.2		Inextensible Reinforcement
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the reinforcement? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Who manufactures the reinforcement?
☐	☐	List each reinforcement type that is to be used with the facing system.
☐	☐	For each type provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each reinforcement type describe corrosion protection measures. If coatings or galvanization are used, provide minimum thickness for 75-year design life.
☐	☐	For each reinforcement type provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each reinforcement type provide the results of any corrosion tests that have been performed.
☐	☐	For each reinforcement type provide detail drawings that show dimensional tolerances.
☐	☐	Describe with text and drawing details how the reinforcement connects to facing units.
☐	☐	List each connection device that is used to connect the facing unit and reinforcement.
☐	☐	Who manufactures each connection device?
☐	☐	For each connection device provide physical property specifications. Address ultimate and yield strengths as well as welds if they are applicable.
☐	☐	For each connection device describe corrosion protection measures and provide specifications. If coatings or galvanization are used, provide minimum thickness for 75-year design life
☐	☐	For each connection device provide sacrificial steel thickness for 75- and 100-year design life.
☐	☐	For each connection device provide the results of any corrosion tests that have been performed.
☐	☐	For each connection device provide detail drawings that show dimensional tolerances.
☐	☐	List facing unit-reinforcement connection strength tests performed, provide test results and strength envelopes the Applicant recommends for design.
☐	☐	List reinforcement pullout (ASTM D6706) tests performed and provide results. Provide test soil properties, corresponding pullout friction factors (F*) and scale effect correction factors (α) Applicant recommends for design (it is recognized that for inextensible reinforcement the value of α may be 1.0). Discuss how test results support these recommendations based on Appendix B at FHWA-NHI-10-025. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.

Appendix C6
Initial Technical Evaluation Checklist for Steel Facing Paired with Inextensible Reinforcement

Tab 1.2		Inextensible Reinforcement
☐	☐	List soil-reinforcement interface shear (ASTM D5321) tests performed and provide results. List interface friction angle (ρ) Applicant recommends for design. Discuss how test results support these recommendations. If no tests have been performed, list the default values that should be used based on FHWA-NHI-10-024/025.

Tab 1.3		Other Components
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to a system component? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Reinforced Soil - Provide the recommended soil classifications (per ASTM D2487), Atterberg Limits range, grain-sized distribution range, minimum effective internal angle of friction and limiting electrochemical properties. Are these soil parameters consistent with current AASHTO requirements?
☐	☐	Drainage - Describe with text any internal and external drainage measures that are inherent in the wall system. That is, they are not optional measures such as blanket and chimney drains or drainage swales, but are built-into wall components.
☐	☐	Coping—Describe with text coping that may be used with the wall system, not including the previously described cap units. Provide specifications, dimensions, dimensional tolerances and plan and section view drawings.
☐	☐	Traffic Barriers—describe with text traffic barriers (i.e. moment slab, post and beam or other) that may be used with the system and any limitations that may apply. Provide typical plan and section view drawings.
☐	☐	Wall-Structure Abutments—Describe with text how the wall is abutted to a reinforced concrete semi-gravity retaining wall with a stem and footing. Provide typical plan and section view details.
☐	☐	Slip Joints—describe with text how slip joints are made to accommodate potential differential settlement. Provide applicable typical plan and elevation view drawings.

Section 2: ERS Design

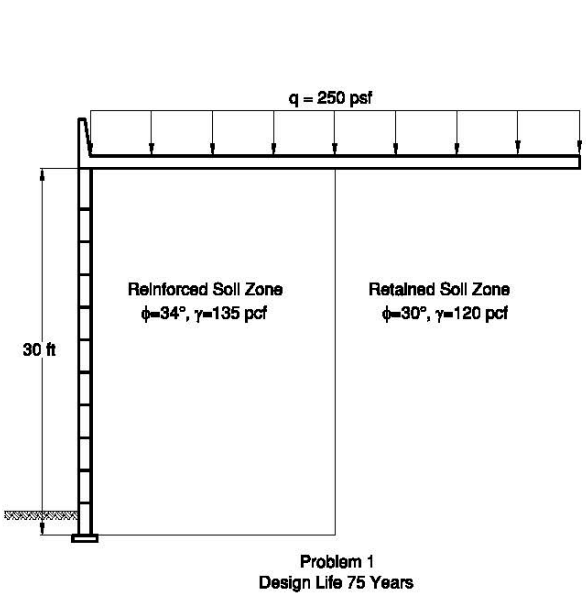
Tab 2.1		Design Methodology
Yes	No	Item
☐	☐	Does the wall system contain what you consider to be an innovation that is related to the design methodology? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Is the design methodology used for the ERS consistent with current *AASHTO LRFD Bridge Design Specifications*?
☐	☐	If the design methodology for the system is not consistent with current *AASHTO LRFD Bridge Design Specifications*, describe the methodology thoroughly, and provide references to supporting literature as appropriate.
☐	☐	Describe with text what design measures and calculations are required to design each type of reinforcement panel, including the steel reinforcement (if any is used).
☐	☐	Describe how the design addresses skewed reinforcement elements (i.e. those which are not installed perpendicular to the structure face). If this does not apply, check “no”.
☐	☐	Describe with text what design measures and calculations are required to account for a

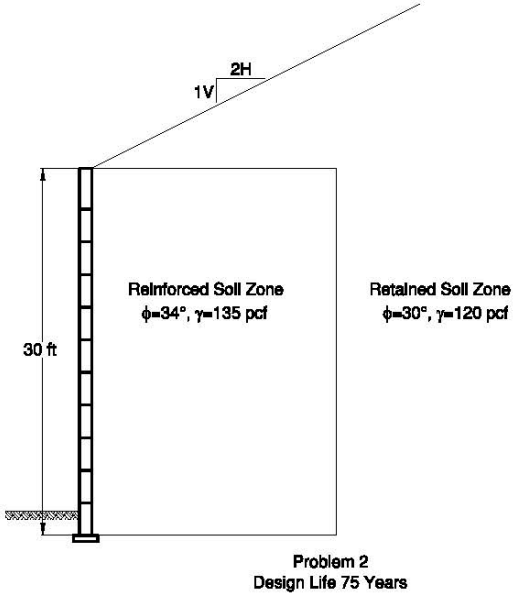
Appendix C6
Initial Technical Evaluation Checklist for Steel Facing Paired with Inextensible Reinforcement

Tab 2.1		Design Methodology
		vertical utility manhole that is located 5 ft. behind the structure face and has an outside diameter of 5 ft. Provide plan and section detail drawings.
☐	☐	Describe with text what design measures and calculations are required to account for a horizontal utility pipe that is located 5 ft. behind the structure face and has an outside diameter of 3 ft. Provide plan and section detail drawings.

Tab 2.2		Design Drawings
Yes	No	Item
☐	☐	Provide a typical set of plans for an actual project that has been constructed. Include (add if necessary) a front elevation view, a typical ERS cross section and details of the system components.

Tab 2.3		Design Example
Yes	No	Item
☐	☐	Problems 1 and 2—provide complete hand calculations for both problems. If a computer program other than *MSEW* [11] is used, provide a working copy of the program for review as well as the file used for Problems 1 and 2. If the computer program *MSEW* can be used for the ERS, omit the hand calculations and provide the *MSEW* results as well as the electronic *MSEW* file.





Section 3: Construction

Tab 3.1		Construction Procedures
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the construction procedures? If yes, please describe the innovation briefly. As items below

Appendix C6
Initial Technical Evaluation Checklist for Steel Facing Paired with Inextensible Reinforcement

Tab 3.1		Construction Procedures
		apply to the innovation, please describe the innovation in further detail.
☐	☐	Describe foundation and leveling pad preparation.
☐	☐	Describe special tools that are required for ERS installation
☐	☐	Describe facing unit installation both at straight and curved sections of the ERS and at corners as well as any modifications that are required to be made to the facing unit.
☐	☐	Describe procedures to install earth reinforcement at straight and curved sections of the structure and at corners. Specifically address any measures that are to be taken at intersection or overlapping panels of reinforcement.
☐	☐	Describe measures that are required to maintain the design vertical and horizontal alignment of the structure face.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Describe measures that are required to prevent erosion behind and in front of the ERS during construction.
☐	☐	Describe experience or other special qualifications that are required of the ERS construction contractor.
☐	☐	Describe the procedures to install soil in the reinforced soil zone.
☐	☐	Provide the construction manual for the ERS.

Section 4: Quality Control

Tab 4.1		Manufacturing
Yes	No	Item
☐	☐	Describe the quality control measures that are required for the manufacturing of facing units. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of earth reinforcement components. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of any shear, alignment, bearing or connection devices. You may do this by providing a manufacturing QC manual.

Tab 4.2		Construction
Yes	No	Item
☐	☐	Describe the quality control measures that are required during construction of the ERS. If these measures are described in the system's construction manual then state that they are so included and refer the reviewer to the appropriate section of the submittal.

Section 5: Performance

Tab 5.1		Warranties and Disclaimers
Yes	No	Item
☐	☐	Provide warranties and disclaimers for ERS components to include facing units and earth reinforcement.

Tab 5.2		Testing
Yes	No	Item
☐	☐	Provide descriptions and the results of any laboratory testing not previously address in the

Tab 5.2	Testing
	checklist. Also provide descriptions and the results of any field tests, instrumented full- or reduced-scale models and numerical models of the full system or of specific components that has been performed.

Tab 5.3		Performance History
Yes	No	Item
Describe the performance history of the system to include:		
☐	☐	The oldest three structures.
☐	☐	The tallest three structures.
☐	☐	The three structures that experienced the most horizontal displacement at the face.
☐	☐	The three structures that experienced the most differential vertical displacement at the face.
☐	☐	The three structures to which the greatest surcharge load was applied by other than a crest slope.
☐	☐	Provide a list of private- and public sector users who have approved the use of the system. Also provide the contact information for a person at the user agency who may be contacted regarding the ERS's performance.

Tab 6.0	Other Information
	In this section, please include anything you think will better help a reviewer understand your ERS that has not been adequately address in the previous questions. Here, you may elaborate on particular innovations, advantages that your system has with respect to other systems or anything about your system you want the reviewer and future users to know. Here is your chance to promote any benefits of the system, but please provide technical justifications.

Appendix C7
Initial Technical Evaluation Checklist for Precast Concrete Modular Gravity Wall System

Guidelines for the Applicant to use this checklist:

1. The submittal should be provided in an electronic format (i.e. portable document format—PDF) with three hardcopies. Please include any other electronic files for computer program calculations that are requested.

2. Organize your submittal in as strict accordance with this checklist as is possible using tabbed sheets to separate the sections. For example, the first section of the submittal should comprise information related to the facing unit under "Tab 1.1 Facing / Gravity Unit".

3. If a report or drawing is requested for a section, provide it in that section even if it is requested again elsewhere in the submittal, unless noted otherwise. For example, if a drawing of the facing unit-reinforcement connection is requested in both Section 1.1 and Section 2.3, include the requested drawing at both locations. Please do not "refer" the reviewer to another section unless noted otherwise. Failure to comply with this requirement will almost certainly delay the review of the submittal.

4. Mark the checklist at each item to indicate "yes" you have included the relevant information. If you must check "no", please provide a brief explanation if appropriate.

Section 1: ERS Components

Tab 1.1		Facing / Gravity Unit
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the facing unit? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Report who manufacturers the units and describe manufacturer and licensee / licensor arrangement.
☐	☐	Provide specifications for each facing component.
☐	☐	List the types of units (e.g. standard, top, corner, base, etc.)
☐	☐	Provide standard dimensions, tolerances and typical steel reinforcement schedule (if any is used) for each type of unit (e.g. standard, top, corner, base, etc.) in plan and section drawings.
☐	☐	Describe the unit fabrication process.
☐	☐	Provide the target 28-day minimum compressive strength.
☐	☐	For wet-cast units, provide the target percent air range.
☐	☐	Discuss whether producers use mix designs to improve durability in areas subject to freeze/thaw or salt scaling.
☐	☐	Provide inter-unit shear test results and design shear capacity envelopes.
☐	☐	Describe with text any unit shear, alignment or bearing devices. Provide specifications and detail drawings. List the manufacturer of the devices.
☐	☐	Describe with text any filter which is used to prevent migration of fill soil through the ERS face. Provide specifications.
☐	☐	Describe with text the aesthetic facing options that are available. Provide photos, drawings

Appendix C7
Initial Technical Evaluation Checklist for Precast Concrete Modular Gravity Wall System

Tab 1.1		Facing / Gravity Unit
		and brochures as appropriate.
☐	☐	Describe any limits on the facing units that are created by curved structure sections and corners.

Tab 1.2		Other Components
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to a system component? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Retained Soil - Provide the recommended soil classifications (per ASTM D2487), Atterberg Limits range, grain-sized distribution range, minimum effective internal angle of friction and limiting electrochemical properties. Are these soil parameters consistent with current AASHTO requirements? To what distance behind the facing units do these soil properties apply?
☐	☐	Drainage - Describe with text any internal and external drainage measures that are inherent in the ERS. That is, they are not optional measures such as blanket and chimney drains or drainage swales, but are built-into system components.
☐	☐	Coping—Describe with text coping that may be used with the ERS. Provide specifications, dimensions, dimensional tolerances and plan and section view drawings.
☐	☐	Traffic Barriers—describe with text traffic barriers (i.e. moment slab, post and beam or other) that may be used with the system and any limitations that may apply. Provide typical plan and section view drawings.
☐	☐	ERS-Structure Abutments—Describe with text how the wall is abutted to a reinforced concrete semi-gravity retaining structure with a stem and footing. Provide typical plan and section view details.
☐	☐	Slip Joints—describe with text how slip joints are made to accommodate potential differential settlement. Provide applicable typical plan and elevation view drawings.

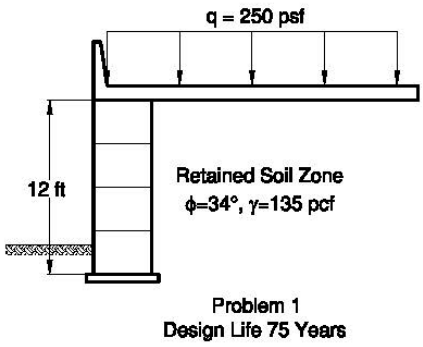
Section 2: ERS Design

Tab 2.1		Design Methodology
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the design methodology? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Is the design methodology used for the ERS consistent with current *AASHTO LRFD Bridge Design Specifications*?
☐	☐	If the design methodology for the system is not consistent with current *AASHTO LRFD Bridge Design Specifications*, describe the methodology thoroughly, and provide references to supporting literature as appropriate.

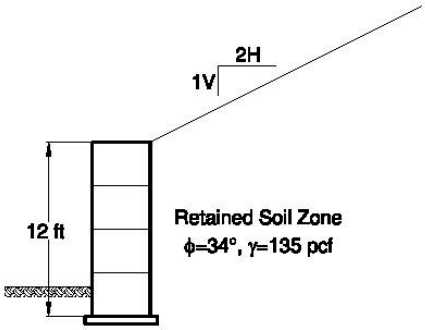
Tab 2.2		Design Drawings
Yes	No	Item
☐	☐	Provide a typical set of plans for an actual project that has been constructed. Include (add if necessary) a front elevation view, a typical ERS cross section and details of the system components.

Appendix C7
Initial Technical Evaluation Checklist for Precast Concrete Modular Gravity Wall System

Tab 2.3		Design Example
Yes	No	Item
☐	☐	Problems 1 and 2—provide complete hand calculations for both problems. If a computer program is used, provide a working copy of the program for review as well as the file used for Problems 1 and 2.



Problem 1
Design Life 75 Years



Problem 2
Design Life 75 Years

Section 3: Construction

Tab 3.1		Construction Procedures
Yes	No	Item
☐	☐	Does the ERS contain what you consider to be an innovation that is related to the construction procedures? If yes, please describe the innovation briefly. As items below apply to the innovation, please describe the innovation in further detail.
☐	☐	Describe foundation and leveling pad preparation.
☐	☐	Describe special tools that are required for ERS installation
☐	☐	Describe facing unit installation both at straight and curved sections of the system and at corners as well as any modifications that are required to be made to the facing unit.
☐	☐	Describe measures that are required to maintain the design vertical and horizontal alignment of the ERS face.
☐	☐	Describe the procedures to install soil in the retained soil zone.
☐	☐	Describe measures that are required to prevent erosion behind and in front of the ERS during construction.
☐	☐	Describe experience or other special qualifications that are required of the ERS construction contractor.
☐	☐	Provide the construction manual for the ERS.

Appendix C7
Initial Technical Evaluation Checklist for Precast Concrete Modular Gravity Wall System

Section 4: Quality Control

Tab 4.1		Manufacturing
Yes	No	Item
☐	☐	Describe the quality control measures that are required for the manufacturing of facing units. You may do this by providing a manufacturing QC manual.
☐	☐	Describe the quality control measures that are required for the manufacturing of any shear, alignment, bearing or connection devices. You may do this by providing a manufacturing QC manual.

Tab 4.2		Construction
Yes	No	Item
☐	☐	Describe the quality control measures that are required during construction of the ERS. If these measures are described in the system's construction manual then state that they are so included and refer the reviewer to the appropriate section of the submittal.

Section 5: Performance

Tab 5.1		Warranties and Disclaimers
Yes	No	Item
☐	☐	Provide warranties and disclaimers for ERS components to include facing units and earth reinforcement.

Tab 5.2		Testing
Yes	No	Item
☐	☐	Provide descriptions and the results of any laboratory testing not previously address in the checklist. Also provide descriptions and the results of any field tests, instrumented full- or reduced-scale models and numerical models of the full system or of specific components that has been performed.

Tab 5.3		Performance History
Yes	No	Item
Describe the performance history of the system to include:		
☐	☐	The oldest three structures.
☐	☐	The tallest three structures.
☐	☐	The three structures that experienced the most horizontal displacement at the face.
☐	☐	The three structures that experienced the most differential vertical displacement at the face.
☐	☐	The three structures to which the greatest surcharge load was applied by other than a crest slope.
☐	☐	Provide a list of private- and public sector users who have approved the use of the system. Also provide the contact information for a person at the user agency who may be contacted regarding the ERS's performance.

Appendix C7
Initial Technical Evaluation Checklist for Precast Concrete Modular Gravity Wall System

Tab 6.0	Other Information
	In this section, please include anything you think will better help a reviewer understand your ERS that has not been adequately address in the previous questions. Here, you may elaborate on particular innovations, advantages that your system has with respect to other systems or anything about your system you want the reviewer and future users to know. Here is your chance to promote any benefits of the system, but please provide technical justifications.