APPENDIX K

PERFORMANCE OBJECTIVE DEVELOPMENT

GEOTECHNICAL DESIGN MANUAL

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K.1 INTRODUCTION

Performance Objectives have been previously developed (see Seismic Specs and Chapter 10) for bridges, ERSs and embankments. However, it is possible that additional Performance Objectives will be required and it will be the responsibility of the design team to develop these additional Performance Objectives. All additional Performance Objectives should be submitted to the PC/SDS and PC/GDS for review and acceptance prior to being used in design. Provided in the following Sections are general guidelines that should be used in the development of Performance Objectives.

K.2 SAFETY

The structure must be designed for safety so as not to collapse when loads are applied to the structure and to control structural damage caused by these loads so that the risk of loss of life is reduced to an acceptable level (see Risk in the following Sections). The reliability of the design to maintain this objective is addressed by designing for the Strength limit state that takes into account the variability of the applied load and the available resistance. Structures that are designed for the Strength limit state will have component/members and foundations that are sized for larger loadings than loadings observed at the Service limit state. Having components/members and foundations of a structure that are sized for Strength limit state typically improves the performance of the structure by increasing the stiffness of the members. Thus resulting in smaller deformations and improved performance and service loads.

K.3 OPERATIONAL CLASSIFICATION

SCDOT has established operational classifications for typical bridges (OC) to allow for differentiation between structures of higher and lower operational requirements to the South Carolina transportation infrastructure. The OC has 3 levels (I, II, and III), where OC I is the highest and OC III is the lowest. The OC is defined in the Seismic Specs. This classification allows SCDOT to vary the reliability, design requirements and performance expectations between structures that have relatively high operational requirements such as the Interstate system to those on low volume roads that are typically part of the secondary roadway system during the EE I limit state check.

K.4 DESIGN LIFE

Design Life is the anticipated life expectancy of the structure, typically 75 years for bridges, 100 years for embankments and ERSs and 20 years for pavements. Typically at the end of the Design Life the existing structure will require either replacement by a new structure or extensive rehabilitation. It is assumed that the structure has periodic inspection and maintenance so as not to reduce the expected Design Life.

K.5 FUNCTIONALITY

Functionality of a structure requires acceptable performance of the structure in order to be useable by the traveling public. This is accomplished by establishing performance limits (traffic projections, deformation limits, rideability requirements, etc.) for the Design Life of the structure.

In order to maintain the required functionality of the structure, periodic maintenance will be required.

K.6 AESTHETICS

The aesthetics of a structure should be consistent with the environment where the structure will be placed. The aesthetic requirement of a structure located in an urban setting with high visibility will be different from those aesthetic requirements of a structure located in a rural setting with low visibility by the traveling public. Aesthetics of the structure are also defined by public perception of how visually safe or appealing a structure appears. A structure that is structurally stable but has cracks, excessive deformations in the form of bulges, out-of-plumbness, etc. is not aesthetically satisfactory. Satisfying aesthetic objectives requires proper planning (public hearings, timely information, etc.), good construction specifications that specify construction tolerances, finish requirements, proper inspection during construction, and periodic maintenance.

K.7 CONSTRUCTION

The development of plans and construction specifications should be clear and take into account the constructability of the design and any construction monitoring. Construction specifications should include construction tolerances, construction methods, and field performance monitoring of the structure such as settlement monitoring.

K.8 MAINTENANCE

A Maintenance Plan should be in place that consists of periodic inspections of the structure and communication with designers to evaluate the results of the inspections. The Maintenance Plan should also provide for the development of the appropriate responses required to meet the serviceability requirements of the structure for the remainder of its design life. Design details of the structure should allow for periodic inspection of vital components that would affect the structure's performance.

K.9 RISK

The selection of the type of structure to be used in the design should consider any associated risk that would affect the performance of the structure. Some factors that increase the risk of unsatisfactory structure performance are presented below:

- Construction: Common types of structures are usually associated with less construction risk due to the familiarity of the construction procedures.
- Structure Selection: Failure to consider the limitations of the structure type selected in relation to the desired performance may lead to unsatisfactory performance. A common misapplication in construction is the use of cantilever sheetpiling for temporary shoring of deep excavations. The deformations typically exceed acceptable performance for adjacent structures.
- Design/Construction Methodology: Misapplication of methodologies in design (i.e. using unaccepted design methods) or construction (i.e. misapplication of ground improvement method).
- Design Experience: Insufficient design experience in either the design of the structure or of any ground improvement required can lead to unsatisfactory performance. Insufficient design experience includes untested designs, new design methodologies, and designer's inexperience.
- Geotechnical Investigation: A subsurface geotechnical investigation that does not adequately describe the foundation soils can lead to construction delays, "changes in

soil/subsurface conditions," redesign of foundations that unfortunately results in contractor claims, increased construction costs, not meeting schedules, litigation, etc. The long-term impacts of an inadequate geotechnical investigation can result in poor long-term performance of the structure that results in higher maintenance costs and in many cases replacement of the structure before it has reached its anticipated design life.

- Change in Soil/Subsurface Conditions: These are unforeseen field conditions that typically cannot be accounted for during design. When changes in soil/subsurface conditions occur, they can be addressed during construction with proper communication between Construction and Design personnel. Field conditions that fall into this category are subsurface soil variability, and environmental factors (weather, etc.). Performing an adequate geotechnical subsurface investigation during the design phase of structure development is the most cost effective method of reducing the risk of having a "change in soil/subsurface conditions" occur during construction.

Quantifiable Performance Objectives are first developed and then Performance Limits are developed to meet these Performance Objectives. The Performance Limits are based on Design Life and Deformation Limits that are defined to meet the Performance Objectives of the Service limit state. Where possible, the factors listed above have been taken into consideration in the development of the Performance Limits listed for the Service limit state.