STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

In the Matter of:	)	
	)	
PROPOSED AMENDMENT TO 20.6.2 NMAC (Copper Rule)	)	**No. WQCC 12-01(R)**

EXHIBIT SCOTT – D-32

1997 Interim Revisions
to the
STANDARD SPECIFICATIONS
FOR
HIGHWAY BRIDGES

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mance requirements of the structure. MSE walls have been successfully used in both fill and cut wall applications. However, they are most effective in fill wall applications. MSE walls shall not be used under the following conditions.

- When utilities other than highway drainage must be constructed within the reinforced zone if future access to the utilities would require that the reinforcement layers be cut, or if there is potential for material which can cause degradation of the soil reinforcement to leak out of the utilities into the wall backfill.
- With soil reinforcements exposed to surface or ground water contaminated by acid mine drainage, other industrial pollutants, or other environmental conditions which are defined as aggressive as described in Division II, Article 7.3.6.3, unless environment specific long-term corrosion or degradation studies are conducted.
- When floodplain erosion may undermine the reinforced fill zone or facing column, or where the depth of scour cannot be reliably determined.

MSE walls may be considered for use under the following special conditions:

- When two intersecting walls form an enclosed angle of 70° or less, the affected portion of the wall is designed as an internally tied bin structure with at-rest earth pressure coefficients.
- Where metallic reinforcements are used in areas of anticipated stray currents within 60 m (200 ft) of the structure, a corrosion expert should evaluate the potential need for corrosion control requirements.

5.2.1.5 Prefabricated Modular Walls

Prefabricated modular wall systems, whose elements may be proprietary, generally employ interlocking soil-filled reinforced concrete or steel modules or bins, rock filled gabion baskets, precast concrete units, or dry cast segmental masonry concrete units (without soil reinforcement) which resist earth pressures by acting as gravity retaining walls. Prefabricated modular walls may also use their structural elements to mobilize the dead weight of a portion of the wall backfill through soil arching to provide resistance to lateral loads. Prefabricated modular systems may be used where conventional gravity, cantilever or counterfort concrete retaining walls are considered.

Steel modular systems shall not be used where the steel will be exposed to surface or subsurface water which is contaminated by acid mine drainage, other industrial pollutants, other environmental conditions which are defined as aggressive as described in Division II, Article 7.3.6.3, or where deicing spray is anticipated.

5.2.2 Wall Capacity

Retaining walls shall be designed to provide adequate structural capacity with acceptable movements, adequate foundation bearing capacity with acceptable settlements, and acceptable overall stability of slopes adjacent to walls. The tolerable level of wall lateral and vertical deformations is controlled by the type and location of the wall structure and surrounding facilities.

5.2.2.1 Bearing Capacity

The bearing capacity of wall foundation support systems shall be estimated using procedures described in Articles 4.4, 4.5, or 4.6, or other generally accepted theories. Such theories are based on soil and rock parameters measured by in-situ and/or laboratory tests.

5.2.2.2 Settlement

The settlement of wall foundation support systems shall be estimated using procedures described in Articles 4.4, 4.5, or 4.6, or other generally accepted methods. Such methods are based on soil and rock parameters measured directly or inferred from the results of in-situ and/or laboratory test.

5.2.2.3 Overall Stability

The overall stability of slopes in the vicinity of walls shall be considered as part of the design of retaining walls. The overall stability of the retaining wall, retained slope, and foundation soil or rock shall be evaluated for all walls using limiting equilibrium methods of analysis such as the Modified Bishop, simplified Janbu or Spencer methods of analysis. A minimum factor of safety of 1.3 shall be used for walls designed for static loads, except the factor of safety shall be 1.5 for walls that support abutments, buildings, critical utilities, or for other installations with a low tolerance for failure. A minimum factor of safety of 1.1 shall be used when designing walls for seismic loads. In all cases, the subsurface conditions and soil/rock properties of the wall site shall be adequately characterized through in-situ exploration and testing and/or laboratory testing as described in Article 5.3.

Seismic forces applied to the mass of the slope shall be based on a horizontal seismic coefficient k_h equal to one-half the ground acceleration coefficient "A," with the vertical seismic coefficient k_v equal to zero.

It must be noted that, even if overall stability is satisfactory, special exploration, testing and analyses may be required for bridge abutments or retaining walls constructed over soft subsoils where consolidation and/or lateral flow of the soft soil could result in unacceptable long-term settlements or horizontal movements.

Stability of temporary construction slopes needed to construct the wall shall also be evaluated.

5.2.2.4 Tolerable Deformations

Tolerable vertical and lateral deformation criteria for retaining walls shall be developed based on the function and type of wall, unanticipated service life, and consequences of unacceptable movements (i.e., both structural and aesthetic).

Allowable total and differential vertical deformations for a particular retaining wall are dependent on the ability of the wall to deflect without causing damage to the wall elements or exhibiting unsightly deformations. The total and differential vertical deformation of a retaining wall should be small for rigid gravity and semi-gravity retaining walls, and for soldier pile walls with a cast-in-place facing. For walls with anchors, any downward movement can cause significant destressing of the anchors.

MSE walls can tolerate larger total and differential vertical deflections than rigid walls. The amount of total and differential vertical deflection that can be tolerated depends on the wall facing material, configuration, and timing of facing construction. A cast-in-place facing has the same vertical deformation limitations as the more rigid retaining wall systems. However, an MSE wall with a cast-in-place facing can be specified with a waiting period before the cast-in-place facing is constructed so that vertical (as well as horizontal) deformations have time to occur. An MSE wall with welded wire or geosynthetic facing can tolerate the most deformation. An MSE wall with multiple precast concrete panels cannot tolerate as much vertical deformation as flexible welded wire or geosynthetic facings because of potential damage to the precast panels and unsightly panel separation.

Horizontal movements resulting from outward rotation of the wall or resulting from the development of internal equilibrium between the loads applied to the wall and the internal structure of the wall must be limited to prevent overstress of the structural wall facing and to prevent the wall face batter from becoming negative. In general, if vertical deformations are properly controlled, horizontal deformations will likely be within acceptable limits. For MSE walls with extensible reinforcements, reinforcement serviceability criteria, the wall face batter, and the facing type selected (i.e., the flexibility of the facing) will influence the horizontal deformation criteria required.

Vertical wall movements shall be estimated using conventional settlement computational methods (see Articles 4.4, 4.5, and 4.6. For gravity and semi-gravity walls, lateral movement results from a combination of differential vertical settlement between the heel and the toe of the wall and the rotation necessary to develop active earth pressure conditions (see Table 5.5.2A). If the wall is designed for at-rest earth pressure conditions, the deflections in Table 5.5.2A do not need to be considered. For anchored walls, deflections shall be estimated in accordance with Article 5.7.2. For MSE walls, deflections may be estimated in accordance with Article 5.8.10.

Where a wall is used to support a structure, tolerable movement criteria shall be established in accordance with Articles 4.4.7.2.5, 4.5 and 4.6. Where a wall supports soil on which an adjacent structure is founded, the effects of wall movements and associated backfill settlement on the adjacent structure shall be evaluated.

For seismic design, seismic loads may be reduced, as result of lateral wall movement due to sliding, for what is calculated based on Division 1A using the Mononobe-Okabe method if both of the following conditions are met:

- the wall system and any structures supported by the wall can tolerate lateral movement resulting from sliding of the structure,
- the wall base is unrestrained regarding its ability to slide, other than soil friction along its base and minimal soil passive resistance.

Procedures for accomplishing this reduction in seismic load are provided in the Article 6 commentary, Division 1A, in particular Equation C6-10, of the 1996 AASHTO Bridge Specifications. In general, this only applies to gravity and semi-gravity walls. Though the specifications in Division 1A regarding this issue are directed at structural gravity and semi-gravity walls, these specifications may also be applicable to other types of gravity walls regarding this issue provided the two conditions listed above are met.

5.2.3 Soil, Rock, and Other Problem Conditions

Geologic and environmental conditions can influence the performance of retaining walls and their foundations, and may require special consideration during design. To the extent possible, the presence and influence of such conditions shall be evaluated as part of the subsurface exploration program. A representative, but not exclusive, listing of problem conditions requiring special consideration is presented in Table 4.2.3A for general guidance.

5.3 SUBSURFACE EXPLORATION AND TESTING PROGRAMS

The elements of the subsurface exploration and testing programs shall be the responsibility of the Designer, based