HIGHWAY CONSTRUCTION FACTORS GROUP ATTACHMENT 12
POLICIES ON RESTRICTION OF CONSTRUCTION LOADS ON BRIDGE DECKS

1. MNDOT CONSTRUCTION SPECIFICATION 1513 (OLD VERSION IN EFFECT AT TIME OF COLLAPSE)
2. FHWA TECHNICAL ADVISORY 5140.28
3. AASHTO POLICY 8.15.3

BRIDGE 9340 COLLAPSE
MINNEAPOLIS, MN.; 8/1/2008
HWY-07-MH024

1513
Restrictions on Movement of Heavy Loads and Equipment

The hauling of materials and the movement of equipment to and from the Project and over completed structures, base courses, and pavements within the Project that are open for use by traffic and are to remain a part of the permanent improvement, shall comply with the regulations governing the operation of vehicles on the highways of Minnesota, as prescribed in the Highway Traffic Regulation Act.

The Contractor shall comply with legal load restrictions, and with any special restrictions imposed by the Contract, in hauling materials and moving equipment over structures, completed subgrades, base courses, and pavements within the Project that are under construction, or have been completed but have not been accepted and opened for use by traffic.

The Contractor shall have a completed Weight Information Card in each vehicle used for hauling bituminous mixture, aggregate, batch concrete, and grading material (including borrow and excess) prior to starting work. This card shall identify the truck or tractor and trailer by Minnesota or prorated license number and shall contain the tare, maximum allowable legal gross mass, supporting information, and the signature of the owner. The card shall be available to the Engineer upon request. All Contractor-related costs in providing, verifying, and spot checking the cab card information (including weighing trucks on certified commercial scales, both empty and loaded) will be incidental, and no compensation other than for Plan pay items will be made.

Equipment mounted on crawler tracks or steel-tired wheels shall not be operated on or across concrete or bituminous surfaces without specific authorization from the Engineer. Special restrictions may be imposed by the Contract with respect to speed, load distribution, surface protection, and other precautions considered necessary.

Should construction operations necessitate the crossing of an existing pavement or completed portions of the pavement structure with equipment or loads that would otherwise be prohibited, approved methods of load distribution or bridging shall be provided by the Contractor at no expense to the Department.

Neither by issuance of a special permit, nor by adherence to any other restrictions imposed, shall the Contractor be relieved of liability for damages resulting from the operation and movement of construction equipment.

U.S. Department of Transportation
Federal Highway Administration

MEMORANDUM

Subject: Technical Advisory 5140.28 - Construction Loads on Bridges

Date: August 8, 2007

From: Frederick G. Wright (Bud)
Executive Director (HOA-3)

To: Division Administrators
Directors of Field Services
Federal Land Highway Division Engineers

PURPOSE

In the ongoing investigation of the collapse of the I-35W Bridge in Minneapolis, the National Transportation Safety Board has identified construction equipment and materials loading on the bridge as part of their review. While no conclusions have been reached, in an abundance of caution, we strongly advise the State Transportation Agencies and other bridge owners who are engaged in or contemplating any construction operation on their bridges to ensure that any construction loading and stockpiled raw materials placed on a structure do not overload its members.

For more discussion on this issue, please refer to the AASHTO Standard Specifications for Highway Bridges, 17th Edition, Division II, Section 8.15 or the AASHTO Load Resistance and Factor Design Bridge Design Specifications, 4th Edition, Section 3.

Please refer any questions to Benjamin Tang at 202-366-4592 or benjamin.tang@dot.gov.

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Unless otherwise specified or ordered by the Engineer, the proportion of cement to sand for mortar shall be one to two and for grout shall be one to one. Proportioning shall be by loose volume.

When nonshrink mortar or grout is specified, either a nonshrink admixture or an expansive hydraulic cement conforming to ASTM C 845 of a type approved by the Engineer, shall be used.

Only sufficient water shall be used to permit placing and packing. For mortar, only enough water shall be used so that the mortar will form a ball when squeezed gently in the hand.

Mixing shall be done by either hand methods or with rotating paddle-type mixing machines and shall be continued until all ingredients are thoroughly mixed. Once mixed, mortar or grout shall not be retempered by the addition of water and shall be placed within 1 hour.

8.14.3 Placing and Curing

Concrete areas to be in contact with the mortar or grout shall be cleaned of all loose or foreign material that would in any way prevent bond and the concrete surfaces and shall be flushed with water and allowed to dry to a surface dry condition immediately prior to placing the mortar or grout.

The mortar or grout shall completely fill and shall be tightly packed into recesses and holes, on surfaces, under structural members, and at other locations specified. After placing, all surfaces of mortar or grout shall be cured by the water method as provided in Article 8.11 for a period of not less than 3 days.

Keyways, spaces between structural members, holes, spaces under structural members, and other locations where mortar could escape shall be mortar-tight before placing mortar.

No load shall be allowed on mortar that has been in place less than 72 hours, unless otherwise permitted by the Engineer.

All improperly cured or otherwise defective mortar or grout shall be removed and replaced by the Contractor at own expense.

8.15 APPLICATION OF LOADS

8.15.1 General

Loads shall not be applied to concrete structures until the concrete has attained sufficient strength and, when applicable, sufficient prestressing has been completed, so that damage will not occur.

8.15.2 Earth Loads

Whenever possible the sequence of placing backfill around structures shall be such that overturning or sliding forces are minimized. When the placement of backfill will cause flexural stresses in the concrete, and unless otherwise permitted by the Engineer, the placement shall not begin until the concrete has reached not less than 80% of its specified strength.

8.15.3 Construction Loads

Light materials and equipment may be carried on bridge decks only after the concrete has been in place at least 24 hours, providing curing is not interfered with and the surface texture is not damaged. Vehicles needed for construction activities and weighing between 1,000 and 4,000 pounds, and comparable materials and equipment loads, will be allowed on any span only after the last placed deck concrete has attained a compressive strength of at least 2,400 pounds per square inch. Loads in excess of the above shall not be carried on bridge decks until the deck concrete has reached its specified strength. In addition, for post-tensioned structures, vehicles weighing over 4,500 pounds, and comparable materials and equipment loads, will not be allowed on any span until the prestressing steel for that span has been tensioned.

Precast concrete or steel girders shall not be placed on substructure elements until the substructure concrete has attained 70% of its specified strength.

Otherwise, loads imposed on existing, new or partially completed portions of structures due to construction operations shall not exceed the load-carrying capacity of the structure, or portion of structure, as determined by the Load Factor Design methods of AASHTO using Load Group IB. The compressive strength of concrete (f_c') to be used in computing the load-carrying capacity shall be the smaller of the actual compressive strength at the time of loading or the specified compressive strength of the concrete.

8.15.4 Traffic Loads

Traffic will not be permitted on concrete decks until at least 14 days after the last placement of deck concrete and until such concrete has attained its specified strength.

8.16 MEASUREMENT AND PAYMENT

8.16.1 Measurement

Except for concrete in components of the work for which payment is made under other bid items, all concrete for structures will be measured by either the cubic yard for each class of concrete included in the schedule of bid

Where prestressed components are used in conjunction with steel girders, the force effects from the following sources shall be considered as construction loads, *EL*:

- In conjunction with longitudinal prestressing of a precast deck prior to making the deck sections composite with the girders, the friction between the precast deck sections and the steel girders.
- When longitudinal post-tensioning is performed after the deck becomes composite with the girders, the additional forces induced in the steel girders and shear connectors.
- The effects of differential creep and shrinkage of the concrete.
- The Poisson effect.

The most common applications of prestressed concrete in steel girder bridges are transverse post-tensioning of the deck and integral pier caps in which the tendons penetrate the girder webs. When a composite deck is prestressed longitudinally, the shear connectors transfer force to the steel. The effect of shrinkage and long-term creep around the shear connectors should be evaluated to ensure that the composite girder is able to recognize the prestressing over the life of the bridge. The contribution of long-term deformations in closure pours between precast deck panels which have been aged to reduce shrinkage and creep may need evaluation.

The Poisson effect recognizes the bulging of concrete when subjected to prestressing. When used in pier caps, post-tensioning causes a transverse Poisson tensile stress resulting in a longitudinal stress in the steel girders.

The load factor for live load in Extreme Event Load Combination I, γ_{EQ}, shall be determined on a project-specific basis.

Past editions of the Standard Specifications used $\gamma_{EQ} = 0.0$. This issue is not resolved. The possibility of partial live load, i.e., $\gamma_{EQ} < 1.0$, with earthquakes should be considered. Application of Turkstra's rule for combining uncorrelated loads indicates that $\gamma_{EQ} = 0.50$ is reasonable for a wide range of values of average daily truck traffic (ADTT).

A load factor for passive lateral earth pressure is not given in Table 2 because, strictly speaking, passive lateral earth pressure is a resistance and not a load. For discussion of the selection of a passive lateral earth pressure resistance factor see Article 10.5.5.2.2.

3.4.2 Load Factors for Construction Loads

3.4.2.1 Evaluation at the Strength Limit State

All appropriate strength load combinations in Table 3.4.1-1, modified as specified herein, shall be investigated.

When investigating Strength Load Combinations I, III, and V during construction, load factors for the weight of the structure and appurtenances, *DC* and *DW*, shall not be taken to be less than 1.25.

Unless otherwise specified by the Owner, the load factor for construction loads and for any associated dynamic effects shall not be less than 1.5 in Strength Load Combination I. The load factor for wind in Strength Load Combination III shall not be less than 1.25.

C3.4.2.1

The load factors presented here should not relieve the contractor of responsibility for safety and damage control during construction.

Construction loads are permanent loads and other loads that act on the structure only during construction. Construction loads include the weight of equipment such as deck finishing machines or loads applied to the structure through falsework or other temporary supports. Often the construction loads are not accurately known at design time; however, the magnitude and location of these loads considered in the design should be noted on the contract documents.

ϕ_f = angle of internal friction (°) (3.11.5.4)
ϕ'_f = effective angle of internal friction (°) (3.11.5.2)
ϕ_r = internal friction angle of reinforced fill (°) (3.11.6.3)
ϕ'_s = angle of internal friction of retained soil (°) (3.11.5.6)

3.3.2 Load and Load Designation

The following permanent and transient loads and forces shall be considered:

- Permanent Loads

DD = downdrag
DC = dead load of structural components and nonstructural attachments
DW = dead load of wearing surfaces and utilities
EH = horizontal earth pressure load
EL = accumulated locked-in force effects resulting from the construction process, including the secondary forces from post-tensioning
ES = earth surcharge load
EV = vertical pressure from dead load of earth fill

- Transient Loads

BR = vehicular braking force
CE = vehicular centrifugal force
CR = creep
CT = vehicular collision force
CV = vessel collision force
EQ = earthquake
FR = friction
IC = ice load
IM = vehicular dynamic load allowance
LL = vehicular live load
LS = live load surcharge
PL = pedestrian live load
SE = settlement
SH = shrinkage
TG = temperature gradient
TU = uniform temperature
WA = water load and stream pressure
WL = wind on live load
WS = wind load on structure

3.4 LOAD FACTORS AND COMBINATIONS

3.4.1 Load Factors and Load Combinations

The total factored force effect shall be taken as:

$$Q = \sum \eta_i \gamma_i Q_i \qquad (3.4.1\text{-}1)$$

C3.4.1

The background for the load factors specified herein, and the resistance factors specified in other sections of these Specifications is developed in Nowak (*1992*).