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Is it Time to Stop Using the Term HS20 for Traffic Loads?

By Ronald Thornton, PE

Delta has received a number of questions lately related to the application of LRFD to various precast products such as manholes and vaults that are traditionally designed for HS20 or HS25 loading under the AASHTO Standard Specification. In order to address this issue, let's first look at a little background related to AASHTO design vehicles.

What we all commonly refer to as H20 or HS20 loading was first developed by AASHTO (previously AASHO) in 1944 (thus the term HS20-44) as a standard vehicle definition for the design of bridges. The design method used for bridge design up until the early 1970's was the Working Stress (WSD) Method otherwise known as the Allowable Stress (ASD) method.

Load Factor Design (LFD) was introduced into the AASHTO Standard around 1970 in order to better recognize variations in load combinations due to dead, live, wind, ice flow, etc. Both methods (ASD and LFD) are still contained in the current AASHTO Standard Specification and both may still be used.

As underground precast structures such as utility manholes and vaults became prevalent, standards needed to be developed by which to design them. Although such structures are clearly not bridges, it was recognized that many of these units are located in areas subject to traffic and, therefore, it was convenient to refer to the AASHTO bridge standard for HS20 loading. ASTM C890 and C857 were developed in order to define how design loads should be applied. However, ASTM uses the designation A-16 when referring to an HS20 load. Also, the design method referred to in the corresponding ASTM product specifications C913 and C858 is ACI-318 and not AASHTO. This is significant because, in the old days, there was very little difference between ACI 318 and AASHTO with respect to concrete design methodology. Serviceability criteria such as for crack control, service load stress, and ductility were pretty much aligned and either method would yield pretty much the same result in terms of member thickness and reinforcing.

In recent years however, the two standards have been moving in markedly different directions. Among other changes, ACI has adopted new methods for controlling the distribution of flexural reinforcing and has revised its criteria for computing rebar development lengths. AASHTO, on the other hand, has been concentrating its efforts in the development of the LRFD (Load and Resistance Factor Design) Specification. LRFD is intended to provide a more uniform and consistent level for bridge safety under a wide variety of load and resistance models and is based on the statistical reliability of any structural element exceeding a given limit state.

If all of this sounds complicated, believe me it is. The LRFD Specification is about 3 times thicker than the AASHTO Standard; yet there is not one mention in the entire specification of underground precast utility or wastewater structures. In fact, the term HS20 no longer exists in the LRFD code. The new design load according to LRFD is called HL-93, which has the same axle load and spacing as HS20 but is not considered an actual "vehicle". This is because lane loads are entered into the mix as part of the overall HL-93 design load.

The LRFD concept makes a lot of sense when one considers the vast number of components, construction methods, and load combinations related to bridges. But, as I previously mentioned, precast vaults and manholes are not bridges and it is no longer convenient to simply apply the new AASHTO standards to these types of structures, particularly since we know that the serviceability of precast underground structures over the years has been unquestionably good. Therefore, we would encourage the phasing out of HS20 as a specified design load and replace it with the ASTM designation A-16 (A-12 or A-8 if appropriate) and design the members in accordance with ACI-318 as specified in ASTM C913 and C858.

It should be noted that precast box culverts and retaining walls related to culverts and bridges are covered in the LRFD code and producers who make these products will eventually have to struggle with the LRFD code provisions if they aren't already. At Delta Engineers we are committed to remaining current with all of the code requirements related to precast products and to working with the industry through NPCA, ASTM, as well as our precast clients to develop the best approach for dealing with them.

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The Delta Advantage

Editor: Ronald E. Thornton, PE
rthornton@deltaengineers.com
Tel: 607-231-6612



184 Court Street
Binghamton, NY 13901-3515
Tel: 607.231.6600
Fax: 607.231.6650
www.deltaengineers.com

Featured Project

Project Name: Smithtown Road Box Culvert

Owner: Metropolitan Council Environmental Services, St. Paul, MN

Produced by: Royal Concrete Pipe, Stacy, MN

Structural Design and Shop Drawings by: Delta Engineers



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This project consisted of a double barrel 10' x 5' box culvert. The cast-in-place head-walls were tied together with cables stretching across the road. Note the critter shelf cast onto each exterior wall. We are still a little unsure as to how the critters actually get onto the shelf but apparently the design satisfied the environmental concerns of the project.



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Binghamton, NY 13901-3515