

**WABO/SEAW
Liaison Committee**

Washington Association of
Building Officials &
Structural Engineers Association
of Washington

WHITE PAPER 11-2014

**Designing for Heavy Vehicle Loads on underground vaults,
bridges, buildings and structures**

Date: March 12, 2015

Abstract:

This white paper establishes guidelines for building officials, design professionals, contractors and building owners related to appropriate design live loads for underground and elevated structures subject to heavy vehicles and/or outrigger loads.

Buildings and structures built on the public right of way are exempt from having to get building permits and therefore are not included in the scope of this white paper. This white paper is not intended to apply to small underground structures such as a 4' square catch basin.

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Committee Mission Statement:

- *Improve communications between the public jurisdictions that administer building codes and the engineering design community that prepares construction documents.*
- *Improve consistency and quality of engineering submittals and project reviews.*
- *Build consensus between the engineering design community and building officials with regard to code interpretation and submittal requirements.*

I. INTRODUCTION:

Many communities have elevated plaza decks, bridges or various types of underground structures which may be subjected to heavy loads from vehicles such as fire trucks (including their outriggers), emergency vehicles, cranes, cement mixer trucks, etc. Buildings or structures which may be subjected to heavy vehicle surcharges must be designed to accommodate the worst case anticipated load. Examples of buildings or structures which may be subject to heavy vehicle loads include retaining walls, underground vaults (utility or storm water), elevated parking decks, and buildings with unrestricted access for vehicles exceeding 10,000-pound gross vehicle weight. These structures must be designed for the anticipated vehicle live loads.

Building and Fire Department review staff are often asked by structural engineers if additional loads are required to be included in the design of such structures within their jurisdiction. This white paper will provide guidelines and advice to determine when it is appropriate to include these loads and how to determine appropriate design loads depending on the location and type of structure being designed. The "anticipated vehicle live loads" indicated in IBC Section 1607.7 may vary from those specified in ASCE

7 depending on the location and use of the structure to be loaded. Design professionals should check both codes for applicability.

II. Applicability

The first question design professionals and building officials should ask is will heavy vehicles be able to drive over and set up on the structure.

Some examples of where heavy vehicle load design is required include:

- An elevated commercial parking deck
- Underground storm detention vaults or similar structures located in a parking lot adjacent to buildings. Smaller vaults and catch basins (typically those with less than a 4' span) would not usually be included in this category.
- Private vehicular bridges.
- Drive routes located on the upper level adjacent to a retaining wall.

Fire truck outrigger concentrated loads:

- The jurisdictional Fire Code Reviewer or Building Plans Examiner will typically determine if an underground vault or elevated plaza must be designed to accommodate outrigger loads. The decision is based on the likelihood of a fire department ladder truck driving over or setting up in the location of the underground structure or elevated plaza. Building and fire officials should collaborate to determine worst-case loads based on the weight exerted from outriggers of jurisdictional fire suppression vehicles as well as those in neighboring jurisdictions who may provide mutual aid.
- The depth of earth or other material located over an underground structure should be considered in the design of the structure. The greater the distance between the driving surface and the top of the underground structure the more the load will be distributed over a wider area of the lid of the structure thereby reducing the concentrated loading.
- Outrigger loads would not typically apply to bridge design as there is a very low likelihood that a ladder truck would ever use a bridge to set up for a rescue or lift a heavy load from a bridge. However, heavy vehicle loads would still apply.

Design professionals should contact the building official or fire marshal in the applicable jurisdiction to inquire about uniform and concentrated live loads for their project design.

III. RECOMMENDATIONS AND GUIDELINES

Design professionals should review and apply the provisions of IBC Section 1607.7 and ASCE 7, Table 4-1 truck loading (250 PSF for the areas subjected to the weight of the heavy vehicles) for all structures intended to support heavy vehicle loads in excess of 10,000 pounds GVW (see IBC Section 1607.7.1) or the actual vehicle weights as permitted in the exception to IBC Section 1607.7.3. Building or Fire Code Officials are responsible to determine the appropriate design loads for heavy vehicles and outrigger loads. Consulting fire truck manufacturer's providing vehicles to the jurisdiction and their mutual aid partners is suggested to determine vehicle loads

and outrigger loads. Operationally there may be a need for posting weight limits not exceeding the applicable design loads.

Design professionals should consider impact and fatigue but in most cases neither of these will be a factor in the design.

Per footnote “m” of IBC Table 1607.1, live load reductions are not permitted unless specifically accepted in Section 1607.10.

Underground vaults and elevated plaza decks located such that fire trucks have the potential to set up outriggers on them should comply with concentrated outrigger loading, as determined by the local building official or fire marshal. Prior to starting the structural design, engineers should confirm with the building and/or fire departments if there is a requirement for special loading criteria. It is not necessary to apply the distributed load and concentrated loads simultaneously.

IV. Commentary

2012 Code Change Significance *(Copied from the Significant Changes to the IBC 2012 Edition)*

“Structures intended to support heavy vehicle loads in excess of 10,000 pounds GVW must be designed in accordance with the same specifications required by the jurisdiction for the design of roadways and bridges. The new requirements specifically apply to fire truck and emergency vehicles, heavy vehicle parking garages, forklifts, and movable equipment. The owner is required to post the maximum weight of the vehicles allowed in a garage or other structure in accordance with Section 106.1.”

V. Appendix/Additional information

Reference documents, code citations, examples

Code References

2012 IBC, Sections:

- 1607.7 Heavy Vehicle Loads
- 1607.7.1 Loads
- 1607.7.2 Fire Truck and Emergency Vehicles
- 1607.7.3 Heavy Vehicle Garages
- 1607.7.4 Forklifts and Movable Equipment
- 1607.7.4.1 Impact and Fatigue
- 1607.7.5 Posting
- Table 1607.1 Uniform and Concentrated Live Loads including footnotes d, e, & m
- 1607.10 Reduction in Uniform Live Loads

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2012 IFC Section:

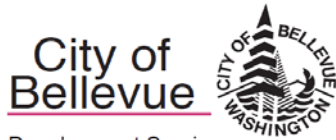
- 503.2.6 Bridges and Elevated Surfaces

ASCE 7-10:

- Table 4-1 including footnotes a, p & q.

AASHTO Standards:

- HS-20
- HS-25
- HL-93



Vehicle, Fire Truck, and Apparatus Loading

Development Services
Handout **B-1**

January 2010

Introduction

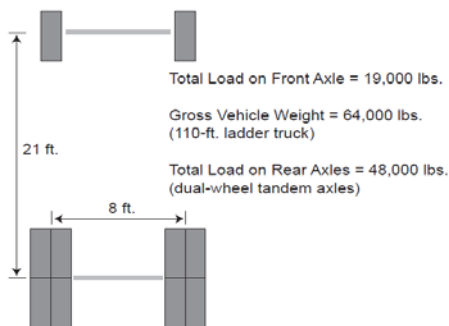
The information in this brochure describes the City of Bellevue's requirements for the structural design of a condition that may occur with underground parking facilities or flood control structures.

Concrete slabs or utility vault lids that are subject to fire truck or semi-trailer loading must be designed for additional loading as prescribed below. This may also include the condition of a fire truck setting down stabilizer outriggers to extend a ladder. The project design team should first contact the Bellevue Fire Department at 425-452-4122 to determine whether the required fire truck access area may be restricted and whether the outrigger load is applicable.

Design Loading

Such a concrete slab must be designed for the following live loads.

- HS20 loading required under the latest edition of the American Association of State Highway and Transportation Officials (AASHTO) publication entitled "Standard Specifications for Highway Bridges"
- Fire truck wheel and axle loads as indicated:



- Point load of 45,000 lbs. due to the maximum reaction which may occur at a stabilizer outrigger. This load must be applied on an 18x18-inch area (2.25 sf) and also applied as an unfactored load on a 10x14-inch area (1.0 sf).

The live load conditions given above are to be applied independent of each other, but in combination with other loads as required by AASHTO and the IBC. Each load must be increased by any factors required by AASHTO or the IBC unless specifically excepted.

For More Information

Please contact a building plans examiner with the Bellevue Building Division at 425-452-4121 or BuildingReview@bellevuewa.gov for additional design information.

This document is intended to provide guidance in applying certain regulations and is for informational use only. It cannot be used as a substitute for the Construction Codes or for other city codes. Additional information is available from Development Services at Bellevue City Hall or on the city website at www.bellevuewa.gov. Assistance for the hearing impaired: dial 711.

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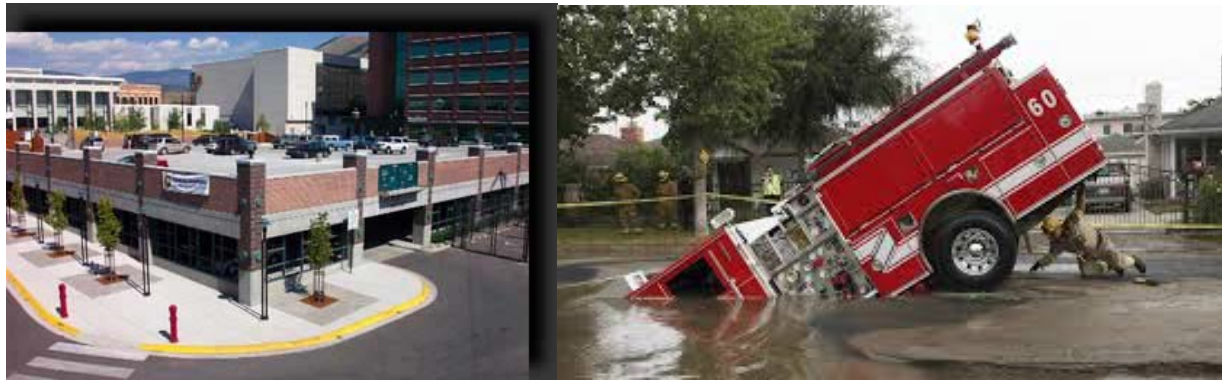
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Death Wish

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Moscow Subway

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