

Universal Structural Engineers, LLC



November 17, 2021

Adlin Netto & Isadore Netto
Agape Daycare Center
3700 Thomas Road Suite 107
Santa Clara, CA 95054

Re: Vehicular Impact Loading and Barrier Design
USE Job Number: 2021194
Project Location: 3700 Thomas Road, Santa Clara, CA

Dear Mr. and Mrs. Netto,

Per your concern of building traffic barrier for the proposed outdoor play area for the Daycare center, we have reviewed the drawings AS1.1 and AS1.4 provided by K+Designs dated 09/28/2021. Please see the following of our evaluation:

Site evaluation

The proposed play area is located at the North-East corner of 3700 Thomas Road. The location is approximate 20 feet off from the curb at both Montague Expressway and Thomas Road. The proposed play area was a drive-in access of the auto repair shop. The tenant space in Suite 107 was subsequently occupied by a child learning center (Tulip Kids) and modified to replace the service bay with windows while retaining the service aisle to the building. The use of the tenant space did not include outdoor activities and ceased operations in March 2020. Thomas Road is a two-way single lane road, the traffic speed limit of 25 mph. Montague Expressway (aka. County Hwy G4) is a major traffic route with traffic speed limit of 45 mph.

Documentation of Findings

Per California Building Code (CBC) 2019 section 1607.9 and ASCE 7-16 Section 4.5.3, “*vehicle barrier systems for passenger vehicles shall be designed to resist a single load of 6,000 lb applied horizontally in any direction to the barrier system and shall have anchorages or attachments capable of transferring this load to the structure. For design of the system, the load shall be assumed to act at heights between 1 ft 6 in. and 2 ft 3 in. above the floor or ramp surface, located to produce the maximum load effects. The load shall be applied on an area not to exceed 12 in. by 12 in. This load is not required to act concurrently with any handrail or guardrail system loadings specified in Section 4.5.1. Vehicle barrier systems in garages accommodating trucks and buses shall be designed in accordance with AASHTO LRFD Bridge Design Specifications.*”

Vehicle barrier design could also follow American Association of State Highway and Transportation Officials (AASHTO) Bridge Design Specifications, Ninth Edition, 2020 and AASHTO Roadside Design

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Guide, Fourth Edition, 2011. In AASHTO Bridge design specifications table 13.7.2-1 (see Reference 1), test levels (TL) are shown. Based on speed limit of Montague Expressway (45 mph), proposed barrier design should follow TL-2. Because of Montague Expressway is also a major truck route, test level could range up to TL-4 (Van Truck) to TL-5 (Semi Truck). Local jurisdiction should specify test level for vehicle barrier design. In AASHTO Roadside Design Guild table 5-3 (see Reference 2), approved barrier type as shown for different test levels. Proposed masonry wall could be used up to TL-3 condition. TL-3 testing criteria is a pick-up truck (5000 lbs.) driving under 60 mph and crash into the barrier in an angle of 25 degree. See Reference 3 for TL-3 masonry wall barrier on Hwy 101. If local jurisdiction has specified TL-4 or TL-5 is required, the proposed masonry wall could build on top of the high rated traffic barrier such as F-Shape or Vertical Concrete Barrier. See Reference 4 for TL-5 barrier on Hwy 101.

Conclusions

Depends on the local jurisdiction specified design method and test level, the proposed masonry wall design may vary. The proposed 6 feet tall masonry wall will meet the requirement of traffic barrier per CBC2019 or AASHTO standard. Structural design details (for example, foundation design, steel reinforcement design, and additional structural component if required, etc.) and supporting calculations will be provided in construction documents and will be submitted for permitting purpose.

Limitations

This evaluation report was prepared upon your request for our services, using that degree of skill and care ordinarily exercised. No other warranty, expressed or implied, is made as to the professional content of this report.

Sincerely,

ZhiMin Hu
Engineer

Kevin O'Keefe
President, S.E.

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Table 13.7.2-1—Bridge Railing Test Levels and Crash Test Criteria

	Vehicle Characteristics	Small Automobiles		Pickup Truck	Single-Unit Van Truck	Van-Type Tractor-Trailer		Tractor-Tanker Trailer
NCHRP Report 350	<i>W</i> (kips)	1.55	1.8	4.5	18.0	50.0	80.0	80.0
	<i>B</i> (ft)	5.5	5.5	6.5	7.5	8.0	8.0	8.0
	<i>G</i> (in.)	22	22	27	49	64	73	81
	Crash angle, θ	20°	20°	25°	15°	15°	15°	15°
	Test Level	Test Speeds (mph)						
	TL-1	30	30	30	N/A	N/A	N/A	N/A
	TL-2	45	45	45	N/A	N/A	N/A	N/A
	TL-3	60	60	60	N/A	N/A	N/A	N/A
	TL-4	60	60	60	50	N/A	N/A	N/A
	TL-5	60	60	60	N/A	N/A	50	N/A
	TL-6	60	60	60	N/A	N/A	N/A	50
AASHTO MASH	<i>W</i> (kips)	2.42	3.3	5.0	22.0	N/A	79.3	79.3
	<i>B</i> (ft.)	5.5	5.5	6.5	7.5	N/A	8.0	8.0
	<i>G</i> (in.)	N/A	N/A	28	63	N/A	73	81
	Crash angle, θ	25°	N/A	25°	15°	N/A	15°	15°
	Test Level	Test Speeds (mph)						
	TL-1	30	N/A	30	N/A	N/A	N/A	N/A
	TL-2	45	N/A	45	N/A	N/A	N/A	N/A
	TL-3	60	N/A	60	N/A	N/A	N/A	N/A
	TL-4	60	N/A	60	55	N/A	N/A	N/A
	TL-5	60	N/A	60	N/A	N/A	50	N/A
	TL-6	60	N/A	60	N/A	N/A	N/A	50

Reference 1. Table 13.7.2-1 from AASHTO Bridge Design Specification, 9th Ed.



Table 5-3. Roadside Barriers and NCHRP Report 350 Approved Test Levels

System	Test Level	FHWA Acceptance Letter	System Designation	Reference Section
FLEXIBLE SYSTEMS				
W-Beam (Weak Post)	2	B-64	SGR02	5.4.1.3
Three-Strand Cable (Weak Post)	3	B-64	SGR01a and b	5.4.1.1
High-Tension Cable Barriers	3 and 4	Various	Various	5.4.1.2
Modified W-Beam (Weak Post)	3	B-64	SGR02	5.4.1.3
Ironwood Aesthetic Barrier	3	B-56, 56-A, and 56-B		5.4.1.4
SEMI-RIGID SYSTEMS				
Steel Post with Steel Blockout	2	B-64	SGR04a	5.4.1.6
Box Beam (Weak Post)	3	B-64	SGR03	5.4.1.5
Steel or Wood Post with Wood or Plastic Blockout	3	B-64	SGR04a and b	5.4.1.6
NU-GUARD by Nucor Marion	3	B-162		5.4.1.8
Trinity T-31 and Trinity Guardrail System	3	B-140		5.4.1.8
Gregory (GMS)	3	B-150		5.4.1.8
Midwest Guardrail System (MGS)	3	B-133		5.4.1.7
Blocked-out Thrie-Beam (Strong Post)	3	B-64	SGR09c SGR09a	5.4.1.9.1
Merritt Parkway Aesthetic Guardrail	3	B-38		5.4.1.10
Steel-Backed Timber Guardrail	2 and 3	B-64-D		5.4.1.11
Modified Thrie-Beam (Strong Post)	4	B-64	SGR09b	5.4.1.9.2
Trinity T-39 Non-Blocked-Out Thrie Beam	4	B-148		5.4.1.9.3
RIGID SYSTEMS (Concrete and Masonry)				
Stone Masonry Wall/Precast Masonry Wall	3	B-64-D		5.4.1.14
New Jersey Safety-Shape Barrier				5.4.1.12
<ul style="list-style-type: none"> • 810 mm [32 in.] tall • 1070 mm [42 in.] tall 	4	B-64	SGM11a	5.4.1.12
	5	B-64	SGM11b	5.4.1.12
F-Shape Barrier				5.4.1.12
<ul style="list-style-type: none"> • 810 mm [32 in.] • 1070 mm [42 in.] 	4	B-64	SGM10a	5.4.1.12
	5	B-64	SGM10b	5.4.1.12
Vertical Concrete Barrier				5.4.1.12
<ul style="list-style-type: none"> • 810 mm [32 in.] • 1070 mm [42 in.] 	4	B-64		5.4.1.12
	5	B-64		5.4.1.12
Single Slope Barrier				5.4.1.12
<ul style="list-style-type: none"> • 810 mm [32 in.] • 1070 mm [42 in.] 	4	B-17, B-45		5.4.1.12
	5	Note 1		5.4.1.12
Ontario Tall Wall Median Barrier	5	B-19	SGM12	5.4.1.12

Note 1: The Single Slope Barriers were not tested to the TL-5 level but may be considered TL-5 barriers when cast in place or slip-formed if the dimensions, reinforcing, and foundation details are equivalent to designs that have been tested. See FHWA Acceptance Letter B-64.

Reference 2. Table 5-3 from AASHTO Roadside Design Guide, 4th Ed.

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Google Maps TL-3 Masonry Barrier Wall at Hwy 101



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Image capture: Apr 2015 © 2021 Google

Google

Reference 3. TL-3 Barrier on Hwy 101

Google Maps TL-5 Vehicle Barrier with Masonry Wall on top



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Reference 4. TL-5 Barrier with Masonry Wall Above