



Date: April 18, 2024

**SUB: CITY OF PALO ALTO PARKLET FORCE PROTECTION MEMORANDUM
PALO ALTO, CALIFORNIA**

The following memorandum provides supplemental information to the Parklet Force Protection Memorandum provided by Siegfried dated August 1, 2023.

As described in Siegfried's analysis, Planters are usually 18" to 24" wide and length may vary between 8ft to 10ft filled with soil. Although these planters are heavy due to presence of soil in it but that is not enough to resist the 6000 lb force requirement for qualifying as a barrier. Therefore, planters wouldn't qualify as a traffic barrier.

The Siegfried analysis also states that the way a planter is constructed is an important consideration, as some materials could shatter and result in flying debris if impacted. To add to this analysis, REI recommends that the use of flexible material would be the safest option for the planter considering that it won't shatter and cause any hazards for the parklet occupants and minimize the damage. Some of the additional reasons are listed below:

- Durability: Flexible materials are generally more durable than brittle ones. They are capable of withstanding minor impacts and deformation without fracturing or shattering.
- Adaptability: Flexible materials offer more creative and custom designs to suit specific aesthetic or requirements due to their greater adaptability in design.

Specifically, REI recommends the following material types be used for planters in conjunction with parklets:

1. Wood
2. Steel
3. Cold form Steel
4. Plastic
5. Fiberglass

August 1, 2023

Holly Boyd, P.E.
Assistant Director
Public Works Department
City of Palo Alto

**RE: CITY OF PALO ALTO PARKLET FORCE PROTECTION MEMORANDUM
PALO ALTO, CALIFORNIA**

I. PROJECT DESCRIPTION AND ASSUMPTIONS

The City of Palo Alto (City) is transitioning the temporary parklet program to a permanent parklet program. To make this transition, the City's goal is to provide guidelines for the construction of improvements to provide a safe parklet experience. The inherent risk to parklets and their occupants is the danger posed by adjacent vehicular traffic. Various solutions have been deployed in other jurisdictions ranging from pedestrian guardrails to permanent or detached highway type barriers. The following is a summary of our review of these options and our findings.

II. BACKGROUND

In conducting our investigation, we reviewed a sample of other Parklet Guidelines and Standards from other jurisdictions and organizations in California. In our limited review of this literature, we found the following design features to be fairly consistent;

- a. A vehicular speed limit of 25 mph as the roads are typically narrow and have low posted speed limits.
- b. A minimum of one foot between the edge of traveled way and any barrier.
- c. Barrier heights ranging from 32 to 48 inches in height.
- d. Barriers are required to be designed and approved by a professional engineer.
- e. Barriers were either guardrails, as defined by building codes, or in some cases planter boxes or similar structures used to create a physical separation between parklet occupants and vehicular traffic.
- f. The barriers were **not designed** as highway type traffic railings or crash barriers and appeared to act as a deterrent as opposed to a crash barrier.

The design requirements for barriers vary. The following is a summary of those prescribed by jurisdictional requirements.

A. Guards

Guards as prescribed by the California Building Code Section 1015 fall into two categories;

1. Guard railing to keep pedestrians from entering hazardous areas or conditions. Pedestrian guard rails are required to;
 - a. Be a minimum of 42 inches in height.
 - b. Not allow a sphere of 4" to pass through the guardrail. The intent of this provision is to prevent small children from passing through the guardrail.
 - c. Be designed to resist a lateral force of either 50 pounds per lineal foot or a concentrated load of 200 pounds applied at the top of the rail.

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2. Vehicle barriers used along the sides of parking garages more than one foot above adjacent grades not subject to bus or truck traffic. Vehicle barriers are required to resist a 6,000 pound load 18 to 27 inches above the pavement.

B. Traffic Railings

Traffic railings are generally barriers designed to prevent vehicles from going off the roadway. The requirements for traffic railings are specified in Caltrans and AASHTO (American Association of State Highway Transportation Officials) standards. These barriers are generally required to be tested at various speeds and approved by governing agencies. Some of the approved railings available for use in parklets may include the following Caltrans standards, however they may not meet the aesthetic goals of the parklet program and will require more area;

1. Type K Temporary Railing (Plan T3A and T3B). Type K Rails are 32 inches in height. Though the title of the plan is “Temporary”, it does provide for long term use if pinned to the pavement as described in plan T3B.
2. Concrete Barrier Type 60M (Plan A76A). This is an unanchored barrier and is 42 inches in height.

Caltrans Standards include many other types of barriers such as metal beam guard rails and crash cushions. In addition, Caltrans approves the use of some proprietary pre-manufactured barriers.

III. FINDINGS

In addition to the barriers described above, we considered the possible use of other barriers such as planters or bollards. The following represents our findings for all barriers investigated;

1. Type K Railing
As previously described, Type K railing meets Caltrans requirements for a traffic barrier, however;
 - a. At only 32 inches in height, the railing does not meet the height limit of a 42 inch tall guard rail. Additional railing would need to be attached on top of the K rail to meet this requirement.
 - b. A K rail is intended to deflect the vehicle back into the roadway. This does not mean that it will not move. Any pedestrian or table abutting this barrier could still be affected by a vehicle impact. Type K railing anchored into a foundation could further restrict barrier movement, however, without a testing program, this system performance is unknown and cannot be verified.
 - c. The railing does not protect the pedestrian from flying vehicle debris that may be associated with a vehicle hitting the barrier.
2. Type 60M Railing
The comments for K Railing above also apply to Type 60M barriers except that the 60M barrier does meet the requirement for guard railing height.

Other Barriers Investigated

We reviewed other various types of barriers. Our analysis assumed the following;

- a. Factor of safety of 1.5 against sliding and overturning.
- b. Vehicle bumper height of 24 inches.
- c. Pavement coefficient of friction of 0.35.
- d. Soil passive force capacity of 200 pcf for foundations, 400 pcf for poles.

1. 500 Pound Water or Soil Filled Structure

A 500 pound, 18 inch wide, unanchored structure is only capable of resisting a 117 pound lateral force. This does not meet the requirement for a guard rail. This option is not recommended for use as a safety barrier.

2. Planter

A planter 42 inches tall by 18 inches wide by 10 feet long filled with soil (80 pcf) is capable of resisting a 490 lb lateral force. This assumes the vehicle hits near the end of the planter causing it to rotate. This meets the requirement of a guard rail but is not sufficient to serve as a traffic barrier. Another consideration is, depending on how the planter is constructed, flying debris from a broken planter may hit a parklet occupant creating an additional hazard. If the planter is constructed of structural concrete or masonry and is anchored to a foundation 48 inches wide by 18 inches deep the lateral force capacity increases to 2,540 pounds.

3. Bollards

Bollards typically consist of a concrete filled steel pipe embedded into a concrete foundation. Bollards are commonly used as a device to protect equipment in traffic areas or prevent vehicular access into restricted areas. A Bollard with a 24 inch diameter foundation 36 inches deep is capable of resisting a lateral force of 550 pounds. Bollards, with added horizontal railings, can meet the requirement of a guard rail but are not sufficient to serve as a traffic barrier.

IV. CONCLUSION

Each type of barrier described and investigated will provide varying levels of protection. Guard rails restrict the parklet occupant from entering the traveled way while traffic railings restrict vehicles from leaving the traveled way. A summary of each barrier's lateral force capacity is as follows:

1. Guardrails – 200 lbs. at 42 inch height, see the attached detail for minimum configuration and requirements.

Barriers with loads applied at 24 inch bumper height;

1. 500 lb. Object – 117 lbs.
2. Planter – Unanchored – 490 lbs.
3. Planter – Anchored – 2,450 lbs.
4. Bollard – 550 lbs.
5. Type K Railing – Capacity per test data.
6. Type 60M Railing – Capacity per test data.

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The values presented provide a degree of magnitude with respect to each barrier's capacity. However, none of the barriers investigated can guarantee a parklet occupant will not be harmed when a vehicle hits the barrier. We trust the information provided herein will assist you in assessing acceptable risk levels and help provide guidance in the development of your Parklet Design Standards.

If you have any questions regarding this proposal, please do not hesitate to call me directly.



Paul J. Schneider, QSD, QSP, P.E.
President | Managing Principal
SIEGFRIED



Attachments:

Typical Guard Rail Detail.pdf

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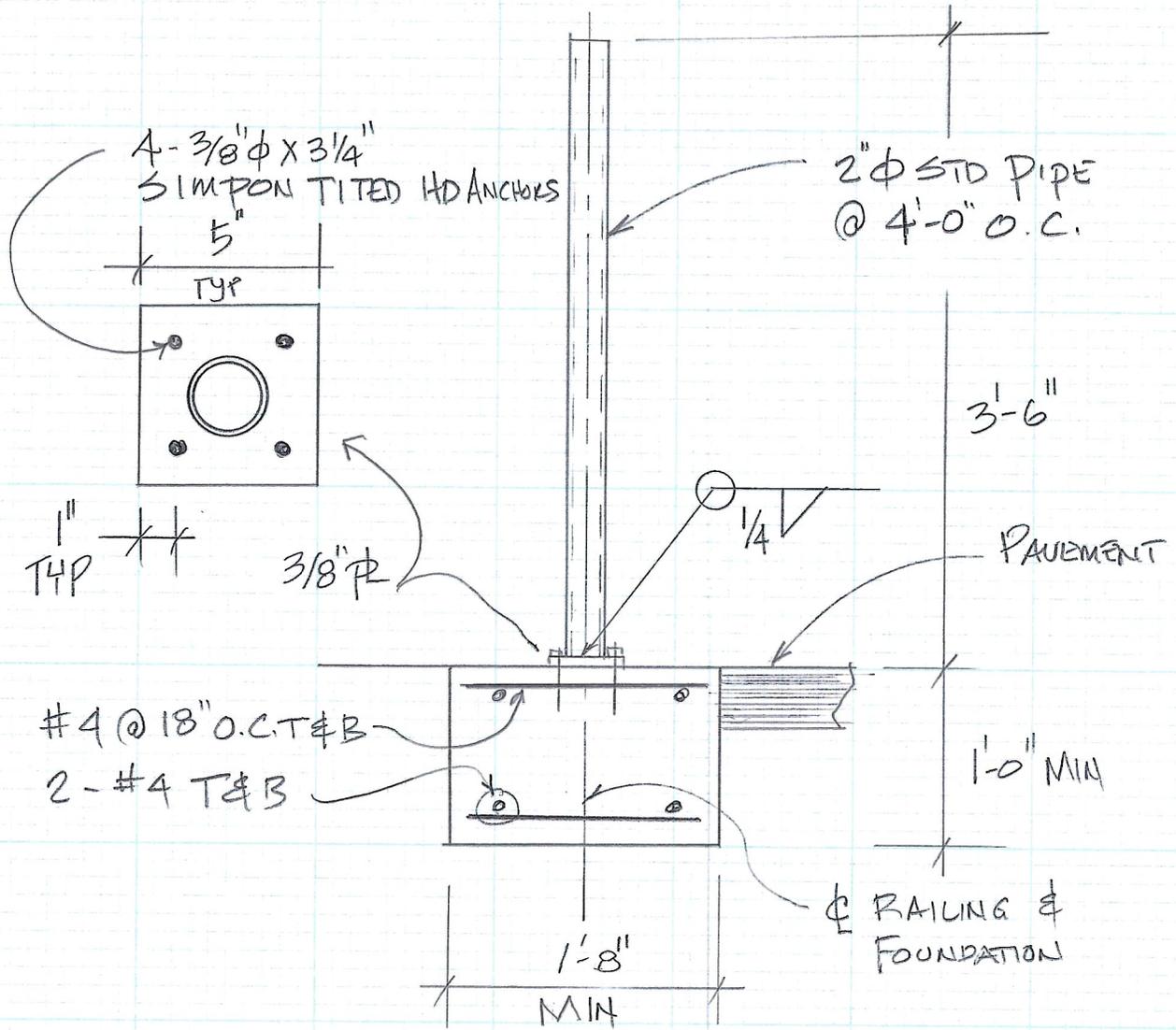
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DETAIL