# TABLE OF CONTENTS

## SUBJECT

### PART 1  TERMS AND DEFINITIONS
- Section 1  TERMS AND DEFINITIONS ......................................................... 2

### PART 2  GENERAL REQUIREMENTS
- Section 1  SCOPE .................................................................................. 4
- Section 2  STRUCTURAL DESIGN ............................................................. 8

### PART 3  PHYSICAL PROPERTIES AND CONDITIONS, STRUCTURAL STRENGTHS AND PERFORMANCE CHARACTERISTICS
- Section 1  GENERAL REQUIREMENTS ................................................... 22
- Section 2  HANDHOLES, PRECAST MAINTENANCE HOLES, AND SIMILAR STRUCTURES OR INSTALLATIONS .................................................. 24
- Section 3  COVERS AND FRAMES AND SIMILAR INSTALLATIONS ........... 30
- Section 4  TEMPORARY TRENCH PLATES, TREE WELL COVERINGS, VENT GRATES, AND SIMILAR INSTALLATIONS ................................. 32
- Section 5  DETECTABLE WARNING SURFACE ....................................... 35
- Section 6  BRICK, CONCRETE OR OTHER DECORATIVE PAVERS .......... 43
PART 1
TERMS AND DEFINITIONS

SECTION 1
TERMS AND DEFINITIONS

1-1.1 Terms.

In this standard plan and other referenced standards:

(a) Unless otherwise stated, the words, “directed,” “required,” “permitted,” “ordered,” “instructed,” “designated,” “considered necessary,” “prescribed,” “approved,” “acceptable,” “satisfactory,” or words of like meaning, refer to, expressions, and prerogatives of the City.

(b) The word “shall” is used to describe specific conditions. To clarify the meaning intended by this word “shall”, the following definitions apply:

**Shall:** A mandatory condition. Where certain requirements are described with the “shall” stipulation, the requirements are mandatory. The City Engineer can approve exceptions to these conditions on a case by case bases.

(c) “Standard Plans” shall mean the City of Los Angeles, Department of Public Works, Bureau of Engineering standard plans and applicable American Public Works Association’s Standard Plans For Public Works Construction (SPPWC) adopted by the City.

1-1.2 Definitions.

In this standard plan and other referenced standards:

(a) **APPLICANT** - See Permittee.

(b) **BASE** - The lowest section with floor or slab for closing the bottom opening of a handhole. Base shall be designed for the bearing pressure.

(c) **PERMIT ENGINEER** - Representative of the City Engineer who enforces the municipal code requirements as described herein by issuing various types of construction and Product Approval permits.

(d) **BOX** - Main section or the upper section of handhole consisting of vertical walls supporting the top slab when multiple sections are used. Other sections that are added to the center of the handhole are referred as extensions.

(e) **CONTRACTOR** - The individual, partnership, corporation, joint venture, or other legal entity having a contract or permit with the City that allows them to perform work
in the public right of way. The Contractor may perform work for an individual permittee.

(f) **COVER AND FRAME** - Cover and its supporting frame (also referred to as "ring") are used to close an access or top opening to the box or maintenance hole.

(g) **EXTENSION** - Intermediate or center section that may be used to increase depth of a handhole.

(h) **HANDHOLE** - Complete box and frame and cover, extension and base if provided, used at grade level and/or below-grade. Includes pull boxes, enclosure, vaults and similar installations.

(i) **MAINTENANCE HOLE** - Precast structure that typically consists of frame and cover that may be set in a concrete curb or collar, grade (adjustment) rings, cone or taper top section (or sometimes referred as “vault neck”), riser sections; and to provide access from existing pavement to below-grade handhole or structure.

(j) **MANUFACTURER** - The individual, partnership, corporation, joint venture, or their legal entity that manufactures the product and material in a plant.

(k) **PAVER** - Any stone, brick or tile unit suitable for sidewalk surfaces, and driveway if permitted by City Engineer.

(l) **PERMANENT DEFLECTION** - The difference between the deflection at the start of proof loading testing (after preload) and the end of testing (at end of 10 cycles).

(m) **PERMITTEE** - A permit applicant who can be a person, a contractor, local utility company or a manufacturer seeking the approval of the testing and analysis by the City of Los Angeles, Department of Public Works (DPW) of any material, product, service, process or technology used in construction of curb, sidewalk, gutter, driveway, approach, roadway surface, pavement, sanitary sewer, sewer work, storm drain, culvert, stairway, retaining wall or any similar structure over the City’s right of way in accordance with Los Angeles Municipal Code Sections 62.105 and 62.105.6.

(n) **PULL BOX** - A non-person entry handhole commonly used in conjunction with street light and traffic signal systems, water meters, irrigation controls and valves within the pedestrian way. See Handhole.

(o) **TOP SLAB** - The upper horizontal portion of the box.

(p) **TREE WELL COVERING** - The cover or grate that is placed over a tree well with or without frame.

(q) **ZERO LOAD DEFLECTION READINGS** - The difference between the deflection readings before preload and after preload.

(r) **VAULT** - A person-entry handhole. Also see Handhole.
2-1.1 General.

This standard plan covers the design criteria, the testing and the approval requirements for the materials and products placed in the public right-of-way. The testing and approvals are required by Los Angeles City Municipal Code Section 62.105 and the testing and approval responsibilities have been delegated to the City Engineer under Section 62.105.6 of the code. Many of the testing and approvals are also required by the Greenbook and its supplements, and the Brown Book used as the specifications for the works constructed in the public right-of-way. The materials and products approved under this standard plan shall be utilized in all Bureau of Engineering (BOE) projects. (Note: Any installation over the below-grade building or basement located under the sidewalk area or the public right of way shall also conform with the building code requirements and shall be approved by Los Angeles City Department of Building and Safety.)

(a) Portions of this standard plan were extracted from the Western Underground Committee’s “Recommended Guide No. 3.6, Non-concrete Handholes.” References shall also be made to ANSI/SCTE 77 2007 Specification for Underground Enclosure Integrity, Standard Specifications for Highway Bridges (17th Edition) of American Association of State Highway and Transportation Officials (AASHTO), and Bureau of Engineering (BOE) Structural Design Manual Part H. It shall be the permittee’s responsibilities that the materials and products are also in conformance with other applicable standards or code requirements.

(b) The brick, concrete or other decorative pavers and their requirements specified herein or as listed in the Citywide-Use approval lists do not intend to replace the standard concrete sidewalk pavement as required in the City of Los Angeles or to replace the existing standard installation details or other standard plan requirements for concrete sidewalk. The brick, concrete or other decorative pavers shall not be allowed in existing improved local street or residential area. The brick, concrete or other decorative pavers may be allowed in non-local street or commercial area or new driveway apron in unimproved local street or residential area at the discretion of the
City Engineer. The information provided herein shall be used as reference information only and as a guide to review the materials and products submitted in accordance with the municipal code. All materials and products must be reviewed, tested and approved by the City Engineer and other applicable governing City departments.

2-1.2 Types of Approvals and Usages.

(a) The City grants the following types of approvals:
Approval for use at a specific location in conjunction with a specific project and a Citywide-Use approval that pre-approves and pre-qualifies the materials and products to be used at any location within the City if the project location meets the conditions of the approval, the applicable code, law and regulation. The permittee for the Citywide-Use approval must be the manufacturer or their authorized representative.

(b) Types of Usage. This standard plan includes materials and products for the following usages:
(1) Those suitable for installation in sidewalks, parkways, and other pedestrian traffic areas.
(2) Those suitable for installation in streets, alleys, driveways and other vehicular traffic areas.

(c) The final approvals of the use of the Citywide-Use approved materials and products to be installed under the required permits shall be made by BOE permit engineer and other applicable governing City departments. Uses of the approved materials or products shall not release the permittee of the responsibilities to provide design and/or obtain structural calculations to verify for their proper use under the project site conditions, to verify for the availabilities of the materials or products, and to obtain the approvals of the installations from the BOE permit engineer and other applicable City departments.

2-1.3 Types of Materials and Products.
The materials and products covered by this standard plan consist of the following:
(a) All handholes, precast maintenance holes and similar installations.
(b) Covers with or without frames. (It is noted that only covers and frames that conforms to the applicable standard plans can be used for City sewer or storm drain maintenance holes.)
(c) Trench plates, tree well coverings, vent grates and other similar installations.
(d) Detectable warning surface.
(e) Brick, concrete or other decorative pavers.

This standard plan does not include the testing requirements or the criteria for sanitary sewer or storm drain materials or products. Refer to Greenbook and Brown Book for the acceptance criteria for the sanitary sewer or storm drain products. (See http://eng.lacity.org/techdocs/product_material/Product_materials.htm.)

2-1.4 Approved Material and Product List(s).
The City Engineer will maintain and issue current list(s) of Citywide-Use approved handholes, covers and frames, tree well coverings, vent grates, trench plates, brick, concrete or other decorative pavers, and other similar installation. The list(s) will indicate the name of the manufacturer, the limits of the approved use, the material each product consists of, the manufacturer’s model number or other identifying designation, and the expiration date of the approval. The list(s) of approved products for Citywide-Use can be found on the Technical Document Center of the BOE website. (See http://eng.lacity.org/techdocs/products/index.cfm.)

2-1.4.1 Duration of Approvals.
The duration of approvals, from the date of the approval letter, for the materials and products included in this standard plan, are as follows:

<table>
<thead>
<tr>
<th>Type of Product</th>
<th>Duration of Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Handholes, precast maintenance holes, covers and frames, and similar structures or installations</td>
<td>2 years*</td>
</tr>
<tr>
<td>(b) Trench plates, tree well coverings and grates, catch basin gratings and similar installations</td>
<td>4 years</td>
</tr>
<tr>
<td>(c) Brick, concrete or other decorative pavers</td>
<td>4 years</td>
</tr>
<tr>
<td>(d) Detectable warning surface</td>
<td>4 years</td>
</tr>
<tr>
<td>(e) Other materials and products not included above</td>
<td>2 years</td>
</tr>
</tbody>
</table>

The manufacturer shall certify in writing to the City Engineer 60 days before the expiration date that no change of ownership or manufacturing plant has been made and the product is made of the same material and other approved components. If the manufacturer fails to provide the certification, the City Engineer will remove the product from the approved list and the approval shall be deemed to have expired. The City Engineer has the right to temporarily or permanently suspend any approval when the materials or the
products are discovered or detected with flaws or defects during manufacturing or
construction which may cause harm to the public. Any change of the governing code
requirements, referenced standards or any part of this standard plan that are affecting the
approval and testing requirements shall deem the existing approval has been obsolete and the
manufacturer shall be notified and to resubmit for new approval to the new requirements.

(* Maximum total duration of the approval with extensions is eight years provided there is no
change of the materials and product fabrication, governing code, referenced standards or any
part of this standard plan. The manufacturer shall provide written certification every two years
as described above. The manufacturer shall provide new submittals with material and product
information, fabrication and/or engineering drawings as described herein for review at the end
of eight years. The manufacturer shall provide additional testing as required by the City
Engineer when deemed necessary.)

2-1.5 Application and Approval Process.
The permittee shall submit a request for approval of the material or product for use in the
City’s public right of way and provide all necessary testing and/or structural calculations in
accordance with the Public Works Products Approval Procedures published in Technical
Document Center of the BOE website.
(See http://eng.lacity.org/techdocs/product_material/Product_materials.htm.)

In accordance with the published Public Works Products Approval Procedures, three main
processes are available for determining the acceptability of a material or product. They
consist of the following:
(a) Submission of laboratory test results that are performed at the City’s approved laboratory
with the testing analysis that demonstrates the material or product meets or exceeds the
strengths and the physical characteristics specified in this standard plan. (Note:
Handholes, precast maintenance holes and similar structures or installations that exceed 48
inches in any size shall be submitted with the structural calculations as described below in
lieu of the structural loading test. All covers and frames shall be performed with structural
loading tests with the exception as indicated in 2-2.3.1(b).)
(b) Submission of drawings and calculations that demonstrates the product meets or exceeds
the structural loadings specified in this standard plan. The drawings and calculations shall
be prepared by a Civil or a Structural Engineer licensed in the State of California.
(c) A combination of both submissions described above. In addition to the structural
drawings and calculations, other evaluation of the physical characteristics of the product
performed by laboratory tests may be required.

SECTION 2
STRUCTURAL DESIGN

2-2.1 General.
When the materials or products are placed in the public right of way or utilized in BOE projects are subjected to vehicular and/or pedestrian loadings, they shall demonstrate in the approval process that they are designed, fabricated and installed to meet these loading requirements. When the permittee submits structural drawings and calculations as part of approval process specified in 2-1.5, the structural drawings and calculations shall conform to the following, but not necessarily limited to:

(a) Unless otherwise specified, allowable deflections and stresses or structural capacity shall be computed in accordance with the Standard Specifications for Highway Bridges (17th edition) of AASHTO. For materials or products made of reinforced concrete, long term deflection resulting from creep and shrinkage with time-dependent factor for the sustained loads shall be computed with the safety factor of 2.0. For materials or products made of structural steel, allowable stress shall be computed by considering the effects of repeated loading with loading condition of four as specified in Manual of Steel Construction published by American Institute of Steel Construction (AISC).

(b) When future street widening or other modification which might affect the loading on any of this material or product or structure is planned, that material or product or structure shall be designed to accommodate the future loading.

2-2.2 Structural Loadings.
The structural loadings shall be the most stringent combination of the applicable live and dead loads applied vertically and laterally.

2-2.2.1 Live Loads.
The live loads can be from vehicular load or pedestrian load depending on the location the material or product is used. The following live loads shall be used:

(a) Live Loads-Vertical.

<table>
<thead>
<tr>
<th>Structure Location</th>
<th>Vertical Live Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Roadways, Alleys or Driveways (Existing or Future)</td>
<td>H20 - wheel loading including Impact.</td>
</tr>
</tbody>
</table>
For effect of impact:
0 to 12 inches below ground, increase live load by 30%
13 to 24 inches below ground, increase live load by 20%
25 to 35 inches below ground, increase live load by 10%
36 inches or more below ground, no increase.

(2) Parkway/Sidewalk 300 psf (see Section 56.09 of Los Angeles Municipal Code)

(b) Live Loads-Lateral.
(1) Lateral live loads shall be those to which the structure is exposed to. When walls are located closer than $\frac{1}{2}$ of the wall height from the nearest wheel load, a wheel load surcharge of two feet shall be assumed to approximate the effects of lateral live loadings.

(2) Any structure containing wall height of less than two feet can be installed in any sidewalk and parkway, with the exception of driveway, without considering wheel load surcharge.

2-2.2.2 Dead Loads.
The following dead loads shall be used:
(a) Dead Loads-Vertical.
(1) Minimum unit weight of the earth cover shall be taken as 120 pcf.
(2) Actual weights of concrete, access cover, grade rings, riser sections, appurtenances and stored contents shall be used.
(b) Dead Loads-Lateral.
(1) Horizontal soil pressure from the earth backfill below ground level and hydrostatic pressure developed from the ground water.
(2) For earth surface, above ground level, containing slope greater than 5:1, two feet of earth surcharge shall be assumed.
(3) Minimum equivalent fluid pressure of 36 pcf shall be used to determine the soil pressure and earth surcharge. Where saturated earth or high groundwater is anticipated, equivalent fluid pressure of 80 pcf shall be used.
(4) Cylindrical Structures. The lateral loads on cylindrical structures shall be unbalanced with the loads as shown below:
Where:
P = The lateral loads from horizontal soil pressure and the earth surcharge, and/or hydrostatic pressure described above.

\(D_o\) = The outside diameter of the structure.

The coefficients for moments and thrust calculations shall be from recognized and accepted theories.

2-2.2.2 Soil Bearing Pressure.
Any handhole, precast maintenance hole, metal frame and similar structure or installation without a bottom, a floor slab, or a solid support shall be submitted with structural calculations indicating the resultant soil pressures due to the structural loadings do not exceed 1,000 psf.

2-2.2.3 Allowable Deflection by Structural Calculations.
The computed deflection by the structural calculations submitted for the approval shall not exceed the allowable deflection as described in 2-2.3.3.

2-2.3 Structural Loading Test.
2-2.3.1 General.
(a) In addition to other property and performance testing specified in this standard plan, all materials and products including those that are located below-grade, or at grade level and spanned over an opening shall be designed and tested to withstand the live and/or dead loads listed above. If the material or product is submitted for approval with the required testing as a part of the approval process, written descriptions of the structural loadings, the testing methods and the procedures shall be included along with the manufacture drawings.
required herein.

(b) Structural loading test shall be applied to handholes, precast maintenance holes, and similar structures or installations, and all covers and frames used over these structures and installations with the following conditions and other requirements specified herein.

(1) For handholes, precast maintenance holes and similar structures or installations that contain any wall dimension greater than 48 inches, structural calculations are required to be submitted for approval in addition to impact load test specified herein.

(2) Structural loading test shall be applied to all covers and frames used over the handholes, precast maintenance holes, or similar structures except for covers and frames that are made of steel or reinforced concrete. For covers and frames that are made of steel or reinforced concrete, the permittee shall have the option to submit for the structural loading test or structural calculations for approval.

(3) For handholes, precast maintenance holes and similar structures or installations that contain open bottom (without any bottom or floor slab), additional structural calculations shall be required to demonstrate that the maximum allowable pressure is not exceeded.

(4) The City Engineer may require structural loading test if the product has an unusual configuration or is manufactured of material other than steel or reinforced concrete.

(c) Materials made of iron castings shall require structural loading test, as specified in the Greenbook including the supplements, the Brown Book, and in this and other applicable standard plans. No structural calculation shall be used as substitution.

2-2.3.2 Structural Loading and Deflection Tests.

(a) Structural load testing on handholes, precast maintenance holes, covers and frames, and tree well coverings, shall be done in a standard laboratory atmosphere with the approved testing procedures. The testing laboratory shall certify that the handholes, precast maintenance holes, covers and frames, and tree well coverings tested are within the dimensions and manufacturing tolerances shown on the manufacturing drawings.

(1) All handholes, precast maintenance holes, and similar structures or installations shall be tested with the appropriate top sections, covers and frames in place and supported as they would be in the field.

(b) Covers and Frames, Tree well Coverings, Vent Grates and Frames. Unless otherwise specified, all covers and grates described in this standard plan shall be tested with the appropriate frames in place and supported. For covers without any frame or support information submitted for testing or approval, structural loading test shall be applied to the covers with two shortest sides supported.
(1) All sewer and storm drain maintenance hole covers and frames used by City of Los Angeles shall be tested to proof loads established in the related standard plans. All other maintenance hole covers and frames utilized by other utility companies shall also be tested to structural loading as specified in this standard plan.

(c) The structural loadings for the testing can be the combination of the live loads (either the vehicular traffic loading or the pedestrian traffic loading), the dead loads and applicable impact loads and wheel load surcharge. The structural loadings in the vehicular traffic and pedestrian traffic areas shall be increased by a factor of safety of 2.5 and 2.0, respectively, for the testing. For material or product that is applicable in both traffic areas, the most stringent structural loading with the designated factor of safety shall be used. When the structural loadings are applied, they shall be distributed or loaded with preload and proof load at the applicable positions as specified in this standard plan without any failure, crack, damage, permanent deformation or exceeded deflection. If multiple loading positions apply, the applicant shall furnish minimum one specimen for each loading position.

(1) Preload. The preload shall be 5% of the proof load and shall be applied for a duration of one minute ± 15 seconds, unloading for one minute ±15 seconds and waiting one minute ± 15 seconds at zero load before proceeding with the test.

(2) Proof Load. Uniform proof load or equivalent concentrated load (ECL) for one minute and shall be repeated 10 times with the corresponding deflection recorded, without failure, cracks or permanent deformation. After the inspection, the specimen shall then be loaded to failure with ultimate proof load and deflection recorded if directed by the City Engineer.

(3) Uniform Proof Load. Loading determined in 2-2.2 or specified in this and other applicable standard plans.

(4) Equivalent Concentrated Proof Load. An equivalent concentrated proof load shall be equal to the uniform proof load described above and can be used instead of the uniform proof load.

i. Unless otherwise specified, the equivalent concentrated proof load applied vertically shall be applied to a 9” x 9” x 1” thick steel bearing plate over a 9” x 9” x ½” thick piece of rubber, with a Shore A Hardness of 80, in the applicable locations of the tested surfaces on the Figures as shown herein. For material or product composed of concrete or other non-concrete or non-metal materials, the size of steel bearing plate and rubber shall be 10” x 10” x 1” and 10” x 10” x ½” thick, respectively. For any handhole or similar structure or installation which has
a top surface area smaller than the area of 9" x 9" or 10" x 10", whichever is applicable, a steel bearing plate and rubber which have the equivalent amounts of surface areas may be used.

ii. For vertical (sidewall) loading location, the load shall be distributed over a 4 ¼" x 9" x 1" thick or 5” x10” x 1” thick steel bearing plate, whichever is applicable, and rubber with appropriate thickness specified herein.

iii. For lateral sidewall loading tests, the load shall be distributed and applied to the top surface of the structure or installation on the longest wall. The load shall be transmitted a flat and rigid plate, 18” x 24”, at the center of the wall.

(5) During the structural loading tests, a vertical brace may be used across from the load plate if required for stability.

(6) Loading Locations. Unless otherwise specified, equivalent concentrated loads shall be applied to the locations indicated on the following figures where applicable:
Notes for Figure 1 through Figure 9:

(1) The handholes, frames and intermediate supports may not be completely shown on all the figures. All structural loading and deflection tests shall be in accordance with 2-2.3.2.

(2) Unless otherwise specified, all lids shall be applied with structural loading and deflection tests in addition to other testing locations as indicated. If the center of the lid to the center of the cover is less than the size of the bearing plate, nine or ten inches, whichever is applicable, the structural loading and deflection tests to the center of the lid shall be exempted.

(3) For all handholes and similar structures which are equal to or less than 48 inches in
length, their applicable covers and frames shall be applied with additional vertical (sidewall) loading test at similar location as indicated in Figure 1(b).

(4) For multiple solid covers similar to those as shown in Figure 8, the covers, frames, access lid and the intermediate cover supports shall be applied with structural loading and deflection tests at loading locations as indicated. For pedestrian traffic areas, the loading at the intermediate cover support shall be determined by considering the pedestrian load over the tributary areas of the adjacent covers. If the size of the cover section No. 3 as shown in Figure 8 is the same as cover section No. 1, the structural loading and deflection tests on cover section No. 3 shall be exempted.

(5) If any part of interior wall of the maintenance hole cover and frame with an inclined plane and an angle from the base less than 85 degrees, or if the ring seat, where cover rests, is projected beyond the vertical plane of the frame by more than one inch as shown in Figure 9, the maintenance hole cover and frame shall be applied with additional vertical (sidewall) loading tests at similar location as indicated in Figure 3(b). There shall not be any bending stresses within the frame wall caused by the vertical live and/or dead loads through the cover. Unless otherwise specified, no resultant live and/or dead load shall be within the kern (middle 1/3) of the base of the maintenance hole frame.

(6) For materials or products which have different configurations than the figures as shown herein, the City Engineer shall determine the appropriate structural loading and deflection tests and the loading locations.

(c) Vehicular Traffic Loading-Vertical.

(1) General. All handholes, precast maintenance holes, and similar structures or installations that are constructed at grade level and within the area subject to vehicular traffic including the driveway area as specified in 2-2.1 and within the distance and the dimensions as specified in 2-2.2.1(b)(1) and 2-2.3.1(b), respectively, shall be tested for vehicular traffic loading. Handholes, precast maintenance holes, and similar structures or installations that are constructed for below-grade use shall be tested based on the most stringent structural loadings as determined in 2-2.2 and herein. All the covers and frames that are constructed over these structures conforming with the conditions as specified in 2-2.3.1(b) shall be tested for the vehicular traffic loading.

(2) Iron castings shall be manufactured, identified and tested in accordance with the testing method specified in the latest adopted edition of the Greenbook including the supplements, the Brown Book and in applicable standard plans as defined in 2-2.3.2.
(d) Vehicular Traffic Loading-Lateral.

(1) For handholes, precast maintenance holes and similar structures or installations that are constructed at grade level and within the distance and the dimensions as specified in 2-2.2.1(b)(1) and 2-2.3.1(b), respectively, and is subject to structural loading test with a minimum lateral (sidewall) structural loading of 400 psf shall be applied. For handholes, precast maintenance holes and similar structures or installations that are constructed below-grade, the most stringent lateral (sidewall) structural loadings as determined in 2-2.2 shall be used. For top surfaces of handholes, precast maintenance holes and similar structures or installations that are less than eight feet below the grade surfaces, the lateral (sidewall) structural loadings shall not be less than 400 psf.

(2) The load shall be applied parallel to the top surface of the structure centered on the sidewall with the longest dimension. The load shall be applied to a flat, steel plate one inch thick, 18 inches x 24 inches wide at the center of the wall. The steel plate shall bear against any suitable medium (such as sand) that will conform to the shape and surface angle of the structure sidewall to achieve a uniform loading.

(e) Pedestrian Traffic Loading (Vertical).

(1) General. Top section of the handholes, precast maintenance holes and similar installations, covers and frames, tree well coverings, vent grates and frames, and other similar installation that are located at grade level within the sidewalks and the parkways, excluding the driveways, subject to pedestrian traffic loading shall be tested through the preload load and proof load. Handholes, precast maintenance holes and similar installations that are constructed for below-grade use shall be tested based on the most stringent structural loadings as determined in 2-2.2 and herein.

i. Uniform Proof Load. An uniform proof load of 600 psf which is equivalent to 300 psf (per Section 56.09 of Los Angeles Municipal code) times a factor of safety of 2.0 shall be applied on the surface area of the top section of the handholes, precast maintenance holes, covers, tree well coverings, vent grates and frames and other similar installations.

ii. Equivalent Concentrated Proof Load. An equivalent concentrated proof load equal to the 600 psf uniform proof load described above may be used instead of the uniform proof load. The equivalent concentrated proof load shall be calculated based on the examples shown in this standard plan.

iii. Example 1-For handholes or precast maintenance hole covers and frames constructed at grade level, 30” wide x 48” long with pedestrian traffic loading. Using Figures 1(a), (b) and (c) of 2-2.3.2(b)(6):
Equivalent Concentrated Load (ECL) at Load Locations 1 and 3 (Figure 1(a) and (c), respectively).
Proof load=\((W \times L) \times \text{uniform load} \times 600 \text{ psf} = (2 \frac{1}{2} ' \times 4') \times 600 \text{ psf} = 6,000 \text{ lbs.}\)

ECL at Load Location 2 (Figure 1 (b) - Vertical (Sidewall) location.
Proof load=\((W \times L) \times \text{uniform load} \times 600 \text{ psf} = (2 \frac{1}{2} ' \times 4')/2 \times 600 \text{ psf} = 3,000 \text{ lbs.}\)

iv. Example 2-For tree well covers, 4' x 4' with 16 inches center square opening  (Note: Dimensions shown for tree well covers represent two-two feet half covers with two feet in length), constructed at grade level with 600 psf pedestrian traffic loading. Using Figures 4(a) and 4(b) of 2-2.3.2(b):

ECL At Load Location 1(Figure 4(a)).
Proof load=\((a \times W) \times 600 \text{ psf} = (1.33' \times 4') \times 600 \text{ psf} = 3,200 \text{ lbs.}\)

ECL At Load Location 2 (Figure 4(b)).
Proof load=\((b/2 \times c) \times 600 \text{ psf} = (0.67' \times 1.33') \times 600 \text{ psf} = 535 \text{ lbs.}\)

v. Example 3-For handhole with three equal sectional steel covers with a combined dimension of 4' x 6' constructed at grade level with 600 psf pedestrian traffic loading. Using Figure 8 of 2-2.3.2(b):

ECL at Load Location 1 and 2. (ECL at Load Location 3 is exempted.)
Proof load=\([(W1 \times L) \text{ or } (W2 \times L)] \times 600 \text{ psf} = (2' \times 4') \times 600 \text{ psf} = 4,800 \text{ lbs.}\)

(f) Pedestrian Traffic Loading (Lateral) for the Sidewalls of Handholes, Precast Maintenance Holes and Similar Structures or Installations.
(1) The sidewalls of the handholes, precast maintenance holes and similar structures or installations shall be subject to a uniform load equivalent to the horizontal soil pressure and/or surcharge inserted on the structure.
   i. For any structure, constructed at grade level, with an overall height of 18 inches and less and without any structural calculations submitted; a minimum uniform load of 100 psf shall be applied over a sidewalk of the structure which shall be uniformly supported on the opposite side. For any structure constructed below-grade, the most stringent lateral (sidewall) structural loadings as determined in 2-2.2 shall be used.
No lateral (sidewall) structural loading to below-grade structure shall be less than 100 psf.

ii. The load shall be applied in accordance with 2-2.3.2(d).

2-2.3.3 Deflection.

A deflection measuring device shall be positioned to measure the relative deflection between the testing machine table and the specimen. All deflection readings shall be recorded during the preload, and the loading and unloading of each cycle at a minimum of three increments for proof load less than 10,000 lbs, or at 5,000 lbs intervals for proof load equal to or exceeding 10,000 lbs. If the compressible medium is used for a reaction base, its deflection shall be measured and subtracted from the total to determine the deflection.

(a) Vertical Deflection.

(1) For handholes, precast maintenance holes, covers and frames, a deflection measuring device shall be positioned so as to measure only the deflection of the top portion of the specimen after preload and the end of 10 cycles of proof load.

(2) For sidewall (vertical) loading, a deflection measuring device shall be positioned to indicate the deflection of the sidewall of the specimen or the wall of maintenance hole frame, whichever is applicable.

(b) Lateral Deflection. A deflection measuring device shall be positioned to indicate lateral deflection wherever maximum deflection occurs after the preload and the end of 10 cycles of proof load.

(c) Allowable Deflection. Maximum deflection due to, vehicular or pedestrian traffic loadings, and any other proof loading specified in other standard plans shall be as follows.

(1) Vertical.

   i. Handholes, Precast Maintenance Holes, and Similar Structures or Installations. For top slab or section made of any concrete with reinforcing steels or other non-metal materials, maximum deflection in any loading cycle shall not exceed 1/8 inch.

   ii. Covers and Frames, Tree well Coverings. For steel or cast iron covers and frames, maximum deflection shall not exceed ½ inch. For concrete and non-metal material, deflection shall not exceed 1/8 inch.

(2) Lateral.

   i. Handholes, Precast Maintenance Holes, and Similar Structures and Installations. Sidewall deflection shall not exceed 1/4 inch per foot of length of the sidewall.

(3) No permanent deflection due to vertical or lateral loading shall exceed 10% of the
deflection measured at the applicable proof load or the maximum allowable deflection value as specified herein, whichever is lesser.
PART 3

PHYSICAL PROPERTIES AND CONDITIONS, STRUCTURAL STRENGTHS AND PERFORMANCE CHARACTERISTICS

SECTION 1
GENERAL REQUIREMENTS

3-1.1 General.
(a) Not all materials and products listed in same categories or have similar installations are subject to same requirements. The materials and products shall conform to the physical properties and conditions, structural strengths and performance characteristics specified in this standard plan, the Greenbook and its supplements, and the referenced industry and testing standards. If there is any conflict, the most stringent requirements shall be applied.
(b) Other tests that would be conducted in an identical manner for both control and test specimens for each property sought can be considered by the City Engineer.

3-1.2 Physical Properties and Conditions.
3-1.2.1 General Standards and Requirements.
(a) All materials and products shall be new. Unless approved by the City Engineer, no product shall be made of used or scrap parts.
(b) All material and products shall have consistent dimension, thickness and color and within the allowable manufacturing tolerance specified in the submittal or referenced standards.
(c) Unless otherwise specified, all materials and products shall be designed for use through an ambient temperature range of -18 °C (0 °F) to 66 °C (150 °F) or tested in accordance with the environmental conditions specified herein.
(d) All materials and products including, but not necessarily limited to, the mortar or the grout, anchor, fastener, adhesive, caulking and/or sealant shall have resistance to corrosion, ultraviolet light, chemical exposure, growth of fungus or mildew and other environmental conditions specified herein. All cementitious materials shall be free of any efflorescence.
(e) All testing samples or specimens shall be taken from the finished materials or final products, that are produced under the same heat or lot, randomly selected and tagged by
the City Engineer from the manufacturing plant or local supplier's distribution yard.

(f) No installation shall result in any difference in level with adjacent improvement in pedestrian traffic area exceeding 1/8 inch. No installation shall result in any ponding or interruption of surface flow.

(g) Unless otherwise specified, all materials or products constructed at grade shall be tested for abrasion and slip resistance with minimum values specified. Unless otherwise directed by the City Engineer, all materials or products made of only concrete or cementitious materials with broom finish shall be exempted. The broom finish must be specified on the approved submittal and/or installation details. All non-concrete materials or products constructed shall be tested.

(1) Initial Slip Resistance Tests: Three sets of specimens, with sizes cut to fit the Gardner Abrasion apparatus for the abrasion resistance test and mechanically held together to form the specimens for the slip resistance test, shall have average static coefficient of friction not less than 0.6 when tested per ASTM C 1028 for uses in pedestrian traffic area and average dynamic coefficient of friction of 0.35 when tested per Calif Test Method No. 342 for uses in vehicular traffic area. For materials or products allowed to be installed in sloped or inclined pedestrian traffic area including the curb ramp area and other area containing slope exceeded 2%, the average static coefficient of friction shall not be less than 0.8. No more than one individual specimen shall have coefficient of friction less than the values specified above. It is noted that the sizes of the specimens to be tested for coefficient of friction, ASTM C 1028 and Calif Test Method No. 342 are different.

(2) Initial Abrasion Resistance: After Initial Slip Resistance test described above, test for Initial Abrasion Resistance with average wear (loss) not to exceed the values as specified in this Standard Plan when tested by ASTM C 418 or modified ASTM D 2486. When tested per ASTM D 2486, the specimens with sizes cut to fit the Gardner abrasion apparatus with abrasive medium (Norton metallic 40 grit sand paper) fixed to the sled and wood block with combined mass of 3.2 lbs and with reciprocating linear motion of 37± cycles per minute over a 10 inches travel of 1,000 cycles. One cycle shall consist of one complete forward and backward motion. Unless otherwise specified, measurements shall be taken on the top surface. Forced air or other approved mean shall be used to clean the sand paper and area to be scrubbed before and during testing. Cleaning and inspection of sand paper shall be performed as frequent as necessary or no less than once every 250 cycles.

(3) Long Term Abrasion and Slip Resistance Tests: Three sets of the specimens from the Initial Abrasion test shall be used to continue for the long term abrasion and slip...
resistance tests. Each specimen shall be subject to abrasive medium (Norton metallic 150 grit sand paper) for additional 3,500 cycles per modified ASTM D 2486 and slip resistance test per ASTM C 1028 for uses in pedestrian areas or Calif Test Method No. 342 for uses in vehicular traffic areas. The average slip resistance of the three acceptable specimens shall not be less than 90% of initial tested coefficient of friction. No more than one individual specimen shall have long term slip resistance less than the 90% of the initial tested coefficient of friction specified above.

(h) No material and product shall be constructed or installed over any utility facility or driveway apron without the approval of the owner and BOE permit engineer.

(i) All works including all necessary coordination and inspections shall be in conformance with the requirements as specified in Greenbook and its supplements, Brown Book, this and other standard plans.

SECTION 2
HANDHOLES, PRECAST MAINTENANCE HOLES AND SIMILAR STRUCTURES OR INSTALLATIONS

3-2.1 Handholes, Precast Maintenance Holes and Similar Structures or Installations.

3-2.1.1 General.

(a) Handholes, precast maintenance holes, and similar structures or installations shall be commercially available and of the highest quality consistent with their intended uses.

(b) All top sections of handholes and similar structures or installations shall not be constructed exceeding the permanent street grades without the uses of approved adjustment or riser rings. The permittee must submit street grades obtained from the City street plans for approval.

(c) Handholes, precast maintenance holes and similar structures or installations shall have adequate soil bearing surface, in firm soil, to prevent settling.

(d) Handholes, precast maintenance holes and similar structures or installations shall be made in the following two major categories of materials with other metal components or attachments:

(1) Concrete with reinforcing steels.

(2) Plastic resin, fiberglass reinforced plastic (FRP), reinforced plastic mortar (RPM), polymer or vitrified polymer composite, or any combination thereof.

(e) Manufacturer identification mark, product model number and manufacturing date shall be
made on the exposed side of the opening of the handhole, precast maintenance hole and similar structure or installation. Markings can be made on metal identification tag installed on the exposed side of the opening without any interference or blockage of the maintenance hole cover and frame and/or access to structure or installation. The marking shall have lettering of \( \frac{1}{2} \) inch high with line width of \( \frac{1}{8} \) inch or sizes otherwise approved by the City Engineer.

3-2.2 Required Information and Submittal.
In addition to the information as required in Public Works Products Approval Procedures, the following information shall be submitted to the City Engineer before any testing or approval can be granted:

(a) For materials and products consisting of plastic resin, fiberglass material, fiberglass reinforced plastic (FRP), reinforced plastic mortar (RPM), polymer concrete or vitrified polymer composite, or any combination thereof.

(1) A description of any felt or other fabric used to manufacture the products.
(2) Woven, non-woven or punched.
(3) Properties of aggregates, chopped glass fibers or other reinforcing required.
   i. The amount, location and orientation of the chopped glass fibers.
   ii. The grade of the glass fibers.
   iii. The type and gradation of any aggregates or sands used.

3-2.3 Testing Requirements and Procedures.
3-2.3.1 Reinforced Concrete.
(a) If directed by the City Engineer or the Inspector, sample of reinforced concrete used to manufacture the handholes, precast maintenance holes and similar structures or installations shall be tested in accordance with requirements specified in the Greenbook and its supplement, Brown Book and in this and other applicable standard plans.

3-2.3.2 Plastic Resin, Fiberglass, Fiberglass Reinforced Plastic (FRP), Reinforced Plastic Mortar (RPM), Polymer Concrete or Vitrified Polymer Composite.
(a) Tests of plastic resin/fiberglass, fiberglass reinforced plastic (FRP), reinforced plastic mortar (RPM), vitrified polymer composite materials used in the manufacture of the handholes, precast maintenance holes, and similar structures or installations shall be performed on specimens taken from the finished materials or final products. The permittee shall provide adequate number of specimens required for the weight change test, the tensile strength test or the flexural strength test.
(b) The size of the weight change specimens shall be ½ inch x 1 inch x 3 inches. The size of the tensile strength specimens shall be “Dogbones” 1 inch (+1/32 inch, -1/16 inch) x 3 inches (+1/32 inch, -1/16 inch) x ¼ inch (+/- 1/32 inch) per ASTM D 638. The size of the flexural testing samples shall be ¼ inch x ½ inch x 6 inches.

(c) Control Specimens. Six specimens shall be cut from the finished product for testing. The specimens shall have the geometry specified herein and shall be designated as control specimens. The methods of testing for tensile or flexural strength shall be at the option of the manufacturer with the provision that the tests shall be conducted in an identical manner for both control and test specimens for each property sought. The control specimens shall be tested for ultimate flexural or tensile strength. The load versus deflection readings shall be taken and the values of load and deflection, at failure, for each specimen shall be averaged to establish the control value.

(d) Accelerated Service Conditions. Three specimens shall be taken from the finished materials or final products for testing under simulated accelerated service conditions. The specimens shall have the geometry specified herein. The specimens shall be weighed and measured for length, width, and thickness.

(1) Unless otherwise specified, the specimens, prior to any physical testing, shall be subject to accelerated service exposures and conditionings in accordance with ASTM D 756, Procedure E.

(2) After the exposure cycle has been completed, the test specimens shall be weighed, measured and visually examined for changes. The specimens shall then be tested for ultimate flexural or tensile strength under the identical conditions used for the control specimens.

(3) The average of the strength values for the test specimens shall be determined shall conform to the following:

i. No more than one individual specimen shall have less than retention of 75% of the control specimen values for ultimate flexural or tensile strength. The average retention of the three specimens shall not be less than 75% of the control specimen values.

ii. No more than one individual specimen shall have more than 2% change in weight or any dimension. The average change in weight or any dimension of the three specimens shall not be more than 2%.

iii. No specimens shall have cracking, delamination, crazing, checking, blistering, or surface pitting.

iv. Changes in color of specimens will be permitted only if the change does not.
indicate degradation of the material, and the change will not in the opinion of the City Engineer be detrimental to the overall appearance of the product.

(c) Chemical Resistance. Twenty-seven specimens shall be cut from the finished materials or final products and prepared in accordance with procedures described herein. Each specimen shall be weighed and measured as in 3-2.3.2.

(1) Three of the specimens shall be exposed to each of the chemical reagents listed below. The specimens shall be exposed to the chemicals in accordance with ASTM D 543, Immersion Test, Practice A, Procedures 1 and 2 with both conducted at room temperature, using standard laboratory atmosphere for 7 days.

<table>
<thead>
<tr>
<th>CHEMICAL SOLUTIONS</th>
<th>CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Chloride</td>
<td>5%</td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>0.1 N</td>
</tr>
<tr>
<td>Sodium Carbonate</td>
<td>0.1 N</td>
</tr>
<tr>
<td>Sodium Sulfate</td>
<td>0.1 N</td>
</tr>
<tr>
<td>Hydrochloric Acid</td>
<td>0.2 N</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>0.1 N</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>5%</td>
</tr>
<tr>
<td>Kerosene</td>
<td>Per ASTM D 543</td>
</tr>
<tr>
<td>Transformer Oil</td>
<td>Per ASTM D 543</td>
</tr>
</tbody>
</table>

(2) After the exposure cycle has been completed, each specimen shall be dried, weighed, measured, and tested for ultimate flexural or tensile strength in accordance with 3-2.3.2.

(3) The values of load and deflection at failure for each of the three specimens from each reagent exposure shall be recorded and averaged to establish the test values. Each specimen shall be visually examined for changes in appearance and conform to the following acceptance criteria:

i. Average retention of the control specimen values for ultimate flexural or tensile strength per procedures as described in 3-2.3.2(d)(3)i.

ii. Average change of weight or dimension per procedures as described in 3-2.3.2(d)(3)ii.

iii. No stain, etched mark, acid burn shall be present.

iv. No other defect or change in color as described in 3-2.3.2(d)(3)iii and iv.

(4) All chemical solutions shall be made, mixed, stirred and maintained in accordance with the testing standards. (If requested by the City Engineer, obtain samples of each
solution to verify for the required concentration at the 1st day and the 7th day of the testing. If allowed by the City Engineer, no sample shall have concentration deviating more than 2.5% from the specified amount. Copies of the testing results shall be a part of the testing report.)

(f) Simulated Sunlight Exposure. If the material or product is used below grade and no part will be exposed to sunlight after installation and the material or the product will not be produced more than two months prior to its use and they will be properly stored and protected from any exposure of sunlight prior to start of construction by the manufacturer, the test may be exempted by the City Engineer.

(1) Three specimens cut from the finished materials or final products shall be prepared, weighed and measured in accordance with 3-2.3.2. The specimens shall be exposed under a fluorescent lamp in accordance with ASTM G 154, Cycle No. 1 of Appendix X2, which will be operating at 340 nM wavelength to simulate direct solar UV radiation for a period of 2,000 hours. After exposure, the specimens shall be measured, weighed, and visually examined for changes, and tested for ultimate flexural or tensile strength in accordance with 3-2.3.2.

(2) The values of load and deflection at failure for each of the three specimens of each set from the exposure shall be recorded and averaged to establish the test value. Each specimen shall be visually examined for changes in appearance. The specimens shall conform to the following acceptance criteria:
   i. Average retention values for ultimate flexural or tensile strength per procedures as described in 3-2.3.2(d)(3)i.
   ii. Average change of weight or dimension per procedures as described in 3-2.3.2(d)(3)ii.
   iii. No other defect or change in color as described in 3-2.3.2(d)(3)iii and iv.

(g) Water Absorption.

(1) Three specimens shall be cut in accordance with 3-2.3.2 and weighed and measured. The specimens shall be exposed to water environments in accordance with ASTM D 570, Sections 6, 7.1 and 7.5.

(2) After the exposures are complete, the specimens shall be weighed, measured, and visually examined for changes and tested for ultimate flexural or tensile strength in accordance with 3-2.3.2 and conform to the following acceptance criteria:
   i. Average retention values for ultimate flexural or tensile strength per procedures as described in 3-2.3.2(d)(3)i.
   ii. Average change of weight or dimension per procedures as described in 3-
2.3.2(d)(3)ii.

iii. No other defect or change in color as described in 3-2.3.2(d)(3)iii and iv.

(h) Flammability. Three specimens shall be tested per ASTM D 635 and have the following values:

1. Flammability tests shall be conducted on specimens 1” wide x 4” long x finished product thickness. Each specimen shall be held in a horizontal position, be ignited on one end and the rate of burning along the length shall not be less than 0.3 inch per minute for each 0.1 inch of thickness.

3-2.3.3 Performance and Durability Test.

The handholes, precast maintenance holes, and similar structures or installations shall be tested in accordance with requirements specified below.

(a) Structural Loading and Deflection Test, if applicable, in accordance with 2-2.3.

(b) Impact Load Test. Any point on the top portions of the handholes, precast maintenance holes, and similar structures or installations, and the covers and frames shall withstand an impact administered with a weight having a “C” tup when tested with ASTM D 2444 without puncturing, cracking, delaminating or splitting. For covers and frames, the test shall be conducted with the covers and frames resting on a flat, rigid surface, such as concrete or an one inch thick steel plate.

1. For installation used for electrical application or installation used for other usage but within the vehicular traffic area, the impact load shall be equal to 70 ft-lbs. Unless otherwise specified, for installation used for non-electrical application and within pedestrian traffic area, the impact load shall be equal to 45 ft-lbs.

2. For handhole, precast maintenance hole, and similar structure or other installation that contain any wall dimension greater than 48 inches, the impact load test can be performed by the approved independent testing laboratory at the manufacturing plant or distribution yard if permitted by the City Engineer.

(c) Long Term Abrasion and Slip Resistance Test in accordance with 3-1.2.1(g). All materials or products made of reinforced concrete or cementitious materials and with broom finishing shall be exempted. The average wear (loss) of the Initial Abrasion Test shall not exceed 0.92 in³/7.75 in² for non-concrete products and 0.46 in³/7.75 in² for metal products when tested per ASTM C 418, and not to exceed 0.05 inch for non-concrete materials and 0.03 inch for metal materials when tested per ASTM D 2486. The average slip resistance shall not be less than 90% of the initial tested coefficient of friction.
SECTION 3
COVERS AND FRAMES AND SIMILAR INSTALLATIONS

3-3.1 Covers and Frames and Similar Installations.
3-3.1.1 General.

Covers shall be solid and contain no slot or opening without any approved protective lid. Covers can be either round, square or rectangular provided with slip resistant surfaces and comply with the American’s with Disabilities Act (ADA) requirements. Unless otherwise approved by the City Engineer, covers shall be placed on the handholes, precast maintenance holes and similar structures or installations and solidly supported on all sides or installed in concrete pavement or over an approved concrete footing. If a frame is required to support the cover, it shall be tested with the cover in place and supported as it will be in use.

(a) Covers and frames or other supports may be manufactured from steel, cast iron, reinforced concrete, aluminum, plastic resin or fiberglass, FRP, RPM, vitrified polymer composite. If covers, frames or supports are made of dissimilar materials, approved protective coatings shall be in all contact surface areas.

(b) All steel covers and frames shall be hot-dip galvanized. All other metal covers and frames shall have approved asphaltic paint, coal tar epoxy or non-corrosive coating in accordance with Greenbook and its supplements, Brown Book or applicable standard plans before testing and fabrication inspection. All bearing surfaces of the covers and frames shall be machined and the covers shall seat firmly into the frame without rocking. All metal covers shall have slip resistance texture treatment if necessary to comply with the slip resistance requirements described herein. All non-concrete or non-metal material or product shall be in grayish color.

(c) Covers weighing less than 200 lbs attached to the handholes, precast maintenance holes, and similar structures or installations that have inside clear height dimension of 18 inches or more shall be provided with a vandal-proof fastening devices. The fastening devices shall require a commercially available tool to open and remove the cover. The fastening devices shall be made of a non-corrosive material. When applicable, such devices shall have a minimum torque strength of 30 ft-lbs and a pullout strength of 750 lbs.

(d) The perimeters of the covers shall be flush with the tops of the supporting frames or adjacent pavements. All covers shall not contain any crown or top surfaces exceeding 1/8 inch above the supporting frames or adjacent pavements.

(e) (1) All metal covers, except the maintenance hole covers, shall have owner and manufacturer identification stamped or placed over a tag that is made of similar metal.
and finish surface and welded at the center of the cover. The surface area or the metal tag shall be within two inches wide with text size of one inch for the owner identification and text size of 1/2 inch for the manufacturer identification. Additional metal tag, of reduced size if approved by the City Engineer, with the manufacturer identification shall be welded or placed at the inside face of the support frame in accordance with the method approved by the City Engineer.

(2) All cast iron covers shall be cast with the letters for the type of covers, and the owner’s identification in accordance with the instruction approved by the City Engineer. The letters shall be 2 ½ inches high with ½ inch line width, and placed in the center of the cover. All letters shall be flush with the finished surface of the cover. No area of the finished surface shall have any groove or depression deeper than 3/16 inch and/or wider than ½ inch.

i. Foundry identifying mark, heat number and manufacturing date shall be cast on the bottom of the cover and on the inside of the frame. Additional foundry identifying mark with text of ½ inch high shall be cast on the top of the frame or at the location on top of the cover approved by the City Engineer.

ii. For imported covers and frames and whenever is applicable, the owner’s identification and the marking of the country of origin shall have letters in compliance sizes in accordance with Sec.134.46 of Title 19-Custom Duties of the Code of Federal Regulations. All markings shall have text of 1 3/16 inches high and 3/16 inch wide on the cover. Provide additional manufacturer identification with letters ½ in high with line width of 1/8 inch on the upper portion of the frame which remains exposed.

(i) During fabrication and or installation, samples of all concrete and metal covers shall be taken and tested with the properties conforming to the requirements indicated in the Greenbook and its supplement, Brown Book, and applicable standard plans.

(j) Covers and frames with materials that are made of plastic resin, fiberglass, FRP, RPM, polymer concrete or vitrified polymer composite shall not be used in vehicular traffic area.

3-3.1.2 Performance and Durability Test. Unless otherwise specified, all covers and frames shall be tested in accordance with the requirements specified below.

(a) Structural loading and deflection test, if applicable, in accordance with 2-2.3.  
(b) Impact load test in accordance with 3-2.3.3.  
(c) Long term abrasion and slip resistance test in accordance with 3-2.3.3. All materials or products made of only concrete or cementitious materials and with broom finish shall be exempted unless it is required by the City Engineer. All non-concrete materials or
3-4.1 Temporary Trench Plates.

(a) General. Whenever trenches and excavations within City’s public right-of-way cannot be completely backfilled or resurfaced within the same work day, they shall be bridged with temporary trench plates made of steel to permit an unobstructed flow of vehicular and pedestrian traffic. The permittee shall provide, install and maintain the temporary trench plates.

(1) The temporary trench plates shall be secured against movement by using holding devices such as adjustable cleats, angles, bolts, tack welding or other devices.

(2) The temporary trench plates shall be installed to operate with a minimum of noise.

(3) The temporary trench plates shall be extended minimum one foot beyond the edges of the trench.

(4) When the temporary trench plates are removed, the dowel holes in the pavement shall be backfilled with either fine graded asphalt concrete mix, concrete slurry or an equivalent material approved by the City Engineer. The contractor shall be responsible for maintenance of the temporary trench plates and the asphalt concrete ramps.

(5) The contractor shall be responsible for maintenance of the temporary trench plates and the asphalt concrete ramps.

(6) The temporary trench bridge shall be installed in accordance with the following methods and details:

i. Method 1. For speeds more than 45 mph, the pavement shall be cold planed to a depth equal to the thickness of the trench plate and to a width and length equal to the dimensions of the trench plate.

ii. Method 2. For speeds less than 45 mph, the approach plate and ending plate (if longitudinal placement) shall be attached to the roadway by a minimum of two dowels pre-drilled into the corners of the plate and drilled two inches into the pavement. Subsequent plates may be butted to each other. (The permittee has the option of installing temporary trench plates using Method 1 for speeds less than 45
The trench shall be adequately shored to support the temporary trench plates, vehicular and/or pedestrian loads. Temporary paving materials shall be used to feather the edges of the temporary trench plates to minimize wheel impacts and comply with ADA requirements. Temporary paving material placed in the roadway shall be placed with four inch run for each one inch thickness of temporary trench plate if the plate is installed per Method 2. Fine graded temporary paving material placed in the pedestrian areas including the crosswalks shall be placed and compacted to form ramps with a maximum slope of 8.50% or a 12 inch run for each one inch thickness of trench plate, and to comply with ADA requirements if the trench plate is installed per Method 2.

Advanced traffic warning signs are required when temporary trench plates are used in the traveled way. The signs shall be type with letters “Steel Plates Ahead” and shall be placed in conformance with the latest edition of the “WATCH” adopted by the City.

The temporary trench plates shall have the following:

1. One inch thick for trenches up to three feet span and 1 1/4 inches thick for up to a four feet span. For spans greater than four feet, a structural design by a registered Civil or Structural Engineer shall be submitted and approved in accordance with Greenbook Section 2-5.3 and submittal procedures specified in this standard plan.

2. Each temporary trench plate shall have a leveled surface without deformation and an approved non-skid surface for the vehicular or pedestrian traffic. The surface shall have dynamic coefficient of friction a 0.35 for vehicular traffic when tested per Calif Test No. 342, and the static coefficient of friction of 0.6 for pedestrian traffic when tested per ASTM C 1028. For temporary trench plates serving for both traffic, they shall be tested and conform to both requirements.

3. Temporary trench plates shall be made of ASTM A 36 steel. Temporary trench plates and non-skid surfaces shall have a minimum abrasion resistance and coefficient of friction as specified on 3-1.2.1(g).

4. Proper identification of the type of coefficient of friction, the manufacturing date and the name of non-skid surface fabricator shall be provided on the surfaces of the temporary trench plates.

5. The inspector may determine the trueness of the temporary trench plate by using a straight edge and will reject any plate that is permanently deflected. When requested by the Inspector, the temporary trench plate and the non-skid surface shall be tested for the coefficient of friction.
3-4.2 Tree Well Coverings and Vent Grates.

(a) General. Tree well coverings and vent grates within the pedestrian traffic area shall comply with the ADA requirements. Opening shall not be greater than \( \frac{1}{2} \) inch in the direction of travel.

(1) Vent grates shall be bicycle safe and shall not have any slot or opening greater than \( \frac{1}{2} \) inch wide.

(2) Tree well coverings shall be made from cast iron, steel, and reinforced concrete with dimensions conforming to current standard plans. Non-standard sized coverings and unreinforced concrete coverings shall not be allowed.

(3) Vent grates shall be made from cast iron, steel or aluminum.

(4) Tree well coverings and vent grates, utilizing any intermediate or non-composite support system for structural purposes shall have the support system permanently attached in such a manner as to prevent removal or disassembly.

3-4.2.1 Performance and Durability Test.

In addition to the physical property tests as required by the Greenbook and its supplements, and the Brown Book, all covers and frames shall be tested in accordance with requirements specified below.

(a) Structural loading and deflection test, if applicable, in accordance with 2-2.3.

(b) Impact load test in accordance with 3-2.3.3.

(c) Long term abrasion and slip resistance test in accordance with 3-1.2.1(g). All covers or grates made of only reinforced concrete or cementitious materials with broom finish shall be exempted unless it is required by the City Engineer. All tree well coverings and vent grates made of metal materials with \( \frac{1}{2} \) inch wide bicycle proof slot openings shall be exempted from the slip resistance test. All other concrete materials or products without broom finish, metal and non-concrete materials or products as described in 3-2.1.1(d)(2) shall be tested in accordance with 3-1.2.1(g).
SECTION 5
DETECTABLE WARNING SURFACE

3-5.1 General

(a) The material and testing requirements specified herein are for detectable warning surface used for exterior and pedestrian traffic applications. They are not considered for vehicular traffic areas.

(1) All installers shall be manufacturer's certified or authorized installers. Certification shall be accomplished by participating in onsite training provided by the manufacturer or its representative. Proof of certification or authorization shall be submitted as part of the submittal prior to the start of any installation work.

(b) The truncated domes and the non-slip surfaces shall be made of homogeneous material. Any use of used or scrap part of the detectable warning surface from other projects is not allowed. Any repair method or repair material of the detectable warning surface shall not be allowed unless they are tested and approved by the City Engineer. If considered by the City Engineer, the repair method and materials shall be separately submitted and tested.

(c) The detectable warning surface shall have consistent dimension, thickness and color as specified in this standard plan. The surface shall have uniform flatness without warping or sagging. (For area requiring multiple sections of detectable warning surface, the sections shall be equally sized and spaced.) All detectable warning surface shall be inspected for defects, damage, cracks, scratches, warping, etc. prior to installation.

(d) For new concrete ramp, cast in place type of detectable warning surface shall be used. All detectable warning surface shall be constructed on approved mortar or adhesive material solidly supported over a minimum four inch thick concrete slab if cast in place detectable warning surface is used or over a minimum three inch thick concrete slab if surface-mounted type of detectable warning surface is used. No cavity or void shall be allowed within the installation.

(e) The detectable warning surface shall be constructed in dimensions over the curb ramps as shown in S-442, latest edition. No detectable warning surface shall exceed the overall surface dimensions by ±1/2 inch. Additional area of detectable warning surface beyond the limits allowed under S-442 and this standard plan which may reduce the negotiability and the safety of the users shall not be allowed. The detectable warning surface shall have the radius where required.

(1) The detectable warning surface shall also be installed over the curb ramps located in the center medians where required in accordance with approved details.
(f) No detectable warning surface shall be installed over non-standard curb ramps. All non-standard curb ramps shall be removed and reconstructed prior to the installation of the detectable warning surface. No detectable warning surface shall be constructed over any maintenance hole and cover.

(g) All material including the mortar and grout and any adhesive system used in the installation shall be free of efflorescence and have resistance to ultraviolet light, chemical exposure, corrosion, growth of fungus or mildew and other environmental conditions specified herein.

(h) Any cement mortar or grout used as part of the installation shall be in conformance with the Greenbook and its supplements and the Brown Book, and shall be fungus and mildew resistant. Cement mortar bed with latex admixture used as thin set method and the uses of other adhesive or sealant materials shall be submitted for review and testing prior to any installation.

(i) The width of the mortar joint to the adjacent concrete pavement shall be minimum 1/8 inch wide and not to exceed ¼ inch. The width of the joint to the abutting detectable warning surface shall not exceed 1/8 inch.

(j) No installation of any adjoining detectable warning surfaces shall result in any difference in level of 1/16 inch or the spacing of the adjoining truncated domes to exceed the maximum spacing as specified herein. No installation of the cast-in-placed detectable warning surface shall result in any difference in level with adjacent slab or pavement exceeding 1/8 inch.

(k) Detectable warning surface shall not be installed over expansion or control joint without the approval of the City Engineer.

(l) Any fastener used as part of the installation shall be made of corrosion resistant material and shall be recessed within the truncated dome or the detectable warning surface. No fastener or any part thereof shall be used as a substitute of the truncated dome or be completely exposed or extended above any truncated dome or other portion of the surface that would reduce the durability and slip resistance of the surface, and the detectability and effective use of wheelchair or cane/crutch.

(m) Cutting of the detectable warning surface shall be avoided. If cutting is considered as part of installation method, the cutting method and patching procedures shall be submitted for review and approval by the City Engineer. No detectable warning surface less than 6 inches in any dimension or partially cut truncated dome shall be allowed. No detectable warning surface with two adjoining cut edges shall be allowed for any installation without the approval of City Engineer. Cut edge shall be sealed or patched in
accordance with the approved manufacturer’s recommended procedures. Samples of
detectable warning surface with cut edges shall be used for testing specified in this
standard plan.

(n) All detectable warning surface shall have manufacturer name or identification and
manufacturing date with maximum text size of 1/2 inch but not less than ¼ inch on
minimum two sides or approved locations of the panel.

(o) The contractor shall provide product and labor warranty for the detectable warning
surface against any defect, cracking, deformation, discoloration, corrosion and movement
for minimum five years or duration as specified on the permit by the BOE permit
engineer, whichever is most stringent.

(p) (1) The nominal thickness of the surface-mounted type of detectable warning surface
shall be 1/8 inch exclusive of the height of the truncated domes. The perimeter edge
shall be tapered with bevel lip in accordance with Standard Plan No. S-442. Any
detectable warning surface greater than 1/8 inch thick, but not to exceed ¼ inch, shall
have bevel lip and edge treatment not exceeding 1/8 inch high. The width of
perimeter edges to the centers of the truncated domes shall not exceed 1.65 inches.
(2) The cast-in-place type of detectable warning surface including the embedment flange
or tile rib shall not exceed 1 3/8 inches thick and no bevel or chamfer shall be
allowed. From edges of the detectable warning surface to the centers of the truncated
domes shall not exceed 1.65 inches.

(q) The truncated domes of the detectable warning surface shall have in-line pattern and shall
be consistently aligned in the horizontal and the vertical directions. The truncated domes
shall have consistent spacing and height. The truncated domes shall be completely
formed domes and measured 0.20 inch in height from top of surface, 0.45 inch diameter
at the top of the dome and 0.90 inch diameter at the base. The top and base of the dome
dimensions shall form a 50% ratio. The truncated domes shall be spaced 1.65 inches
from center to center horizontally and 2.35 inches from center to center diagonally. For
areas where adjoining detectable warning surface are required, the spacing between the
first rows of the truncated domes of any two adjoining detectable warning surface shall
not exceed 2.35 inches. No truncated dome shall be made completely of metal fastener
or other substituted material as indicated in 3-5.1(l). (Truncated domes in staggered
pattern used for positioning surface shall not be used in the curb ramp.)

(r) The truncated domes, tile or panel surfaces shall not consist of any raised points or micro-
textures greater than 0.045 inch in height. The height of truncated dome shall be
measured from the top of surface, without any raised points or micro-textures, to the top
of the truncated dome and not to the raised points or micro-textures of the dome. Any
use of the raised points or micro-textures shall not reduce the 0.20 inch height requirement for the truncated domes.

(s) The detectable warning surface shall also have physical properties and performance values from testing as specified herein.

(1) The detectable warning surface completely constructed of the concrete or cementitious materials without the use of any resin or plastic shall have minimum properties and performance values as indicated in Greenbook. (Truncated domes produced by molding or stamping the top surface of freshly poured or precasted concrete or surfaced applied products are not an approved installation and are not permitted.)

The concrete or cementitious materials shall also have the following:

i. Hardness: Moh’s Hardness Scale of 6 or higher when tested per Mohs Scale Testing.

ii. Water Absorption: Maximum 0.30% when tested per ASTM D 570, C 97 or equivalent.

(2) Any part of the detectable warning surface that is manufactured with glass, carbon, plastic or polymer resin, fiberglass, fiberglass reinforced plastic (FRP), reinforced plastic mortar (RPM), vitrified polymer composite, or any combination thereof shall have the following properties and performance values:

**Polymer Concrete**

i. Ultimate Compressive Strength: Minimum 7,500 psi when tested per ASTM C 39, D 695 or approved equivalent.

ii. Ultimate Tensile Strength: Minimum 1,700 psi when tested per ASTM C 496, D 638 or approved equivalent.

iii. Ultimate Flexural Strength: Minimum 2,400 psi when tested per ASTM C 947, D 790 or approved equivalent.

iv. Hardness: Shore (Durometer) Test, minimum 75 Shore D Hardness when tested per ASTM D 2240.

v. Water Absorption: Maximum 0.50% when tested per ASTM D 570, C 97 or approved equivalent.

vi. Flammability: As described in 3-2.3.2(h)(1).

**Vitrified Polymer Composite (with or without reinforced fiber or woven roving).**

i. Ultimate Compressive Strength: Minimum 18,000 psi when tested by ASTM D 695.
ii. Ultimate Tensile Strength: Minimum 12,000 psi when tested per ASTM D 638.

iii. Ultimate Flexural Strength: Minimum 24,000 psi when tested per ASTM D 790.

iv. Hardness: Shore (Durometer) Test, minimum 75 Shore D when tested per ASTM D 2240.

v. Water Absorption: Maximum 0.10% when tested per ASTM D 570.

vi. Flammability: As described in 3-2.3.2(h)(1).

(t) Color: Surface shall have Federal Color No. 33538 in accordance with Federal Standard No. 595A/595B and shall contrast with adjacent concrete surface, either light-on-dark or dark-on-light, with contrast value greater than 70% in accordance with Appendix Note A4.29.2 of the Accessibility Guidelines For Buildings and Facilities (ADAAG) developed by United States Access Board. Color shall be integral with the detectable warning surface and shall not be surface applied. Paint or surface applied coating shall not be used. No loss of color after abrasion resistance test or environmental conditioning as indicated in this standard plan shall be allowed.

(u) Efflorescence Test: No efflorescence when tested per modified ASTM C 67.

(v) Fungal and Mold Resistance: No growth or with the Rating of 10 when tested per ASTM D 3274.

(w) Chemical Stain Resistance: No change of weight and dimension. No appearance of discoloration, stain, deformation or etch mark when tested for Standard Dirt, Bleach, Gums, Inks (and graffiti), 5% Urea, Turpentine and 1% Soap Solution by ASTM D 650 or C 1378 for 24 hours.

(x) All detectable warning surface shall be inspected for defect, damage, crack, scratch and warping prior to installation. All detectable warning surfaces with the deficiencies shall be removed from the job site immediately.

3-5.2 Basic Physical Property Tests.

(a) Unless otherwise specified, all detectable warning surface shall be tested for the property values as specified in 3-5.1(s) through (w) in accordance with the applicable material standards specified. The permittee shall coordinate with the testing laboratory for the numbers and the sizes of specimens and/or coupons for the testing.

(b) After the detectable warning surface has been satisfactorily completed the tests listed above and has met the property requirements, all detectable warning surface shall also be tested for the following values in accordance with 3-1.2.1(g). (Unless otherwise specified, all specimens shall be minimum 12” x 12” detectable warning surface embedded in concrete pavement with applicable thickness as specified in 3-5.1(d), approved cement bed or adhesive system and perimeter sealing.) For cast in place type of
detectable warning surface and if applicable, one embedment flange (also referred as “tile rib”) shall be embedded in each specimen. If any fastener or anchoring system that has no structural value is used in the material or product, the number of the fastener or anchoring system used in each specimen shall be proportioned to the total number of the fastener or anchoring system used over the actual material or product surface area, but not to exceed one.

(1) Initial Slip Resistance Tests in accordance with 3-1.2.1(g). Three 12" x 12" (or specimens, with sizes cut to fit the Gardner abrasion apparatus for the abrasion resistance test, mechanically held together to form 12" x 12" specimens) shall have minimum static coefficient of friction of 0.8 for ramp and 0.6 for level surface when tested per ASTM C1028. (Unless the manufacturers can distinguish their products for ramp or level surface application, all detectable warning surface shall be tested for the ramp application with the most stringent value.)

(2) Initial Abrasion Resistance: After Initial Slip Resistance test described above, test for Initial Abrasion Resistance with average wear (loss) not to exceed 0.05 inch when tested per modified ASTM D 2486. Height measurements shall be taken on each of the minimum six dome locations from the top surface to the top of truncated dome, excluding the raised points or micro-textures as discussed in 3-5.1(r), before and after the Initial Abrasion Resistance test. The wear (loss) of each truncated dome shall be computed by subtracting the final measurement from the initial measurement.

(3) Long Term Abrasion and Slip Resistance Tests: Three sets of specimens from the Initial abrasion test shall be used to continue for the long term abrasion and slip resistance tests. The average slip resistance shall not be less than 90% of initial tested coefficient of friction, and not less than 0.5.

3-5.3 Performance and Durability Tests.

(a) In addition to the physical properties listed above, the detectable warning surface shall be subject to the following performance and durability testing after exposed to the environmental conditioning specified below:

(1) Environmental Conditioning.

i. Chemical Exposure Test per ASTM D 543 and procedures as described in 3-2.3.2(e)(4) with exposures for the duration of seven days. (Note: If detectable warning surface is completely made of concrete or cementitious materials and with cementitious mortar bed and grout and without any use of resin or plastic, and no adhesive or perimeter edge treatment is used during installation; the
Chemical Exposure Test shall not apply.)

**CHEMICAL SOLUTIONS**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Chloride</td>
<td>5%</td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>0.1 N</td>
</tr>
<tr>
<td>Sodium Sulfate</td>
<td>0.1 N</td>
</tr>
<tr>
<td>Hydrochloric Acid</td>
<td>0.2 N</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>0.1 N</td>
</tr>
<tr>
<td>Ammonium Hydroxide</td>
<td>10%</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>5%</td>
</tr>
<tr>
<td>Kerosene</td>
<td>Per ASTM D 543</td>
</tr>
<tr>
<td>Diesel Oil</td>
<td>Per ASTM D 543</td>
</tr>
</tbody>
</table>

ii. Accelerated Weathering Test per ASTM G 151 with exposure period of 2,000 hours of xenon arc ultraviolet light and water spray. The specimens shall not show any deterioration, fading, chalking, color change or cracking. (If the detectable warning surface is completely made of concrete or cementitious materials with cementitious mortar bed and grout and without any use of resin or plastic, and without any use of adhesive or no perimeter edge treatment during installation, the Accelerated Weathering test shall not apply.)

iii. Elevated Temperature Test with specimens to be conditioned at 80 °C (176 °F) in accordance with procedures as specified in ASTM D 756, Procedure E. Specimens shall not show any deterioration, fading, chalking, color change or cracking. Specimens shall be allowed to cool to room temperature before next cycle of testing. If detectable warning surface is completely made of concrete or cementitious materials with cementitious mortar bed and grout and no adhesive or perimeter edge treatment is used, the Elevated Temperature Test shall not apply.

iv. Salt and Spray Performance Test per ASTM B 117 (and evaluation of rusting by ASTM D 610, and Blistering by ASTM D 714) with exposure period of 200 hours. No appearance of any defect, discoloring, scaling or rusting shall be present.

(2) Performance and Durability Tests:

i. Compression Strength Test per ASTM C 936 or C 648 with a 1000 lbs of force over the center of a truncated dome. No appearance of any crack, failure, damage or permanent deformation shall be detected.

ii. Impact Resistance (Weight Drop) Test per modified ASTM D 2444. A selected
truncated dome and a location of beveled edge of the detectable warning surface shall be subject to 24 ft-lb impact achieved by dropping a steel rod of 12 lbs with “B” Tup from an approximate height of two feet. A failure is noted if any appearance of crack or hairline fracture, chipping, failure, damage or permanent deformation of the truncated dome is visible in the specimen. Localized indentation is not considered as a failure.

iii. Sidewalk Traffic Impact Test per modified ASTM D 2794 with each specimen supported at a 60 degree angle from horizontal and subject to a 4 ft-lb impact force from a metal cylinder weight with similar “B” Tup end, dropped from a predetermined height and positioned by guide tube, at the side of the truncated dome. No appearance of any crack, failure, chipping, damage or permanent deformation shall be detected.

iv. Bond Strength or Adhesive Test per modified ASTM C 1583 with bond strength not less than 100 psi. (For any detectable warning surface that consists of structural fastener or anchoring system with or without the use of adhesive in the installation, full size product sample (minimum 3 feet x 4 feet) with actual amount of fasteners and anchoring system can be used in lieu of sample size as described in 3-5.2(b) for the Bond Strength or Adhesive Test.)

(b) Performance and Durability Testing Procedures.

(1) With the chemical exposure conditioning per ASTM D 543 as described above, four groups of specimens and each group containing a total of 27-12” x 12” specimens with a minimum four inches thick concrete base and applicable mortar base or adhesive (with three specimens for the exposure to each of the nine chemical reagents listed) after exposure, perform the following tests with number of specimens specified:

i. Compression Strength Test as described above-One group of specimens exposed to each of the nine chemical reagents.

ii. Impact Resistance (Weight Drop) Test as described above-One group of specimens exposed to each of the nine chemical reagents.

iii. Sidewalk Traffic Impact Test as described above-One group of specimens exposed to each of the nine chemical reagents.

iv. Bond Strength or Adhesive Test as described above-One group of specimens exposed to each of the nine chemical reagents.

(2) Provide number of specimen as specified below for the Accelerated Weathering conditioning per ASTM G 151 as described in 3-5.3(a)(1)ii and perform the following
tests after the exposure:
  i. Compression Strength Test as described above-Three specimens.
  ii. Impact Resistance (Weight Drop) Test as described above-Three specimens.
  iii. Sidewalk Traffic Impact Test as described above-Three specimens.
  iv. Bond Strength or Adhesive Test as described above-Three specimens.

(3) After the Elevated Temperature conditioning described above, perform the following tests with number of specimens specified:
  i. Compression Strength Test as described above-Three specimens.
  ii. Impact Resistance (Weight Drop) Test as described above-Three specimens.
  iii. Sidewalk Traffic Impact Test as described above-Three specimens.
  iv. Bond Strength or Adhesive Test as described above-Three specimens.

(4) After the Salt and Spray conditioning per ASTM B 117 as described above, perform the following tests with number of specimens specified:
  i. Compression Strength Test as described above-Three specimens.
  ii. Impact Resistance (Weight Drop) Test as described above-Three specimens.
  iii. Sidewalk Traffic Impact Test as described above-Three specimens.
  iv. Bond Strength or Adhesive Test as described above-Three specimens.

SECTION 6
BRICK, CONCRETE OR OTHER DECORATIVE PAVERS

3-6.1 General.

(a) All pavers shall be submitted with the Manufacturing or Quarry Certificate indicating the physical properties of the pavers to the City Engineer for review and approval. The physical properties of the materials shall conform to the minimum physical properties specified herein.

(b) The pavers covered in this standard plan are for exterior application and with pedestrian traffic. If considered by the City Engineer, any pavers intended for the driveway apron shall be submitted for appropriate testing as determined by the City Engineer and with structural calculations for the vehicular traffic loadings. All paver surfaces shall be level and shall not be made of or contain any split face, cobble or pebble stone. All pavers shall not be acid sensitive or have any iron or rust stains or etch marks.

(c) Unless otherwise specified and wherever is applicable, all pavers shall be impervious and have minimum wear rating of Group V or equivalent in accordance with Porcelain Enamel Institute (PEI).
(d) Unless otherwise specified, all pavers shall be tested per Mohs Scale Testing and have Mohs Hardness Scale of 6 or higher. All pavers shall be tested per ASTM C 648 and have breaking strength not less than 250 lbs when the paver actually breaks into two or more pieces. All pavers shall be tested per ASTM C 482 or C 1583 with minimum bond strength of 100 psi to the mortar base and to rigid concrete pavement.

(e) No pavers shall be allowed on the top of concrete curb or curb ramp.

(f) All pavers shall be installed over mortar base and slip sheet (if required by the City Engineer) on top of minimum three inches thick rigid concrete pavement and compacted aggregate bases and subgrade. If paver is approved to be installed over driveway apron, the rigid concrete pavement support shall conform with the minimum thickness as determined by structural calculations but not less than the thickness as specified for driveways shown in Standard Plan No. S-440. When requested by the City Engineer, the rigid concrete pavement shall have one inch diameter weep hole to the bottom of the pavement every five feet covered with approved filter cloth. For locations where high water table existed, install approved moisture barrier below rigid concrete pavement and weep hole over the aggregate bases and subgrade. Turn the moisture barrier up or down against the back of concrete curb, abutting building wall or foundation and seal all openings and around the weep holes, from moisture penetration.

(g) Unless otherwise specified, all pavers shall have cementitious mortar beds, grout joints or approved bond coats. All grout joints shall be a minimum of 1/8 inch but not to exceed 3/8 inch wide.

(h) Sand joint is not allowed in any installation. All pavers, mortar beds, grout joints and approved bond coats shall have the resistances to the following:

1. Paver, mortar bed and grout joint materials shall have resistance to fungus and growth of mold, and efflorescence when tested per ASTM D 3273 and ASTM C 67, respectively. Any installation using a polymer adhesive as the bonding or grout joint material shall be tested for the bond strengths with each of the environmental conditioning as specified in 3-5.3(a)(1).

2. Paver shall have the chemical resistance when tested per ASTM C 650.

(i) Size of the pavers if different unit pavers are used, size of grout joint, thickness of the mortar bed and all installation method and procedures must be provided and submitted for the City Engineer’s review and approval.

(j) All style and color of the paver shall be final-approved by Los Angeles City Cultural Affairs Department and BOE permit engineer.

(k) No paver shall have coating or sealer before and after the installation without the review
and testing by the City Engineer. If requested by the City Engineer, pavers shall be tested for presence of any coating by ASTM C 216.

(l) All pavers shall have static coefficient of friction not less than 0.6 when tested per ASTM C 1028 for pedestrian area containing slope less than 2%. For pedestrian area containing slope greater than 2% and driveway apron area where allowed by the City Engineer, the pavers shall have static coefficient of friction not less than 0.8 when tested per ASTM C 1028. In addition, all pavers in the driveway apron area shall have dynamic coefficient of friction not less than 0.35 when tested per Calif Test Method No. 342.

(m) All pavers shall have no rounded or beveled edges or chamfers.

(n) All pavers shall have minimum six inch wide concrete collars constructed around all maintenance holes, tree wells, street lighting standards or similar installations. All pavers shall have approved expansion joints at the footings of parking meters, bicycle racks, newspaper stands, control cabinet and other similar installations. No other installations shall be allowed directly on top of the pavers. Construct concrete footings for such installations where necessary before paver installation.

(o) All unit pavers shall have approved concrete rigid edge restraints to secure the whole paving system laterally including the area along the parkway. Concrete rigid edge restraints shall be built before pavers are laid.

(p) No paver smaller than 1/3 of the whole paver in width shall be used any installation.

(q) Patterns of the pavers shall be arranged on the submittal and/or in the field. All narrow gaps between the pavers and concrete curbs or concrete rigid edge restraints or collars shall be filled by mortar. Care should be given to adopt an appropriate pattern conforming to the any curving character of the surface area or round corners.

(r) All pavers and rigid concrete pavement shall have expansion joints in spacing not to exceed 15 feet. All pavers shall have expansion joints at the changes of bond pattern, paving slope or direction, at separation of dissimilar materials, along the perimeter such as the adjacent walls, foundation or fixed objects, and shall correspond with the control or expansion joints in the mortar bed and the rigid concrete pavement below. Expansion joint filler shall be highly compressible and durable when exposed to weather or abrasion and conform to the Greenbook and its supplements and the Brown Book.

(s) All pavers shall be laid in accordance with standard bricklaying or tile setting procedures. No paver shall be laid in mortar setting bed with more than two feet ahead of the laying of the pavers.

(t) The edges of any paver shall not vary from the plane of adjacent pavers and surfaces more than 1/8 inch.

(u) Unless otherwise specified, all grout joints shall be tooled with a concave finish.
(v) No installation shall result in any ponding or interruption of surface flow. Larger paved areas or areas containing planting beds higher than the paving surface shall have intermediate or area drains, or scupper approved by the BOE permit engineer.

(w) All pavers shall be protected from mortar or grout stains.

(x) When deemed necessary, it shall be the City Engineer’s discretion to request the permittee to perform additional testing in addition to those specified in this standard plan for verification of the physical properties of the pavers at the permittee’s expense.

(y) All construction shall conform to the requirements as indicated in this standard plan and the standard industry practices as recommended by the Brick Institute of America, BIA (2815 Frampton Ave, Torrance, Calif 90501, http://www.masonryinstitute.org), Brick Industry Association (11490 Commerce Park Drive, Reston, Virginia 20191, http://www.brickinfo.org), Ceramic Tile Institute of America, Inc. (12061 Jefferson Blvd., Culver City, Calif 90230-6219, http://www.ctioa.org.), the Interlocking Concrete Pavement Institute, ICPI, (14441 I Street, NW, Suite 700, Washington, D.C. 20005-6542, http://www.icpi.org), and Porcelain Enamel Institute, PEI (3700 Mansell Road, Suite 220, Alpharetta, GA 30022, http://www.porcelainenamel.com), whichever is applicable. If there are any conflicts, the most stringent requirements shall govern.

(z) It shall be the permittee’s responsibilities to ensure the future availability of the approved paver and/or maintain adequate amount of spare paver for the future maintenance and repair. No substituted paver shall be allowed for any change or repair.

(aa) Unless otherwise specified, all pavers or pavings consisted of exposed aggregates shall be tested per modified ASTM C 627 with 300 lbs weight per each steel wheel for a total of 450 cycles. The number of loss or damaged aggregates along the wheel path shall not be greater than 1%.

3-6.2 Brick Pavers.

(a) Brick paver shall be unglazed paving brick to support pedestrian traffic. All brick paver shall be non-effloresced brick paver with Class SX, Type 1 Traffic, and Application PX as described in ASTM C 902 and shall have a minimum a 2 5/8 inch thickness.

(b) Brick paver shall have minimum compressive strength of 8,000 psi, maximum water absorption rate of 5% and weathering index less than 50 when tested with ASTM C 67. Brick paver shall be within the allowable dimensional tolerances (± 1/16 inch in length, width and depth) and have the range of chippage less than 1/4 inch in edge and 3/8 inch in corner as described in ASTM C 902.

(c) Brick paver shall have minimum abrasion resistance of 35 when tested per modified
ASTM C 241; minimum abrasion wear value of 35 when tested per ASTM C 501; or maximum Abrasion Index of 0.11, or a maximum volume abrasion loss of 0.10 in³/0.16 in² (or maximum abrasion loss of 0.67 inch) when tested in accordance with ASTM C 418.

(d) Mortar bed shall be Type M mortar with minimum compressive strength of 1,800 psi and conform with ASTM C 270.

(e) The brick pavers shall meet the required minimum coefficient of friction as specified herein before and after the abrasion resistance test.

(f) Brick paver shall be constructed in 90-degree Herringbone pattern.

(g) If a manufacturing certificate is submitted with all the physical property data and the data conform with the requirements specified herein, only the abrasion wear test and the slip resistance test shall be performed for the physical property test. If a manufacturing certificate is not provided with the submittal, the brick paver shall be tested per the ASTM C 902 and other testing standards specified herein to verify for all the physical requirements. The City Engineer has the right to order any additional tests to verify the physical properties of the material or product.

3-6.3 Concrete Pavers.

(a) Concrete pavers shall be uncoated and non-effloresced paver conforming to the requirements as specified in ASTM C 936 and shall have a minimum thickness of 2 3/8 inches.

(b) Concrete pavers shall have minimum compressive strength of 8,000 psi, maximum water absorption rate of 5% and weathering index less than 50 when tested with ASTM C 140.

(c) Concrete pavers shall have a minimum abrasion resistance of 35 when tested with modified ASTM C 241, minimum abrasion wear value of 35 when tested with ASTM C 501, or maximum abrasion volume loss of 0.92 in³/7.75 in² (or a thickness loss not more than 1/8 inch) when tested per ASTM C 418.

(d) Concrete pavers shall be within the allowable dimensional tolerances as described in ASTM C 936.

(e) Polymer adhesive for the concrete pavers shall not be used without the environmental conditioning test and the approval the City Engineer.

(f) Concrete pavers shall be constructed in 90-degree Herringbone pattern.

(g) The concrete pavers shall meet the required minimum coefficient of friction as specified hereinbefore and after the abrasion resistance test has been completed.

(h) If a manufacturing certificate is submitted with all the required physical property data and the data conform with the requirements specified herein, only the abrasion wear test and
the slip resistance test shall be performed for the physical property test. If a manufacturing certificate is not provided with the submittal, the concrete paver shall be tested per the ASTM C 936 and other testing standards specified herein to verify for all the physical requirements.

3-6.4 Granite, Sandstone, Marble and Limestone Pavers.

3-6.4.1 General.

(a) All granite, sandstone, marble pavers including limestone pavers shall be natural stones and for exterior application, in accordance with ASTM C 119-Standard Terminology Relating To Dimension Stone, that are sawed, cut, split and shall exclude molded, cast, or artificially aggregated nits composed of fragments and crushed or broken. Unless otherwise specified, all pavers shall have a minimum thickness of 1 ¼ inch. All pavers shall be submitted with a Quarry Certificate indicating the physical properties of the materials to the City Engineer for review and approval. The physical properties of the materials shall conform to the minimum physical properties specified herein. Abrasion resistance wear test and slip resistance test shall be performed for the physical property test. If a Quarry Certificate is not provided, the material or product shall be tested per the ASTM C 615-Standard Specification for Granite Dimension Stone, ASTM C 616-Standard Specification For Quartz-Based Dimension Stone, ASTM C 1526-Standard Specification for Serpentine Dimension Stone, ASTM C 1527-Standard Specifications for Travertine Dimension Stone or ASTM C 568-Standard Specification for Limestone Dimension Stone, whichever is applicable, to verify the physical requirements.

(b) If requested by the City Engineer, the pavers shall be tested for compressive strengths per ASTM C 170.

3-6.4.2 Granite.

(a) Granite paver shall be vitreous type and have minimum compressive strength of 19,000 psi when tested per ASTM C 170, maximum absorption rate of 0.4% when tested with ASTM C 97, and shall have minimum abrasion resistance or wear value of 75 conforming to ASTM C 501 when tested with ASTM C 241 or C 1353, or maximum abrasion volume loss of 0.92 in³/7.75 in² (or a thickness loss not more than 1/8 inch) when tested per ASTM C 418.

3-6.4.3 Sandstone.

(a) Sandstone pavers shall be either Type II Quartzitic Sandstone or Type III Quartzite Sandstone with minimum compressive strength of 10,000 psi or 20,000 psi, respectively,
when tested per ASTM C 170; maximum absorption rate of 3% and 1%, respectively, when tested per ASTM C 97. All sandstone pavers shall have a minimum 1½ inch thickness and shall conform to ASTM C 616 and have minimum abrasion resistance value (Ha) or wear valve of 18.5 when tested per ASTM C 241.

3-6.4.4 Marble and Limestone.
(a) Marble pavers shall be Class III Serpentine or Class IV Travertine marble as defined in ASTM C 119-Definitions of Terms Relating to Dimension Stone or have Marble Soundness Classification of Group C in accordance with the Marble Institute of America (28901 Clemens Road, Suite 100, Cleveland, Ohio 44145, http://www.marble-institute.com), or better. Class III Serpentine or Class IV Travertine marble is also referred to as limestone with equitable class as defined in ASTM C 568.
(b) Class III Serpentine and Class IV Travertine Marble Pavers. Class III Serpentine and Class Travertine marble pavers shall have the following properties in conformance with ASTM C 1526 and C 1527, respectively.
(1) Class III Serpentine and Class IV Travertine marble pavers shall have minimum compressive strengths of 10,000 psi and 7,500 psi when tested with ASTM C 170, and maximum water absorption rate of 0.2% and 2.5% when tested with ASTM C 241, respectively. Class III Serpentine and Class IV marble pavers shall have minimum thickness of 1 1/4 inches and with minimum abrasion resistance value (Ha) of 12.0 when tested per ASTM C 241.
(c) Limestone other than those indicated above shall be minimum Class III high density limestone as defined in ASTM C 568. Class III high density limestone shall have a minimum thickness of 1 ¼ inches, minimum compressive strengths of 8,000 psi when tested with ASTM C 170, maximum water absorption rate of 3.0% when tested with ASTM C 97 and minimum abrasion resistance value (Ha) of 12.0 when tested per ASTM C 241.

3-6.5 Performance and Durability Test.
In addition to the physical property tests as indicated herein, all pavers shall be tested in accordance with requirements indicated below unless otherwise specified. All testing specimens shall be made in accordance with the approved installation details and/or specified testing standards. Unless otherwise specified, all specimens shall have rigid concrete pavement support with minimum thickness as specified in 3-6.1(f), and approved mortar base or adhesive material.
(a) Impact load test in accordance with 3-2.3.3 hereinbefore. Unless otherwise specified, the
impact load shall be minimum 24 ft-lb by a metal weight having “B” Tup.
(b) Bond Strength or Adhesive Test in accordance with 3-5.3(a)(2)iiv with sample size as described in the ASTM C 482 or C 1583 standards. If polymer adhesive is used as bonding and grout joint material, perform bond strength or adhesive test with specimens exposed to environment conditionings per 3-5.3(a)(1).
(c) Paver and Grout Joint Performance Test in accordance with modified ASTM C 627 with 300 lbs weight per each steel weight for a total of 450 cycles. No chippage of tile or paver and any grout joint loss along the wheel path shall exceed 3.0%. Unless otherwise directed by the City Engineer, any installation of tile or paver located in residential area or local street, and commercial area or non-local street with a total combined area of less than 50 sq. ft. and 100 sq. ft., respectively, shall be exempted from the paver and grout joint performance test. This exemption is not applicable to the materials or products made with exposed aggregates.