

DATE: January 28, 2022

ADDENDUM NUMBER: 3

MODIFYING: Specifications No. 1873A

PROJECT: **La Verne Shops Building Completion – Stage 4**

BID TIME AND DATE: 2:00 p.m., March 1, 2022

FROM: THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
700 North Alameda Street, Third Floor
Los Angeles, California 90012
(213) 217-6515

TO: All prospective bidders

This addendum forms a part of the contract documents. Use Specifications No. 1873A as originally issued to submit bids, in conjunction with this addendum and all previously issued addenda, and acknowledge receipt of this addendum by completing Item 4 in Document 00420, "Bidder's General Information," in the specifications. Failure to acknowledge this addendum will render a bid non-responsive and the bid will be rejected.

This addendum consists of 5 pages of text and 20 pages of attached documents.

CHANGES TO BIDDING REQUIREMENTS:

1. Change the time and date for the opening of bids from 2:00 p.m., February 9, 2022, to 2:00 p.m., March 1, 2022.
2. In Document 00200, Information Available to Bidders, replace item 18 with the following:

| No. | Title | Date | Author |
|-----|---------------------------|-----------|------------------------------------|
| 18 | Field Office Rental Quote | 10/4/2021 | Atlas Performance Industries, Inc. |

3. After the end of Document 00480, insert Document 00485, Sexual Harassment and Abusive Conduct Prevention Training Certification, attached to this addendum.

CHANGES TO CONDITIONS OF THE CONTRACT:

4. In Document 00800, Supplementary General Conditions, delete Article 1 and replace with the following:
 1. In subparagraph 1(a)(11) of Document 00700, General Conditions, the edition of the Metropolitan Standard Detail Book shall be 2015 and 2017.
5. In Document 00800, delete Article 2 and replace with the following:
 2. In Document 00700, change subparagraph 64(b)(2) to read:

(2) The minimum limit shall be \$3,000,000 per occurrence for bodily injury, personal injury and property damage (including operations, products and completed operations). During the period of time that any aircraft is used, a current certificate of insurance with aircraft liability coverage of \$5,000,000 will be required. If a general aggregate limit is used, either the general aggregate limit shall apply separately to the project or location, or the general aggregate limit shall be twice the specified occurrence limit.
6. In Document 00800, delete Article 3 and replace with the following:
 3. In Document 00700, change subparagraph 64(b)(2) to read:

(2) The minimum limit shall be \$3,000,000 per accident for bodily injury and property damage, combined single limits.

CHANGES TO SPECIFICATIONS:

7. In Section 02200, Earthwork, delete subparagraph 3.08D.3 in its entirety and replace with the following:
 3. The lateral limits of the required overexcavation and recompaction beneath foundations and concrete slabs shall be as follows:
 - a. Unit Substation: Lateral limits of required overexcavation shall extend across the entire footprint of the foundation or concrete slab, and for a horizontal distance of at least 3 feet beyond the foundation or concrete slab on the east, south, and west sides. Lateral limit of required overexcavation on the north side shall be a horizontal distance of at least 2 feet. The lateral extent of required excavation shall be measured from the outside edge of the foundation or concrete slab.
 - b. Air Compressor and Canopy: Lateral limits of required overexcavation shall extend across the entire footprint of the foundation or concrete slab, and for a horizontal distance of at least 3 feet beyond the foundation or concrete slab on the east, north, and west sides. Lateral limit of required overexcavation on the north side shall be a horizontal distance of at least 1 foot. The lateral extent of required excavation shall be measured from the outside edge of the foundation or concrete slab.
 - c. Lateral overexcavation for plasma cutter, water jet, hydraulic shear, vertical band saw, horizontal band saw, and brake press are not required.
8. Delete Section 02251 and replace with the attached Section 02251, dated January 2022.
9. After Section 03300, Cast-In-Place Concrete, insert Section 03360.
10. In Section 13005, Installation of Metropolitan-Furnished Equipment, after Paragraph 1.02B, insert the following Paragraph:
 - C. ASTM International
 1. ASTM C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
11. In Section 13005, after Paragraph 1.03F, insert the following Paragraph:
 - G. Product Data
 1. The Contractor shall submit product data including test report or certification for rigid, cellular polystyrene thermal insulation compressible material per ASTM C578 for the Engineer's approval.
12. In Section 13005, after subparagraph 3.03M.1.c, insert the following subparagraphs:
 - d. The Contractor shall submit construction excavation sequencing plan and procedure, and support system design plan for review and acceptance per Section 02251, Protection and Support of Existing Machine, Fabrication, and Coating Shop.
 - e. Compressible material between the existing grade beam and new foundation shall be minimum of 6-inches thick, and conform to ASTM C578. The compressive resistance of the material shall be a minimum of 40 psi.
 - f. The existing building columns, foundations and grade beams shall be protected in place.
13. Delete Section 17540, Telecommunications Fiber Optic Cable Systems, in its entirety.

QUESTIONS AND CLARIFICATIONS:

Requests for clarification of details on the drawings or of provisions of the specifications have been identified. The questions with the appropriate Metropolitan responses are as follows:

- (1) Question: We are requesting drawings and list for each fiber cable run to and from. We are also requesting the fiber type and strand count for each cable run.
- Answer: No fiber optic cable is used in the project. Specification Section 17540 has been deleted. Refer to Changes to Specifications in this addendum.
- (2) Question: What is the required self-performance percentage on this project?
- Answer: There is no minimum self-performance percentage required.
- (3) Question: Reference is made to Drawing Sections S-311/A&B and S-312/B at Vertical Machining Center. Between the new foundation and the existing concrete grade beam, there's a call out for "compressible material". However, plans and specifications do not specify type of compressible material. Please provide the details of compressible material.
- Answer: 6-inch thick minimum rigid cellular polystyrene thermal insulation per ASTM C578 shall be used for the indicated compressible material. Refer to changes to Section 13005 in this addendum for compressible material requirements.
- (4) Question: Reference S-200 and Detail 1/S-307, please confirm or provide the following for Ladder Numbers L-20-1, L-20-3R, L-20-6, L-21-1R, L-21-2R, L-22-1, L-22-2 and L-22-3:
- A) Please confirm six (6) linear feet of guardrail is required on both sides of the ladder.
- B) Please provide Ladder Numbers requiring guardrails at parapet walls where the top is less than 42" above the roof deck.
- C) Please provide Ladder Numbers requiring a mid-rail on the guardrails at parapet walls where the top is less than 1'-9" above the roof deck.
- Answer: A) Guardrails are required as detailed each side of ladder where noted in Table on Sheet S-200.
- B) Guardrails are required where stated on the contract drawings and where height of the parapet is less than 42" from the roof finish floor. The Contractor shall verify in the field. For bidding purposes, assume guardrails are required where noted in the Table on Sheet S-200.
- C) The mid-rail is not required where the parapet is taller than 1'-9" in height from the roof finish floor. For bidding purposes, assume all guardrails require mid-rail.
- (5) Question: Can you please provide a copy of bid form 00485 Sexual Harassment and Abusive Conduct Prevention Training? This was not included in the bid documents, but looks like it is mandatory to turn in with our bid.
- Answer: This document is provided in this addendum.
- (6) Question: Please confirm that if one of the three refurbishing entities are listed in our bid (Bourn & Koch, KRC Machine Tool Services, Five Machining Systems), that we do not need to submit Document 00421, Supplementary Bidder's Information, and that this information is only required for alternatives?
- Answer: Document 00421 shall be submitted with bid. This is required regardless if one of the 3 entities listed in the specifications is being used or a proposed alternative.
- (7) Question: Print E-307, note 7 says to run conduit to the Tele/Data Closet. Where is the Tele/Data Closet located?
- Answer: The Tele/Data Closet is located in the southwest corner of the coating shop at grid lines V.1/A2.1 on Sheet E-307.

- (8) Question: Is there any duct cleaning on this project, if so what HVAC equipment, etc., evap coolers, exhaust fans?
- Answer: Duct systems that are included in the scope of work for the project shall be cleaned of debris in accordance with specification Section 15596, subparagraph 3.01A.5.
- (9) Question: Print E-312 notes 1 & 2 show 5 conduits running east and west. The conduits run from various equipment back to 06US-7R. Once the conduits penetrate the wall it is unclear how the conduits get back to the substation. Do they run exposed the entire length of the run? Do we intercept exiting conduit? Please clarify
- Answer: Once the conduits penetrate the wall, the design intent is to extend the new conduits to the existing pull box shown in Photo 5/E-602. The pull box has spare conduits that connect to Unit Substation "06US 7R." There will be sufficient spare conduits after the scope of demolition work shown on sheet E-206 is completed. Photo 5 on Sheet E-602 shows the pull box in the upper right corner of the wall in the breezeway.
- (10) Question: Refer to specification Section 02251, subparagraph 1.04A.8, requiring that support systems be designed to current ACI (and other) code requirements.
- A) Does this include application of overload factors such as 1.6 for lateral earth pressure in design of temporary concrete support elements?
- B) If not, what overload factors if any, will be required for lateral pressures calculated based on combined active earth pressure, construction equipment surcharge and nominal 500 psf slab surcharges specified in Section 02251, subparagraph 1.04C.1 for temporary support design?
- Answer: A) For design of temporary protection and support systems in general, the Contractor has the option to use LRFD or ASD method per ASCE 7 (latest edition), but not a combination of LRFD and ASD. For design of the concrete component of the temporary protection and support system, LRFD method shall be used per ACI 318, except for serviceability requirements required by the code.
- B) Surcharge from the interior concrete slab shall consist of dead load based on the actual existing configuration of adjoining/adjacent concrete elements plus construction live load from equipment, traffic, materials, and stockpile located within a horizontal distance equal to the exposed height of the support systems or 10 feet, whichever is greater. Refer to changes to Specifications for Section 02251 in this addendum.
- (11) Question: Refer to Specification 02251, subparagraph 1.04A.10.c.3 prohibiting any use of soil nails. Will MWD consider the use of soil nails or tiebacks in areas free of utilities, grade beams, footing or other structural elements?
- Answer: Yes. Refer to changes to Specifications for Section 02251 in this addendum.
- (12) Question: Refer to Specification 02251, subparagraph 1.04B.2.a.
- A) Will Metropolitan accept a less stringent deflection limit for design of temporary support elements such as lagging?
- B) Can lagging deflection limit be expressed as a function of span?
- Answer: A) Yes. Refer to changes to Specifications for Table 1 in Section 02251 in this addendum.
B) No.
- (13) Question: Refer to Specification 02251, subparagraph 3.05B.1. Can the dimension of underpinning installation pits be longer than 2' normal to the element being underpinned?
- Answer: Plan dimensions are increased to 3 feet by 3 feet. Refer to changes to Specifications for Section 02251 in this addendum.

- (14) Question: Refer to Specification Section 02251, subparagraph 1.04C.1.b.
A) Can the Contractor use temporary barriers around work areas, subject to the Engineers approval, to limit the requirement to include a 500 psf interior floor concrete slab surcharge load on temporary support systems?
B) Since the floor design live load is 100 psf, can this surcharge load be reduced?
- Answer: A) Refer to Changes to Specifications for Section 02251 in this addendum.
B) Refer to Changes to Specifications for Section 02251 in this addendum.
- (15) Question: Refer to Specification 02251, subparagraph 3.05B4. Can multiple underpinning installation pits be excavated simultaneously subject to a specified lateral separation?
- Answer: Yes. Multiple excavation for the installation of underpinning support can be performed at any given time, provided the open excavations are separated by at least one unexcavated location. Refer to Changes to Specifications for Section 02251 in this addendum.
- (16) Question: Refer to Specification 02251, which requires over 200 LDRP and DRPs to monitor the building footings and temporary shoring. Please confirm that three DRPs per column are needed to adequately protect the building columns at the VMC, Air Compressor and Unit Substation, and that if DRPs are required at the midspan between columns at the blast booth.
- Answer: Locations and numbers of DRPs and LDRPs have been revised. Refer to Changes to Specifications for Section 02251 in this addendum.
- (17) Question: Confirm the following structures require lateral limits of overexcavation to extend three feet beyond the foundations and slabs in accordance with Section 02200, subparagraph 3.08D.3. Air Compressor, Horizontal Band Saw, Hydraulic Shear, Brake Press, Vertical Band Saw, Water Jet, Plasma Cutter, Unit Substation.
- Answer: Lateral limits of required overexcavation have been revised. Refer to changes to Specifications for Section 02200 in this addendum.
- (18) Question: Can Metropolitan provide an updated quote for the field office lease?
- Answer: Yes. Refer to Changes to Bidding Requirements for the field office lease quote provided and referenced in Document 00200.

END OF ADDENDUM



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 PO Box 5754
 Santa Maria, CA 93456
 Phone No.: 800-394-9217
 Fax No.: 805-928-9190
 Home Page: www.apitrailers.com

QUOTE

Order Number: SM184779
 Document Date: 10/04/21
 Page: 1
 Salesperson: Steven Reyburn
 Email: salesassist@apitrailers.com
 Exp. Date

Customer Bill To Address

Customer Ship To Address

Order Contact Information

Pave West
 P.O. Box 789
 Artesia, CA 90702-0789
 Ph: 562.694.3113
 e-mail: Pauline@pavewest.com

Pave West
 3201 Wheeler Ave
 3201 Wheeler Ave
 La Verne, CA 91750
 Site Contact: Pauline
 Phone No.: 562.686.1991
 e-mail: Pauline@pavewest.com

Phone No.: 562.694.3113
 e-mail: Pauline@pavewest.com

Customer ID

Unless otherwise stated, Equipment rental prices listed below are the "total costs" per month. There will be no extra charge for tax, license or steps, these items are included in the lease price.

Items Rented (Recurring Monthly Charges)

| Item / Description | Quantity | Unit Price | Total Price |
|---|----------|------------|-------------|
| 12x60 Office Trailer Item Shipped: 666001001 (SN:MSWP727121) | 1 Ea | 362.50 | 362.50 |
| 12x60 Office Trailer Item Shipped: 666001004 (SN:MSWP727124) | 1 Ea | 362.50 | 362.50 |
| 12x60 Office Trailer Item Shipped: 666001005 (SN:MSWP727125) | 1 Ea | 362.50 | 362.50 |
| 12x60 Office Trailer Item Shipped: 666001006 (SN:MSWP727126) | 1 Ea | 362.50 | 362.50 |
| Foundation (Triple Pad) Item Shipped: T-FOUNDATION, Qty. 120 Unit will sit on Dirt & 3/4"-1" Crushed Rock | 120 Ea | 1.50 | 180.00 |
| Metal Step Item Shipped: FAS00074 | 1 Ea | 20.00 | 20.00 |
| Metal Step Item Shipped: FAS00500 | 1 Ea | 20.00 | 20.00 |

 *Order being transferred from SM182645 (MMC Inc.)

Subtotal: 1,670.00
 Total: 1,670.00

As stated in the "Terms and Conditions of Lease", Compliance with all Codes including, but not limited to, federal, state, and/or local codes or zoning ordinances shall be the sole responsibility of the Customer. Customer is solely responsible for locating and adequately marking any underground structures and/or utility services including but not limited to, gas, water, sewer, telephone, cable etc. prior to the unit delivery. Customer agrees to lease the Equipment from api and api hereby agrees to lease the Equipment to the Customer, on the terms and conditions set forth in this document and those in the Conditions of Lease Agreement located at <http://www.apitrailers.com> which are incorporated herein by reference. API Must be provided with an accessible site and level pad. Lessee/Purchaser will be held responsible & agrees to compensate API for any time delay resulting from Lessee/Purchaser or the site being unprepared, unlevel and restricted or difficult to access. Utility hook-ups, ADA Ramps, Custom steps, & permits are not included in this bid. If steps are required, Lessee/Purchaser is responsible to bring grade to first riser of step into compliance. If ADA Access ramp is required Lessee/Purchaser is responsible for the transition from end of ramp to grade. Lessee must provide API with a certificate of insurance naming API as additionally insured or purchase our "Insurance Surcharge" at 10% of the monthly rental cost. Lessee will be held responsible for all damage, vandalism & neglect in the use of this unit. Equipment quoted above is subject to availability. Price quote is valid for 30 days. Delivery, setup, take down & return are billed at the beginning of the lease.

Signature _____ Date: _____

SECTION 02251
PROTECTION AND SUPPORT OF EXISTING MACHINE, FABRICATION, AND COATING
SHOP BUILDINGS

PART 1 GENERAL

1.01 APPLICATION

- A. This section provides requirements for the protection and support of the existing machine, fabrication, and coating shop buildings and the ground underlying the foundations and interior floor concrete slabs of the existing buildings, during the excavation for and construction of foundations for the new equipment, structures, features, and foundations at the locations shown in the drawings.

1.02 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for referenced standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Concrete Institute (ACI)

1. ACI 318, Building Code Requirements for Structural Plain Concrete
2. ACI 336.3R, Design and Construction of Drilled Piers

C. American Institute of Steel Construction (AISC)

1. Manual of Steel Construction

D. ASTM International (ASTM)

1. ASTM A36, Standard Specification for Carbon Structural Steel
2. ASTM A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
3. ASTM A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

E. California Department of Transportation (Caltrans)

1. Trenching and Shoring Manual

F. Federal Highway Administration

1. Portions pertaining to underpinning
 - a. Lateral Support Systems and Underpinning, Volume I, Design and Construction, FHWA-RD-75-128
 - b. Lateral Support Systems and Underpinning, Volume II, Design Fundamentals, FHWA-RD-75-129
2. Micropile Design and Construction (Reference Manual for NHI Course 132078), Publication No. FHWA NHI-05-039

G. Standard Specifications for Public Work Construction (SSPWC)

H. United States Naval Facilities Engineering Command (NAVFAC)

1. NAVFAC Design Manual 7.01-Soil Mechanics
2. NAVFAC Design Manual 7.02-Foundations & Earth Structures

I. Western Wood Products Association (WWPA)

1. Standard Grading Rules for Western Lumber

J. American Society of Civil Engineers

1. Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE 7

1.03 DEFINITIONS

- A. Displacement Reference Point (DRP)—Established point on the structure or support system monitored by optical survey methods to determine vertical and horizontal displacements, if any, occurring during excavation and construction.
- B. Lateral Displacement Reference Point (LDRP)—Established point on top or face of a structure or support system, monitored by optical survey methods, to determine horizontal displacements, if any, occurring during excavation and construction.
- C. Displacement, Deformation, Deflection—These terms are synonymous, and when used in conjunction with DRPs, LDRPs, and instrumentation and monitoring for the support system and the existing buildings, refer to any deviation of survey readings on a DRP or LDRP from its baseline survey readings. Deviation may be in the horizontal direction, the vertical direction, or both directions. Deformation may also manifest itself as visually discernible distress on the adjoining or adjacent interior floor concrete slabs, walls, columns, ceilings, or roofs of the existing buildings.
- D. Threshold Value—The specified magnitude of displacement when the Contractor shall notify and immediately meet with the Engineer to discuss their construction means and methods to determine what changes, if any, shall be made to better control ground movement and prevent further deformation of the existing buildings, support system, or underlying ground.
- E. Correction Action Value—The specified magnitude of displacement when the Contractor shall notify the Engineer and implement corrective measures to limit further deformation.
- F. Shutdown Value—The specified magnitude of displacement at which the Contractor shall stop all work immediately, and notify and meet with the Engineer to develop an approved plan of corrective action, including modification of procedures, techniques, and equipment, before work can be resumed.
- G. Corrective Action, Corrective Measure,—These terms are synonymous and refer to modifications to Contractor-responsible design or to the Contractor’s means and methods that are required to limit or meet specified requirements on deformation response values in Table 1.
- H. Contingency Plan—The detailed description of the Contractor’s specific means and methods that would be implemented to limit deformations to existing buildings, support system, and underlying ground in the event that specified deformation response values have occurred or are exceeded.
- I. Compacted Fill Soils, Compacted Fill—These terms are synonymous, and refer to soils that are moisture-conditioned, placed, and compacted to the required percent compaction as structural fill for support of foundation loading from the existing buildings.
- J. Native Soils—The terminology “native soils” refers to alluvium or alluvial soils below the compacted fill soils.
- K. Ground—When used to refer to or in conjunction with protection and support system, ground is consisted of compacted fill and native soils.
- L. Protection and Support System, Support System, Protection and Support Element, Support Element—These terms are synonymous, and refer to a structural system used to protect and support existing buildings and the underlying ground during the excavation for and construction of foundations for the new equipment, structures, features, and foundations at the locations shown in the drawings.
- M. Existing Buildings—Reference to protection and support of the existing buildings include the existing machine shop building (Building No. 20), the existing fabrication shop (Building No. 21), and the existing coating shop building (Building No. 22).

1.04 DESIGN CRITERIA FOR PROTECTION AND SUPPORT SYSTEMS

- A. General
 - 1. The existing machine, fabrication, and coating shop buildings are reinforced-concrete buildings with strip and spread footings, grade beams at various locations and varied embedment depth, columns, walls, interior floor concrete slabs, and roof.
 - 2. Excavation, construction, or any other activities for all new equipment, features, and foundations as shown in the drawings shall not cause interference, disruption, or delay to any functions or operation of the existing buildings.

3. Any affected proximate utilities shall be fully supported and protected in conjunction with excavation, construction, or any other activities for the construction of the new equipment, structures, features, and foundations at the locations shown in the drawings.
4. The existing buildings and the underlying ground shall be fully supported and protected in conjunction with excavation, construction, or any other activities required for all new equipment, structures, features, and foundations at the locations shown in the drawings.
 - a. The excavation for and construction of the new vertical machining center (VMC) foundation and the new blast booth at the locations shown in the drawings require protection and support systems for the existing buildings and the underlying ground.
5. The Contractor shall refer to Section 02200 for additional specification requirements on earthwork which enables the excavation for and construction of the new VMC foundation and blast booth.
6. The Contractor shall be responsible for the detailed final designs and their adequacy, and for the furnishing, maintenance, monitoring, and installation of the protection and support systems needed for the construction of the new VMC foundation and blast booth. These final system designs for the protection and support of the existing buildings and the underlying ground shall require the Engineer's review and acceptance as specified.
7. Final designs shall be submitted, reviewed, and accepted by the Engineer prior to any excavation, including excavation needed to install the protection and support elements for the existing buildings.
8. The design of protection and support systems shall comply with accepted design practices, including but not limited to, Caltrans, FHWA, and NAVFAC guidelines, ASCE criteria, and current ACI and AISC code provisions, unless design criteria specified herein or in the drawings are more stringent.
9. The design of protection and support systems shall be fully functional, adequate, and stable throughout any and all intermediate and subsequent configurations of use, not just the final configuration.
10. Protection and support systems may be designed either as temporary protection and support systems to be removed following the new construction of the VMC foundation and blast booth or as permanent protection and support systems to remain in-place and be incorporated into the new construction.
 - a. The use of a permanent support system to remain in-place and be incorporated into the new construction shall be subject to Engineer's review and acceptance.
 - b. All temporary protection and support elements shall be designed and installed to allow for their removal, as required, in accordance with the Contractor's submittals and approved working drawing, as part of the completion of the work.
 - c. Acceptable protection and support systems:
 - (1) Soldier piles with laggings, slurry walls, micropiles, reinforced shotcrete, internal bracing
 - (2) Underpinning: Helical piles, drilled piers, micropiles, and concrete pit underpinning, in conjunction with pile cap, bearing assembly, haunch footing, or any structural element that functions to transfer the existing building loads through the underpinning system onto the underlying ground.
 - (3) Lateral supports to retain the adjoining compacted fill and/or native soils are required. Lateral supports that require installing structural elements into the adjoining/adjacent compacted fill and native soils may be used, provided there are no conflict with existing or new utilities, grade beams, footings, or any other structural elements of the Building No. 20, Building No. 22, and adjacent/nearby existing buildings. Examples include soil nails and tiebacks. Minimum closest clearance between any lateral supports into the adjoining/adjacent compacted fill and native soils and the existing or new utilities, grade beams, footings, or any other structural elements shall be 2.5 feet from edge to edge.
 - d. Protection and support systems that require dynamic methods for installation and/or removal, including pile driving and vibratory removal, are prohibited
11. Temporary sloped excavation is not allowed.

B. Design Requirements

1. Protection and support systems and the accompanying excavation shall be designed and installed (a) to support the existing buildings, (b) to retain the underlying ground, (c) to prevent caving and loss of compaction and shear strength of foundation subgrade directly below the footings, grade beams, and interior floor concrete slabs of the

existing buildings, and (d) to provide for the protection and safety of workers in accordance with CCR Title 8.

2. Protection and support systems, and excavation for the construction of the new VMC foundation and blast booth shall be subject to the following design requirements:
 - a. During all phases of excavation, installation and construction, the support systems shall restrict deformation or lateral deflection of any part of the existing buildings and any part of the exposed portion of the support systems to the threshold values specified in Table 1 at the end of this section.
 - b. Support system designs shall include provisions to account for all subsequent excavation and construction activities, and sequencing in near proximity to the support system and any resulting increase or reduction in supporting lateral earth pressure.
 - c. Temporary support systems shall be designed to allow for removal, as required, without adversely affecting or damaging the existing or installed facilities or features.
 - d. Dynamic or vibratory methods for support element installation and removal are prohibited.
 - e. Protection and support systems may be designed to remain in-place permanently and be incorporated into the new construction, provided the designs are reviewed and accepted by the Engineer. Any changes to the concrete structures and reinforcing steel to accommodate the support systems shall be clearly identified in these designs. Decision by the Engineer is final.
 - (1) All features of the protection and support system that are to remain in-place permanently and be incorporated into the new construction shall maintain ACI concrete cover requirements.
 - f. No features of the protection and support systems, if installed as temporary support elements, shall protrude into the structural elements of the new VMC foundation and blast booth.
 - g. Protection and support system designs shall be based upon the design parameters contained herein and shall include all applicable surcharge loads.
 - h. Protection and support system designs shall consider the construction methods needed to install the support elements and to remove them as required in accordance with the Contractor's submittals and approved support system working drawings.
 - i. Construction methods and equipment shall not impose loads on to any adjacent or nearby structures, conduits, duct banks, or any other permanent features that exceed the requirements of Section 01540.
 - j. Protection and support systems shall provide for continuous support of all retained materials and structural elements of the existing building, including footings and interior floor concrete slabs. This could include continuous lagging. The design of the continuous support shall include provisions to maintain drained conditions in the retained materials. Acceptable materials for continuous support or lagging include reinforced concrete, reinforced shotcrete, timber, or steel plates, or any combination thereof.
 - (1) Continuous support or lagging to remain in-place permanently and be incorporated into the new construction shall consist of reinforced concrete or reinforced shotcrete, include provisions to maintain drained conditions in the retained materials, and are subject to the review and acceptance of the Engineer. Timber (treated and non-treated) lagging or steel plates shall not be left in-place. Decision by the Engineer is final.
 - (2) No features of the continuous support or lagging if installed as temporary support elements shall protrude into the structural elements of the new VMC foundation and blast booth.

C. Design Parameters

1. Protection and support systems shall be designed to support the loading specified herein.
 - a. Footing load surcharge of 2,000 pounds per lineal foot for strip and spread footings of the existing buildings.
 - b. Surcharge from interior concrete slab shall consist of dead load based actual existing configuration of adjoining/adjacent concrete elements plus construction live load from equipment, traffic, materials, and stockpile located within a horizontal distance equal to the exposed height of the support systems or 10 feet, whichever is greater.
 - c. Lateral earth pressure shall be as follows:

- (1) Cantilever Shoring Condition: Equivalent fluid pressure of 42 pounds per cubic foot (pcf), based on level ground within the active wedge.
 - (2) Braced Shoring Condition: Uniform distribution of $28H$ psf, where H is the height of the exposed shoring wall above the bottom of shored excavation, and based on level ground within the active wedge.
- d. Lateral Resistance: The lateral resistance of the support systems shall be taken as 400 psf per foot of embedment depth below the lowest adjacent grade exposed in the excavation to a maximum of 4,000 pounds per foot. The specified allowable lateral resistance does not include the use of a factor of safety for reduction or the use of an adjustment factor to account for passive arching capability of the soils. The lateral resistance shall be ignored for a depth of 1 foot immediately below the lowest adjacent grade exposed in the excavation.
 - e. Base Coefficient of Friction. Base coefficient of friction shall be taken as 0.27 for use to compute frictional resistance, which equals the coefficient of friction times the dead load. The specified base coefficient of friction includes a factor of safety of 1.5.
 - f. The specified lateral earth pressures consider that the protection and support systems are retaining non-saturated materials. Hydrostatic pressure is not present.
2. In the event construction-related surcharge loading onto the support systems or top of excavations is required, this additional loading shall be added to the values of the design parameters. For the design of support systems, the resulting increase in lateral loading imposed by the construction-related surcharge pressures shall be added to the lateral earth pressures specified herein. The lateral earth pressure coefficient for additional uniform vertical surcharge loads applied behind the support systems shall be taken as 0.31, which will result in a uniform pressure distribution for the additional uniform vertical surcharge load along the entire height of support system.
 - a. All construction-related activities, equipment, and materials that will contribute to loading onto the support systems or top of excavations shall be clearly identified in the Contractor's design submittal and working drawings, and are subject to the review and acceptance of the Engineer. Decision by the Engineer is final.
 3. Protection and support system designs shall be capable of limiting deformations to the threshold values indicated herein in Table 1 at the end of this section.

1.05 SUBMITTALS

A. Documentation of Pre-Construction Structural Condition

1. The Contractor shall submit a report of a pre-construction structural condition survey of the interior and exterior of the entire existing machine, fabrication, and coating shop buildings. The purpose of the pre-construction structural condition survey is to document the existing structural condition prior to excavation, construction, or any other activities for the construction of the new equipment, structures, features, and foundations at the locations shown in the drawings. The documentation serves as a baseline for determining distresses on any element of the existing buildings attributable to excavation, construction, or any other activities for the construction of the new equipment, structures, features, and foundations at the locations shown in the drawings.
 - a. The Contractor shall submit pre-construction structural condition survey report to the Engineer for review and acceptance before the start of any excavation for the new equipment, structures, features, and foundations at the locations shown in the drawings, including excavation needed for the installation of protection and support system elements.
 - b. The pre-construction structural condition survey report shall include documentation consisting of photographic documentation with clear written descriptions and/or video documentation with clear verbal narrative descriptions. The photographic or video documentations shall indicate locations of any distress features in the structural elements of the existing buildings prior to any work activities.
 - c. The pre-construction structural condition survey shall be performed by a civil or structural engineer who is registered in the State of California and has at least 10 years of experience in performing forensic engineering and structural distress documentation.

B. Excavation Sequence, Staging, and Schedule

1. The Contractor shall submit a plan of the overall sequence, staging, and schedule of excavation and construction activities for the new equipment, structures, features, and foundations at the locations shown in the drawings. The plan shall include the locations of all protection and support elements, excavation needed for the installation of the

protection and support system, and construction of the new equipment, structures, features, and foundations at the locations shown in the drawings. This plan shall be submitted before the start of excavation, including excavation needed for the installation of any protection and support elements. Any excavation activities for the construction of the new equipment, structures, features, and foundations at the locations shown in the drawings, including protection and support elements, shall not begin until the Engineer has reviewed and accepted this overall plan.

C. Support System Designs

1. The Contractor shall submit the protection and support system designs to the Engineer for review and acceptance before the start of excavation for the new equipment, structures, features, and foundations at the locations shown in the drawings, including excavation needed for the installation of protection and support system elements. The submittal shall include all calculations and supporting documentation, and shall illustrate the locations, and installation and removal sequence of the submitted protection and support system. Any excavation activities for the new constructions shall not begin until the Engineer has reviewed and accepted this overall plan.
2. Submitted protection and support system designs shall provide continuous, fully-drained support for the retained ground (i.e., compacted fill and native soils) or existing buildings. The completed protection and support system drawings shall include a detailed procedure for the installation of the systems, including the removal of any temporary elements of the protection and support system. Design calculations shall follow the guidelines set forth in Title 8, Chapter 4, Article 6, of the California Code of Regulations (CCR). Industry standard accepted methods of analysis shall be used, including but not limited to, Caltrans, FHWA, and NAVFAC guidelines, and current ACI and AISC code provisions. Loads shall be as specified herein and shall include all construction and temporary surcharges. All members shall be secured to prevent sliding, falling, or kickouts. Design calculations shall also be included to show anticipated deformations of the submitted support system designs.
3. The Contractor shall submit a deformation monitoring plan. The deformation monitoring plan shall include clear description of monitoring methodology, list and qualification of the personnel installing and performing the deformation monitoring, list of equipment and materials, working drawings showing the locations of the DRPs and LDRPs, details illustrating the mounting of DRPs and LDRPs, and monitoring schedule.
4. Working drawings for the protection and support systems shall indicate the following:
 - a. Sizes, details, dimensions, arrangement of support elements, method of assembly, lists of materials, and other appropriate data for all protection and support elements as required to check the adequacy of the proposed installations.
 - b. Drawings and design calculations for the protection and support systems signed and stamped by a civil or structural engineer registered in the State of California.
 - c. Proposed methods and equipment to be used for installation of all protection and support elements, and the removal of any temporary support elements.
 - d. Layout and proposed setbacks of stockpiles and construction equipment from the installed support systems.
 - e. Sequence of installation of protection and support elements, and associated excavation.
 - f. Sequence of backfill and the removal of any temporary support elements.
 - g. Methodology of backfill, including types of backfill materials, including any voids created from the excavation, construction, or any other activities for all new equipment, structures, features, and foundations at the locations shown in the drawings.
 - h. Dimensions, spacing, tolerances, and general pattern of installation of the protection and support systems with respect to excavations, the new construction, and the existing buildings.
 - i. Details showing incorporation of the all permanent features and elements of the support system into the structural elements of the new VMC foundation and blast booth, as applicable.
4. Shop drawings for all fabricated materials shall include the following:
 - a. Complete dimensions.
 - b. Details of protection and support elements, connections, hardware, connectors, materials, and other accessories.
 - c. Details of the continuous support of excavation retained by the protection and support systems.

D. Geotechnical Instrumentation

1. Shoring Deformation Monitoring

- a. Manufacturer's product data for pre-fabricated instruments.
- b. Installation Schedules and Procedures
 - (1) Schedule and procedures for installation and initial survey readings, and monitoring of DRPs and LDRPs.
 - (2) Location of survey points, reference points, and schedule for initial survey.
- c. Shop Drawings of Geotechnical Monitoring Instruments
 - (1) The Contractor shall submit Shop Drawings, prepared by the Contractor's design engineer, showing the installed DRP and LDRP locations, the identification numbers for each installed DRP and LDRP, the installation dates and times, initial surveyed elevations, and initial surveyed coordinates.
 - (2) Shop drawings shall be submitted within five days of establishment of the monitoring instruments.

E. Contingency Plan

1. A contingency plan shall be submitted to fully describe Contractor's plan of action if survey readings exceed the threshold, corrective action, and shutdown values specified in Table 1 at the end of this section.

F. Product Data

1. Manufacturer's product data for all materials to be incorporated into protection and support systems.
2. Mix designs and product data for cement grout, shotcrete, and concrete used for the protection and support systems.
3. Mix designs of concrete to be used as backfill materials, as applicable.
4. Earthen backfill materials and associated submittals shall be as specified in Section 02200.

G. Quality Control

1. Health and safety procedures in accordance with CCR Title 8, addressing protection and support system construction.
2. Qualifications of the Contractor's protection and support system design engineer.
3. Manufacturer's certification for all materials to be incorporated into protection and support systems. The certification shall state that the materials or assemblies to be provided will fully comply with these specifications.
4. Survey results from DRP and LDRP for monitoring the displacement and performance of the protection and support systems and the existing facilities, including baseline surveys.
5. The engineer responsible for the design of the protection and support system shall provide written interpretation of the monitoring data from the DRPs and LDRPs of the support system, the existing buildings, and any affected proximate utilities.
6. Results of strength testing for concrete, shotcrete, and grout.

H. Construction Equipment and Procedures

1. Procedures and specifications of construction equipment to be used for the installation and removal of the support elements, excavation, placement and compaction of backfill materials, and new construction shall be submitted to the Engineer for review and acceptance prior to starting work on support system installation and excavation.

1.06 QUALITY ASSURANCE

- A. The design submittal, working drawings, and supporting calculations for the protection and support systems shall be prepared, signed, and stamped by a civil or structural engineer registered by the State of California.
- B. The pre-construction structural condition survey report shall be signed and stamped by a civil or structural engineer registered in the State of California.
- C. A land surveyor, licensed in the State of California, shall perform baseline surveys, monitoring of DRPs and LDRPs, and monitoring survey results and reports.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Structural steel shall be in accordance with ASTM A36, minimum Grade 36.
- B. Concrete, shotcrete, and cement grout materials shall be in accordance with Sections 03300, 03360 and 03600.
- C. Welded wire fabric shall conform to ASTM A1064.
- D. Timber lagging shall be sound, well-seasoned lumber, and be WWPFA Douglas Fir-Larch structural grade or better.

2.02 DISPLACEMENT REFERENCE POINTS (DRPs) AND LATERAL DISPLACEMENT REFERENCE POINTS (LDRPs)

- A. DRPs and LDRPs shall be established by a survey prism welded or connected to the exposed face of the support elements and the walls/columns of the existing machine, fabrication, and coating shop buildings.

PART 3 EXECUTION

3.01 GENERAL

- A. Any excavation required for the construction of the new equipment, structures, features, and foundations at the locations shown in the drawings shall be designed and carried out as required herein, and subject to the review and acceptance by the Engineer. Any excavation activities for the new construction, including excavations for support elements, shall not commence without receipt of the Engineer's acceptance of all submittals, including baseline survey readings of installed DRPs and LDRPs, specified herein.
- B. The Contractor shall design, furnish, install, and maintain protection and support systems as specified herein and shown on the accepted submittals and approved working drawings to protect and support the existing buildings and underlying ground during the construction of new VMC foundation and blast booth.
- C. Protection and support system shall continuously support the retained ground behind the support system, the footings and interior floor concrete slabs of the existing building, and any affected proximate utilities in accordance with the requirements specified herein.
- D. The Contractor's furnished protection and support system designs shall be consistent with the design criteria specified herein. Designs for the protection and support systems supporting the existing buildings and underlying ground as specified herein shall restrict deformations of the support systems to the threshold values specified in Table 1 at the end of this section.
- E. All excavation should be performed in accordance with the requirements specified in Section 02200, and applicable city, county, state, and federal agency rules and regulations. In the event of conflict between the requirements contained herein and a governing agency, the most stringent criteria shall govern.
- F. All construction activities associated with new equipment, structures, features, and foundations at the locations shown in the drawings shall be subject to the requirements herein and shall not damage or compromise the integrity, reliability, and operation of the existing buildings.
- G. All installed temporary support elements shall be removed in accordance with the Contractor's submittals and approved working drawings.
- H. Compliance monitoring of the protection and support systems, and the existing facilities deformation shall be conducted as required herein.
- I. Documentation of Pre-Construction Structural Condition
 - 1. The Contractor shall perform a survey of the pre-construction structural condition of the existing machine, fabrication, and coating shop buildings.
 - a. The pre-construction structural condition survey shall consist of detailed photographic and/or video documentation of the following items:
 - (1) Exterior and interior structural walls and columns.
 - (2) Interior floor concrete slab
 - b. Photographic documentation shall consist of photographs with clear written descriptions and video documentation shall consist of videos with clear verbal narrative descriptions. The documentation shall

indicate locations of any distress features, such as cracks, offsets, and/or separations in the structural elements of the existing buildings, which are present prior to any excavation and construction activities associated with the new equipment, structures, features, and foundations at the locations shown in the drawings.

- c. Photographs or videos with descriptions demonstrating lack of distress features should also be included in the report. Any existing distress features that are not fully documented in the report will be attributed to any work activities associated with the new construction and shall be mitigated or repaired by the Contractor at no cost to Metropolitan.
2. Any excavation activities for the construction of the new equipment, structures, features, and foundations at the locations shown in the drawings, including all activities related to the protection and support systems, shall not commence until pre-construction structural survey is complete and the report is accepted by the Engineer.
3. The scheduling of the pre-construction structural condition survey shall be coordinated in advance with the Engineer. The pre-construction structural condition survey shall be conducted in the presence of the Engineer, unless otherwise agreed upon by the Engineer.

3.02 CONSTRUCTION SEQUENCE

- A. Any excavation activities for the construction of the new equipment, structures, features, and foundations at the locations shown in the drawings shall not commence until the DRPs and LDRPs on the walls/columns of the existing machine, fabrication, and coating shop buildings are installed and surveyed for baseline readings, and the installation and the baseline survey readings are accepted by the Engineer.
 1. Any excavation below the existing grade shall not proceed more than 3 feet, vertically, below any DRPs or LDRPs on the exposed faces of the support systems until the installation and the baseline survey readings of the DRPs or LDRPs are accepted by the Engineer.
 2. DRPs on the underpinned elements, if used, for the footings and/or concrete slabs of the existing buildings shall be installed immediately upon completion of the installation of the underpinning supports as specified herein.
- B. The sequence of excavation, protection and support system installations, foundation construction, placement and compaction of backfill materials and removal of any temporary protection and support system elements shall be in accordance with the Contractor's submittals and approved working drawings.
- C. No more than 2 vertical feet of compacted fill or native soils may be excavated without any continuous support directly below the footings and/or interior floor concrete slab of the existing buildings. The ground directly below the footings and interior floor concrete slab of the existing buildings shall not be undermined. If the ground is undermined, the undermined portion shall be backfilled with Class N concrete as directed by the Engineer at no additional cost.

3.03 RESTRICTIONS FOR WORK ABOVE AND ADJACENT TO EXISTING FACILITIES

- A. All construction methods, procedures, and activities used shall not subject the existing buildings and facilities, adjacent or nearby structures, conduits, or any other permanent features to dead or live loads in excess of the limits specified in Section 01540. Impact loads shall not be imposed upon the existing facilities, adjacent or nearby structures, conduits, or any other permanent features.

3.04 PROTECTION AND SUPPORT SYSTEM INSTALLATION RESTRICTIONS

- A. Protection and support system installation shall be consistent with the design criteria and installation restrictions specified herein.
- B. Methods utilized to install, maintain, repair, and remove protection and support systems shall not subject Metropolitan's structures, facilities, proximate utilities, and features to ground vibration.

3.05 CONTINUOUS SUPPORT OF FOOTINGS AND INTERIOR FLOOR CONCRETE SLABS OF EXISTING BUILDINGS

- A. The footings and interior floor concrete slabs of the existing buildings shall be supported, as specified herein, in order to provide continuous protection and support of the structure throughout all excavation and construction activities for new equipment, structures, features, and foundations at the locations shown in the drawings.
- B. Underpinning of footings and interior floor concrete slabs of the existing buildings for the excavation and construction of the new VMC foundation and blast booth:
 1. Excavations for the installation of underpinning supports shall not exceed 3 feet by 3 feet in plan dimensions.

2. Spacing between each underpinning support shall not exceed 5 feet.
 3. Each underpinning support shall be sequentially numbered and the number for each location of underpinning support shall be clearly and visibly marked in the field.
 4. Multiple excavations for the installation of underpinning support may be performed at any given time. Open excavations shall be separated by at least one unexcavated location and not less than 10 feet.
 5. Underpinning support shall be installed immediately upon completion of excavation as specified in the accepted design submittal.
 6. Underpinning shall establish and maintain firm contact between the interior floor concrete slabs and footings and the underlying foundation subgrade. Adjacent or adjoining footings shall be firmly supported or underpinned as applicable.
 7. Compacted fills and native soils below the footings of the existing buildings and between the underpinning supports shall not be excavated or undermined.
 8. Subject to Engineer's review and acceptance, the Contractor shall identify groups of excavations and underpinning support installation to be performed sequentially. Excavation for the next sequentially numbered set of excavations and underpinning support installation shall not begin until the installation of current set of underpinning support has been completed and accepted by the Engineer.
- C. The excavation for the underpinning supports and any voids below the footing and between the underpinning supports shall be filled with new concrete infill as shown in the drawings or structural concrete for the walls of the new blast booth.

3.06 CONTINUOUS SUPPORT OF SOILS RETAINED BY PROTECTION AND SUPPORT SYSTEMS

- A. The compacted fill and native soils retained by the protection and support systems shall be continuously supported, as specified herein, throughout all excavation and construction activities for new equipment, structures, features, and foundations at the locations shown in the drawings.
- B. Continuous support or lagging may consist of reinforced concrete, reinforced shotcrete, timber, or steel plates, or any combination thereof.
1. Laggings to remain in-place permanently and be incorporated into the new construction shall only consist of reinforced concrete or reinforced shotcrete.
- C. The continuous support shall be installed concurrently with required excavation.
1. No more than 2 vertical feet of compacted fill or native soils are allowed to be unsupported as excavation progresses from the existing ground surface to the target elevation at the bottom of excavation.
 - a. Compacted fill and native soils in the excavation shall not be left unsupported overnight. All exposed compacted fill and native soils in excavation shall be supported by the end of each work day.
- D. Shotcrete lagging shall be installed in accordance with SSPWC Section 303-2.
- E. The continuous support shall include provisions and constructed features to ensure that the supported compacted fill and native soils maintain fully drained conditions at all times.

3.07 PROTECTION AND SUPPORT SYSTEM INSTRUMENTATION AND MONITORING

A. General

1. The protection and support systems, and the existing facilities shall be instrumented, and monitoring shall be performed as required herein.
2. The instrumentation program and the data derived shall not relieve the Contractor of its responsibility to protect the existing buildings, facilities, adjacent ground, features, utilities, and other structures, and to provide adequate support systems for all excavations.
3. The Contractor shall provide all instrumentation hardware, equipment, and materials necessary to conduct the monitoring program. Prior to installation, all materials and equipment shall be available for inspection by the Engineer.
4. Except where otherwise specified, the Contractor shall maintain access to all monitoring points to ensure that survey readings can be obtained at the frequencies specified herein.

5. Responsibility

- a. The Contractor shall be fully responsible for the furnishing, installation, testing, calibration, and maintenance of all DRPs, LDRPs, and instrumentation hardware, equipment, and material necessary to conduct the monitoring program.
 - b. The Contractor shall initialize and monitor all DRPs and LDRPs, interpret data, and furnish the Engineer with a copy of the results.
6. Additional instrumentation, DRPs, and/or LDRPs shall be installed as directed by the Engineer in the event of unsatisfactory performance of a support system or if unforeseen conditions are encountered for which more extensive monitoring will be required.

B. Preparation

1. Prior to construction, survey benchmarks and baselines necessary to monitor DRPs and LDRPs to the tolerances stated herein shall be established.
2. Benchmarks for DRPs and LDRPs shall be located outside of the zone of influence of all excavation.

C. DRP And LDRP Instrumentation Locations

1. The Contractor shall be fully responsible for the furnishing, installation, calibration, monitoring, and maintenance of all DRPs and LDRPs. DRPs and LDRPs shall be installed on the support systems and the existing buildings as specified herein.
2. The locations of DRPs and LDRPs shall be reviewed and accepted by the Engineer prior to any installations, and shall be in accordance with the approved working drawings and the following:
 - a. South Wall Along Grid M11 of Existing Machine Shop Building: DRP arrays shall be established on imaginary vertical lines on the south wall along Grid M11 of the existing building structure as follows.
 - (1) The DRPs shall be installed on the interior face of the wall, excepted as noted below. The Contractor may install the DRPs on the exterior face of the wall, provided that the Contractor submit a justification based on space and line-of-sight limitations and the submittal is reviewed and accepted by the Engineer.
 - (2) Two DRPs shall be installed near the centerline of each column at Grids A, B, C, D, and E.
 - (a) The first DPR shall be within 5 feet from the top of the column.
 - (b) The second DRP shall be at mid-height of the column.
 - (3) Two DRPs shall be installed at mid-distance on each wall between columns at Grids A-B, Grids B-C, and Grids C-D.
 - (a) The first DPR shall be within 5 feet from the top of the wall.
 - (b) The second DRP shall be at mid-height of the wall.
 - (4) One DRP shall be installed at mid-distance on each wall between columns at Grids G-H and Grids H-J.
 - (a) The DRP shall be on the exterior face of the wall at mid-height.
 - b. West Wall Along Grid A of Existing Machine Shop Building: DRP arrays shall be established on imaginary vertical lines on the west wall along Grid A of the existing building structure as follows.
 - (1) The DRPs shall be installed on the interior face of the wall. The Contractor may install the DRPs on the exterior face of the wall, provided that the Contractor submit a justification based on space and line-of-sight limitations and the submittal is reviewed and accepted by the Engineer.
 - (2) Two DRPs shall be installed near the centerline of column at Grid M10.
 - (a) The first DPR shall be within 5 feet from the top of the column.
 - (b) The second DRP shall be at mid-height of the column.
 - (3) Two DRPs shall be installed at mid-distance on each wall between columns at Grids M9-M10 and Grids M10-M11.
 - (a) The first DPR shall be within 5 feet from the top of the wall.

- (b) The second DRP shall be at mid-height of the wall.
- c. East-West Trending Wall Along Grid M9 of Existing Machine Shop Building: DRP arrays shall be established on imaginary vertical lines on the east-west trending wall along Grid M9 of the existing building structure as follows.
 - (1) The DRPs shall be installed on the interior face of the wall.
 - (2) Two DRPs shall be installed near the centerline of each column at Grids A, B, C, D, and E.
 - (a) The first DPR shall be within 5 feet from the top of the column.
 - (b) The second DRP shall be at mid-height of the column.
 - (3) Two DRPs shall be installed at mid-distance on each wall between columns at Grids A-B, Grids B-C, and Grids C-D.
 - (a) The first DPR shall be within 5 feet from the top of the wall.
 - (b) The second DRP shall be at mid-height of the wall.
- d. North Wall Along Grid M1 of Existing Machine Shop Building: DRP arrays shall be established on imaginary vertical lines on the north wall along Grid M1 of the existing building structure as follows.
 - (1) The DRPs shall be installed on the exterior face of the wall.
 - (2) Two DRPs shall be installed at mid-distance on the wall between columns at Grids M-N.
 - (a) The first DPR shall be within 5 feet from the top of the wall.
 - (b) The second DRP shall be at mid-height of the wall.
- e. Interior Walls of Existing Coating Shop Building Bounded by Grid A7 on the North, , Grid 1 on the South, Grid W on the West, and Grid X on the East: DRP arrays shall be established on imaginary vertical lines on the north wall along Grid M1 of the existing building structure as follows.
 - (1) The DRPs shall be installed on the interior face of the walls.
 - (2) Two DRPs shall be installed near the centerline of each column within the specified grids.
 - (a) The first DPR shall be within 5 feet from the top of the column.
 - (b) The second DRP shall be at mid-height of the column.
 - (3) Two DRPs shall be installed at mid-distance on the wall between the columns within the specified grids.
 - (a) The first DPR shall be within 5 feet from the top of the wall.
 - (b) The second DRP shall be at mid-height of the wall.
- f. Protection and Support System: One horizontal row of DRPs shall be established at the protection and support system within 12 inches from the top of the support system and spaced at an interval of 15 feet. A second of LDRPs shall be established at mid-height of the protection and support system, also spaced at an interval of 15 feet.
- g. Installation of DRPs on the existing buildings shall be completed, including baseline readings, and accepted by the Engineer 5 working days prior to any excavation.
- h. Excavation for the construction of the new VMC foundation and blast booth shall not exceed deeper than 2 vertical feet from the position of the DRPs and LDRPs on the protection and support system, until the installation of the DRPs or LDRPs at their respective positions are completed and the baseline readings are accepted by the Engineer 5 working days prior to continue any excavation activities.

D. Monitoring

- 1. Monitor position and elevation of DRPs, and position of LDRPs as follows:
 - a. The DRPs and LDRPs shall be monitored at the start and end of each workday on a daily basis during support system installation and at the start of excavation below existing ground surface adjacent to the existing facilities. This monitoring frequency shall continue during non-working days at approximately the same times of day as during workdays.

- b. After support system installation and the initial excavation has been completed, the monitoring of DRPs and LDRPs can be reduced to once a day, including non-work days.
 - c. Twenty-eight days after support system installation and the excavation has been completed and with the acceptance of the Engineer, the monitoring of all DRPs and LDRPs can be reduced to once a week, thereafter, while the excavation being supported remains open.
 - d. Monitoring shall be performed at the same time(s) every day.
 - e. The frequency of survey readings shall be doubled or otherwise modified, as directed by the Engineer, when survey readings exceed the threshold values specified in Table 1 at the end of this section.
 - f. Additional immediate survey readings shall be taken where measured values indicate excessive variability, as determined by the Engineer.
 - g. These requirements shall be in effect for each phase of support system installation.
- 2. Survey data of the DRPS and LDRPs, and written interpretation of the survey monitoring data shall be made available to the Engineer within 24 hours.
 - 3. The Engineer reserves the right to modify the monitoring schedule.
 - 4. The monitoring of DRPs and LDRPs shall continue until directed otherwise by the Engineer.
- E. Tolerances
- 1. DRPs and LDRPs shall be installed within 1 inch of the locations shown on the approved working drawings except where otherwise accepted by the Engineer to avoid visual obstacles or shoring element features.
 - 2. During the taking of initial instrumentation survey readings, the Contractor's surveyor shall achieve level circuit closure with a closure error no greater than $e = 0.025n^{1/2}$ where n is the number of readings and e is the error expressed in inches.
 - 3. Survey Readings
 - a. DRP elevation and position to within 0.005 foot
 - b. LDRP position to within 0.005 foot
 - c. DRP and LDRP tolerances shall apply to initial readings and all subsequent readings.
- F. Protection and Replacement
- 1. The Contractor shall take every practical measure to protect and prevent damage to the DRPs and LDRPs during handling, installation and construction operations.
 - 2. All damage resulting from construction operations, weather, traffic, or vandalism shall be repaired or replaced and installed at no additional cost to Metropolitan within 24 hours.

3.08 PROTECTION AND SUPPORT SYSTEM DEFORMATION LIMITS AND CORRECTIVE ACTION

- A. If movement of the DRPs or LDRPs installed on the existing facilities or the protection and support system is taking place or occurs relative to the displacement design criteria specified herein, the Contractor shall provide supplemental support and modify construction procedures, as necessary, to minimize additional ground displacement of the protection and support system, as accepted by the Engineer.
- B. Deformation limits for the DRPs and LDRPs identified herein as threshold values, Contractor response values, and shutdown values are provided in Table 1, Deformation Response Values, at the end of this section.
- C. The Contractor's corrective actions, as required herein, shall be accepted by the Engineer prior to implementation.
- D. Threshold Value: When DRP and LDRP data indicate that movement equal to the threshold value has occurred, the Contractor shall notify and immediately meet with the Engineer to discuss his/her construction means and methods to determine what changes, if any, shall be made to better control ground movement and prevent further deformation of the existing facilities and/or the support system. When the threshold value has been reached, DRP and LDRP readings shall be required on a four times per day basis (including weekends), minimum, or more frequent as determined by the Engineer. The Engineer will determine the frequency of subsequent DRP and LDRP readings. The Contractor shall also prepare and submit a contingency plan to the Engineer for review of proposed changes in construction methods and procedures in the event that further deformations occur.

- E. Contractor Corrective Action Value: When DRP and LDRP data indicates that movement equal to the contractor corrective action value has occurred, the Contractor shall immediately notify the Engineer and actively control ground movement in accordance with the previously submitted and Engineer accepted contingency plan to prevent further deformation beyond the contractor corrective action value. The Contractor shall also immediately meet with the Engineer to discuss if any changes to the contingency plan need to be made to better control ground movement and prevent further deformation. DRP and LDRP readings shall be required on a four times per day basis (including weekends), minimum, or more frequent as determined by the Engineer. The Engineer will determine the frequency of subsequent DRP and LDRP readings.
- F. Shutdown Value: When the DRP and LDRP data indicates that movement equal to the shutdown value has occurred, the Contractor shall stop all work, and notify the Engineer immediately. The Contractor shall also implement measures to prevent further deformation and shall meet with the Engineer immediately to develop a plan of action before work can be resumed.

TABLE 1 – Deformation Response Values (Feet)

| Facilities or Support System | Movement Category | Threshold Value | Corrective Action Value | Shutdown Value |
|--|------------------------------------|-----------------|-------------------------|----------------|
| Walls and Columns of Existing Machine and Coating Shop Buildings | Movement of Individual DRP or LDRP | 0.01 | 0.015 | 0.02 |
| Protection and Support System | Movement of Individual DRP or LDRP | 0.02 | 0.030 | 0.04 |

END OF SECTION

SECTION 03360 PNEUMATICALLY PLACED CONCRETE

PART 1 GENERAL

1.01 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. ASTM International (ASTM)

1. ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
2. ASTM C94, Standard Specification for Ready-Mixed Concrete
3. ASTM C685, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing

C. American Concrete Institute (ACI)

1. ACI 305R, Guide to Hot Weather Concreting
2. ACI 306R, Guide to Cold Weather Concreting

D. Society for Protective Coatings (SSPC)

1. SSPC SP-6, Commercial Blast Cleaning

E. Standard Specifications for Public Works Construction (SSPWC)

1.02 SUBMITTALS

A. Product Data

1. Mix proportions, manufacturers' data, test results, and certifications shall be submitted in accordance with Section 03300, Cast-In-Place Concrete.

B. Placement Drawings

1. Composite concrete placement drawings for each individual placement shall be submitted, indicating location and sizes of pipe sleeves, conduits, inserts, reglets, anchor bolts, openings, recesses, construction joints, expansion joints, and other embedded items. Placement drawings shall be coordinated with drawings required by Section 03100, Concrete Formwork, and Section 03210, Reinforcing Steel.
2. The scale used shall not be less than 1/4 inch to 1 foot but shall be sufficient to adequately show all details of the construction.
3. Each drawing shall show only 1 placement. Match-lines shall reference adjoining placement drawings, and an index shall be provided on each sheet showing the location of the placement in the overall structure.

1.03 DEFINITIONS

- A. Method A (Shotcrete) — A proportioned combination of portland cement, aggregate, and water mixed by mechanical methods, pumped in a plastic state through a pipe or hose to the nozzle where, by the addition of air, the mixture is forcibly propelled to the work. Also known as wet-mix process.

1.04 QUALITY ASSURANCE

- A. Mock-Ups: If data from prior experience on Metropolitan work is not available, the Contractor shall make test panels from the proposed mix proportions and have them tested. Exemption of mock-up test shall be approved by the Engineer.

Pneumatically Placed Concrete

1. The Contractor shall prepare test panels for examination and testing prior to construction. Test panels shall be prepared in the presence of the Engineer.
2. Test panels shall be made by each application crew using the equipment, materials, and mix proportions proposed for the project.
3. A test panel, at least 24 inches by 48 inches, shall be made for each mix and for each shooting position to be encountered in the job, i.e., slab, vertical, and overhead. At least half the test panel shall have the same reinforcement as the structure to test for proper embedment of reinforcing steel. Test panels shall be fabricated to the same thickness as the structure, but not less than 3-1/2 inches. Coring and testing will be performed by the Engineer. Cut or broken surfaces shall be dense and free from laminations and sand pockets.

PART 2 PRODUCTS

2.01 CEMENTS

- A. Except as noted below, cement shall be in accordance with Section 03300.
 1. White portland cement shall only be used with the approval of the Engineer.
 2. Shrinkage compensating cement shall not be used with pneumatically placed concrete.

2.02 POZZOLANIC MATERIALS

- A. Pozzolanic materials shall be in accordance with Section 03300.

2.03 AGGREGATE

- A. Except as otherwise noted below, aggregates shall be in accordance with Section 03300.
- B. Aggregate for Method A (Shotcrete) placement shall be Combined Grading E in accordance with the requirements of SSPWC, Section 201-1.3.2.

2.04 ADMIXTURES

- A. Except as otherwise noted below, admixtures shall be in accordance with Section 03300.

2.05 CURING MATERIALS

- A. Curing materials shall be in accordance with Section 03300.

PART 3 EXECUTION

3.01 PREPARATION OF SURFACES

A. Earth

1. Earth surfaces shall be compacted and trimmed to line and grade prior to placement. Shotcrete shall not be placed on frozen, muddy, or uncompacted surfaces.
2. Surfaces shall be dampened 24 hours prior to placement and shall be maintained in a moist condition until placement. Surfaces shall be damp but shall be without visible free water.

B. Existing Concrete or Masonry

1. Unsound or loose material, including areas contaminated by chemicals or oils, shall be removed before applying shotcrete. Areas to be repaired shall be chipped or scarified to remove offsets that would cause an abrupt change in thickness, unless reinforcement is specifically provided. Re-entrant and outside corners may be tapered slightly. Feathered edges are not permitted.
2. Surfaces shall be dampened 24 hours prior to placement and shall be maintained in a moist condition until placement. Surfaces shall be damp but shall be without visible free water.
3. Existing surfaces shall be abrasive-blasted or chipped to remove paint, oil, grease, and other contaminants, and to provide a roughened surface for proper bonding of the shotcrete. Abrasive-blasting or chipping shall be sufficient to expose the coarse aggregate in the existing surface, as determined by the Engineer.

C. Steel: Steel surfaces to receive shotcrete shall be blast-cleaned in accordance with SSPC SP-6.

D. Rock: Rock surfaces shall be cleaned of loose material, mud, or other foreign matter that will prevent the bonding of the shotcrete.

E. Forms: The forms shall be designed to resist the impact of the shotcrete. All forms shall be constructed so as to permit the escape of air and removal of rebound.

F. Reinforcing shall be in accordance with Section 03210 and the drawings.

3.02 BATCHING AND MIXING

A. Method A (Shotcrete): Shotcrete shall be ready-mixed concrete in accordance with Section 03300 and the requirements of this section.

3.03 PLACEMENT EQUIPMENT

A. Method A (Shotcrete): The pump system used to convey premixed concrete shall deliver a uniform and uninterrupted flow of materials, without segregation or loss of the ingredients. The main run from the pump to the work shall be at least a 3-inch-diameter steel pipe or flexible hose reduced to 2-inch diameter at the point of expulsion. Aluminum pipe will not be permitted.

3.04 PLACEMENT

A. General

1. The thickness, method of support, air pressure, and water content of shotcrete shall be controlled to preclude sagging or sloughing off. If wind or air currents cause separation of the nozzle stream, placement shall be discontinued or suitable means shall be provided to screen the nozzle stream. For vertical or near-vertical surfaces, placement shall be limited to a maximum rise of 4 feet per hour.
2. The surface of freshly placed shotcrete shall be broomed or scarified if additional layers of shotcrete are to be bonded to it after it hardens.
3. Corners and areas where rebound cannot escape or be blown free shall be filled with sound material first. Corners between the web and the flanges of structural steel shall be completed before application to the flat areas.
4. For all placements and under all conditions, a blow pipe shall be provided for the removal of rebound and overspray.
5. The nozzle shall be held at a distance and angle that will place material behind reinforcement before any material is allowed to accumulate on its face.
6. Shotcrete shall not be placed through more than one layer of reinforcing steel or mesh in one application.
7. A properly operating air compressor shall be used. It shall have ample capacity to maintain a supply of clean, dry air with sufficient nozzle velocity to perform the application and, at the same time, to operate a blow pipe for clearing rebound. The air compressor shall have the capacity to deliver at least 100 cfm for each operating nozzle.
8. The Contractor shall use adequate ground wires or other approved means to establish the thickness, surface planes, and finish lines of the shotcrete. Specified tolerances shall be maintained by keeping ground wires secure and taut.
9. Shotcrete shall not be placed if drying or stiffening of the mix takes place at any time prior to delivery to the nozzle. Rebound or previously expended material shall not be used in the mix.
10. Overspray or rebound shall be removed prior to final set and before placement of any shotcrete material on such adjacent surfaces.

B. Except as noted in this Section, shotcrete shall be placed to provide the minimum cover over reinforcement shown on the drawings. Where coverage is not specified on the drawings, tolerances for coverage shall be in accordance with Section 03210.

3.05 REPAIR OF DEFECTS

A. The Contractor shall remove and replace shotcrete that lacks uniformity, exhibits segregation, honeycombing, or lamination, or that contains any dry patches, slugs, voids, or sand pockets.

1. Defective surfaces to be repaired as specified shall be cut back from true line a minimum of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required to deepen the area properly, the surface shall be prepared for bonding by the removal of laitance or soft material, and not less than 1/32-inch depth of the surface film from hard portions, by means of efficient abrasive blasting.

2. After cutting or abrasive blasting, the surfaces shall be wetted sufficiently in advance of shooting so that while the repair material is being applied, the surfaces under repair will remain moist but not so wet as to overcome the adhesion upon which a good bond depends.
 3. The material used for repair purposes shall consist of a mixture of 94 pounds of cement to 3 cubic feet of sand. On exposed work, where required by the Engineer, the cement shall contain such a proportion of approved white portland cement as is required to make the color of the patch match the color of the surrounding concrete. The sand shall be in accordance with SSPWC, Section 200-1.5.4, except that when tested by means of laboratory sieves, sand shall be in accordance with the grading requirements of SSPWC, Section 200-1.5.5, for mortar sand or portland cement concrete sand.
- B. Core holes, holes left by the removal of form ties, cone-bolt and she-bolt holes, narrow slots cut for repair of cracks, and areas that are small in width and relatively deep shall be repaired using dry-pack mortar. Dry-pack shall not be used for shallow depressions where lateral restraint cannot be obtained nor for filling behind steel reinforcement. Repairs by dry-pack mortar shall be in accordance with Section 03600, Grout and Dry-Pack.
- C. Wherever the Engineer approves repairs to be made with an adhesive, the adhesive shall be epoxy resin in accordance with Section 03300.
- D. Repairs requiring pressure grouting shall be made with epoxy resin in accordance with Section 03300.

3.06 FINISHING

- A. Provide troweled finish. Troweling of thin sections of shotcrete shall be avoided unless both troweling and commencement of moisture curing take place immediately after placement.
- B. Scraping or cutting to remove high spots shall not begin until the shotcrete has become stiff enough to withstand pull of the cutting device.

3.07 JOINTS

- A. Construction joints shall be sloped to form a shallow horizontal edge one inch deep, except where the joint will be subjected to compressive stress. In such cases, non-tapered joints shall be used, and special care shall be taken to avoid or remove trapped rebound at the joint. The entire joint shall be thoroughly cleaned and wetted prior to the application of additional shotcrete. Joints shall be perpendicular to the main reinforcement. Reinforcement shall be continuous across joints.
- B. All other joints shall be installed in accordance with the drawings. Reinforcement or other embedded metal items that are bonded to the shotcrete shall not extend continuously through control joints unless shown otherwise on the drawings.
- C. Vertical or near vertical construction joints shall be formed with bulkheads. Waterstops and expansion joints shall be in accordance with Section 03251, Expansion Joints, Control Joints and Waterstops, and as shown on the drawings.

3.08 CURING AND PROTECTION

- A. Immediately after finishing, shotcrete shall be kept continuously moist for at least 24 hours, using one of the following materials or methods, as agreed by the Engineer.
1. Ponding or continuous sprinkling
 2. Absorptive mat, burlap, or other covering kept continuously wet
 3. Vapor mist
- B. The Contractor shall provide additional curing of 14 days immediately following the initial curing and before the shotcrete has dried. One of the following materials or methods shall be used.
1. Continuing the method used for initial curing.
 2. Covering with sheet materials in accordance with Section 03300.
 3. Curing compounds in accordance with Section 03300, subject to the following limitations:
 - a. On gun or flash finishes, the minimum application rate shall be 100 square feet per gallon.
 - b. When curing compounds are used on surfaces against which additional shotcrete, gunite, or other finishing materials are to be bonded, abrasive-blasting shall be used to remove curing compounds completely prior to the application of additional materials.

4. Use of other moisture-retaining coverings when approved by the Engineer.
- C. If forms are to be removed during the curing period, the Contractor shall immediately use one of the curing materials or methods listed above.
- D. The shotcrete temperature shall be maintained above 50 °F throughout the curing period.
- E. Rapid drying at the end of the curing period shall be prevented. Curing mats, moisture retaining covering, or ponding shall remain in place after the curing period until removal is approved by the Engineer.
- F. Hot weather concreting procedures provided in ACI 305R shall be used when ambient conditions dictate.
- G. Cold weather concreting procedures provided in ACI 306R shall be used when ambient conditions dictate.
- H. Concrete shall be protected against damage until final acceptance by the Engineer. Special care shall be taken to prevent the concrete from drying out during the curing period and to avoid damaging the surfaces.
- I. Precautions shall be taken to prevent overloading floors, beams, and other members. The Contractor shall comply with the Engineer's instructions regarding the loads that will be permitted on these members during construction.

3.09 FIELD QUALITY CONTROL

- A. The Engineer will:
 1. Review and check proposed mix proportions.
 2. Secure production samples of materials at plants or stockpiles during construction, and test for compliance with the specifications.
 3. Cut and examine cores from in-place work to determine adequacy of coverage of reinforcing. The Contractor shall repair all cored locations.
 4. Cut cores from the structure or test panel, and test for compressive strength in accordance with ASTM C42. The Contractor shall repair all cored locations from the structure.
- B. During the work, the Contractor shall make one test panel with the minimum dimensions of 18 by 36 by 3-1/2 inches, gunned in the same position as the work represented, for every 50 cubic yards placed, but at least one panel per shift. Panels shall be gunned during the course of the work by the Contractor's regular nozzleman. Panels shall be field-cured in the same manner as the work. The Engineer will cut a minimum of three 4-inch-diameter cores from each panel for testing.

END OF SECTION