Appendix E.6 Memorandum Regarding Grading for Drilled Piles

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MEMO

DATE: October 12, 2016

TO: David Weil

FROM: Rick Davis, KPFF Consulting Engineers

RE: Harvard-Westlake Parking Structure
KPFF Job #109046

The design of the parking structure and pedestrian bridge indicates that, in certain locations, drilled (concrete) pile foundations are to be used and that such drilled piles be anchored at least eight feet into bedrock. The project's structural engineer, John A. Martin & Associates, has designed a preliminary foundation plan that incorporates the results of detailed geotechnical testing of onsite soils and bedrock conditions. The installation of the foundations will require the excavation of 1,221 cubic yards of soil, calculated as follows:

HARVARD-WESTLAKE - Excavation Calculation for Foundation Piles

DATE: 10-10-2016	Pile Info			Export Info	
Project Area	**#**	**Diameter (ft)**	**Depth (ft)**	**Cu Ft**	**Cu Yds**
South parking - column	63	2	70	13854	513.1
South parking - slab on grade	32	2	35	3519	130.3
North parking - column	42	2	60	7917	293.2
North parking - slab on grade	25	2	25	1963	72.7
Bridge column	9	2	65	1838	68.1
Elevator tower column	8	2	65	1634	60.5
Stair columns	12	2	60	2262	83.8
				Total	**1221.7**

The 1,221 cubic yards of excavation was included in the 140,00 total cubic yards of grading referenced in the Recirculated Draft EIR (February, 2016).

For reference see attached:

John A. Martin & Associates, Inc. 75% Structural Schematic Design Report, Dated May 13, 2015 (Pages 2 thru 9)

1.0 STRUCTURAL SYSTEM STUDY AND EVALUATION

1.1 GENERAL

The structural design for the Upper School Infrastructure Project at Harvard-Westlake School will provide a structural system integrated with the program requirements for space layout as well as the architectural and building service needs. User needs in terms of future adaptability of the spaces and current flexibility of use relative to the various department layouts and needs have been carefully considered. The systems described herein are consistent with previous studies performed by others. However, some changes from the previous studies are required due to recently enacted building code revisions.

The building will house three levels of parking and an athletic field level on the roof, for a total program area of approximately 337,000 gross square feet. The typical floor to floor heights will be between 11'-4" and 11'-10" with additional height at the lower level to accommodate the slope of the site. Connecting the parking structure to the school campus will be a pedestrian bridge spanning across Coldwater Canyon Boulevard. A stair and elevator tower will be required on the east side of Coldwater Canyon Boulevard for access to the school.

The structural design will be in accordance with the 2014 City of Los Angeles Building Code (2014 LABC) for resisting vertical, seismic and wind loadings. The 2014 LABC is based on the 2013 CBC, which is based on the 2012 International Building Code. The 2012 IBC adopts numerous design standards via reference to other organizational entities such as ASCE, ACI, AISC, etc.

Harvard-Westlake has requested the use of increased seismic and live loads to provide additional load carrying capacity. The minimum design live load for typical parking areas is 40 pounds per square foot (psf) per the 2014 LABC, but the parking levels of this structure will use a 60 psf live load. The field level will be designed for an increased live load of 150 psf which provides live load carrying capacity 50% above the 100 psf live load required by code. Additional allowances for field buildings and equipment storage at the field level have been considered as well. The 2014 LABC pedestrian bridge live load of 60 psf will be also be increased by 50% to a design live load of 90 psf. This increases the design live load to the AASHTO requirements for pedestrian bridges while providing an additional factor of safety above the 2014 LABC.

Cast in place concrete will be utilized at parking and field level floors, including concrete columns and foundations. Steel framing attached to the edge of concrete slabs will be used to create support for the vertical catchment fencing and netting canopy draped above the field. The pedestrian bridge will be a steel Vierendeel truss with concrete over metal deck floor framing, while the elevator towers servicing the bridge will be steel and concrete.

The draft #5 Geological and Soils Engineering Update dated April 20, 2015 prepared by Byer Geotechnical, Inc. indicates that the site is located in an area of high seismicity. Since the building is located in a high seismic region, earthquake resistance will be an important objective of the structural design. The building's lateral force resisting system will provide ductility for dissipation of energy generated during an earthquake. In accordance with direction from Harvard-Westlake, the parking structure will be designed using essential facility-level seismic design loads which will be calculated using an importance factor of I=1.5. Structural systems will be detailed to limit the effects of earthquake damage to both structural and nonstructural components of the building. Seismic restraints are to be provided for all equipment.

1.2 STRUCTURAL/ARCHITECTURAL/SERVICE COORDINATION

The structural framing will relate to the architectural layout of the spaces. The preferred concrete-framed structural system has taken into consideration the floor-to-floor height requirements, the building weight as it applies to seismic design, the acoustic and vibration requirements, the future flexibility and adaptability with respect to program, and the architectural aesthetics for the building. The seismic resisting system is dependent on the primary structural materials. The selection of the structural systems and to what extent they are utilized was also driven by current market conditions, architectural considerations, construction cost, and construction schedule.

Long, clear drive aisles and column-free spaces were maximized by locating the lateral force resisting systems at the building perimeter. Cast in place reinforced concrete moment frames were selected as the primary lateral load resisting elements based on the desired program layout and requirements for open ventilation and building user safety.

A service road is planned to be located on the south side of the project to provide access to the field level for light-duty trucks and ambulances. At this location we will coordinate a structural framed slab extension or bridge connecting to the service road’s termination at the field level. A seismic separation joint will be provided to allow adequate movement of the parking structure separate from the hillside; the detailing of the expansion joint will be provided by the architect with structural assistance.

To provide additional protection against moisture intrusion below the field level, we are investigating several options to enhance the performance of the field level slab. The options include one or a combination of the following: fiber reinforcing, concrete admixtures, additional post-tensioning, and increased reinforcing concrete cover.

1.3 PRELIMINARY STRUCTURAL SYSTEMS

1.3.1 Parking Structure

The typical framing at all elevated parking floors and the field level roof will utilize post-tensioned concrete slabs spanning 18 feet between post-tensioned concrete beams. Each floor level will utilize two delay strips that will be cast at least 90 days after the primary slab has been post-tensioned. Slabs will typically be 5” supported by 14” wide by 35” deep beams at parking levels. 7” slabs will be supported by 16” wide by 46” deep beams at the field level. Concrete columns supporting the elevated concrete floors will typically be 24 inches square.

Support for the 30 foot high catchment fence at the perimeter of the field and the overhead mesh netting will be provided by structural steel sections built-up from plate stock interconnected with hollow structural sections along its length. The size and shape of the catchment support will be coordinated with the architect to provide both the desired look and appropriate structural strength and stiffness to support the netting over the field.

Special concrete moment resisting frames will be located at the perimeter of the building to act as the primary lateral force resisting system. The north and south sides of the building will each be supported by six bays of moment frames, each bay being roughly 18 feet wide between column centers. 10 bays of moment frame will support the west side and 14 bays will support the east side with similar bay lengths of 18 feet. Moment frame beams will be 24” wide by 49” deep, upturned to act as a barrier at the parking levels. North and south side columns will be 30” by 48” using concrete strength between 5,000 and 8,000 psi. East and west moment frame columns will be 24” by 36” using concrete strength between 5,000 and 6,000 psi. At the foundation, the moment frame columns will be connected by concrete grade beams below finished grade.

1.3.2 Pedestrian Bridge

The primary framing for the pedestrian bridge will consist of a structural steel Vierendeel truss formed from pipe sections. The top and bottom chords of the truss will be 20" diameter pipe, and the vertical truss webs will be 16" diameter pipe as shown in Figures 1 and 2 below. The bridge will be supported by two cruciform concrete columns, one on either side of Coldwater Canyon Boulevard. The bridge composite deck floor system will utilize a 6-1/4" thick composite metal deck slab consisting of 3-1/4" of light weight concrete topping over a 3" deep (18 gauge minimum) wide ribbed profile metal deck. This composite metal deck system provides a 2 hour fire rated deck without fireproofing. The metal deck slab will span between steel pipe beams spaced an average of 13 feet on center. The elevator towers and stair will be a combination of light steel framing and concrete walls. The configuration of the elevator and stair towers is still being developed and will be coordinated with the architect to provide the desired appearance with an appropriate amount of structural strength and stiffness.

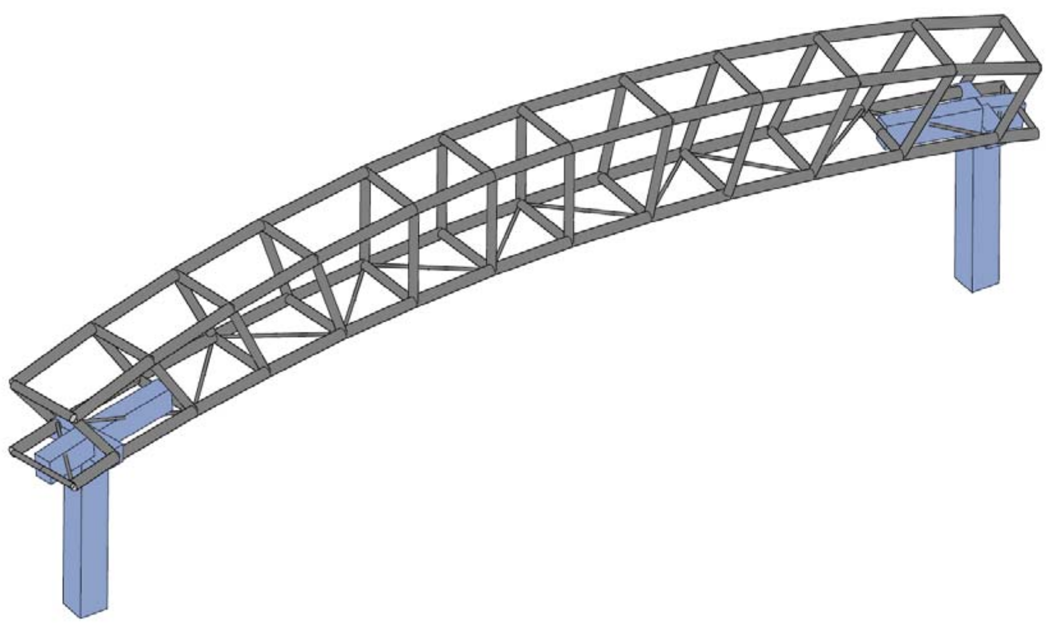

Figure 1: Bridge Model Isometric

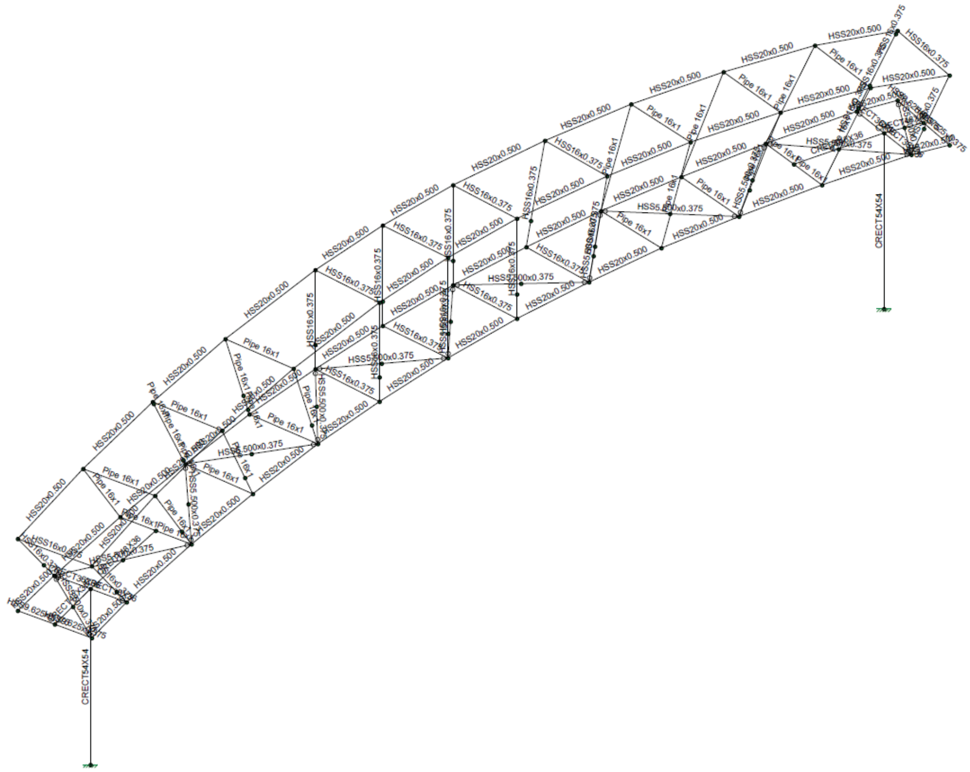

Figure 2: Bridge Sizes Isometric

1.3.3 Foundations

The Geotechnical report recommends two primary foundation systems – conventional footings and drilled cast-in-place concrete friction piles - depending on the soil throughout the site. Foundations founded in bedrock will be conventional spread footings. Typical interior column footings will be 11 feet square by 36 inches deep. Footings at the perimeter of the structure will be 10 feet square by 36” deep on the east and west sides, and 9 feet square by 36” deep on the north and south sides. Exterior footings will be offset towards the interior of the structure to allow space for adjacent walls and roads at the property line. Tops of footings will be located 18” minimum below the top of grade to allow for sloping, drainage, and other utilities. The footings will be lowered up to an additional 5 feet if suitable bedrock support substrate is less than a depth of 9’ from finish grade.

At locations where there is more than nine feet of alluvium between the ground level and bedrock, which occurs at a portion of the southern and eastern sides of the site as well as the area East of Coldwater Canyon, 24 inch diameter drilled cast-in-place concrete friction piles will be the foundation system as recommended by the geotechnical report. At each column supported this way, three to four piles per column will be founded into bedrock with typical embedment depths of 40 to 50 feet. The selection and location of the two foundation systems will be coordinated with the geotechnical engineer in order to arrive at the optimal foundation system relative to cost and constructability. See attached Conceptual Pile plan for estimated pile locations and quantities.

Over bedrock, the on grade slab will consist of 5” concrete slab reinforced with #4 reinforcing bars at 16” on centers each way. Where the slab-on-grade is located over alluvium, we will use a 7” concrete slab designed to span 15 feet between piles and grade beams as recommended in the soils report.

Permanent soil nail retaining walls designed by others and built independently from the parking structure are required for stabilization of adjacent slopes around the perimeter of the building. They are not addressed in this report.

1.4 APPROXIMATE STRUCTURAL MATERIAL QUANTITIES

TABLE 1 – STRUCUTRAL STEEL QUANTITIES – BRIDGE

Component	Steel estimate	Area applicable for steel quantity
Pedestrian Bridge Primary Structure	85 tons	Bridge supported length

Notes: 1. Estimate should include 15% allowance for connection plates. Maintain Contingency for finalization of design and detailing.

TABLE 2 - CONCRETE REINFORCING QUANTITIES

Component	Reinforcing Estimates	Area applicable for quantity estimates
Parking Level Slab	1.2 psf rebar .24 psf PT	Entire area of supported concrete structure
Field Level Slab	1.5 psf rebar .24 psf PT	Entire area of supported concrete structure
Slab-on-grade	1.2 psf rebar	Entire area of supported concrete structure
Parking Level Beam	16 plf rebar 6.2 plf PT	Entire length of beam
Field Level Beam	20 plf rebar 12.0 plf PT	Entire length of beam
Moment Frame Beam	50 plf rebar 2.6 plf PT	Entire length of beam
Exterior Columns	65 plf rebar	Height of column, including depth of foundation
Interior Columns	55 plf rebar	Height of column, including depth of foundation
Ramp Columns	115 plf rebar	Height of column, including depth of foundation
Moment Frame Columns	190 plf rebar	Height of column, including depth of foundation
Spread Footings	60 lb/cu.yd.	Volume of foundations (assume 36" deep typ each column)
Piles	35 plf rebar	Number and length of piles shown in "Conceptual Pile Count" (total approx. length in bedrock plus fill is 9,600 feet)
Grade Beams	50 plf rebar	Entire length of beam

Notes:
1. Estimate does not include allowances for splices, hooks, and support bars.
2. Estimate may vary once framing plans and building shape are confirmed. Maintain an allowance.

1.5 OUTLINE SPECIFICATIONS

1.5.1 DESIGN CRITERIA

Governing Codes

a) City of Los Angeles Building Code 2014
b) California Building Code 2013
c) International Building Code 2012
d) ASCE 7-10 Minimum Design Loads for Buildings
e) Risk Category – II (CBC 1604.5)
f) Building Wind Speed – 115mph (Risk Category III & IV 3 second gust per CBC Fig 1609B)
g) Wind Exposure Type B (CBC 1609.4.3)
h) Wind Directionality Factor Kd = 0.85 (ASCE TBL 26.6-1)
i) Soil Site Class C
j) Short Period Spectral Acceleration Ss = 2.374g
k) One Second Period Spectral Acceleration S1 = 0.825g
l) Seismic Importance factor I = 1.5 (ASCE 7-10 TBL 1.5-2)
m) Seismic Design Category: SDC = E (CBC 1613.3.5)
n) Special Reinforced Concrete Moment Frame R = 8 (ASCE 7-10 TBL 12.2-1)
o) Over Strength Factor: Ωo = 3 (SRCMF)
p) Deflection Amplification Factor: Cd =5.5 (SRCMF)

Reference Standards

a) American Society of Civil Engineers (ASCE 7)
b) American Institute of Steel Construction (AISC 360)
c) American Welding Society (AWS D1.1)
d) American Society for Testing and Materials (ASTM)
e) Reinforced Masonry Engineering Handbook (TMS 402)
f) American Concrete Institute (ACI 318)
g) AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges

1.5.2 DESIGN LOADS

1.5.2.1 FLOOR LIVE LOADS

a)	Parking Areas	60 psf unreduced (= 1.5 x 40 psf)
b)	Field Level	150 psf unreduced (= 1.5 x 100 psf)
c)	Pedestrian Bridge	90 psf unreduced (= 1.5 x 60 psf)

1.5.2.2 SPECIAL LOADS

a)	Exterior Skin	15 psf average over wall area
b)	Ceiling / Services Above Grade	5 psf (slab soffit load)
c)	Bridge Cladding	5 psf average over exterior surface

1.5.3 MATERIALS

1.5.3.1 CONCRETE

a) Aggregates	
(1) ASTM C-33	(Hard rock)
(2) ASTM C-330	(Lightweight)
b) Cement - ASTM C-150, Type I or II	
c) 28-Day Compressive Strengths	
(1) Foundations	4000 psi (Hard rock)
(2) Moment frame beams	5000 psi to 6000 psi (Hard rock)
(3) Moment frame columns	5000 psi to 7000 psi (Hard rock)
(4) Slab on grade	4000 psi (Hard rock)
(5) Elevated concrete slabs	5000 psi (Hard Rock)
(6) Concrete fill on metal deck	3000 psi (Lightweight)
(7) All other concrete	4000 psi (Hard rock)

1.5.3.2 REINFORCING STEEL

a) ASTM A-615 grade 60 typical
b) ASTM A-706 grade 60 at special concrete moment frames and where bars are welded

1.5.3.3 STRUCTURAL STEEL

a) Wide flanges, tees	ASTM A992-Grade 50
b) Steel plate	ASTM A572-Grade 50
c) Channels and angles	ASTM A36
d) Tubes	ASTM A500 Grade B
e) Pipes	ASTM A53 Grade B
f) Bolts	ASTM A-325SC; A490SC where noted
g) Weld electrodes	ASTM E70XX
h) Metal deck	ASTM A653-A, galvanized
i) Anchor bolts	ASTM F1554 Grade 50 S1
j) Headed studs (3/4” diameter)	ASTM A-108

1.5.3.4 MASONRY (Field Structures and Non-load Bearing Partitions)

a) Units conforming to ASTM C90
b) Mortar strength - 1800 psi
c) Grout strength - 2000 psi
d) Block design strength (f'_m) - 1500 psi


Innovative Design Group
HARVARD-WESTLAKE
Harvard-Westlake Upper School Infrastructure Project
PROPOSED SITE PLAN
A2
Parking Column/SOG Foundations (Alluvium Zone 2)
Columns: (42) 24" diameter piles embedded 50' into bedrock over +/- 10' of fill
Slab-on-grade: (25) 24" diameter piles embedded 15' into bedrock over +/- 10' of fill
Bridge Column Foundation
(9) 24" diameter piles embedded 50' into bedrock over +/- 15' of fill
Elevator Tower Foundation
(8) 24" diameter piles embedded 50' into bedrock over +/- 15' of fill
Stair Column Foundation
(4) 24" diameter piles embedded 40' into bedrock over +/- 20' of fill per stair column. 12 piles total.
Conceptual Pile Count
JAMA - May 13, 2015
Notes:
1. Remainder of structural elements are assumed to be supported on spread footings bearing directly on Bedrock (Modelo Formation).
2. Reduce pile length in fill by 5' to allow for pile cap and fill above cap.
Parking Column/SOG Foundations(Alluvium Zone 1)
Columns: (63) 24" diameter piles embedded 50' into bedrock over +/- 20' of fill
Slab-on-grade: (32) 24" diameter piles embedded 15' into bedrock over +/- 20' of fill
COMPACTED FILL OVER ALLUVIUM
PROPOSED PEDESTRIAN BRIDGE
PROPOSED SOIL NAIL WALL
PROPOSED DEBRIS BASIN
ALLUVIUM OVER BEDROCK
COLLUVIUM OVER BEDROCK
FILL OVER ALLUVIUM
HACIENDA DRIVE (VACATED)
(SEE REGIONAL TOPOGRAPHIC MAP)
LEGEND
REVISED GEOLOGIC MAP
BYER GEOTECHNICAL INC.