MEMORANDUM

DATE: April 12, 2016

TO: Amy Dunlap, LEED AP BD+C, HKT Architects

FROM: Kevin M. Champagne, P.E., Pare Corporation
Nick Romano, Pare Corporation

CC: Andrew Chagnon, P.E., Pare Corporation
Marc Gabriel, P.E., Pare Corporation

RE: **Boxborough – New Public Safety Building**
Continued Feasibility Study
Structural Feasibility Design Narrative
Boxborough, MA
(Pare Job No. 15017.01)

Per your request, Pare Corporation has prepared this structural feasibility design narrative for the proposed Public Safety Building in Boxborough, Massachusetts.

GENERAL CRITERIA

Building Description

This narrative is based upon the Conceptual Drawings prepared by HKT Architects as well as a review of existing documentation provided by the Town of Boxborough indicating potential subsurface conditions. Key elements related to the project are as follows:

- The proposed structures for the project are:
  - A two-story main building with an approximate footprint of 8,500 square feet. First floor-to-second floor height = 14'-0" +/-; Second floor-to-roof height = 15'-0" +/-
  - A single-story apparatus building with an approximate footprint of 9,700 square feet. Floor-to-underside of roof structure = 25'-0" +/-. The apparatus building will be connected to the two-story building and accessible via the 2nd floor. An approximately 1,300 square foot mezzanine will be located above the storage rooms along the south side of the apparatus building.
  - A single-story building for sally port/impound, evidence, booking, and restrooms with an approximate footprint of 3,000 square feet. Floor-to-underside of roof structure = 14'-0" +/-
- The structures will have flat roofs and no basements. The first floor will be a concrete slab-on-grade. The second floor will be a concrete slab on metal deck. The slab-on-grade within the buildings will be approximately at or slightly above adjacent grade around the buildings.
- As the structure will be built into a hillside, the first floor of the main building will be located approximately 10'-0" below the apparatus bay floor slab.

- The public safety building will contain: locker rooms, training rooms, booking and detainment areas, sally port/impound, fitness areas, living quarters, storage, and office areas. The apparatus building will be a large garage area for emergency vehicles.
- It is assumed that the elevator shaft will be constructed concrete masonry units (CMU). Stairwells will be steel-framed and enclosed in gypsum wallboard (GWB).
- Exterior envelope will generally consist of brick veneer and fiber-cement siding with metal stud or concrete masonry unit (CMU) back-up.

Building Codes and Standards

All structural design criteria for the building will be based on the latest building codes and standards listed below, and by criteria specified by the owner and architect.

- Massachusetts Building Code: 8th Edition (2009 International Building Code with Massachusetts amendments) and referenced standards. *Note that the 9th Edition (2015 IBC) is scheduled to be adopted in the summer of 2016 which may change some structural loading requirements.*
- American Institute of Steel Construction (AISC), Specifications and its Code of Standard Practice, 2005.
- AISC "Design Guide 11 – Floor Vibrations due to Human Activity."
- American Concrete Institute Building Code Requirements for Reinforced Concrete, ACI 318.
- American Concrete Institute Building Code Requirements for Concrete Masonry Structures, ACI 530 and ACI 530.1.
- Steel Joist Institute (SJI) and Steel Deck Institute (SDI) design standards.

STRUCTURAL SYSTEMS

Foundations

A geotechnical investigation was not performed as part of this feasibility design phase. The foundation systems indicated below are based upon a presumptive net allowable bearing pressure of 3,000 pounds per square foot (psf) determined from an existing plan made available to the design team titled "Boxborough Town Buildings," Drawing S-1, dated 1/4/89. Based upon notes contained in Drawing S-1, some over-excavation of organics and loose fill may be required for installation of the foundations.

All fill and unsuitable soil shall be removed from within the influence area of the proposed foundations and slabs-on-grade and replaced with structural fill. The influence zone is defined as a 1H:1V slope extending downward and outward from two feet outside the edges of the footings. A shallow foundation system is anticipated. Exterior walls will be supported on continuous concrete footings. Interior and exterior columns will be supported on square footings. At least 12 inches of compacted structural fill shall be placed below all foundations. Sub-base preparation shall result in the required net allowable bearing pressure.

A comprehensive geotechnical investigation is strongly recommended during the next design phase to better define the project's foundation recommendations and requirements.

The apparatus bay slab-on-grade is located above the main building slab-on-grade. Therefore a 16" inch thick concrete wall reinforced with #6 at 6" on-center, each face, will be required to support this change in grade.

Slab-on-Grade

The concrete slab-on-grade within the main building shall generally be 5" thick, reinforced with welded wire fabric. Embedded fibers shall be added to the mix where the slab will be exposed.. Saw cut contraction joints shall be spaced at 15'-0" on-center, maximum.

The concrete slab-on-grade within the apparatus building and sally port shall be 8" thick, reinforced with #4 bars at 12" on-center, each way. Saw cut contraction joints shall be spaced at 24'-0" on-center, maximum.

At least 12 inches of compacted structural fill and vapor barrier shall be placed below all slabs on grade. Sub-grade preparation shall result in a subgrade modulus of 150 pounds per cubic inch (pci).

Second Floor Structure and Mezzanine

The second floor of the new main building will consist of composite steel beams supporting a concrete slab on composite metal deck. The slab will be comprised of 3 ½ normal-weight concrete placed on 2" composite metal deck (total thickness of 5 ½"). Beams will be spaced approximately 8'-0" on-center with welded shear studs attached to the top flanges. The beams will be supported by steel girders and steel HSS tube columns. The columns will generally be located along exterior walls, interior corridor walls, and demising walls resulting in a maximum beam span of approximately 30'-0". Columns will be spaced along these lines (i.e. girder span) at 25'-0" on-center maximum. The final column spacing will be based upon programming as well as braced frame considerations.

The mezzanine located at the south side of the apparatus bay building will consist of composite steel beams supporting a concrete slab on composite metal deck. The slab will be comprised of 3 ½" normal-weight concrete placed on 2" composite metal deck (total thickness of 5 ½"). Beams will be spaced approximately 8'-0" on-center. The beams will span north-south and be supported by the south, exterior CMU wall and an interior CMU demising wall resulting in a maximum beam span of approximately 14'-0".

Roof Structure

The roofs will be flat and framing will generally consist of steel joists, steel girders, and steel HSS tube columns. Joist spacing will be approximately 5'-0" on-center maximum with tighter spacing adjacent to roof steps (due to snow drifts). Steel beams will be used in lieu of joists along column grid lines. Girders and columns will be spaced as described in the previous section.

A row of steel columns and girders will be installed along the centerline of the apparatus building, resulting in a maximum joist span of approximately 49'-0". Along the north exterior wall of the apparatus building, the joists will be supported by steel girders above the overhead doors. The girders will be supported by reinforced concrete walls between the overhead doors. Along the south

side of the apparatus bay building, the joists will bear directly on the CMU walls. The roof deck will consist of 20 gauge 1-1/2" Type B galvanized metal deck.

Lateral Force Resisting Systems

The lateral force resisting system for the public safety building will consist of steel braced frames (tube braces and columns). The concrete floor deck and metal roof deck will serve as horizontal diaphragms.

The lateral force resisting system for the apparatus building will consist of reinforced CMU shear walls and reinforced concrete shear walls (narrow piers between overhead doors). The metal roof deck will serve as the horizontal diaphragm.

Exterior Wall Construction

It is assumed that the exterior wall construction will generally consist of brick veneer or fiber cement siding with CMU or metal stud back-up.

The brick veneer back-up system shall be designed for maximum out-of-plane deflections of span/720.

- Kevin Champagne, P.E.
  Pare Corporation