LARSEN & LANDIS
STRUCTURAL ENGINEERS

October 1, 2024

Mr. Jeffrey Bento, AIA, NCARB
The S/L/A/M Collaborative
1 Cedar Street, Suite 201
Providence, RI 02903

***Via Email Transmission***

RE: South Kingstown High School
215 Columbia Street
South Kingstown, RI 02879

Dear Jeff:

As requested, we have prepared this structural design narrative for the proposed construction of the South Kingstown High School building at 215 Columbia Street in South Kingstown, Rhode Island.

**Standard of Care and Use of Report**

Please note that the information in this report is based on our interpretation of the drawings and information provided by the design team, as summarized below. The findings of this report represent our best professional opinion based on the information available to us at this time.

## 1 GENERAL STRUCTURAL CRITERIA

### 1.1 Building Description

This narrative is based on updated schematic design Revit model files managed by your office and coordinated with us using BIM360 through September 27, 2024. Based on this information, we understand that the project will comprise the following key elements:

- Construct a new steel-framed High School building to house classrooms, multipurpose areas, a cafeteria, a gymnasium, a theatre, and other common-use academic areas.
- The total new construction building area is approximately 92,200 gsf on the First Floor Level, 48,700 gsf on the Second Floor Level, and 18,000 gsf on the Third Floor Level of the enclosed structural floor area.
- Construct new exterior stair landings & ramps as required to support new site layout requirements.

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

## 1.2 Building Codes and Standards

1.2.1 State Building Code

- Rhode Island State Building SBC-1 2022 (International Building Code IBC 2018 with Amendments).

1.2.2 Industry Reference Standards

- American Concrete Institute, "Manual of Concrete Practice – 2015 Edition"
- American Concrete Institute, "ACI 530-13 Building Code Requirements for Masonry Structures"
- American Concrete Institute, "ACI 318-14 Building Code Requirements for Structural Concrete"
- American Institute of Steel Construction, "Steel Construction Manual, Fifteenth Edition"
- American Society of Civil Engineers, "ASCE 7-16 Minimum Design Loads for Buildings and Other Structures"
- American Institute of Steel Construction, "Design Guide 11 - Floor Vibrations Due To Human Activity"
- American Institute of Steel Construction, "AISC 341-16 Seismic Provisions for Structural Steel Buildings."
- American Institute of Steel Construction, "AISC 360-16 Specifications for Structural Steel Buildings"

1.2.3 Project Specific Reference Standards

- "South Kingstown High School" Revit BIM file of overall building construction prepared by The SLAM Collaborative of Providence, RI, and coordinated through September 26, 2024.

## 1.3 Design Loads

The building will be designed to support all applicable loads and loading conditions prescribed by the governing Building Code as well as specific loading conditions provided by the Owner, including:

1.3.1 General Design Requirements

- Municipality..... South Kingstown
- Risk Category ..... III

1.3.2 Floor Live Loads (Per IBC 2012, Section 1607)

- Classrooms ..... 40 psf
- Corridors – First Floor..... 100 psf
- Storage & Mechanical ..... 125 psf
- Offices..... 50 psf
- Stairs & Lobby Areas ..... 100 psf

1.3.3 Roof Live Loads (Per IBC 2018, Section 1608 & SBC-1 Table 1608.1)

- Ground Snow Load, Pg..... 35 psf
- Minimum Flat Roof Snow Load, Pf..... 30 psf **
- Surface Roughness Category .....C
- Exposure of Roof..... Partially Exposed
- Snow Exposure Factor, Ce .....1.00
- Thermal Factor, Ct .....1.00
- Snow Load Importance Factor, Is .....1.00
- Additional snow loading as required for drift
- Roof ponding loads are not considered in the design due to the sloped roof profile.
- ** - Additional self-weight DL and snow drift LL will be applied at roof regions designated to receive future Solar/PV array systems.

1.3.4 Wind Loads (Per IBC 2018, Section 1609 & SBC-1 Table 1608.1)

- Ultimate Wind Speed, Vult .....139 MPH
- Nominal Wind Speed, Vasd..... 108 MPH
- Wind Exposure Category..... C
- MWFRS Design Method..... Directional Procedure (ASCE 7-16)
- Components & Cladding Loads..... Chapter 30 (ASCE7-16)

1.3.5 Earthquake Loads (Per IBC 2018 Section 1613 & SBC-1 Table 1608.1)

- Site Class..... D (To be verified by Geotechnical Engineer)
- Spectral Response Accelerations
  - Ss..... 0.186
  - S1 ..... 0.052
- Spectral Response Coefficients
  - Sds .....0.198
  - Sd1 ..... 0.083
- Seismic Design Category..... B
- Seismic Importance Factor, Ie .....1.00
- Seismic Force Resisting System
  - Steel Systems Not Specifically Detailed for Seismic Resistance (R = 3.0, Wo = 3.0, Cd = 3.0)
  - Ordinary Reinforced Masonry Shear Walls (R = 2.0, Wo = 2.5, Cd = 2.0)
- Analysis Procedure- Equivalent Lateral Force
  - Seismic Analysis will consider the total seismic mass of the building, including the self-weight of all significant equipment.

# 2 STRUCTURAL SYSTEMS

## 2.1 Foundations

The foundation design will be based on recommendations made in a geotechnical report by GEI Consultants, Inc. (Project No.: 2302246) dated July 14, 2023.

The site soil conditions are suitable for conventional spread footing foundations based on compacted structural fill or native soils. The subsurface preparation beneath all new slabs on grade and foundations shall be per the geotechnical report. All topsoil, existing fill, and other unsuitable materials must be removed and replaced with a minimum of 6” compacted granular structural fill or prepared per the geotechnical engineer’s requirements. All new foundations will be designed assuming a net allowable bearing pressure of 4,000 psf for footings founded on suitable native soils or compacted structural fill.

The typical exterior foundation walls at all new construction areas will vary in width but typically be 16” wide reinforced concrete construction with an assumed veneer support shelf of 8”. The wall thickness and shelf configuration may change depending on total height and architectural support requirements. At conventional wall locations, the foundation walls will be supported by continuous reinforced concrete footings typically 3’-0” wide by 1’-0” thick and located 3’-4” minimum below finish grade at exterior locations.

Unless noted otherwise, the walls at the exterior perimeter of the building will be constructed so that the top of the wall stem extends to the top of the first-floor slab elevation.

Isolated columns will be supported by concrete spread footings that are 6’-0” x 6’-0” x 18” thick (minimum), with larger sizes provided at high-load locations. Reinforced concrete piers that are 24” x 24” minimum in area will be provided at all interior footing locations where the bottom of the footing elevation must be lowered to support interior MEP, Utility, or architectural requirements.

Where required, site retaining walls will be designed as cantilevered retaining walls of a minimum thickness of 12" and sized and reinforced to resist overturning and sliding forces applied due to the soil lateral loads. The retaining walls will be supported by continuous concrete retaining wall footings that vary in size and geometry depending on the final layout and height of the retained earth. Refer to the site drawings for additional information on all retaining wall systems.

If ledges or boulders are encountered, they must be removed to a minimum depth of 12” below all slabs and foundations and replaced with a compacted stone layer.

Groundwater may be encountered and must be considered in the design and construction of the new foundations and slabs on grade. An adequate drainage system and waterproofing system must be provided for all foundations (and under the slabs where recommended by the geotechnical engineer). Note that the structural drawings may indicate but will not include the design of the drainage and waterproofing system – this must be coordinated with the project's geotechnical engineer, plumbing engineer, and civil engineer. Foundation walls will be designed assuming no hydrostatic pressure on walls; a properly designed groundwater drainage system must be provided should observed groundwater elevation extend above the lowest slab elevation.

## 2.2 Slabs on Ground

The slabs-on-grade throughout the new building structure at the First Floor Level will consist of 5" thick cast-in-place concrete slabs reinforced with welded wire fabric located 1" below the top of the slab unless specifically noted otherwise. The slab on grade at the new gymnasium structure at the First Floor Level of the building will consist of 6" thick cast-in-place concrete slabs reinforced with welded wire fabric at the slab mid-depth. All slabs on grade will bear upon subgrade prepared per the recommendations of the Geotechnical Engineer (6" min. compacted granular structural fill). Appropriate sealants, admixtures, and finishes will be applied to all slabs on grade to satisfy the project requirements and saw-cut joints will be provided at 10'- 0" on center maximum spacing. All 4" thick concrete slabs on grade will be constructed to standard floor flatness (Ff = 25) and floor levelness requirements (FL = 20) unless noted otherwise. More stringent flatness and levelness requirements may be required at the Music/Movement studio, Gymnasium, and other regions of the building to support floor finish system requirements.

All exterior concrete slabs on grade and all concrete exposed to deicing chemicals shall be reinforced with epoxy-coated reinforcement.

In locations that require an under-slab drainage system (designed by the geotechnical engineer), 18" of compacted crushed stone must be provided below slabs on grade. Slabs on grade will be designed assuming no hydrostatic pressure or uplift on them; a properly designed groundwater drainage system must be provided should observed groundwater elevation extend above the lowest slab elevation.

## 2.3 Second and Third-Floor Structures

The elevated floor structures at the Second- and Third-floor levels will consist of composite steel beams and slab-on-metal deck construction. The slab system will consist of a 4 ½" lightweight concrete slab placed atop a 1 ½" – 20-gauge composite metal deck (total slab thickness 6"). The slab system will be supported by wide flange steel beams located at approximately 5 feet on center with welded shear studs on the top flanges. The wide flange steel beams will be supported by wide flange steel girders supported on wide flange steel columns located along the exterior walls and adjacent to corridors at approximately 24'-0" to 30'-0" on center. The supporting columns will be

continuous down to the foundation structures below.

At this design stage, we suggest considering a steel weight of 12 - 14 pounds per square foot of building area for preliminary budgeting purposes at typical elevated composite concrete slab locations (unless noted otherwise). This estimated value of steel weight includes beams, columns, bracing, and connections. All steel weights are subject to revision based on the final building design.

At select locations around the perimeter of the Second and Third Floor Levels, bent plate pour stops may be required at the elevated levels of the building to accommodate the stepped slab/deck edge conditions. Further bent plate edge details may be required at additional locations where special detailing is needed.

All estimating and budgeting for the project shall include provisions for additional steel framing for mechanical openings and chases (not necessarily indicated on the structural framing plans but shown in typical details), miscellaneous steel for support of mechanical equipment/piping/ductwork, support for rooftop screen walls, and support angles for brick relief.

## 2.4 Roof Structure

The typical Roof-level structural framing system at classroom spaces, administrative spaces, and other regions of the main building will consist of 1½"-20-gauge galvanized roof deck that is supported by typical K-series and long-span LH-series open web steel joists spaced at approximately 5'-0" on center which are supported by wide flange steel girders (W21 typ.). The wide-flange steel girders will be supported by wide-flange steel columns located at the exterior perimeter of the new construction within the exterior walls of the building and the classroom/corridor demising walls spaced at approximately 24'-0" to 30'-0" on center. The supporting columns will be continuous down to the foundation structures below. The roof beams will be sloped to support the architectural roof requirements.

The Roof Level structural framing system at the Cafeteria will consist of 1½"-20-gauge galvanized roof deck that is supported by long-span LH-series joists supported on wide flange steel beams. The wide flange steel beams are supported on round HSS columns spaced 25'-0" to 30'-0" on center.

Gymnasium and Theatre area structural framing systems will consist of 3"-20-gauge galvanized roof deck that is supported by DLH-series areas joists spaced 10'-0" on center. The DLH-series joists will be supported on wide flange steel beams and steel columns (12" HSS) spaced 25'-0" to 30'-0" on center along the perimeter. The supporting columns will be continuous down to the foundation structures below.

Acoustic roof decking or other acoustic treatment may be required at the Theatre and Music/Movement spaces and other acoustically sensitive areas within the building to support project requirements.

Note: Acoustic deck will be required in the Cafeteria, gymnasium and Theater.

The structural design assumes that the roof structure throughout the building will be framed flat or pitched to drain as required by the architect. Additional secondary drains are provided to prevent ponding water loading conditions.

At this design stage, we suggest a steel weight of 12 pounds per square foot of building area be considered for preliminary budgeting purposes at typical elevated roof deck locations unless noted otherwise (estimated steel weight accounts for loading of future Solar/PV array system). We suggest that a steel weight of 15 pounds per square foot of building area be considered for preliminary budgeting purposes at the building's Cafeteria, Gymnasium, and Theatre areas. This value excludes the self-weight of the metal decking. This estimated value of steel weight includes beams, columns, bracing, and connections. All steel weights are subject to revision based on the final building design.

## 2.5 Lateral Force Resisting System

The lateral force-resisting system at the new building structure will combine ordinary steel moment frame construction and steel braced frames with rectangular HSS bracing members (inverted-V configuration) at additional locations. The locations of the braced and Moment Frames are not all specifically indicated on the schematic design drawings.

Intermediate reinforced masonry shear wall construction will be used at the elevator pit structures. The wall system will be designed and detailed to serve as a shear wall and will be tied back to the main building structure with miscellaneous metal clips at the Second and Third Floor Levels. The masonry walls will be supported by reinforced concrete elevator pit walls on top of a reinforced concrete foundation mat. The elevator pit shall be sealed with an approved waterproofing membrane system.

## 2.6 Exterior Wall Construction

The new exterior wall construction at the structure may consist of architectural panelized veneer and brick masonry veneer with light gauge metal stud backup wall systems. The backup wall systems at all new construction supporting brick masonry veneer will be designed for maximum out-of-plane deflections of span/900 or 0.375” maximum. The backup wall systems at all new construction supporting panelized veneer will be designed for maximum out-of-plane deflections of span/360 or 0.50” maximum. The architectural veneer must be designed to span from the foundation wall to the top of the wall without intermediate vertical support. Vertical control joints may be required at a predetermined spacing in the architectural veneer system. Refer to the architectural drawings for all information related to the veneer.

Brick relieving angles will be provided at areas where brick masonry veneer overhangs lower areas of roof framing or spans across wall openings greater than 8’-0” in width. Veneer control joints shall be coordinated with brick relief locations.

To provide full lateral support for these systems, additional vertical jamb posts and horizontal structural steel support girts (top and bottom) will be provided at large wall openings and window assemblies exceeding 10'-0" in width.

## 2.7 Additional Design Considerations

Horizontal steel girts will be provided within the structural exterior wall assembly at all architectural pre-engineered sunscreen, awning, and canopy locations. The girts shall be connected to the columns at each end with moment connections. Additional similar rectangular HSS steel girts with brick relieving angles shall be provided at the head of all window openings greater than 8'-0" through brick veneer systems and at all locations where the brick veneer system is immediately above alternate (concrete panel, metal panel, etc.) veneer systems.

Steel columns and beams exposed to view at select interior locations and other isolated areas identified in the architectural drawings may be specified as Architectural Exposed Structural Steel (AESS) and may be required to adhere to more stringent fabrication, erection, and finishing criteria. At select locations, round steel HSS columns will be used to support architectural interior requirements. Refer to the architectural drawings for identification of any areas of AESS framing.

Structural steel framing outside the building envelope and connected back to the main building structure shall be thermally isolated as required by the project architectural documents. Once the building envelope design is completed, all thermal isolation details will be finalized.

Small steel-framed canopies are located at several locations around the perimeter of the building at entryways. These assemblies will be constructed with round HSS columns supporting W8 steel beams supporting a 3"-20-gauge galvanized metal roof deck.

Steel columns and beams exposed to the exterior environment of the new structure shall be galvanized steel or otherwise protected from the elements.

## 3 SUMMARY

The description of the scope of new construction work for this project is based upon the best information available to this office. The project design criteria, building scale/scope, and the structural systems described in this document will continue to evolve as the project design is developed. All cost and estimating work that uses this information shall include adequate contingency to address changes to the project scope of work in the future.

Please contact our office if you have any questions or require additional information.

Sincerely,

John O. Grieshaber, P.E.
Principal Structural Engineer