1. GENERAL

1.1 GENERAL REQUIREMENTS

.1 The General Conditions of CCDC2-2008, and the General requirements of Division 1, form part of this Section and must read in conjunction with the requirements of this Section, and all related Sections.

.2 The Work of this Section and related Work specified in other Sections shall comply with all requirements of Division 1.

.3 The Work of this Section and related Work specified in other Sections shall comply with all requirements of Division 16 section-16010 Electrical General Provisions.

1.2 WORK INCLUDED

This section provides minimum acceptance requirements for vibration isolation and seismic restraints for all electrical equipment, and conduit as required by codes

1.3 QUALITY ASSURANCE

.1 Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:

   .1 National Building Code 2010

   .2 Ontario Building Code 2006

   .2 All vibration isolation and seismic/wind restraint systems shall be by one manufacturer.

   .3 The following guides shall be used for supplemental information on typical seismic installation practices.


1.5 SUBMITTALS

.1 Submit Product data in accordance with Div.-1 submittal procedures.

.2 Shop Drawings shall include:

   1. Device dimensions
2. Placement, attachment and anchorage requirements.
3. Operating and maintenance clearances. e.g. access door swing spaces.
4. Professional Seismic Engineer’s calculations and equipment selection.
5. Acoustical sound power data, where applicable.
6. Certification of compliance to applicable codes.

2 PRODUCTS

2.1 VIBRATION ISOLATION:

A. Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have \( k_x/k_y \) ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.

B. Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be galvanized, powder-coated enamel, or painted with rust-resistant paint. Hot-dipped galvanized housings shall be provided as indicated on the Schedule.

C. Isolators:

1. Free Spring Floor Mounted Isolators: Type FS – Free-standing, laterally stable, unhoused spring isolators with components for leveling and securing equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 6 mm (0.25”) thick, bonded to the base plate. Type FST – same as Type FS with the addition of an equipment support top plate.

2. Restrained Spring Floor Mounted Isolators: Type CSR – Laterally stable, vertically restrained spring isolators with welded steel housings and heavy top plates for supporting equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 6 mm (0.25”) thick, bonded to the base plate. Housings shall include vertically restraining limit stops. Minimum clearance around the restraining bolts and between the housing and the spring shall be 13 mm (0.5”). Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts.

3. Closed Mount Spring Isolators: Type CM – Floor mounted spring isolators with telescoping housings and bolts for leveling and securing equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a neoprene noise isolation pad, minimum 6 mm (0.25”) thick,
bonded to the base plate. Housings shall be fabricated or welded steel telescoping housings that incorporate neoprene stabilizers to minimize short circuiting and provide vertical damping.

4. Rubber-in-Shear Floor Mounts: Type RD – “Double-deflection” neoprene isolators, with neoprene-coated metal surfaces, and top and bottom surfaces ribbed. Isolators shall have bolt holes in the base.

5. Spring Hangers: Vibration isolator hanger supports with steel springs and welded steel housings. Hangers shall be designed for a minimum of 15 degree angular misalignment from vertical before support rod contacts housing; hangers serving lightweight loads 0.90 kN (200 lbs) and less may be exempt from this requirement. Provide a vertical uplift stopwasher on spring hangers for seismically restrained equipment, duct or piping.
   a. Type SH – spring hanger isolators complete with spring, compression cup, and neoprene acoustic washer.
   b. Type SHR – spring hanger with neoprene isolators complete with spring, compression cup, and neoprene “double-deflection” element at top of hanger.
   c. Type SHB – spring hanger with bottom cup isolators complete with spring, compression cup, and neoprene cup under spring.

6. Neoprene Hangers: Type NH – “Double-deflection” neoprene hanger isolators, each with an integral neoprene sleeve between hanger rod and housing. The neoprene element shall include an internal metal washer as a fail safe to prevent pull-out failure. Provide vertical uplift stopwasher on neoprene hangers for seismically restrained equipment, duct or piping.

7. Vibration Isolation Pads: Type N – Neoprene pad type isolators, 10 mm (0.375”) minimum thick, ribbed on both sides. Type NSN – Sandwich neoprene pad type isolators, with 10 mm (0.375”) minimum thick ribbed neoprene pads bonded to each side of a 3.5 mm (10 ga) minimum galvanized metal plate. Isolator pads shall be selected to ensure that deflection does not exceed 20% of isolator free height.
2.2 SEISMIC AND WIND RESTRAINTS

.1 General:

1. Provide positive seismic and wind restraints on those systems and components required by the applicable building code and by the local authority having jurisdiction.

2. Provide restraint devices as required, specified, and as scheduled for isolated and non-isolated systems and equipment. Provide calculations to determine restraint loadings for all restrained systems and equipment resulting from seismic forces.

3. See the vibration isolation and seismic restraint schedule on the drawings for equipment specific values to be used in calculating the seismic restraint forces, including component importance factor, $I_p$.

.2 Vibration isolators with integral seismic restraint: Isolator housings shall be capable of withstanding the applicable design forces for the specific installation.

4. Seismic Spring Floor Mounts: Type SFS – Laterally stable, restrained spring type with support for bolting to the equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a neoprene noise isolation pad, minimum 6 mm (0.25") thick, bonded to the base plate. Mount shall include integral all-directional limit stops with elastomeric grommets preventing metal-to-metal contact and with minimum 1/4" clearance under normal operation.

5. Seismic Restrained Spring Isolator: Type SCSR – Laterally stable, restrained spring type with housings and heavy top plates for supporting the equipment and resisting seismic and wind loading. Housings shall be of welded steel construction and include vertically restraining limit stops. Maximum clearance around the restraining bolts shall be 6 mm (0.25"). Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts.

6. Seismic Restrained Curb-mounted Spring Rail: Type RTR w/ seismic restraint – Full-perimeter rail type, minimum 16 ga formed galvanized steel construction with integral spring isolators designed to fit over a roof curb and under the isolated equipment. Seismic and wind resistance shall be provided by means of wire rope assemblies and resilient snubbers with a minimum clearance of 3 mm (0.125") so as not to interfere with the spring action under normal operation. The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof, flexible neoprene connection joining the outside perimeter of the upper and lower members. The rail shall be manufactured, shipped
and installed as a single piece unless its size exceeds standard shipping dimensions. Shipping splits and lifting points shall be coordinated with the installing contractor. An optional acoustic barrier package shall be provided as required and scheduled.

7. Seismic Cable Restraints: Type SRK – Seismic cable sway bracing restraints shall consist of 7x19 galvanized steel aircraft cable sized to resist seismic loads with a safety factor of five (5). Cable end connections shall use heavy brackets, thimbles, and wire rope clips or compression sleeves.

8. Hanger Rod Stiffener: Structural steel angle attached with a formed steel clamp (Type VAC) to threaded rod support. Steel angle to be provided by contractor; steel clamp to be provided by seismic restraint manufacturer.

9. Seismic Restraint Brackets: Type SRB – Formed steel brackets for securing floor-mounted equipment complete with pre-drilled holes. Brackets shall be galvanized or powder coated enamel for corrosion protection.

10. Seismic Snubber: Structural steel angle(s) with surfaces covered with ribbed neoprene pads to cushion contact with snubber. Customized snubber designs may use other structural shapes and configurations as required. Snubbers shall be designed to limit equipment motion to no more than 6 mm (¼”) in any direction.

11. Concrete Anchor Bolts: Post-installed anchors in concrete shall be qualified for seismic restraint application in accordance with ACI 355.2.

   a. Mechanical anchor bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications.

   b. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications.

12. Grommet Washers: Type GW neoprene grommet washers, 70 durometer, of sufficient size to accommodate USS standard washers, long enough to sleeve through 6 mm (¼”) plate material, and with at least 3 mm (1/8”) thick material around the bolt hole.

2.3 ACCEPTABLE PRODUCTS

1. Vibro-Acoustics
2. Kinetics Noise Controls
3 EXECUTION

3.1 GENERAL:

A. Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.

B. Coordinate locations and sizes of structural supports with locations of vibration isolators and seismic/wind restraints.

3.2 VIBRATION ISOLATION:

A. Block and shim all bases level so that all electrical connections can be made to a rigid system at the proper operating level, before isolators are adjusted. Ensure that there are no rigid connections or incidental physical contacts between isolated equipment and the building structure or nearby systems.

B. Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchors.

C. Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.

D. Extent of Conduit Isolation:

1. Isolate all conduits larger than 25 mm (1") dia. rigidly connected to vibration isolated equipment with 25 mm (1") static deflection spring hangers at spacing intervals in accordance with the following:

<table>
<thead>
<tr>
<th>Conduit Diameter</th>
<th>Distance from Vibrating Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2” to 4”</td>
<td>50'</td>
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</tbody>
</table>
3.3 SEISMIC RESTRAINTS:

E. General:

1. All equipment and conduits shall be restrained to resist seismic forces per the applicable building code(s) as a minimum. Additional requirements specified herein are included specifically for this project.

2. Install seismic restraint devices per the manufacturer’s submittals. Any deviation from the manufacturer’s instructions shall be reviewed and approved by the manufacturer.

3. Attachment to structure for suspended equipment: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

4. Wall penetrations may be used as bracing locations provided the wall can provide adequate resistance without significant damage.

5. Coordinate sizes and locations of cast-in-place inserts for post-tensioned slabs with seismic restraint manufacturer.

6. Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.

7. Where rigid restraints are used on equipment, conduits, support rods for the equipment and conduits at restraint locations must be supported by anchors rated for seismic use. Post-installed concrete anchors must be in accordance with ACI 355.2.

8. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough to ensure adequate edge distance for restraint anchor bolts to avoid housekeeping pad breakout failure.

F. Concrete Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre- or post-tensioned tendons, electrical and telecommunications conduits.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

G. Equipment Restraints:

1. Install fasteners, straps and brackets as required to secure all the mechanical equipment.

2. As indicated on the schedule, install seismic snubbers on free standing electrical switchboards supported by floor-mounted, non-seismic vibration isolators. Locate snubbers as close as possible to vibration isolators and attach to equipment base and supporting structure as required.

3. Install neoprene grommet washers on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 3.2 mm (0.125 inch).

4. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Conduit Systems:

1. Unless otherwise indicated on the drawings, the component importance factor for conduit systems shall be assigned as follows:
   
a. Electrical conduits: Ip=1.5.

2. For projects with a Seismic Design Category of C, provide seismic cable restraints on the following:
   
a. All conduit systems assigned a component importance factor, Ip, of 1.5 with a nominal pipe diameter greater than 50 mm (2") or trapeze-supported piping with combined operating weight over 15 kg/m (10 lb/ft).
3. For projects with a Seismic Design Category of D, E or F, provide seismic cable restraints on the following:
   a. All conduit greater than 75 mm (3") nominal diameter.
   b. All conduit systems assigned a component importance factor, Ip, of 1.5 with a nominal pipe diameter greater than 25 mm (1") or trapeze-supported conduits with combined operating weight over 15 kg/m (10 lb/ft).

4. This specification does not allow the use of the “12-inch rule” where conduit may be exempted from seismic restraint based on the length of the support rods.

5. Restraint spacing:
   a. For conduits, space lateral supports a maximum of 12 m (40’) o.c., and longitudinal supports a maximum of 24 m (80’) o.c.
   b. For conduit risers, restrain the piping at floor penetrations using the same spacing requirements as above.

6. Brace a change of direction longer than 3.7 m (12’).

7. Longitudinal restraints for single conduit supports shall be attached directly to the conduit, not to the conduit hanger.

8. For supports with multiple conduits (trapezes), secure conduits to trapeze member with clamps approved for application.

9. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

10. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.

11. Install flexible connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

12. Coordinate seismic restraints with thermal expansion compensators, guides and anchor points. Thermal expansion anchor points shall be designed to accommodate seismic forces.
3.3 BATTERY PACKS, LIGHTING & EMERGENCY LIGHTING, PANELBOARDS

.1 Battery packs, wall mounted panelboards, lighting & emergency remote heads can be directly mounted to the building structure with approved fasteners to suit. Minimum 2 or more anchors shall be provided on each side of all wall mounted equipment. For battery packs pre-installed brackets must be used.

4 INSPECTION AND CERTIFICATION:

.1 After installation, arrange and pay for the vibration isolation product manufacturer to visit the site to verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that isolators are adjusted, with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.

.2 After installation, arrange and pay for the seismic restraint product manufacturer to visit the site to verify that the seismic restraint systems are installed properly, and shall submit a certificate so stating.

END OF SECTION