
Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Seismic restraint systems for statically supported and vibration isolated electrical equipment and systems; including electrical light fixtures, transformers, MCC's, UPS, diesel generators, standby power, equipment and systems, both vibration isolated and statically supported.

1.2 RELATED SECTIONS

- .1 General conditions clauses and supplementary general conditions clauses are applicable to the present section as if they were reproduced entirely.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Research Council Canada (NRC-CNRC).
 - .1 National Building Code of Canada (NBC) - 2010.
- .4 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE, Applications Handbook (SI).
- .5 American Society for Testing and Materials International (ASTM).
 - .1 ASTM E488-10, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
- .6 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA, Addendum No. 1, September 2000 to Seismic Restraint Manual, Guidelines for Mechanical Systems.
 - .2 SMACNA, Seismic Restraint Manual, Guidelines for Mechanical Systems.

1.4 DEFINITIONS

- .1 SRS: acronym for Seismic Restraint System.

1.5 DESCRIPTION

- .1 SRS fully integrated into, and compatible with:
 - .1 Noise and vibration controls specified elsewhere.

- .2 Structural, mechanical, electrical design of project.
- .2 Systems, equipment not required to be operational during and after seismic event.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Québec.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Québec, Canada.
- .3 Submit design data including:
 - .1 Full details of design criteria.
 - .2 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
 - .3 Separate shop drawings for each SRS and devices for each system, equipment.
 - .4 Identification of location of devices.
 - .5 Schedules of types of SRS equipment and devices.
 - .6 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
 - .7 Installation procedures and instructions.
 - .8 Design calculations including restraint loads to NBC and Supplement.
- .4 Quality Assurance Submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.7 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling, and Unloading:
 - .1 Deliver, store, and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store, and handle materials in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.9 SEISMIC PARAMETERS

- .1 Seismic parameters to be selected according to NBC.
- .2 Seismic lateral force for design purpose is given by the following equation:
 $V_p = 0,3 * F_a * S_a (0.2) * I * S_p * W_p$.
- .3 For Québec region, $S_a (0.2)$ is: 0.59.
- .4 Depending on the type of application, a priority seismic factor shall be applied:
 - .1 Normal buildings: $I = 1.0$;
 - .2 Schools: $I = 1.3$;
 - .3 Civil protection buildings: $I = 1.5$.
- .5 Depending on the installation type, a horizontal force coefficient “ S_p ” shall be applied:
 - .1 Coefficient value is defined in paragraph 4.1.8.17.1 of NBC 2010.

1.10 DETERMINATION OF PROTECTION LEVEL

- .1 For electrical raceways and conduits, install seismic anchors and restraints according to SMACNA “Seismic Restraint Manual”.
- .2 Following the calculation of design lateral seismic force, determine the level of protection to apply. Level SHL-A protection is designed to withstand a lateral seismic force equivalent to 48% of the weight of the equipment. SHL-B level is designed to withstand a seismic lateral force equivalent to 30% of the weight of the equipment. Finally, SHL-C level is designed to resist lateral seismic force equivalent to 15% of the weight of the equipment.

Part 2 Products

2.1 SRS MANUFACTURER

- .1 SRS from one manufacturer regularly engaged in SRS production.

2.2 GENERAL

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in every direction.
- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.

- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to RC structure:
 - .1 Use high strength mechanical expansion anchors.
 - .2 Drilled or power driven anchors not permitted.
- .7 Seismic control measures not to interfere with integrity of firestopping.
- .8 All electrical equipment mounted on suspended ceilings must be attached directly to the building structure.
- .9 Seismic devices shall prevent permanent displacement and damage caused by the horizontal and vertical movements, and overturning.
- .10 Seismic devices must be compatible with the electromechanical design. They should not interfere with normal operation of electromechanical systems.
- .11 No device or related support nor any plot should yield before the structure or the structure breaks.
- .12 Accessories, such as speakers and lighting fixtures installed in suspended ceilings, do not have to be stabilized, except in exit corridors or if the ceiling is specifically designed to withstand earthquakes.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
 - .1 Anchor equipment to equipment supports.
 - .2 Anchor equipment supports to structure.
 - .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Install tight to structure.
 - .2 Cross-brace in every direction.
 - .3 Brace back to structure.
 - .4 Slack cable restraint system.
 - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
 - .3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Floor mounted equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Vibration isolators with built-in snubbers.
 - .2 Vibration isolators and separate snubbers.
 - .3 Built-up snubber system approved by Departmental Representative, consisting of structural elements and elastomeric layer.

- .2 SRS to resist complete isolator unloading.
- .3 SRS not to jeopardize noise and vibration isolation systems. Provide 6-12 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
- .4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Slack cable restraint system.
 - .2 Brace back to structure via vibration isolators and snubbers.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

2.6 SERVICE UTILITIES ENTRANCE INTO BUILDING

- .1 Provide flexibility to prevent breakage in the event of earthquake activity.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Attachment points and fasteners:
 - .1 To withstand same maximum load that seismic restraint is to resist and in every direction.
- .2 Restrain electrical raceways and conduits with 35 mm nominal diameter and over inside mechanical or electrical room.
- .3 Restrain electrical raceways and conduits with 63 mm nominal diameter and over outside mechanical or electrical room.
- .4 Materials that have suspension rods less than 300 mm do not have to be restrained.

- .5 Provide longitudinal and transverse bracing to the supports. These braces can be rigid or cable type.
 - .1 A cross bracing can be used as longitudinal bracing, if it is installed within 600 mm of the change of direction of the raceway.
- .6 Anchors:
 - .1 Check that anchor bolts, diameters of the ankles, depth of the indentations in the concrete and length of the welds are done according to the drawings submitted for approval.
 - .2 Oblong openings for adjustment bolts are prohibited.
 - .3 Anchors in the concrete slabs should be removed from the edges following the standard ASTM E488 and recommendations of the manufacturer of the anchors.
- .7 Slack Cable Systems (SCS):
 - .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
 - .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
 - .3 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .4 Orient restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), tie back to structure at maximum of 45° to structure.
 - .5 Adjust restraint cables so that they are not visibly slack, but permit vibration isolation system to function normally.
 - .6 Tighten cable to reduce slack to 19 mm under thumb pressure. Cable not to support weight during normal operation.
- .8 Install SRS devices at the following distances:
 - .1 For transversal restraint:
 - .1 SHL-A : every 6.1 linear meters;
 - .2 SHL-B : every 10 linear meters;
 - .3 SHL-C : every 12.2 linear meters.
 - .2 For longitudinal restraint:
 - .1 SHL-A : every 12 linear meters;
 - .2 SHL-B : every 20 linear meters;
 - .3 SHL-C : every 24.4 linear meters.
- .9 Install SRS at least 25 mm from equipment, systems, services.
- .10 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through house-keeping pad to structure.
- .11 Co-ordinate connections with other disciplines.
- .12 Protective measures against earthquakes shall be in accordance with NBC Requirements.

- .13 Ensure anchors and attachment points can withstand the same maximum loads than seismic devices.
- .14 Ensure that electrical raceways and conduits connected to isolated devices does not diminish the flexibility of vibration control components, and that raceways and conduits through walls or floors do not transmit vibrations.
- .15 For equipment not provided with attachment points, provide for the addition of these items or provide for the attachment belt installation.
- .16 The structural bases of equipment shall be restrained to prevent their overthrow.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
- .2 Inspection and Certification:
 - .1 SRS: inspected and certified by Manufacturer upon completion of installation.
 - .2 Provide written report to Departmental Representative with certificate of compliance.
- .3 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION