
Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Seismic restraint systems for statically supported and vibration isolated equipment and systems; including laboratory fume hoods, BSC's, incinerators, kitchen equipment, electrical light fixtures, transformers, MCC's, UPS, diesel generators, standby power, fire protection, communications, equipment and systems, both vibration isolated and statically supported.
- .2 Related Requirements
 - .1 Section 23 05 00 - Common Work Results for HVAC

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21, 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 Building Code of Canada (NBC-2010)
 - .1 ANSI/NFPA 13-2013, Installation of Sprinkler Systems;
 - .2 NFPA 14-2013, Installation of Standpipe Systems;
 - .3 NFPA 20-2013, Installation of Stationary pumps for fire protection;
 - .4 SMACNA – Seismic Restraint Manual Guidelines for Mechanical System;
 - .5 ASHRAE – Seismic and Wind Design;
 - .6 FEMA;

1.3 DEFINITIONS

- .1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.
- .2 SRS: acronym for Seismic Restraint System.

1.4 DESCRIPTION

- .1 The Contractor is responsible for calculating, supplying and installing seismic protection devices for all technical components installed under his responsibility.
- .2 SRS fully integrated into, and compatible with:
 - .1 Noise and vibration controls specified elsewhere.
 - .2 Structural, mechanical, electrical design of project.

- .3 Except for fire protection systems, equipment and systems seismically protected are not required to be operational during and after a seismic event.
- .4 During a seismic event, SRS to prevent systems and equipment from displacement, falls or being turned over thus causing personal injury.
- .5 Designed by a Professional Engineer specializing in design of SRS and registered in the Province of Quebec.
- .6 The Contractor is responsible for calculating, supplying and installing seismic protection devices for all technical components installed under his responsibility.
- .7 Obtain the services of an engineer who is a registered member of the OIQ to evaluate and calculate seismic risk and calculate mitigation measures. The Engineer selected must demonstrate proven expertise in seismic protection. The Contractor shall provide contact information to the Engineer not later than two (2) weeks after signing the contract.
- .8 During an earthquake, seismic restraints must prevent permanent shifts and damages due to vertical and horizontal movements as well as from overturned equipment.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .3 Report for the evaluation and mitigation of seismic risk
 - .1 Provide the Departmental Representative with the evaluation and mitigation of seismic risk report prior to installing the technical components.
 - .2 Report must at least include the following information:
 - .1 Project's general data :
 - .1 Building location (Quebec city).
 - .2 Summary description of building including the building height (hn)
 - .3 Building location category (Type A according to NBC 2010)
 - .4 Building risk category (Type « high » according to NBC 2010).
 - .5 Applicable $S_a(0,2)$ value;
 - .6 Applicable F_a value;
 - .7 Applicable I_e value .
 - .3 The list of all technical components that are included in the Contractor's contract for which a seismic risk assessment is required.
 - .4 The list of technical components subject to an exemption from assessment with supporting documents.
 - .5 For each technical component (TC), provide the seismic risk assessment and mitigation measures applied. Include the following elements:
 - .1 TC identification according to drawings and specifications.
 - .2 TC location including height h_x
 - .3 TC description, including

- .1 Equipment type;
 - .2 Make and model;
 - .3 Dimensions;
 - .4 Weight;
 - .5 Cp, Ar and Rp categories and values;
 - .4 Lateral V_p and structural building loads calculations;
 - .5 The applied mitigation measure description including:
 - .1 Make and model of chosen material;
 - .2 Applicable installation sketch;
 - .3 Location of seismic devices shown on drawings;
 - .6 For each TC installed on floor, slab or base, provide the overturning force calculation and description of the mitigation measure. Including the following elements:
 - .1 TC identification according to drawings and specifications.
 - .2 TC location including height h_x
 - .3 TC description including
 - .1 Make and model
 - .2 Dimensions
 - .3 Weight
 - .4 Position of center of gravity
 - .4 Overturning force calculation
 - .5 The applied mitigation measure description including :
 - .1 Make and model of the chosen material
 - .2 Applicable installation sketch .
 - .3 Location of seismic devices shown on drawings.
 - .7 For fire protection piping, the evaluation report and the installation of seismic restraint systems must also meet the requirements of NFPA 13.
- .4 Provide structural engineer with location of attachment points for seismic protection devices; provide structural engineer with shop drawings and technical specifications.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .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 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .6 Closeout Submittals:
- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.

1.6 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.

1.7 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.

Part 2 Products

2.1 MANUFACTURER

- .1 Seismic protection devices and systems must be supplied by a single manufacturer with experience in the field.

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.

2.3 STEEL ANGLE

- .1 Cold formed steel angle with minimum breaking strain of $F_u = 410 \text{ MPa}$ (59 ksi) and strength limit of $F_y = 300 \text{ MPa}$ (43 ksi), in compliance with AISI.

2.4 STEEL CHANNEL

- .1 Steel channel according to ASTM A1011/A1011M GR 33 and CSA G40.20/G40.21.

2.5 STRUCTURAL PIPING

- .1 Structural piping built according to ASTM A53/A53M, type E or S, grade B.

2.6 BOLTS

- .1 Bolts built according to standard ASTM A307, grade A, hexagonal head.

2.7 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.

2.8 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 4-8 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.

2.9 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.

2.10 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 Install seismic devices as indicated in the evaluation and mitigation of seismic risk report.
- .2 Changes in seismic installation must be recalculated by a Seismic Engineer and issued as an amendment to the report.
- .3 Attachment points and fasteners:
 - .1 To withstand same maximum load that seismic restraint is to resist and in every direction.
- .4 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 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
 - .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
 - .6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
 - .7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.
- .5 Install SRS at least 25 mm from equipment, systems, services.

- .6 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through house-keeping pad to structure.
- .7 Co-ordinate connections with other disciplines.
- .8 Vertical tanks:
 - .1 Anchor through house-keeping pad to structure.
 - .2 Provide steel bands above centre of gravity.
- .9 Horizontal tanks:
 - .1 Provide at least two straps with anchor bolts fastened to structure.

3.3 **INSTALLATION FOR FIRE PROTECTION PIPING**

- .1 Perform installation and design of seismic restraint systems according to the requirements of ANSI / NFPA 13.
- .2 Install flexible mechanical joints approved for groove pipes on piping with a diameter greater than or equal to NPS 2½ at following locations:
 - .1 At less than 0610 mm from upper slab of supply risers if they are longer than 0.9 m;
 - .2 At less than 305 mm from floor below supply riser;
 - .3 At less than 610 mm from a supply riser fitting and on its horizontal portion;
 - .4 At less than 610 mm from building expansion joints;
At less than 610 mm from the top of supply drop pipes;
 - .5 At less than 610 mm above the highest support of supply drop pipes attached to the structure, a shelf or a mezzanine.
 - .6 At less than 610 mm from the bottom of supply drop pipes.
- .3 Install seismic separation assemblies in areas where piping passes through the building's seismic separation. Transversely, vertically and longitudinally stabilise assemblies located at less than 1.83 m of either side of the seismic separation.
- .4 Transversely stabilize, at least at every 12.2 m, all supply mains regardless of their size and all branches of NPS 2½ and over.
- .5 The distance between the end of the pipe to stabilize and the transverse seismic protection devices and stabilizers shall not exceed 1.8 m.
- .6 Transversely stabilize the last pipe length of water mains.
- .7 Transverse seismic protection systems and devices for pipes of NPS 2½ and over can be used as longitudinal seismic protection systems and devices for perpendicular pipes of the same size if bracing is at less than 600 mm from elbows or tees.
- .8 Transversely stabilize mains at less than 610 mm from flexible mechanical joints other than those required above.
- .9 At the least, longitudinally stabilize all supply mains at every 24.4 m.
- .10 The distance between the end of the pipe to stabilize and the longitudinal support shall not exceed 12.2 m.

- .11 Do not transversely stabilize pipes suspended by brackets and within 150 mm of the structure. This exception does not apply to longitudinal stabilization.
- .12 Transversely, vertically and longitudinally stabilize the top of vertical columns of more than 1 m in length at every 7,6 m.

3.4 INSTALLATION FOR PIPING OTHER THAN FIRE PROTECTION

- .1 Perform installation and design of earthquake resistant systems according to "ASHRAE, A Practical Guide to Seismic Restraint" and ANSI / SMACNA 001.
- .2 The seismic protection systems and devices must comply with the requirements for anchoring and guiding pipes.
- .3 Stabilize pipes NPS 3 and over.
- .4 Stabilize oil supply pipes NPS 1 and over.
- .5 At a minimum, install mechanical restraint devices on pipes at every:
 - .1 For transversal stabilization:
 - .1 NPS 8 and under: 12.2 m.
 - .2 NPS 10 and over: 6.1 m.
 - .3 Halve these distances for non-ductile or screwed gas piping.
 - .2 For longitudinal stabilization:
 - .1 NPS 5 and under: 24.4 m.
 - .2 NPS 6 to NPS 8: 12.2 m.
 - .3 NPS 10 and over: 6.1 m.
 - .4 Halve these distances for non-ductile or screwed gas piping.
- .6 Transverse seismic protection systems and devices of a pipe section can be used as longitudinal seismic protection systems and devices for perpendicular pipe sections of the same size if bracing is at less than 600 mm from elbows or tees.
- .7 Install seismic separation assemblies in areas where piping passes through the building's seismic separation. Transversely, vertically and longitudinally stabilise assemblies located at less than 1.83 m of either side of the seismic separation.
- .8 Stabilize either side of a cast iron pipe upon a 90° change in direction.
- .9 Do not stabilize pipes suspended by brackets and within 300 mm of the structure.

3.5 STIFF RODS AND ATTACHMENT POINTS

- .1 Connect retaining rods to hardware so that they axially address the center of gravity of the equipment to protect.
- .2 Use rods of an appropriate diameter in accordance with seismic protection systems and devices manufacturer's requirements.
- .3 Vertical, lateral and longitudinal rods shall be installed in accordance with seismic protection systems and devices manufacturer's requirements.

3.6 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 Consultant within 3 days of manufacturer representative's review.
- .2 Inspection and Certification:
 - .1 SRS: inspected and certified by Seismic Engineer upon completion of installation.
 - .2 Provide written report to Consultant with certificate of compliance.
- .3 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to Consultant complete set of construction documents, revised to show "as-built" conditions.

3.7 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