# SEISMIC REQUIREMENTS AND RECOMMENDATIONS

| **Revision** | **Changes** | **Date** |
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# Foreword:

The current editions of the OBC and NBC have expanded the areas where seismic restraint may be required to many areas that previously were exempt. In addition, there have been new requirements with regard to anchors in masonry and additional guidelines that are being referred to in the engineering specifications.

With this document we are hoping to give contractors new to seismic a starting point and update the remaining contractors on changes and good practice.

Please ensure to read this carefully and distribute to your site team, project managers, and estimators.

Wind load review is not always requested in the engineering specifications, but in many cases the loads can exceed those of seismic, especially in low seismic areas. Capital Seismic and Engineering Ltd. conducts this as standard practice. In non-seismic areas, we will often provide this as a separate price. We recommend checking with the engineers prior to tender on whether or not this will be required if it is not noted in the specification.

For any questions about this document, please send an email to hello@capitalseismic.ca, and someone will get back to you as quickly as possible.

Yours sincerely,

The Capital Seismic Team

1. Seismic rated cables:
    a. Our clients are free to supply their own materials, but our preference is for cable systems that have OSHPD approval (Gripple) or are third-party tested to ANSI/ASHRAE Standard 171-2017 (Vibro-Acoustics Bulletbrace/lock). Documentation must state the testing and the maximum allowable load, or design strength (LFRD/LSD). Please ensure to confirm if the cables you intend to use are acceptable prior to purchase/installation.
    b. Capital Seismic & Engineering Ltd. has prepared an approved cable list which will be provided in our packages and available on our website.
    c. Please note the following general information:
        i. Seismic restraint cables must state that is their purpose and cannot state "static loads only". Any cables with this on the documentation will be rejected. Please check the documentation carefully as "seismic rated for hanging a duct", for example, is not the same as "seismic rated as a restraint cable". We cannot accept Shark Cable by Duct Mate or Gripple standard hanging cables for this reason.
        ii. We cannot accept the Kinetics V-Lock at this time for the following reasons:
            1. We are concerned about its reliance on friction.
            2. We do not have evidence of how it will perform when connected to equipment which vibrates.
            3. The potential for installation error appears high.
        iii. The use of rolls of aircraft cables with saddle hangers again makes it difficult for us to confirm the strength of the restraint. We will be requesting that any client using this system provide the shop drawings for all components c/w confirmation of which equipment it is being used with prior to installation. As part of this information, third party testing documentation is required. If this information is not provided, we may not be able to sign off on your project. For high-importance and post-disaster projects (IE = 1.3 & 1.5), approved seismic cables must be used; standard aircraft cable will not be accepted.

2. Anchors:
    a. Anchors must be seismic rated. This applies to both the direct support (hanging) and restraint.
    b. Power/powder-actuated anchors are not to be used.
    c. Drop-in anchors must be seismic-rated, which primarily limits them to the Dewalt Snake + (1/4"ø, 3/8"ø, ½"ø), Hilti HDI TZ anchors (now available in 3/8"ø, ½"ø, and 5/8"ø) and, particularly for hollow core, HDI-P TZ anchors (3/8"ø and ½"ø). The use of seismic-rated drop-in anchors requires pre-approval to confirm the load rating is acceptable, and since we are unable to verify if the drop-ins that were used are seismic-rated after installation.
    d. When we provide a diameter for an anchor, it is always in reference to the nominal diameter – i.e., the threaded section penetrating the material, not the head diameter. We will start providing both on the drawings, but please ensure to ask if you are in doubt.
    e. Wall condensing unit brackets cannot be attached to brick veneer only. They must be installed through the brick to the main structure.
    f. **Nail-in anchors are not to be used for any purpose**. They specifically state not to be used for overhead hanging, sustained tension, or life safety. They must not be used.
    g. We have provided an approved anchor list. If the anchor you intend to use is not on this, please contact us to review ahead of time, as it may not have the necessary certification.

3. Support of lightweight equipment such as VAVs, Fans, Bypass boxes & Ductwork:
    a. We have always assumed lightweight equipment was installed adequately (in accordance with SMACNA, etc.) with independent supports. Moving forward, and due to some recent inspections, we will be inspecting/requiring photographs for small cross-sectional ductwork, VAVs, and small fans as necessary to ensure the installation is adequate. Our drawings will be updated to reflect the following.
    b. Fans should be installed with four threaded rods to the structure.
        i. On a normal importance job, if the ceiling exhaust fan is less than 20 lbs and mounted in a seismic-rated T-bar grid/drywall ceiling, independent support can be waived as long as the fan is secured to the main runners with a minimum of four #12 self-drilling screws (in accordance with CISCA). Note we will require confirmation the grid is seismic rated, otherwise install with independent support as normal.
        ii. For lightweight (24 lbs and less) fans and other flexibly connected equipment, restraint will not be required (unless critical for life safety/operation of a high importance or post-disaster building); however, they must be hung using the manufacturer hanging brackets c/w four threaded rods or cables, and with seismic rated anchors.
        iii. At 25 lbs and above, restraint will be required as per the package.
    c. Rigidly ducted terminal units < 75 lbs
        i. Boxes should be installed with independent support and trapezed installation with 3/8”ø threaded rods is preferred. A second trapeze should be installed on the attenuator or, less attenuator, on the attached rectangular ductwork within 36” of the box flange.
        ii. Concrete anchors for use with rods should be Hilti KH EZ I or DeWalt Hangermate+ anchors 3/8”ø (internal thread) x ¼”ø minimum (bit) x 1-5/8” embedment. Seismic rated wedge anchors with coupling nuts are also acceptable.
        iii. For open web steel joists, either use beam clamps with retaining straps or strut bolted to the joist.
        iv. For normal importance projects where the box is less than 50 lbs (and the structure is concrete or wood), strapping is permitted. Preferred 1.5” wide, minimum 20 gauge strapping with ¼”ø threaded anchors (seismic-rated screws with min 1-5/8” embedment for concrete or equivalent wood screws). Two straps are to be installed directly on the box with another two on the attenuator or rectangular ductwork within 3 ft of the first set. Straps are to be secured to the box with a minimum of three #12 anchors. One underneath, one at the bottom on the side, and the third at the top on the side.
        v. Note we have recently learned that Coratech bypass boxes are substantially heavier than the normal manufacturers we see. When provided with attenuators, all sizes are potentially over 75 lbs and require restraint. If you intend to use them, please let estimates@capitalseismic.ca know as there will be an additional cost.
    d. Ductwork supports must meet seismic requirements, using seismic anchors, rods, and trapezes or min 1” wide strapping where SMACNA permits. Ductwork requiring restraint requires installation using threaded rods.
    e. Again, please note nail-in anchors are not to be used for any purpose.

4. Fan powered boxes and fans:
    a. Units are to be suspended with threaded rods to the factory brackets or a trapeze. Strapping is not to be used.
    b. Restraints to be installed as per the package.

5. Strut supports:
    a. Strut allowable load is based on the span, whether or not it is slotted, where the loading is applied and, of course, the model. We have prepared a strut span guide which is included with.
    b. If the strut you are using is not Sasco/Unistrut these charts may not be accurate. It is the contractor's responsibility to obtain the manufacturer's data and to provide it to Capital Seismic prior to installation if the strut being used differs.
    c. It is the contractor's responsibility to review the provided strut span sheets to ensure what they are using the appropriate strut size for the span and weight. If in doubt, please contact Capital Seismic (projects@capitalseismic.ca ) for further direction.

6. OWSJs:
    a. Equipment support and restraint is to be installed to the top chord. Where this is not possible, contact Capital Seismic (projects@capitalseismic.ca ) for further direction.
    b. Do not screw into or drill OWSJs. Any mechanical fasteners/welds require EOR/joist manufacturer approval.
    c. The preferred restraint is strut sandwiching the top chord with a threaded rod and the restraint bracket bolted to the threaded rods or strut. Restraints are to be installed within 4" of a panel point.
    d. We will permit cables to be installed directly to the top chord of a joist, installed at a panel point to prevent movement towards the unit. The cable should be installed through the eyelet and pulled tight before going through the clutcher, through the equipment bracket and then back through the clutcher. If installing this way, the installed cables will need to be sized so that the allowable load is twice the cable tension to allow for any risk of fraying over time. We will be preparing new drawings to reflect this installation method. In the meantime, please contact Capital Seismic with any questions.
    e. Where the top chord is difficult to attach to (flat pan on deck) contact Capital Seismic as soon as possible and prior to installation for options (cables between the pan sections, etc.).

7. Equipment supports:
    a. Where roof-mounted condensing units are being installed with stands, they should be sufficiently substantial for the unit, and loads, and stands must have cross members in both directions, i.e., avoid ECO-foot MF series.
        i. For post-disaster projects, stands with either a seismic and/or high wind certification will be required. (Ecofoot is able to supply these on their EcoFrame and EcoFrame XL models. Some Quicksling models offer Florida wind rating, although we typically find they tend to flex more than the Ecofoot and Bigfoot stands).
        ii. Strut stands will need to be reviewed for the loads. We do not typically include this in our price unless otherwise stated. If it is your intention to build your own stand, please let estimation know.
    b. Roof top unit adapters will require wind/seismic review if they do not come with stamped drawings. This will be an extra cost unless included in our quote and will require time - please allow accordingly.
    c. Roof top unit curbs are to be provided with stamped drawings. If these are not provided by the manufacturer, this will be an extra cost, unless included in our quote, and will require time - please allow accordingly.
    d. Wall mounted brackets are to be sufficient for the units. Units with wind or seismic loading documentation is preferred, otherwise additional work may be required.
    e. All vibration isolators are required to be seismic-rated. Restrained seismic springs are preferred for base mounted equipment.

8. Diffusers:
    a. In accordance with CISCA requirements, diffusers 20lb to 56lb require two chains across the diagonal to the structure.
    b. Diffusers less than 20lb are meant to be secured to the main runners. This is not practical for square cone style diffusers but should be done for linear slot diffusers.
    c. For post-disaster projects all diffusers should be provided with seismic clips and chained to the structure.

9. Roof-mounted equipment:
    a. Please make sure to use the package provided for all roof-mounted equipment prior to installation; otherwise, re-roofing may be required.
    b. All rooftop units on steel decks, regardless of weight, must be secured to the secondary steel provided by the GC. In the absence of secondary steel (for lightweight equipment), threaded rods bolted to strut and secured to the joists must be provided.
    c. All roof-mounted condensing units must be secured to the structure. In some cases, where units are not close to the edge or exposed to high wind loads, it may be possible to secure the unit back to the doghouse if there is no new roofing being conducted. The doghouse must be of sufficient strength and securement to the structure and must be adequate to withstand the loads. We will require the details of the construction of the doghouse and securement to the secondary steel framing the opening/the concrete deck. If this is an option, we will detail it in the drawing package. Always allow for the roofing in of sleepers at tender time to be safe. Otherwise, sleepers will be required to be secured to the open web steel joists, secured to strut, which is in turn secured to the joists, or secured to a concrete slab.
    d. Roof-mounted fans must again be secured to the structure. In some cases, securement to the deck will be sufficient, otherwise, securement to secondary steel or using strut to joists may be required. Please refer to project-specific drawings.
    e. All roof-mounted ductwork and piping, regardless of size, requires review and may require restraint. Short runs (< 20 ft) of low-pressure gas piping under 1”Ø may be allowed to go unrestrained or with securement back to the curb. High pressure piping, regardless of size, will need restraint. Allow for sleepers at the regulator to prevent movement. While short runs of ductwork rigidly attached at each end may not require seismic, please allow for the roofing in of sleepers for ductwork and piping at every change of direction and every 20-24 ft at tender time to be safe. Please contact Capital Seismic & Engineering Ltd. with plenty of time before the tender closes for further advice on a project.
    f. Units mounted on adapters will require the existing curb to be reinforced where possible and secured to the deck due to the increase in center of gravity. We understand this is not simple due to timelines, but we will provide general drawings and can be on site for lifts to help modify the plan when the roof is exposed.
    g. Gas piping adhesion: We consider the adhesion of gas piping blocks to the roofing membrane to be a last resort as the longevity is not guaranteed. We will not approve it on new construction.
        h. It will only be considered on projects where all these four apply:
            1. The gas piping is 2-1/2”Ø or less for 7-14” WC, 1-1/4”Ø or less for high pressure.
            2. There is no other roofing required on the project.
            3. The roof is set for replacement within the next five years.
            4. The pipes are installed on heavy, non-hollow rubber blocks such as the MIFAB CEW-12.

        ii. If the building owner will not permit penetration of the roof, a letter on their letterhead will need to be provided, at which point we will typically have to exclude the gas piping.

10. Roof deck use (from interior):
    a. Cable/rigid restraints must never be fastened to a roof deck.
    b. Equipment and piping should not be supported from the roof deck.
    c. If the structural EOR/deck manufacturer allows it, an item (< 100 lbs) on a normal importance job may be allowed to be supported from the deck if there is no other practical option. It must be reviewed prior to installation and will be reviewed on a case-by-case basis. If permitted, we recommend:

        1. Four min. 1.5" 16ga straps with two ¼"Ø tek screws per strap to the deck and to the equipment (total of sixteen screws).
        2. Or two heavy-duty Q-deck hangers using a minimum of four ¼"Ø tek screws each, two 3/8"ø rods and a strut trapeze.

11. Anchors and beam clamps:
    a. Capital Seismic & Engineering Ltd. requires to witness in person or potentially via photographs the anchor head markings to confirm the exact models. If we cannot see the markings, we may not be able to sign off on its installation.
    b. For post-disaster projects, we will be asking contractors to submit shop drawings on the anchors they intend to use to ensure they are suitable prior to installation.
    c. All beam clamps for direct support will require restraining straps to prevent motion.
    d. Capital Seismic will be providing an approved anchor list with minimum edge distances, anchor spacings and minimum concrete thickness in each package. Please ensure to check these sheets when installing. If you are unable to achieve any of the distances or the thickness is incorrect, advise Capital Seismic & Engineering Ltd. before installation.
    e. For hollow block walls, the new code clearly states:

(e) post-installed mechanical and adhesive anchors in masonry and post-installed mechanical anchors in structural steel shall be pre-qualified for seismic applications by cyclic tension load testing, (See Note A-4.1.8.18.(7)(e))

The Simpson Titen HD is seismic approved for hollow block walls in light loads only. Hilti HY-270 c/w HAS rods and HIT-SC screens are an option that works for hollow-block with some measure of seismic resistance, but again it is not strictly seismic rates. Finally, there are double expansion anchors such as the Dewalt Double that are good for hollow-block walls but do not have seismic rating. Please review the approved anchor document for more information and do not install until it has been discussed.

12. Anchor spacing in concrete
    a. The spacing between the holes on standard strut brackets is typically 1-7/8". This is less than the minimum spacing allowed for most anchors required for seismic restraint in concrete.
    b. Where two anchors are required, a section of 8" strut will need to be secured to the concrete with the anchors spaced 6" apart (or as directed by the drawing package). The bracket will then be secured to the strut using two bolts and spring nuts (diameter of bolts as per package)

13. OBC 2024 Acceleration Rate increase (approximately 50% increase):
    1. BASED ON PERMIT DATE
    2. Due to the increase in seismic acceleration rates, anchor sizing and cable ratings may change. Always consult the specific package issued for the current job to ensure no issues come up during inspection. Do not refer to a package from a previous job.
    3. With the increase in acceleration rate, all projects in Ottawa, regardless of site class, will require full seismic if the permit is applied for using the 2024 OBC or 2020 NBC.
    4. Areas west of Ottawa that have been exempt since 2020 may now require seismic again. This includes areas in the Golden Horseshoe as well as Belleville, Napanee, Kingston, Gananoque, Brockville, Smith Falls, Perth, and Carleton Place. Please make sure to check with your seismic provider prior to starting work to ensure you know for sure if your project requires seismic.
    5. Regardless of whether the spec states seismic is required, the building department may still require it. Again, please contact us to confirm and check the permit issue date/code the project is designed to.

14. Communication, documentation, and time:
    1. If you decide to work with us on a project, we appreciate being informed as soon as possible and need to receive all relevant information as soon as possible. With this we can flag any potential items of concern prior, prepare a drawing package and advise on installation to avoid re-work and delays.
    2. SIs, CCNs and Issued for Construction drawings must be provided for review when issued as there may be additional work that needs to be done, and additional costs incurred. Failure to do so will potentially result in delays and elevated pricing on the changes.
    3. Due to the timelines on projects, we accept non-reviewed shop drawings, but the contractor is responsible for making sure any changes are communicated to Capital Seismic & Engineering. Failure to do so may result in delays with the letter and additional costs.

15. ANSI MSS SP-58-2018 and Piping Support
    a. ANSI MSS SP-58-2018 is referenced in most engineers' specifications with regard to piping installation. The guide provides maximum support spacing and information on rod diameter sizes.
    b. Note that many engineers have their own minimum rod sizes in their specifications that should be observed.

16. Stamped support drawings - Engineer's specifications

    a. A number of engineers have added specification sections, like the ones below, with regards to submitting stamped drawings for all supports, hangers, etc. These sections, particularly on projects in existing buildings with substantial obstructions, can add a significant extra cost. This is typically in the Hangers and Supports specifications.
    b. From discussions with an engineering firm, it would appear that this may not always be heavily enforced but we would recommend confirming with the engineer prior to tender questions closing.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario Canada.

.2 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

1.2.2. The Mechanical Division shall prepare detailed Shop Drawings showing all anchors and guides for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The drawings shall bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and Place of the Work. The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the Project Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division. No anchor points shall be permitted without reviewed Shop Drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Engineer's Representative.

17. Engineer's specifications – additional new requirements

    a. In WSP 23 05 48 2.7.2.6.3 the spec asks for neoprene at all seismic cable connection points.