

Professional Engineers  
and Geoscientists of BC  
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## BC CODES AND PRACTICES EXAMINATION 2002

### SAMPLE QUESTIONS FOR RELEASE

JUNE 26<sup>TH</sup>, 2003

Choose the best answer to the following questions. Any reference to 'the Code' shall be taken as a reference to the current British Columbia Building Code.

#### Section A – Code Administrative Requirements

##### **Sample A1**

Which of the following is true?

British Columbia Building Code Schedule B-1, 'Assurance of Professional Design and Commitment for Field Review':

- i) must be submitted along with Schedule B-2, 'Summary of Design and Field Review Requirements'.
  - ii) must be submitted before issuance of a building permit.
  - iii) must be submitted upon commencement of construction.
  - iv) is not required to be submitted by an SER.
- 
- A. iv) only.
  - B. i) and ii).
  - C. i) and iii).
  - D. None of the above.

### Sample A2

Which of the following design aspects are included under the Structural Discipline (Section 2) of British Columbia Building Code Schedule B-2, 'Summary of Design and Field Review Requirements'?

- i) seismic restraint of architectural components
  - ii) seismic restraint of mechanical components
  - iii) seismic restraint of electrical components
  - iv) design of guardrails and handrails
- 
- A. None of the above
  - B. i) and iv)
  - C. i)
  - D. i), ii) and iii)

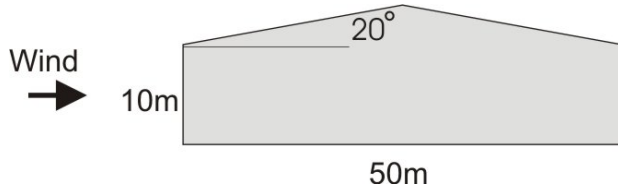
### Section B – Load Provisions

#### Sample B1

Loads due to Snow are classified under the category of Live Load, L, according to the Code. Can the load on a structural member supporting a tributary area Snow load be reduced by the Live Load Reduction factor,  $0.3 + \sqrt{9.8/B}$ , where B is the tributary area in square metres?

- A. No.
- B. Yes, but only if the member tributary area exceeds 20 m<sup>2</sup>.
- C. Yes, but only if the member tributary area exceeds 80 m<sup>2</sup>.
- D. Yes.

Diagram B-1

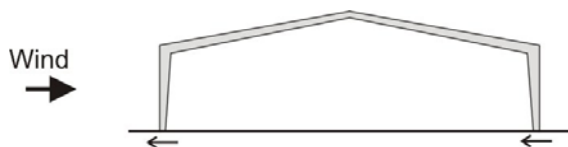


**Sample B2**

In Diagram B-1, a 50m (160') x 50m (160') building with 20° roof slope is subject to wind load in the direction shown  $q=0.45$  kPa. (9.5 psf) Using the simplified approach, what is the maximum factored external windward wind load on the wall cladding? Ignore any positive or negative internal wind pressure.

- A. 0.53 kPa (11 psf).
- B. 1.3 kPa (27 psf).
- C. 0.9 kPa (18 psf).
- D. 1.5 kPa (31 psf).

Diagram B-2



### Sample B3

If the building in question sample B2 has moment resisting steel frames at 7m (23') spacing (see Diagram B-2) for primary lateral load resisting purposes, what is the total factored horizontal shear force at the base of each frame? (Assume frame is not influenced by an end zone.)

- A. 93.5 kN (21.0 kips).
- B. 51.9 kN (11.7 kips).
- C. 56.6 kN (12.7 kips).
- D. 74.2 kN (16.7 kips).

### Sample B4

The extreme value analysis of meteorological observations of hourly wind speeds taken at a site somewhere in BC resulted in a reference wind speed of 126 kph (78 mph). For a 75m (246') tall building in a suburban area, determine the hourly mean wind speed at the top of the building. (Use the Detail Procedure)

- A. 139 kph (87 mph).
- B. 126 kph (79 mph).
- C. 152 kph (95 mph).
- D. 117 kph (73 mph).

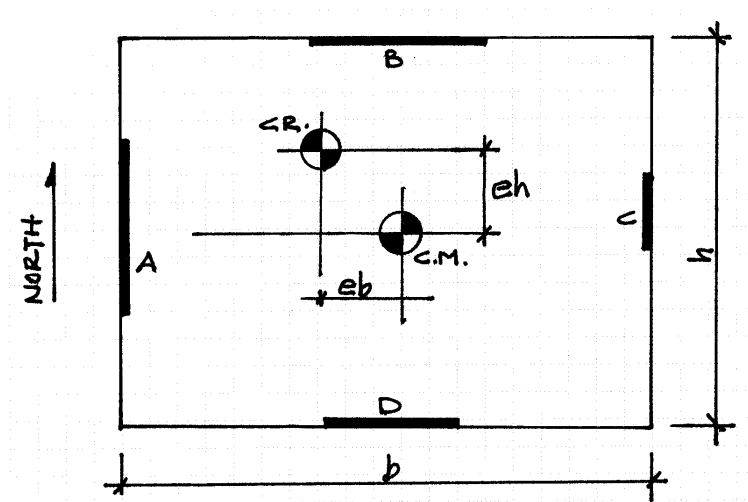
## Section C – Basic Seismicity and Seismic Principles

### Sample C1

In the event of an earthquake, which of the following is the best answer to describe the primary goal of seismic design provisions in the BC Building Code?

- i) preventing loss of life.
  - ii) preventing major structural failures (collapse).
  - iii) preserving property.
- 
- A. All of the above.
  - B. i) only.
  - C. i) and ii).
  - D. i) and iii).

Diagram C-1



### Sample C2

For the single story building in Diagram C-1, with a rigid diaphragm, what is the code prescribed torsional moment for seismic design in the east - west direction?

- A.  $1.5 e_b +/-.1b.$
- B.  $1.5 e_h +/-.1h.$
- C.  $1.5 e_b +/-.1h.$
- D.  $1.5 e_h +/-.1b.$

### Sample C3

The second floor diaphragm of a 6-story building has 64.5 kips (287 kN) inertial design force (design force taken from your computer seismic analysis of the building). The diaphragm weighs 945 kips (4203 kN) plus 75 kips (334 kN) added weight tributary to the diaphragm. What is the total force in the floor for checking diaphragm design?

Assume:  $I = 1.0$ ;  $V = 0.2$ ;  $S = 3.0$ ;  $F = 1.0$ ;  $R = 3.0$ .

- A. 64.5 kips (287 kN).
- B. 122 kips (544 kN).
- C. 142 kips (635 kN).
- D. 204 kips (907 kN).

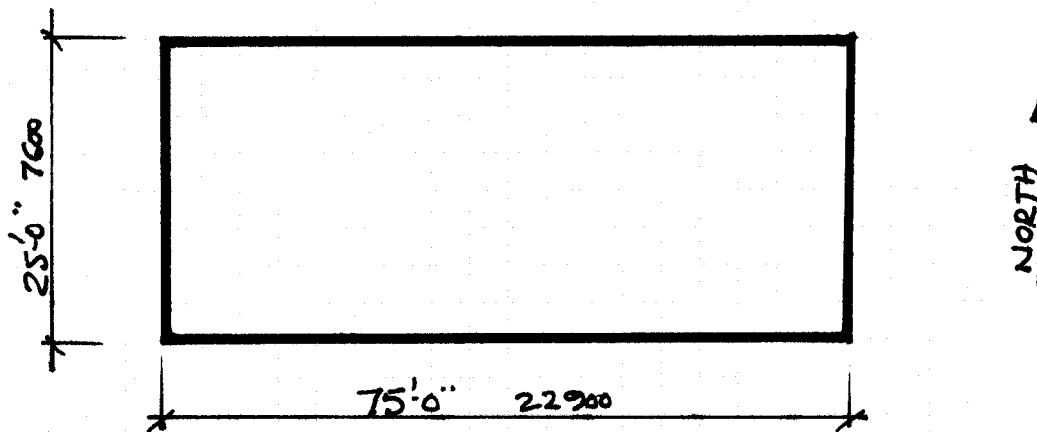
### Sample C4

The foundation factor for a project with loose and soft fine grained soils to a depth of 4 meters over bedrock is:

- A. 1.0.
- B. 1.3.
- C. 1.5.
- D. 2.0.

## Diagram C-2

Please use this diagram for the following four questions:



This 20-ft 6000mm high building is to be built in an area where  $v=.2$  and design roof snow load = 40 psf, with masonry perimeter walls and a steel roof deck with a unit weight of the masonry wall of 80 psf (3.8 kPa) and unit weight of the roof of 20 psf (1.0 kPa). The building is to be designed to the BC Building Code with reinforced masonry shearwalls around the perimeter with nominal ductility. Ignore any parapet height and assume for your calculations that the walls are solid (without openings).

$$Z_A = 4; \quad Z_V = 4; \quad I = 1.0; \quad F = 1.0.$$

### Sample C5

Determine the maximum roof diaphragm shear force if torsion forces are not included.

- A. 634 lb/ft (9.3 kN/m).
- B. 384 lb/ft (5.6 kN/m).
- C. 846 lb/ft (12.3 kN/m).
- D. 1269 lb/ft (18.5 kN/m).

### Sample C6

Determine the maximum factored tension force in the diaphragm chords along the North and South walls.

- A. 11.9 kip (53 kN).
- B. 7.9 kip (35 kN).
- C. 15.9 kip (71 kN).
- D. 23.8 kip (106 kN).

### Sample C7

If a puddle weld has a factored resistance of 300lb. (1.3 kN), what is the minimum number of puddle welds required to connect the chord to the decking of the North and South walls?

- A. 106.
- B. 40.
- C. 53.
- D. 80.

### Sample C8

The connection of the perimeter masonry walls to the roof diaphragm is achieved via the puddle welds along the roof edge angle. For this calculation, assume the puddle weld has a factored capacity of 1500 lb. (6.67 kN). What spacing should the puddle welds be to provide a suitable connection? Assume the connection to be “non-ductile”, and ignore deck flute spacing.

- A. 6 in. (150 mm).
- B. 8 in. (200 mm).
- C. 12 in. (300 mm).
- D. 15 in. (375 mm).

### Sample C9

If the embed plates to the masonry wall have a pullout capacity of 7.2 kips (32 kN), what is the maximum spacing of the embed plates?

- A. 2 ft. (600 mm).
- B. 3 ft. (900 mm).
- C. 4 ft. (1200 mm).
- D. 6 ft. (1800 mm).

### Sample C10

An architect proposes to add a heavy landscaped plaza to the top of an existing, older 10 storey building. It has been determined that the vertical structure has adequate capacity to support the gravity loading of the landscaping materials, structural improvements to carry the gravity loading, plus live load of 100 psf (4.8 Kpa). Should the project proceed at this time?

- A. Yes, landscape plaza loading is a relatively insignificant load and it is located farthest away from the ground so it's impact on seismic loading is the smallest that it can be.
- B. Yes, if the gravity loading is dealt with, seismic loading need not be considered in such a design.
- C. No, the effect of the landscape loading must be considered on the lateral load resisting system. The lateral loading due to the landscaping could be significant since the load occurs at the top of the building where the effect is the greatest.
- D. No, but only because it would first be necessary to obtain approval from the Authority Having Jurisdiction to place the landscaping on the roof.

### Sample C11

The primary purpose of “strong column / weak beam” theory in moment frame design is:

- A. To protect columns from yielding because they are the vertical load carrying elements of the building and their yielding is generally considered to be undesirable.
- B. Beams generally yield in a manner much more predictable than columns, therefore the beam should be the yielding element.
- C. After all beams in a moment frame reach their yield plateau, the columns begin to act as simple cantilever elements from the ground, a desirable state for the design of a moment frame.
- D. All of the above.

### Sample C12

If heavy equipment is added to the roof of a building, the fundamental period of the building will:

- A. Increase due an increase in mass.
- B. Decrease due to an increase in mass.
- C. Decrease due to an increase in stiffness.
- D. Remain unchanged.

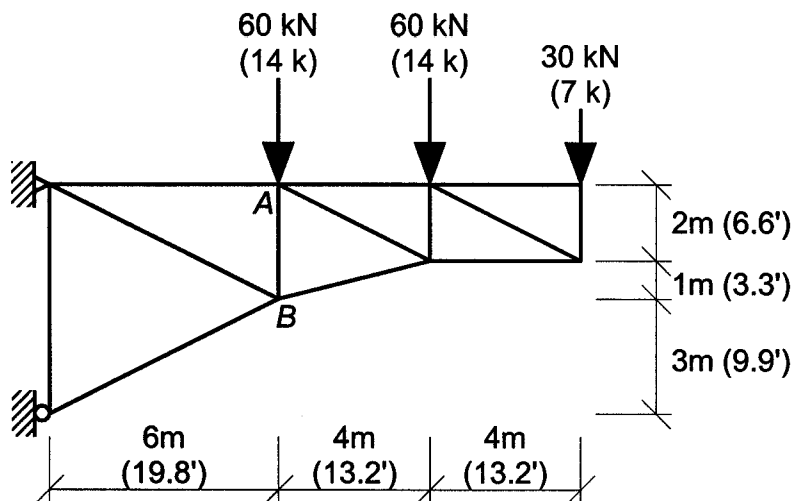
### Sample C13

What is the effect upon design calculations when  $Z_a > Z_v$ ?

- A. The seismic response factor of short period structures is greater with  $Z_a > Z_v$  than it is when  $Z_a = Z_v$ .
- B. The seismic response factor of short period structures is less with  $Z_a > Z_v$  than it is when  $Z_a = Z_v$ .
- C. The seismic response factor of long period structures is greater with  $Z_a > Z_v$  than it is when  $Z_a = Z_v$ .
- D. The seismic response factor of long period structures is less with  $Z_a > Z_v$  than it is when  $Z_a = Z_v$ .

### Section D – Mechanics and Building Structure

Diagram D-1

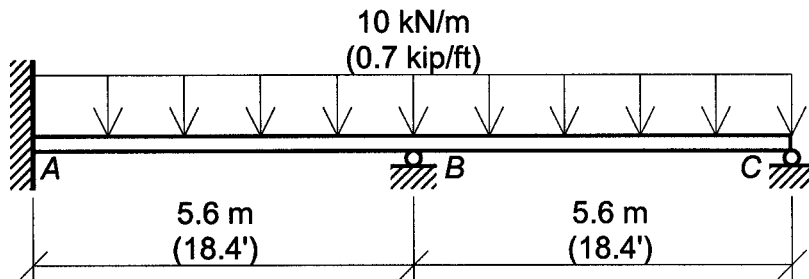


### Sample D1

What is the force in the vertical member AB in Diagram D-1?

- A. 90 kN (21 kip) compression.
- B. 110 kN (25.67 kip) compression.
- C. 130 kN (30.33 kip) compression.
- D. 150 kN (35 kip) compression.

### Diagram D-3

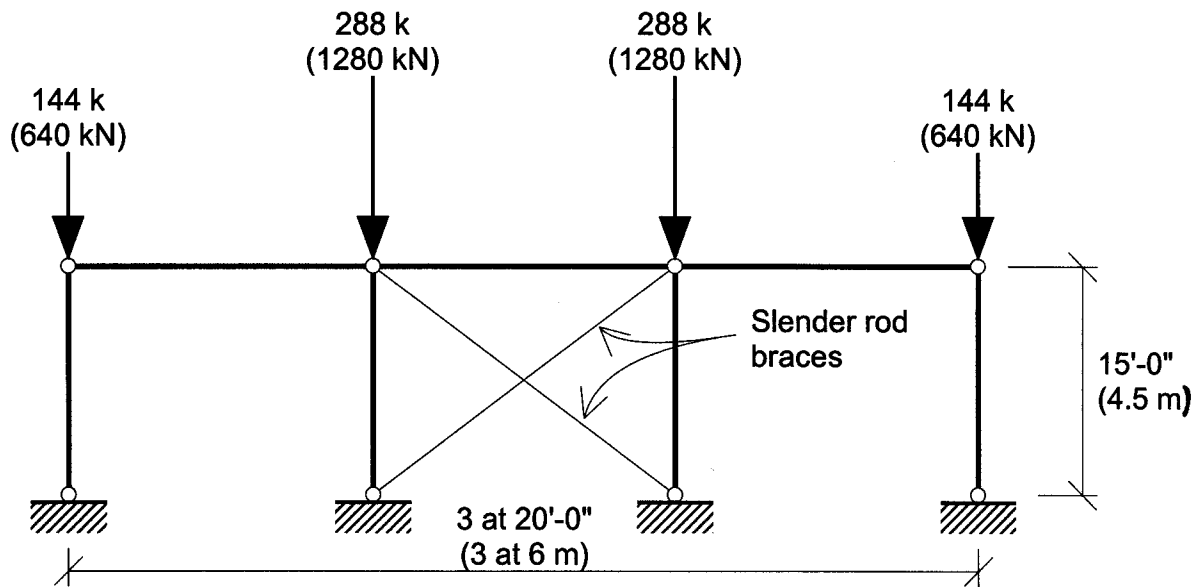


### Sample D2

What is the upward vertical reaction at support B for the beam shown in Diagram D-3? (Hint: Consider using beam tables and the principle of superposition.)

- A. 49 kN (11.3 kips).
- B. 56 kN (12.9 kips).
- C. 64 kN (14.7 kips).
- D. 70 kN (16.1 kips).

Diagram D-5



**Sample D3**

A three-bay frame is braced by two slender steel rods ( $E = 30,000 \text{ ksi} = 207,000 \text{ MPa}$ ), as shown in Diagram D-5. The frame has been erected with its columns out of plumb by  $1/4$ -inch (6 mm), all in the same direction. The frame is to carry the loads indicated in Diagram D-5. If the bracing must restrict additional lateral displacement at the top of the frame to  $1/4$ -inch (6 mm), what is the minimum required cross-sectional area of each bracing rod?

- A.  $0.0375 \text{ in}^2$  ( $24 \text{ mm}^2$ ).
- B.  $0.075 \text{ in}^2$  ( $48 \text{ mm}^2$ ).
- C.  $0.150 \text{ in}^2$  ( $97 \text{ mm}^2$ ).
- D.  $0.300 \text{ in}^2$  ( $193 \text{ mm}^2$ ).

## Section E – Concrete Codes (CSA Standard A23.3–94 & Appendices)

### **Sample E1**

A concrete frame system is designed to carry the gravity loads. The compressive strength of the concrete,  $f'_c$ , required for the columns is 50 MPa while the strength of the concrete required for the floor is 25 MPa. If the concrete for the floor is placed through the column floor region, what is the effective concrete compressive strength for the resistance of the column in the joint region for the columns located along the edge of the floor slab in accordance with Chapter 10?

- A. 25 MPa.
- B. 35 MPa.
- C. 39 MPa.
- D. 50 MPa.

### **Sample E2**

A slab–band system is designed to support a wood framed building with drywall finishing which is likely to be damaged by large deflections. The following computed deflections are obtained for a typical 9.6 metre (32') span slab band:

- Due to initial dead load: 6 mm (0.25")
- Additional deflection due to long-term creep: 12 mm (0.5")

If the finishing is installed immediately after the shoring of the slab band is removed, what is the maximum allowable deflection for immediate deflection due to specified live load according to Table 9.2?

Assume that there are no specified adequate measures to prevent damage to the finishing.

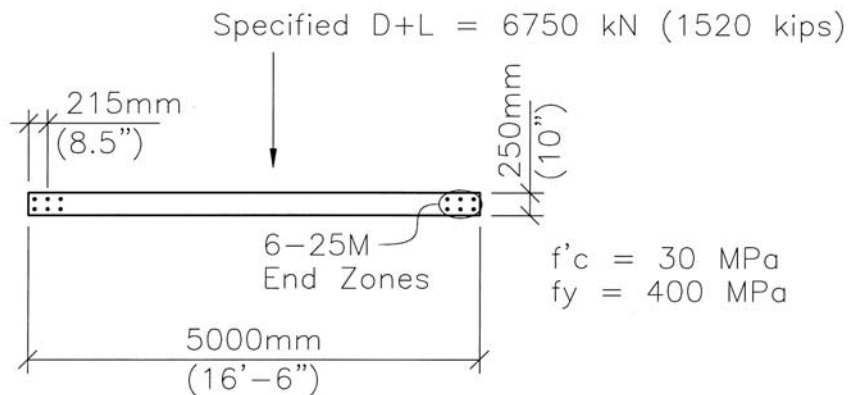
- A. 6 mm (0.25’’).
- B. 8 mm (0.3’’).
- C. 28 mm (1.1’’).
- D. 40 mm (1.5’’).

### Sample E3

A 250 mm (10’’) x 5 m (16’-3’’) long ductile shear wall with an R factor of 3.5 and  $f'_c$  of 30 MPa is required to resist a shear force of 1400 kN (315 kips) corresponding to the probable flexural capacity of the wall in the plastic region. What is the appropriate horizontal shear reinforcement arrangement for this wall?

- A. 15M @ 200 mm (8’’) on centre in the middle of the wall.
- B. 15M @ 400 mm (16’’) on centre Each Face.
- C. 15 M @ 300 mm (12’’) on centre Each Face.
- D. All of the above.

### Diagram E-1



### Sample E4

In Diagram E-1 a 250 mm x 5000 mm (10''x16'-6'') long concrete wall is subject to a specified Dead plus Live load of 6,750 kN (1520 kips). Calculate the nominal capacity of the wall assuming both zones yield, ignoring the distributed reinforcement:

- A. 12800 kN-m (9440 kip-ft).
- B. 15800 kN-m (11650 kip-ft).
- C. 18600 kN-m (13720 kip-ft).
- D. 23400 kN-m (17250 kip-ft).

### Sample E5

A ductile flexural wall has a length of 6 metres (20') and a height of 26 meters (85'). The wall is subject to a specified seismic overturning moment of 10,000 kN-m (7400 kip-ft) at the base and it has been designed for a probable moment resistance of 15,000 kN-m (11000 kip-ft) at the base. What is the minimum probable design moment at mid-height of the wall if the plastic hinging in the wall is restricted to the base?

- A. 5000 kN-m (3700 kip-ft).
- B. 7500 kN-m (5500 kip-ft).
- C. 9750 kN-m (7200 kip-ft).
- D. 15000 kN-m (11000 kip-ft).

### Section F – Steel Design Codes

#### Sample F1

What is the maximum factored moment resistance of a 550 mm (21") deep I shaped beam section with  $F_y=350$  MPa, no axial load, flange widths = 300 mm, flange thickness = 16 mm (5/8") and web thickness = 8 mm (5/16")?

- A. 760 kN-m (560 k-ft).
- B. 890 kN-m (660 k-ft).
- C. 976 kN-m (720 k-ft).
- D. 1120 kN-m (825 k-ft).

### Sample F2

What is the minimum number of M20 A325 bolts required for a concentric bearing type connection that is loaded with a shear force = 400 kN (90 kips) and a simultaneous tension force = 300 kN (67.5 kips)? Bolt threads are intercepted and prying does not apply.

- A. 2.
- B. 5.
- C. 6.
- D. 8.

### Sample F3

Which section would not be adequate to resist a factored axial load of 700 kN (157 kips) due to gravity loads for a column with an unsupported height of 4000 mm (13.1 ft)?

- A. HSS 152 x 152 x 6.4 Class C with  $F_y = 350$  Mpa.
- B. HSS 203 x 102 x 8 Class C with  $F_y = 350$  Mpa.
- C. W200x46 with  $F_y = 350$  Mpa.
- D. Double L 127 x 127 x 13 strut with back-to-back gap = 10 mm and  $F_y = 300$  MPa.

### Sample F4

An HSS 152 x 152 x 4.8 (Class C) diagonal tension or compression brace is used to resist earthquake forces in a building located in Surrey. The design force = 525 kN (118 kips) and the unsupported length = 4500 mm (14.8 ft) with  $R = 2.0$  and  $F_y = 350$  Mpa. What is the brace connection design force?

- A. 966 kN (217 kips).
- B. 583 kN (131 kips).
- C. 525 kN (118 kips).
- D. 1050 kN (236 kips).

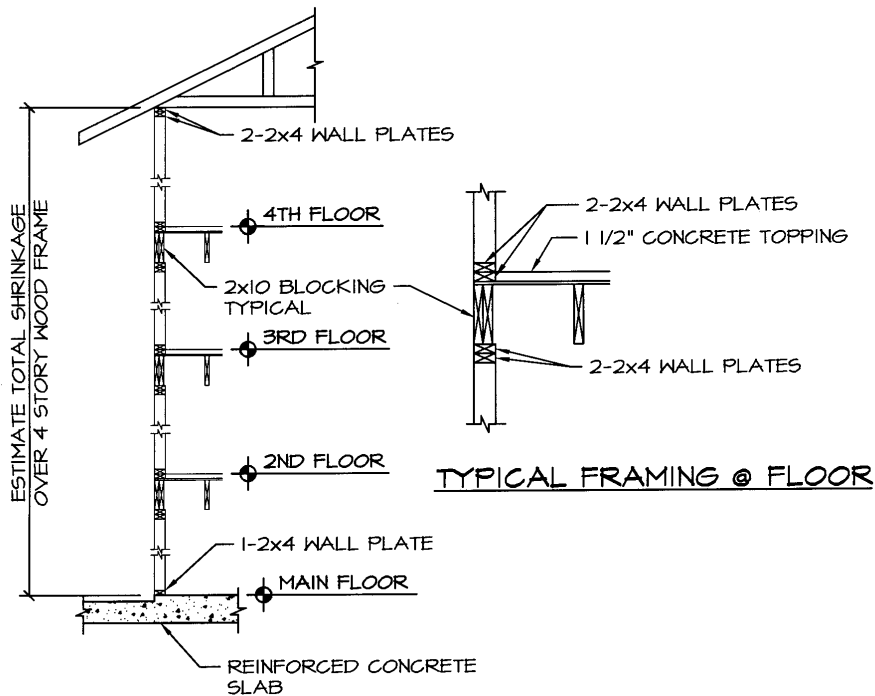
## Sample F5

In an eccentrically braced system the ductility comes from:

- A. Brace elongation/shortening.
- B. Brace hinging near the beam link.
- C. Flexure or shear yielding of the beam link.
- D. Flexure or shear yielding of the beam outside the link.

## Section G - Timber Codes

### Diagram G-1



### Sample G1

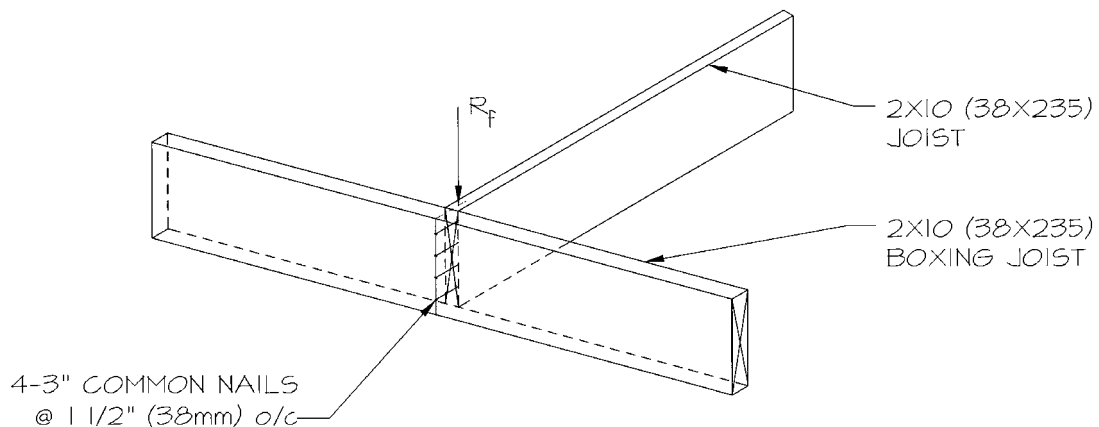
In Diagram G-1, assume the wall shown supports the following service loads:

Roof snow live load =	660 plf (9.63 kN/m)
Roof dead load =	200 plf (2.92 kN/m)
Floor live load =	300 plf (4.38 kN/m)
Floor dead load =	200 plf (2.92 kN/m)
Wall self weight =	10 psf (0.48 kPa)

Assuming floor-to-floor height = 9'-0" (2745 mm) with 5/8 inch (16 mm) plywood, 2x4 (38x89) No. 3/Stud Grade D.Fir-L material determine the stud spacing at the bottom storey. Consider gravity loads only.

- A. 16 inches (400) on-centre.
- B. 24 inches (600) on-centre.
- C. 12 inches (300) on-centre.
- D. 8 inches (200) on-centre.

### Diagram G-2



### Sample G2

A 2x10 (38x235) joist is nailed to a boxing joist with 4 - 3" long common nails as shown in Diagram G-2. Joists are D.Fir-L and the boxing joist is unincised pressure treated Hem-Fir in dry service conditions. Calculate the total capacity  $N_r$  of the nailed connection.

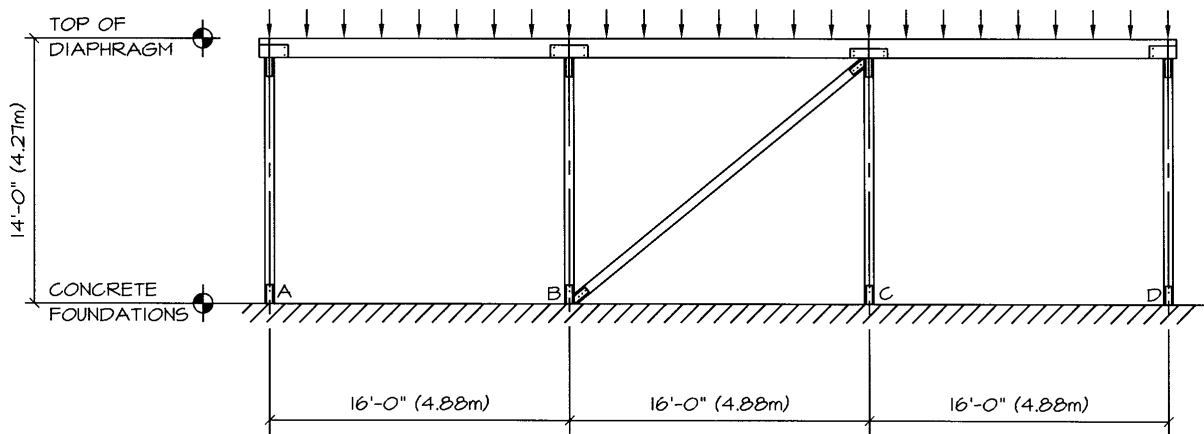
- A. 434 lbs. (1.93 kN).
- B. 506 lbs. (2.25 kN).
- C. 537 lbs.(2.39 kN).
- D. 647 lbs. (2.88kN).

### Sample G3

Using Section 9.15 of the B.C. Building Code determine the minimum clearance between exterior finished ground level and wood framing.

- A. None.
- B. 4 inches (100 mm).
- C. 6 inches (150 mm).
- D. 8 inches (200 mm).

### Diagram G-4



### Sample G4

The tension brace shown in Diagram G-4 consists of a 5.125 inch thick x 6 inch deep (130x152) D.Fir-L glulam sandwiched between two ¼ inch (6mm) side plates. The connection consists of 3-3/4 inch (19mm) diameter A307 bolts in one row at 3 inches (76 mm) on-centre with an end distance of 7.5 inches (191 mm). Members have been protected from moisture during construction and the frame is inside a heated dry building with a fire-retardant treatment. Determine the factored resistance of the tension brace connection due to seismic load. Use CSA O86.1-94.

- A. 8.27 kips (36.8 kN).
- B. 12.0 kips (53.3 kN).
- C. 16.6 kips (73.6 kN).
- D. 20.0 kips (88.8 kN).

### Sample G5

CSA O86.1 Section 5.2 allows Finger-Joined lumber for use interchangeably with wood:

- A. Typically.
- B. Never.
- C. Where stamped in accordance with NLGA Special Product Standard SPS 1.
- D. Where stamped in accordance with NLGA Special Product Standard SPS 3.

## **Section H – Masonry**

### **Sample H1**

What does the specification H/15/A/M mean?

- A. Hollow concrete block, masonry compressive strength 15 MPa (2175 psi), standard weight, moisture controlled.
- B. Hollow concrete block unit, unit compressive strength 15 MPa (2175 psi), standard weight, moisture controlled.
- C. Hollow concrete block, unit strength 15 MPa (2175 psi), light-weight, moisture controlled.
- D. Hollow concrete block, masonry compressive strength 15 MPa (2175 psi), light-weight, uncontrolled moisture.

### **Sample H2**

Which type of mortar joint is recommended to be used in the rainy areas of British Columbia?

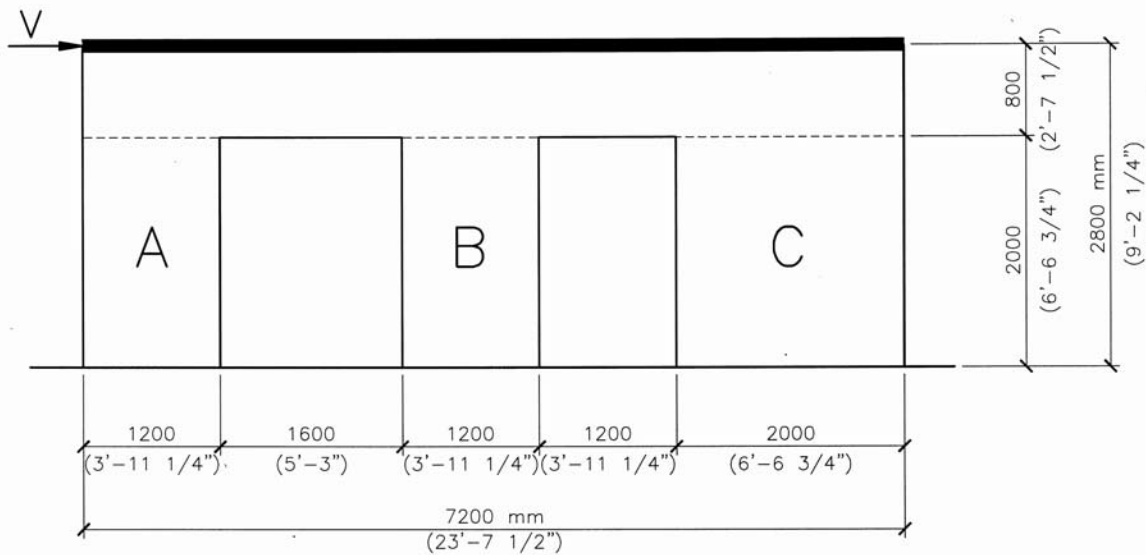
- A. Flush joint.
- B. Raked joint.
- C. V- shaped joint.
- D. Concave joint.

### **Sample H3**

What is the maximum recommended vertical spacing of bond beams in masonry shear walls designed for seismic load conditions?

- A. 1200 mm (3'– 11 ¼ ") on centre.
- B. 2400 mm (7'–10 ½ ") on centre.
- C. 2800 mm (9'– 2 1/4 ") on centre.
- D. None of the above.

## Diagram H-1



### Sample H4.

South elevation of a 1-storey block masonry building is shown in Diagram H-1. The total seismic design load on the south wall  $V = 400$  kN (89.9 kip) (note that  $R = 1.5$  was considered in the seismic force calculation). The wall is fully grouted and it has been constructed using 200 mm (8") hollow concrete blocks with 15 MPa (2175 psi) compressive strength and Type S mortar. Calculate the shear force carried by pier C. In calculating the wall stiffness, make the following assumptions: 1) the piers and the wall strip above the openings are fixed against the rotation at both ends; 2) shear area =  $5/6$  gross area, and 3) shear modulus  $G = 0.4 \times E$  (modulus of elasticity).

- A. 218 kN (49.0 kips).
- B. 133 kN (30.0 kips).
- C. 251 kN (56.5 kips).
- D. 91 kN (20.5 kips).

### Sample H5

Determine the minimum required amount (size and spacing) of the vertical reinforcement in the pier C shown in Diagram H-1 due to the in-plane bending moment  $M_f = 96$  kNm (70.85 kip-ft) and the axial compressive force  $P_f = 38$  kN (8.54 kips) (neglect the effect of the wall self-weight). Also, consider the seismic reinforcement requirements of CSA-S304.1-94. Assume  $R = 1.5$  and  $\alpha = 2/3$  (Cl. 5.2.2). Assume that the wall is fully grouted, 15 MPa (2175 psi) block unit strength and Type S mortar. Steel yield strength  $f_y = 400$  MPa (58.0 ksi).

- A. 1-15 M bar at each end and 1-15 M bar at the center of the pier.
- B. 1-15M bar at each end and 1-20M bar at the center of the pier.
- C. 1-20M bar at each end and 1-15 M bar at the center of the pier.
- D. 1-10M bar at each end and 1-15M bar at the center of the pier.

### Sample H6.

Determine the shear resistance  $V_r$  for the pier C shown in Diagram H-1 assuming no horizontal reinforcement and ignoring axial load effects. Assume fully grouted wall, 15 MPa (2175 psi) block unit strength and Type S mortar.

- A. 78 kN (17.54 kip).
- B. 73 kN (16.41 kip).
- C. 85 kN (19.11 kip).
- D. 40 kN (8.99 kip).

### Sample H7

A reinforced concrete block masonry wall needs to be designed according to the 1998 BC Building Code seismic requirements for nominally ductile masonry ( $R=2$ ). Which of the following requirements is most critical in ensuring the flexural mode of failure in the wall?

- A. Vertical reinforcement shall be uniformly distributed over the length of the wall.
- B. The maximum compressive strain in the masonry plastic hinge zone shall be shown not to exceed 0.0025 at the desired ductility level.
- C. Plastic hinge zone of the wall shall be solidly grouted.
- D. The wall shall be designed to resist a shear force greater than the shear that is present when the wall develops a plastic hinge mechanism.