Exam Format
50 minute time limit. You will be allowed to use your steel manual, a calculator, and writing supplies, only.

Coverage
Lessons 19 through 23

Lesson Objectives and Examples
The main body of this Study Guide is a list of every lesson objective from Lessons 19 through 23. Example problems are given for most.

Example Problems and Questions, Categorized by Lesson Objective
Lesson 19. Calculate the wind effects (moments, shears) on wall components, such as studs.(with the next two objectives)
Lesson 19. Calculate resultant forces from wind pressures to building diaphragms (with the next objective)
Lesson 19. Calculate brace forces in simple-braced diaphragm buildings for the simple case of determinate bracing
The following 9 problems refer the building shown. All connections are simple (non-moment-resisting). The floors are considered to be diaphragms, but diaphragms and floor beams are not shown, for clarity. The exterior wall consists of studs, spaced 16” apart, spanning between the floors, as shown (only shown along Line 1, Between B and C, for clarity). All column lines are 24’ apart. All story heights are 12’. All braces are HSS5x5x3/8”. The braced bays are:
• Along column lines 1 and 4, between B and C
• Along column line A, between 2 and 3.
1. (8 points). Determine the ASD maximum applied moment for a typical wall stud for the previous building.
   Given: Studs are spaced at 16” apart around the entire exterior of the building (though only shown in one bay, for clarity).
   Use a wind pressure of 20 psf (the ultimate wind pressure is 33.33 psf, but the ASD factor for wind is 0.6 in the load combinations, so simply use 20 psf), producing a positive pressure on the south wall. The wall studs are spaced 16” apart. Other dimensions are given.

2. (5 points) For a constant wind pressure of 20 psf from South to North, circle the correct answer. The braces with the greatest magnitude of axial force in them are:
   A). Braces between ground and 2nd Floor
   B). Braces between 2nd Floor and 3rd Floor
   C). Braces between 3rd Floor and Roof
   D). All brace forces are the same
   E). Cannot be determined from the given information.

3. (5 points) For wind blowing from South to North (putting positive pressure on the south wall) the brace along column line A, between lines 2 and 3, between the ground and 2nd floor is subjected to:
   A). Compressive force
   B). Tensile force
   C). Zero force.
   D Cannot be determined from the given information.

4. (5 points) For wind blowing from South to North (putting positive pressure on the south wall) the brace along column line 1, between lines B and C, between the ground and 2nd floor is subjected to:
   A). Compressive force
   B). Tensile force
   C). Zero force.
   D Cannot be determined from the given information.

5. (5 points) For wind blowing from South to North (putting positive pressure on the south wall) the brace along column line 1, between lines B and C, between the 2nd and 3rd floor is subjected to:
   A). Compressive force
   B). Tensile force
   C). Zero force.
   D Cannot be determined from the given information.

6. (20 points) For wind blowing from South to North (putting positive pressure on the south wall) determine the force in the brace along column line 1, between lines B and C, between the 2nd and 3rd floor, and state whether it is in compression or tension. Given: Use a wind pressure of 20 psf (the ultimate wind pressure is 33.33 psf, but the ASD factor for wind is 0.6 in the load combinations, so simply use 20 psf).

7. (30 points). Assuming that South-to-North wind controls for the previous brace (along column line 1, between lines B and C, between the 2nd and 3rd floor), determine if the HSS5x5x3/8” brace is adequate per ASD as a compression member (do not analyze the connection).

8. (10 points). With wind blowing from South to North, report the horizontal base reactions for grid locations B1, C1, and D1. Use ASD.

9. (35 points). For wind blowing from East to West (putting positive pressure on the east wall) determine the force in the brace along column line 1, between lines B and C, between the 2nd and 3rd floor, and state whether it is in compression or tension. Given: Use a wind pressure of 20 psf (the ultimate wind pressure is 33.33 psf, but the ASD factor for wind is 0.6 in the load combinations, so simply use 20 psf).

10. (10 points). Referring to the building below, determine whether the brace along column line A, between 1 and 2, between the Ground and 2nd floor is in Tension or Compression, for wind pressure directed from East to West.

11. (30 points). Referring to the building below, determine the magnitude of force on the brace along column line 1, between A and B, between the ground and the 2nd floor, for an applied wind pressure of 20 psf (the actual pressure is 33.33psf, but the ASD factor for wind is 0.6, so use 20 psf), directed from South to North and state whether the member is in tension or compression, in this case.

12. (30 points). Referring to the building below, determine the magnitude of force on the brace along column line A, between 1 and 2, between the 2nd floor and the Roof, for an applied wind pressure of 20 psf (the actual pressure is 33.33psf, but the ASD factor for wind is 0.6, so use 20 psf), directed from East to West and state whether the member is in tension or compression, in this case.
13. (30 points). Referring to the building below, determine the magnitude of force on the brace along column line A, between 1 and 2, between the ground and the 2nd floor, for an applied wind pressure of 20 psf (the actual pressure is 33.3 psf, but the ASD factor for wind is 0.6, so use 20 psf), directed from East to West and state whether the member is in tension or compression, in this case.

14. (20 points). For the building below, determine the maximum moment ASD applied moment M on a typical interior wall girt along column line 1 due to wind pressure of 20 psf (use 20 psf, as this corresponds with an ultimate wind pressure of 33.3 psf, but the ASD factor on wind is 0.6, leading to an ASD pressure of 20 psf), directed from East to West. The girts are evenly spaced and simply-connected (non-moment-resisting) to the columns.

15. (20 points). For the previous building, determine the maximum moment ASD applied moment M on a typical interior wall girt along column line A due to wind pressure of 20 psf (use 20 psf, as this corresponds with an ultimate wind pressure of 33.3 psf, but the ASD factor on wind is 0.6, leading to an ASD pressure of 20 psf), directed from East to West. The girts are evenly spaced.

Lesson 21. Distinguish between N, X, and SC bolts and describe where each would be specified.

16. (3 points) TRUE or FALSE. Given the same loads, a bolted connection that uses Group A (A325) N bolts requires a greater number than a connection that uses the same sized Group A (A325) SC bolts.
17. (3 points) TRUE or FALSE. Group A (A325) Slip Critical Bolts are made from a stronger high-carbon steel than Group A (A325) N bolts.

18. (3 points) TRUE or FALSE. It is conservative to specify N bolts rather than X bolts because the specification of X bolts requires that the detailer assure that the bolt’s threads are always excluded from the shearing planes.

19. (3 points) TRUE or FALSE. Slip Critical bolts look the same as N bolts and both are installed the same way, with the same level of torque.

20. (3 points) TRUE or FALSE. Slip Critical bolts are specified for any connection in which slip is not permitted when the working (actual maximum) loads are applied to the connection.

21. (3 points) TRUE or FALSE. Even though bearing type bolts (e.g., N or X) are installed the same way as slip critical bolts (i.e., torqued until the bolts are significantly pre-tensioned so that the connection is compressed together), it is understood that the bolted connection may slip under working loads, in the case of bearing type bolts.

Lesson 21. **Compute** the nominal bolt-shear strength of an N or X bolt, \( r_n \), and use this to compute the nominal strength of the entire connection, \( R_n \).

22. (15 points) A ½” diameter bolt was tested in tension, failing at a load of 11.78 kips. Three (3) ¾” diameter bolts from the same manufacturer, manufactured from the same steel (assume the strength is identical) will be used in a double shear application, as shown, and threads will not be excluded from the shearing planes. Determine: \( P_n / \Omega \) for the bolted connection, assuming that bolt shear controls.

Lesson 21. **Compute** the bolt-slip allowable strength of an SC bolt, \( r_n / \Omega \), and use this to compute the capacity of the entire connection, \( R_n / \Omega \).

23. (7 points) Compute the nominal strength \( R_n \) of the double-angle tension angle connection shown, with respect to the limit state of bolt slip. Given: (3) ¾” Group A (A325) SC bolts in standard holes and a Class A faying surface on double L4x3x1/4” sections. Material is A36.

24. (10 points) Determine \( R_n / \Omega \) with respect to the limit state of bolt slip for the connection shown per ASD specifications. Given: The bolts were pretensioned to 11 kips. Class B faying surface. Standard holes.

Lesson 21. **Determine** bolt nominal strengths via Part 7 tables.

25. (5 points) What is the nominal strength (breaking strength) of a ¾” Group A (A325) N bolt if it is loaded in double shear?

26. (5 points) What is the allowable strength \( r_n / \Omega \) of a ¾” Group A (A325) N bolt if it is loaded in single shear?
Lesson 21. **Select** the number of bolts needed for a connection

27. (10 points) Problem: For the 70 kip applied (ASD) load, specify the number of ¾” Group A (A325) N bolts needed for the connection shown, considering bolt shear, only.

   **Given:** 2L4x4x1/4“A36 double angle with a ½” thick gusset plate. Single line of bolts is assumed.

![Diagram](Diagram1.png)

Lesson 22. **Explain** why yielding must never be allowed along any structural member, but it is allowed (locally) on a connection (around bolt holes). **Explain** why yielding is allowed at the connection, so that the limiting stress for connections is the ultimate (fracture) stress.

28. (7 points) Explain why yielding is actually considered acceptable at or around bolt holes, so that the limiting stress for connections is the ultimate (fracture) stress, rather than the yield stress.

Lesson 22. **Calculate** the controlling nominal strength \( P_n \), allowable tensile load (ASD) \( P_n/\phi \) and the design strength (LRFD) \( \phi P_n \), based on yielding, fracture (and bolt) limit states.

29. (20 points). Use the ASD method to compute the allowable tensile load \( P_n/\phi \) with respect to the fracture mode for the A36 Double Channel section (each channel is a C10x15.3) if it is connected to the gusset using ¾” bolts in standard holes. Do not analyze the gusset.

![Diagram](Diagram2.png)

30. (20 points): Determine the allowable (ASD) load \( R_{all} = P_n/\phi \) with respect to yielding, fracture, and bolt limit states for the double channel tension member shown, which consists of two C3x6 A36 channel shapes, back-to-back on a ¾” thick gusset plate. The double channel section is connected with (4) ¾” A325-N bolts in standard holes.

   **Note:** Do not consider the gusset plate or any other modes.

![Diagram](Diagram3.png)

Lesson 23. **Judge** when the shear lag factor will tend to be lower (greater reduction in strength).

31. (3 points) For which double-angle connection is shear lag a more serious problem (i.e., leads to a lower fracture strength), assuming the gross areas are the same?
Lesson 23. Determine the shear lag factor $U$, using the “Case 2 equation” or by using one of the generic $U$ values (cases 1, 3, 4, 5, 6, 7, 8) from Table D3.1.

32. (10 points) What is the fracture strength of the 2L5x3x1/4” A36 double-angle tension member, if a single line of (4) ¾” bolts in standard holes is used? The spacing between each bolt is 3”. Note the orientation of the angles.

33. (10 points) What is the fracture strength of the 2L5x3x1/4” A36 double-angle tension member, if a single line of (4) ¾” bolts in standard holes is used? The spacing between each bolt is 3”. Note the orientation of the angles.

Lesson 23. Compute the nominal strength $R_n$ and the allowable (ASD) load $R_a/\Omega$ corresponding with the limit states of block shear and bolt bearing.

Lesson 23. Compute the nominal strength $R_n$ and allowable (ASD) load $R_a/\Omega$ of a bolted tension connection, considering all five failure modes, as applicable.

34. (50 points) Problem: Determine $P_{all} = P_n/\Omega$ for the 2L5x3x1/4” double angle member, considering all possible modes. Circle the final allowable loads for each failure mechanism and clearly identify the controlling allowable load.

Given:
- The short legs are back to back (SLBB)
- Gusset is already adequate (do not check the gusset)
- A36 material
- ¾” Group A (A325) N bolts in standard holes

35. (20 points) Problem: Determine $P_{all} = P_a/\Omega$ for the 2L5x3x1/4” double angle member, considering bolt bearing/tearout, only.

Given:
- Gusset is 3/8” thick
- A36 material for all.
- 3/4” Group A (A325) N bolts in standard holes

3/8” thick Gusset plate

2L5x3x1/4” A36

Pall