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The worksheets listed above, or equivalent information, are required to be prepared/sent for use with each project.

All constructions or installations shall be supervised by a Wisconsin registered architect or engineer under section Comm 61.50, except that a Wisconsin registered HVAC designer may supervise the installation of heating, ventilating and air conditioning systems. The plans, specifications, worksheets and calculations require the signature and seal or stamp of an appropriate professional listed above per Comm 61.31(1).

Seal and signature is required at right, unless exempt by Comm 61.30(1).

GRADE PLANE DETERMINATION WORKSHEET

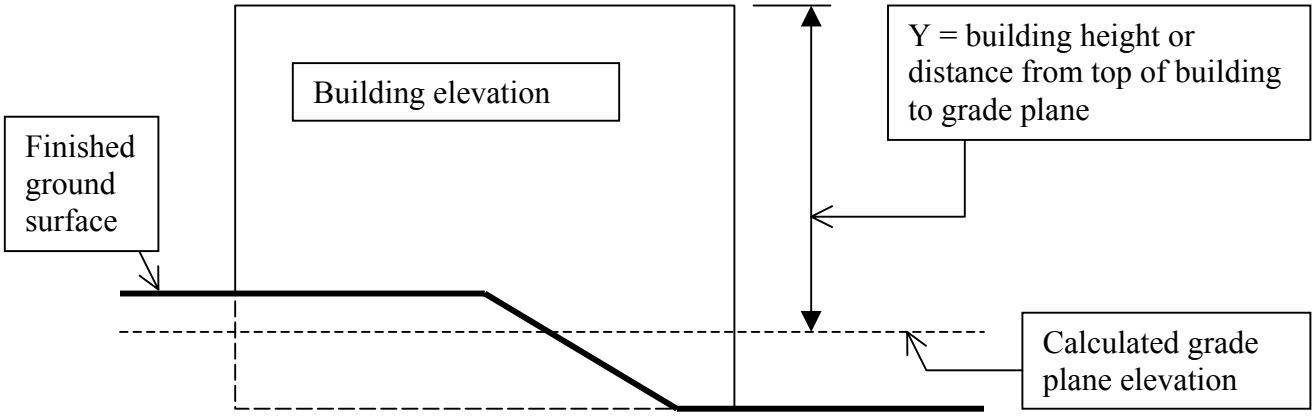
WALL DESIGNATION	WALL LENGTH	WALL AREA

Total of all wall lengths (building perimeter) = _____ Feet

Total of all wall areas from above table = _____ Square feet

Building height Y = (Total wall area / Total wall length) = _____ Feet

Permitted building height from Table 503 including modifications to building height within section 504 = _____ Feet *(This value must be equal to or greater than the value "Y" calculated above.)*



DETERMINATION OF NUMBER OF STORIES ABOVE GRADE WORKSHEET:

Building height Y (from grade plane determination worksheet) = _____ feet

Grade plane elevation = _____ feet

Lowest ground level elevation = _____ feet

Floor level designation	Floor level elevation	Story above grade (yes/no)	Finished floor elevation above > 6 feet above grade plane (yes/no)	50 % or more of finished floor level above > 6 ft above finished ground level (yes/no)	Finished floor level above > 12 feet above finished ground level (yes/no)

Stories above grade = (# of yes responses in column 3) + (# of yes responses in column 4) + (# of yes responses in column 5) + (# of yes responses in column 6) = ____ stories

Permitted number of stories from Table 503 including any modifications to the number of stories from IBC section 504 = _____stories (this value must be equal to or greater than the number of "stories above grade" as calculated above)

OCCUPANT LOAD WORKSHEET

1	2	3	4	5	6	7	8	9
ROOM OR SPACE DESIGNATION	CLASSIFICATION OF Table 1003.2.2.2 OCCUPANCY OR USE	FLOOR AREA (square feet)	DENSITY SF/PERSON (specify if net or gross value)	OCCUPANT LOAD BY CALCULATION	OCCUPANT LOAD BY ACTUAL NUMBER	OCCUPANT LOAD BY COMBINATION	ROOM OR SPACE TOTAL	OCCUPANTS ACCOUNTED FOR IN OTHER SPACES

The total occupant load for this worksheet page (or story of the building) =_____ Occupants

The total occupant load for this building =_____ Occupants *(total of all worksheets/stories)*

Caution: Note that this form is not adequate for use of covered mall total occupant calculations.

EGRESS WIDTH WORKSHEET

ROOM OR SPACE DESIGNATION	OCCUPANCY OR USE CLASSIFICATION	OCCUPANT LOAD FROM WORKSHEET	STAIR WIDTH FACTOR	REQUIRED STAIRWAY WIDTH	OTHER EGRESS COMPONENT FACTOR	OTHER EGRESS COMPONENT WIDTH

Is part of the space shown above an *assembly seating facility*? ____ If yes, then the Assembly Egress Width Sub-Worksheet should be completed for calculating minimum width requirements.

Ideally the Occupant Load Worksheet should be completed first, before this worksheet, so that the results of that sheet may be simply inserted into the first three columns of this worksheet.

ASSEMBLY EGRESS WIDTH SUB-WORKSHEET

Is the occupant load of a Group A occupancy over 300 persons? ____ (Yes or No) If yes, see Section 1008.1

Is the assembly seating area smoke-protected? _____ (Yes or No)

> If **yes**, then an evaluation per NFPA 101 shall be submitted with the plans and the egress widths shall be based on IBC Table 1008.5.2 minimums. All of the requirements of Sections 1008.5.2.1, 1008.5.2.2, and 1008.5.2.3 must be met, or else it is not smoke-protected seating.
>
> If **no**, then use the following requirements from Section 1008.5.1 as listed below.

Clear width of aisles and other means of egress for non-smoke-protected seating shall be per cases 1 through 6 below. *(Indicate which formula is being used.)*

Where **W** = Required width in **inches per occupant**
R = Riser height in inches (from tread to tread)

Case 1 – Where **R** $\leq$ 7.0" Then **W = 0.3** (Formula 10-1)

Case 2 – Where **R** > 7.0" Then **W = 0.3 + 10(R – 7.0")(0.005)** (Formula 10-2)

Case 3 – Where egress requires stair descent without a handrail within a horizontal distance of 30" and **R** $\leq$ 7.0", then add 0.075" additional width per occupant
Then **W = 0.375** = 0.3 + 0.075 (Formula 10-3)

Case 4 – Where egress requires stair descent without a handrail within a horizontal distance of 30" and **R** > 7.0", then add the 0.075" additional width per occupant plus a factor
Then **W = 0.375 + 10(R – 7.0")(0.005)** (Formula 10-4)

Case 5 – Where ramped means of egress > 1:12 slope Then **W = 0.22** (Formula 10-5)

Case 6 – Where level or ramped means of egress $\leq$ 1:12 slope Then **W = 0.20** (Formula 10-6)

Note that for outdoor smoke-protected assembly seating, the width may meet the lesser of clear width of Section 1008.5.3 or the Table 1008.5.2 requirement serving the same number of seats.

Case 7 – Where outdoor smoke-protected seating using stairs Then **W = 0.08** (Formula 10-7)

Case 8 – Where outdoor smoke-protected seating using ramps, corridors, tunnels or vomitories
Then **W = 0.06** (Formula 10-8)

NOTE THAT MINIMUM AISLE WIDTHS PER SECTIONS 1008.7.1, 1008.7.2, 1008.7.3, AND 1008.7.4 MUST ALSO ALWAYS BE PROVIDED. ***These widths include:***

42" aisle for level or ramp with seats both sides
36" aisle for level or ramp with seats on both sides if under 50 seats
36" aisle for level or ramp with seats one side
23" clear to handrail serving aisle stair less than 5 rows on one side
48" for aisle stairs with seats on both sides
36" aisle stair w/seats both sides if < 50 seats
36" for aisle stairs with seats one side
23" clear to handrail dividing an aisle stair

MULTIPLE OCCUPANCIES WORKSHEET

☐ I am using separated uses in my design. (IBC 302.3.3)

☐ I am using non-separated uses in my design. (IBC 302.3.2)

☐ I am using a combination of separated and non-separated uses in my design.

SEPARATED USES

LOCATION (story or side of building)	**OCCUPANCIES SEPARATED** (both classifications)	**FIRE RATING** (hourly rating)
(sample) *east third floor*	*office B and lunchroom A-2*	*2 hours*

NON-SEPARATED USES **CONSTRUCTION TYPE ___**

LOCATION (story or side of building)	**OCCUPANCIES NOT SEPARATED** (all classifications)	**MOST RESTRICTIVE**
(sample) *east third floor*	*office B and lunchroom A-2*	*A-2*

Go to Allowable Areas Worksheets to verify building size allowable for uses shown above.

ALLOWABLE AREAS WORKSHEET

AREA MODIFICATIONS TO TABLE 503

Allowable area = Tabular area + Frontage increase + Sprinkler increase

$$A_a = A_t + [(A_t)(I_f)/100] + [(A_t)(I_s)/100] = \_\_\_\_\_$$

A_a = Allowable area per floor

A_t = Table 503 area per floor

I_f = Area increase due to frontages = (100)[F/P – 0.25](W/30)

I_s = Area increase due to complete sprinkler protection (NFPA 13)

F = Building perimeter which fronts an open space having a minimum width of 20 feet

P = Perimeter of the entire building

W = Minimum width of open space for frontage exposure on any side

Sprinkler increase
I_s = Sprinkler increase for one-story buildings = 300 percent

I_s = Sprinkler increase for multi-story buildings = 200 percent

I_s = Building not completely sprinkler protected = 0 percent

Frontage calculation (note that frontage is only permitted on open space that is a public way or space that is a minimum 20 feet wide which is accessed from a street or fire lane)

	North wall	East wall	South wall	West wall
Building frontage lengths	_____	_____	_____	_____
Minimum width of open space	_____	_____	_____	_____

Minimum width of open space (W) = _____ (least of above ≥ 20 feet)

Total building frontage (F) = _____ (total of above four frontages)

Total building perimeter (P) = _____ (total of four building sides)

Area increase due to frontages I_f = (100)[F/P – 0.25](W/30) = _____

ALLOWABLE AREAS WORKSHEET

(One story per worksheet – add additional worksheets as necessary)

STORY LOCATION	USE GROUP	ACTUAL FLOOR AREA	TABLE 503 AREA	MODIFIED AREA ALLOWABLE	RATIO Actual/Allowable
				TOTAL OF ALL RATIOS =	

Must be ≤ 1.0

MAXIMUM AREA DETERMINATION OF BUILDING (check only required if > 3 stories)

Total floor area of the building (all stories) = _____ *(the actual building total square feet)*

Modified allowable area for any story (based on ratios if multiple uses) = _____

Allowable floor area of building (IBC 503.3) = _____ *(3 times the maximum modified area)*

Is actual total area less than maximum allowable area? _____

EXTERIOR WALL OPENING WORKSHEET

Wall designation	Wall area	Fire separation distance	Area of unprot. openings (A_u)	Area of protected openings (A)	% factor from Table 704.8 for unprotected openings	Allowable area of unprotected openings (a_u)	% factor from Table 704.8 for protected openings	Allowable area of protected openings (a)	Ratio of unprot. openings (A_u/a_u)	Ratio of protected openings (A/a)	Interaction check of ratios (A_u/a_u) + (A/a)

FIRE APPARATUS ACCESS AND FIRE LANE WORKSHEET

1. Building is limited in area? _____ (YES OR NO)

2. Building is unlimited in area based on section 507 of the IBC? _____ (YES OR NO)

3. Building is completely protected by an automatic fire sprinkler system, per IBC section 903.3.1.1 or 903.3.1.2? _____ (YES OR NO)

4. Fire lanes are unobstructed? _____ (YES OR NO)

5. Fire lanes are accessible from a public road? _____ (YES OR NO)

6. Fire lanes extend to within 150 feet of any portion of the exterior wall of the first story of the building or facility? _____ (YES OR NO)
   If no, a letter from the fire code official allowing and indicating acceptance of a distance greater than 150 feet shall be submitted to the department.

7. Is any part of the building greater than 30 feet above the lowest level of the fire apparatus access? _____ (YES OR NO)
   If yes, answer the following five questions:

a) Is fire lane parallel to one entire side of the building? _____ (YES OR NO)
b) Is the near edge of the fire lane within 30 feet of the building on that parallel side? _____ (YES OR NO)
c) Is a fire lane provided capable of accommodating aerial fire apparatus? _____ (YES OR NO)
d) Are overhead power or utility lines located across or within a fire lane for aerial fire apparatus? _____ (YES OR NO)
e) Fire apparatus access has a minimum unobstructed width of 26 feet? _____ (YES OR NO)

8. Fire apparatus access roadways have an unobstructed vertical clearance of at least 13 feet 6 inches? _____ (YES OR NO)

9. Fire lanes have an unobstructed width of at least 20 feet? _____ (YES OR NO)

10. Is a fire hydrant provided to supply fire apparatus on the fire lane? _____ (YES OR NO)
    If yes, the minimum unobstructed width of the fire lane shall be at least 26 feet wide for at least 20 feet on each side of the fire hydrant.

11. The minimum inside turning radius of the fire lane is at least 28 feet? _____ (YES OR NO)

12. Is the fire lane dead-ended with a length greater than 150 feet? _____ (YES OR NO)
    If yes, answer the following questions:
    Is an area for turning around fire apparatus provided by a cul-de-sac with a minimum diameter of 70 feet? _____ (YES OR NO)
    Is an area for turning around fire apparatus provided by a 45-degree wye with a minimum length of 60 feet per side? _____ (YES OR NO)
    Is an area for turning around fire apparatus provided by a 90-degree tee with a minimum length of 60 feet per side? _____ (YES OR NO)

SANITARY FIXTURE DETERMINATION WORKSHEET

Total building design occupancy = _____ (determined from IBC 1003.2.2)

Building occupancy which most closely resembles the use of the space (list each separately) (Caution: Table 2902.1 uses may be more exact than general use groups of IBC chapter 3)

As in the past, a submitter may document an actual occupancy load, rather than the load determined strictly by square footage, to the building reviewer for consideration of a reasonable number of toilet fixtures. In no case should the reviewer accept less than 50% capacity or less than the seating indicated on the plans, except possibly via the petition for variance process.

OCCUPANCY		WATER CLOSETS			LAVATORIES		TUB/SHOWER		D F	OTHER
Type	Number People	Factors	Fixtures # Male	Fixtures # Female	Factor	Number Fixtures	Factor	Number Fixtures	Number Fixtures	List the Type

_____

Total = _____ (this number should equal building total shown at top on this page)

Round fractions up to a whole number or to one decimal place, if shared facilities are used.

Note that urinals may be substituted for up to 50% of water closets for men per COMM 62.2902(1)(a).

COMPLIANCE CHECK	Men		Women	Lavatories	Bath Tub/ Shower	Drinking Fountain	Other (List)
	Urinals	Water Closets	Water Closets				
REQUIRED							
PROVIDED							

For swimming pools see Comm 90 and DH&FS rules for sanitary fixtures serving those areas. See IBC 2902.2 & 2902.3 for special exceptions, as well as Comm 62.2902 special restrictions.

CONTROL AREA WORKSHEET:

1) Will there be any hazardous materials stored or used within the building? _____ (YES or NO)
If "**NO**" then the remainder of the worksheet does not have to be completed.

If "**YES**" proceed to question 2.

2) Will this building be designed as a Group H occupancy? _____ (YES or NO)
If "**NO**" then the remainder of the worksheet starting at question 3 must be completed.

If "**YES**", complete the "Control Area Sub-worksheet" and answer question 2a. The completion of the remainder of the worksheet is not required.

2a) Are the quantities of hazardous materials provided within column 6 of the Control Area Sub-worksheet greater than the quantities permitted in Tables 307.7(1) or 307.7(2) shown in column 7 of the Control Area Sub-worksheet? _____ (YES, NO OR N/A)

3) Will this building be divided into control areas? _____ (YES or NO)
If "**YES**" complete the "Control Area Table" and the "Control Area Sub-worksheet".

If "**NO**", complete the "Control Area Sub-worksheet" and answer question 3a.

3a) Are the quantities of hazardous materials provided within column 6 of the Control Area Sub-worksheet greater than the quantities permitted in Tables 307.7(1) or 307.7(2) shown in column 7 of the Control Area Sub-worksheet? _____ (YES, NO OR N/A)

4) "Control Area Table" is completed and attached? _____ (YES or NO)

5) "Control Area Sub-worksheet" is completed and attached? _____ (YES or NO)

CONTROL AREA TABLE:

Floor level above or below grade in which material is stored or used	Number of control areas per floor	Permitted number of control areas per floor (from Table 414.2.2)	Fire resistive rating of fire barriers used to define control areas	Required fire resistive ratings for fire barriers (from Table 414.2.2)	Hazardous materials on floor level	Permitted % of the maximum allowable quantity of material per control area from Table 414.2.2

CONTROL AREA SUB-WORKSHEET:

Designation of control area (floor level & location on floor)	Materials located within control area	Amount of materials in storage (gallons, pounds, & gas)	Amount of materials used in closed systems (gallons, pounds, & gas)	Amount used in open systems (gallons, pounds, & gas)	Total of each material stored or used in designated control area	Maximum amount of materials permitted (from Tables 307.7(1) and 307.7(2) of the IBC)	Actual % of the materials within the control area (column 6 divided by column 7)	Permitted % of the maximum allowable quantity of material per control area (same as column 7 of Control Area Table)

LATERAL SYSTEMS AND CONNECTIONS WORKSHEET

BACKGROUND

All loads (e.g., vertical loads, lateral loads, impact loads, etc.) on a building or structure must be provided with a continuous path to the foundation. Not only must the individual structural elements and/or structural systems resist and transfer the applied loads to the foundation, the connections must also be designed to resist and transfer the applied loads to the foundation. If all of the connections, structural elements and/or structural systems are not adequately designed, the load path will not be continuous.

The worksheets that appear on the following pages address these connections, structural elements, and/or structural systems. They are divided into 7 categories: DIAPHRAGMS, COLLECTOR ELEMENTS, SHEAR WALLS, BRACED FRAMES, MOMENT-RESISTING WALL FRAMES, ANCHORAGE and OTHER CONNECTIONS. Under each category heading are the category definitions as used in the 2000 International Building Code (IBC).

Consistent with recognized structural engineering practice, the 2000 International Building Code (IBC) requires that a continuous load path to the foundation be provided for all buildings and structures.

DIRECTIONS FOR FILLING OUT THE ACCOMPANYING WORKSHEETS

The size, type, location, spacing, and/or length (for welds) of ALL connections designed and specified in the submitted structural calculations must be shown on the corresponding building plans. If horizontal shear values for structural systems (e.g., shear walls, diaphragms, diagonal bracing, etc.) are taken from the IBC tables, the design construction of these structural systems (fastener size, fastener type, fastener spacing, minimum penetration of fasteners, framing spacing, etc.) shall be shown on the plans to be constructed AS INDICATED in the IBC Tables for the respective horizontal shear value. If any substitutions in materials, material thickness, connections, connection spacing, etc. are made, the design values in the IBC tables CANNOT be used, unless permitted by table footnotes.

For horizontal shear values that are not listed in the IBC tables, there are two options:

1. Horizontal shear capacity data from a recognized testing agency is submitted for these non-tabular values; OR
2. Horizontal shear capacity data can be determined based on recognized principles of engineering mechanics by using structural panel shear tested values and approved fastener values. Detailed calculations are required to be submitted for this option.

For each of the items listed under the categories on the following pages, you will notice that there is only one blank that precedes the item being requested. If more than one blank is required for a particular item or items, additional worksheets may be copied, completed and submitted to relay all of the structural design and construction specifications. As indicated above, all of the design results are to be clearly shown on the accompanying building plans.

There are four types of responses that can be provided in the blank spaces next to each item. These responses are as follows:

- A **TRUE (T)** response indicates that the calculations and/or plans reflect the requirement specified in that item OR that the statement in that item is true and/or code-compliant;
- A **FALSE (F)** response indicates that the calculations and/or plans DO NOT reflect the requirement specified in that item OR that the statement in that item is false and/or non-code-compliant. If the statement is indicated to be false or non-code-compliant, additional information and/or revised plans and calculations may need to be submitted prior to approval. There should not be any **FALSE** responses to any of the items on the following worksheets.
- A **N/A** response means "not applicable" and indicates that the item does not apply to the project.
- The fourth type of response requires that an alphanumeric value be entered in the blank provided. This response can either be one of the options given in a particular line item or a design value taken from the Code, a design standard, etc. For example: **6d** for the size of nails used in a shear wall, **250 plf** for the shear value of a diaphragm, etc

Every item shown on the following pages should be provided with one of the responses listed above. Another way of indicating "N/A" for a type of structural system(s) is to cross out the entire section. Please do not leave any blank spaces.

ALL CONNECTIONS SHALL BE OF SUFFICIENT SIZE AND STRENGTH TO PROVIDE A CONTINUOUS LOAD PATH TO THE FOUNDATION.

STRUCTURAL DESIGN CALCULATIONS MUST BE SUBMITTED TO SUBSTANTIATE THE RESPONSES TO EACH OF THE ITEMS NOT HAVING A RESPONSE OF "N/A".

DIAPHRAGMS (ROOF AND/OR FLOOR)

The IBC defines a DIAPHRAGM as a horizontal or nearly horizontal system acting to transmit lateral forces to the vertical-resisting elements. When the term "diaphragm" is used, it includes horizontal bracing systems.

- **General**

_____ Where supported by masonry shear walls, the span-to-width or span-to-depth ratio of floor and/or roof diaphragms do not exceed the values shown in IBC Table 2109.2.1.3.

- **Metal Deck Diaphragms:**

_____ Calculated (actual) shear capacity, in pounds per lineal foot (plf)
_____ Tabular (allowable) shear capacity, in pounds per lineal foot (plf)
_____ Composite metal deck (C) or non-composite deck (NC)
  _____ Normal weight concrete (NW) or light weight concrete (LW)
  _____ Indicate weight of concrete in pounds per cubic foot (pcf)
_____ Metal deck size and type (e.g., 0.6C, 1.0C, 1.5B, 1.5BI, 2VLI, 3N, etc.)
_____ Metal deck gage (e.g., 22, 20, 18, etc.)
_____ Typical fastener layout (e.g., 36/7, 36/4, 30/4, 32/4, 24/4, etc.)
_____ Support fasteners (puddle welds or screws)
  _____ Size of support fasteners (e.g., ¾" puddle weld, #12 TEK screws)
_____ Sidelap fasteners (welded or screws)
  _____ Size of sidelap fasteners (e.g., welded, #10 TEK screws)
  _____ Number of sidelap fasteners per span
  _____ Maximum span between supports

- **Wood Structural Panel Diaphragms** (see IBC Table 2306.3.1):

_____ Calculated (actual) shear capacity, in pounds per lineal foot (plf)
_____ Tabular (allowable) shear capacity, in pounds per lineal foot (plf)
_____ Structural panel grade (e.g., structural I grade, sheathing, etc.)
_____ Span rating (permitted spacing of support framing, inches)
_____ Common nail size or staple length and gage (e.g., 6d, 1½" 16 gage)
_____ Minimum fastener penetration in framing, in inches
_____ Minimum nominal panel thickness, in inches
_____ Minimum nominal width of framing member (2 inches or 3 inches)
_____ Blocked diaphragm (B) or unblocked diaphragm (UB)
  _____ Framing case (i.e., Case 1, 2, 3, 4, 5, or 6)
  _____ Fastener spacing, in inches (panel edges/intermediate)
_____ Maximum diaphragm aspect ratio is not exceeded (length-to-width limits of IBC 2305.2.3)

- **Load Transfer**

_____ Indicate the lateral unit shear value (in pounds per lineal foot, plf) being transferred to the collector element(s). REMINDER: the connections must be adequately designed to transfer all of the loads.

COLLECTOR ELEMENTS

The IBC defines COLLECTOR ELEMENTS as members that serve to transfer forces between floor diaphragms and members of the lateral-force-resisting system.

- Collector elements (e.g., bond beams, chords, drag struts, purlin anchors, truss ties, rafter ties, etc.) of sufficient size, capacity and material are provided to ensure adequate load transfer between the horizontal lateral load resisting system(s) and the vertical lateral load resisting systems.

_____ Size, type, or model number (if proprietary, specify manufacturer) of collector element
_____ Calculated (actual) lateral load to be transferred to collector element (in pounds)
_____ Tabular (allowable) lateral capacity of collector element (in pounds)

_____ Calculated (actual) uplift load to be transferred to collector element (in pounds)
_____ Tabular (allowable) uplift capacity of collector element (in pounds)

- Connections of adequate size, type, strength, and spacing is provided to ensure a continuous load path from the horizontal lateral load-resisting member or system to the vertical lateral load-resisting member or system.

_____ Calculated (actual) load on each fastener (in pounds)
_____ Tabular (allowable) capacity of each fastener (in pounds)
_____ Size and type of connections (e.g., 8d R.S. nails)
_____ Number and/or spacing of fasteners (e.g., 6 nails @ 12" o.c.)
_____ Welds: size, type, length and spacing (e.g., ¼" E70XX fillet 3" @ 12" o.c.)
_____ Concrete anchorage design and construction complies with the applicable portions of Allowable Stress Design (IBC Section 1912) or with the applicable portions of Strength Design (IBC Section 1913)

- **Load Transfer**

_____ Indicate the lateral unit shear value (in pounds per lineal foot, plf) being transferred to the shear wall(s). REMINDER: the connections must be adequately designed to transfer all of the loads.

SHEAR WALLS

The IBC defines a SHEAR WALL as a wall designed to resist lateral forces parallel to the plane of the wall.

Shear Walls with Openings (IBC Section 2305.3.7)

Force Transfer around Openings (IBC Section 2305.3.7.1)

_____ The maximum aspect ratios of IBC Table 2305.3.3 apply to the overall shear wall, including openings and to each wall pier at the side of an opening.
_____ The height and width of the wall pier(s) are as defined in Section 2305.3.7.1 and Figure 2305.3.4(b).
_____ Design of force transfer around openings is based on a rational analysis.
_____ Adequate detailing of boundary elements around the opening is provided. The IBC defines a BOUNDARY ELEMENT as diaphragms and shear wall boundary members to which sheathing transfers forces. Boundary elements include chords and drag struts at diaphragm and shear wall perimeters, interior openings, discontinuities and re-entrant corners.

No Force Transfer around Openings (IBC Section 2305.3.7.2)

_____ The tabulated design shear capacity (in plf), set forth in Table 2306.4.1 is adjusted in accordance with Table 2305.3.7.2 based on the maximum unrestrained opening height and the percentage of full-height sheathing.
_____ The total shear capacity (in pounds) is equal to the adjusted shear capacity (in plf), multiplied by the sum of the widths of the shear wall segments meeting the aspect ratio requirements of Table 2305.3.3.
_____ Overturning restraint at the ends of the shear wall, uplift and shear connections at the base of each shear wall segment, drag struts and collectors are calculated using the unadjusted allowable shear capacity from Table 2306.4.1 or calculated by rational analysis.
_____ Overturning restraint is located at each end of the shear wall adjacent to a shear wall segment meeting a height to width ratio set forth in Table 2305.3.3
_____ The controlling deflection of a blocked shear wall with openings uniformly nailed throughout is taken as the maximum individual deflection of the shear wall segments calculated in accordance with Section 2305.3.2, divided by the appropriate shear capacity adjustment factor calculated in accordance with Section 2305.3.7.2.

Sheathing on Wood Framing

- **IBC Section 2305.1.4 – Positive connections and anchorages, capable of resisting the design forces, are provided between the shear panel and the attached components**
- **Wood Structural Panel Sheathing** (see IBC Table 2306.4.1):

_____ Calculated (actual) shear capacity, in pounds per lineal foot (plf)
_____ Tabular (allowable) shear capacity, in pounds per lineal foot (plf)

_____ Structural panel grade (e.g., structural I grade, sheathing, etc.)
_____ Minimum nominal panel thickness, in inches
_____ Minimum fastener penetration in framing, in inches

Panels applied direct to framing:

_____ Size of common or galvanized box nails or staples
_____ Fastener spacing, in inches (panel edges/intermediate)

Panel applied over ½" or 5/8" gypsum sheathing:

_____ Size of common or galvanized box nails or staples
_____ Fastener spacing, in inches (panel edges/intermediate)

_____ Maximum shear wall aspect ratio is not exceeded (height-to-width limits of IBC 2305.3.3)

- **Particleboard Sheathing** (see IBC Table 2306.4.3):

_____ Calculated (actual) shear capacity, in pounds per lineal foot (plf)
_____ Tabular (allowable) shear capacity, in pounds per lineal foot (plf)
_____ Structural panel grade (M-S "Exterior Glue" or M-2 "Exterior Glue")
_____ Minimum nominal panel thickness, in inches
_____ Minimum nail penetration in framing, in inches

Panels applied direct to framing:

_____ Size of common or galvanized box nails
_____ Fastener spacing, in inches (panel edges/intermediate)

- **Lath and Plaster or Gypsum Board Sheathing** (see IBC Table 2306.4.5)

_____ Calculated (actual) shear capacity, in pounds per lineal foot (plf)
_____ Tabular (allowable) shear capacity, in pounds per lineal foot (plf)
_____ Thickness of material
_____ Wall construction (Blocked, unblocked, or two-ply)
_____ Maximum fastener spacing in inches
_____ Minimum fastener size

Sheathing on Light Framed, Cold-Formed Steel Walls (see IBC Section 2211)

- **Wood Structural Panel Sheathing**

_____ Nominal shear values used to establish the allowable shear value for wind forces are per IBC Table 2211.1(1) OR are determined by using the principles of mechanics by using wood structural panel shear values and approved fastener values. Submit detailed calculations if the latter option is used.
_____ Orientation of structural panels (parallel or perpendicular to framing)
_____ Screws used to attach plywood and OSB is approved and is a minimum No. 8 flat-head, self-drilling, tapping screws with a minimum head diameter of 0.292-inch (7.42 mm) in accordance with SAE J78. Such screws are of sufficient length to penetrate through the cold-formed steel framing member by at least three exposed threads.

- **Gypsum Board Panel Sheathing**

_____ The shear values listed in IBC Table 2211.1(2) are not cumulative with the shear values of other materials applied to the same wall unless otherwise permitted in IBC Section 2211.4.1
_____ Orientation of gypsum board structural panels is applied perpendicular to framing
_____ Screws used to attach gypsum board is a minimum No. 6 in accordance with ASTM C954. Such screws are of sufficient length to penetrate through the cold-formed steel framing member by at least three exposed threads.

- **Sheet Steel Sheathing**

_____ The nominal shear is based on the values listed in IBC Table 2211.1(1) for wind loads and IBC Table 2211.1(3) for seismic loads. Installing sheathing on both sides of a steel stud wall is not permitted to increase the shear resistance value.
_____ Is the orientation of steel sheets applied perpendicular or parallel to the framing?
_____ Screws used to attach steel sheets is a minimum No. 8 modified truss head. Such screws are of sufficient length to penetrate through the cold-formed steel framing member by at least three exposed threads.

SHEAR WALLS (cont'd)

Structural Masonry Shear Walls

- **Specify which design method was used:**

_____ Working Stress Design (IBC Section 2107). Specify which section(s) of ACI 530/ASCE 5/TMS 402 was (were) used in the submitted design calculations.

_____ Strength Design (IBC Section 2108).

IBC Section 2108.9, Reinforced Masonry

_____ Reinforced masonry is based on the design assumptions of IBC Section 2108.9.1

_____ Out-of-plane reinforced masonry wall loads per IBC Section 2108.9.4.

_____ In-plane reinforced masonry wall loads per IBC Section 2108.9.5.

IBC Section 2108.10, Plain (unreinforced) masonry

_____ Flexural strength design of unreinforced masonry is based on the assumptions IBC Section 2108.10.2.

_____ Unreinforced masonry shear strength per IBC Section 2108.10.4.

_____ Empirical Design of Masonry (IBC Section 2109) is NOT to be utilized for any of the conditions listed in Section 2109.1.1. If <u>any</u> one of the three listed conditions is not met, masonry is designed in accordance with the provisions of Section 2107 or Section 2108.

_____ Section 2109.2.1 – Masonry shear walls (using the Empirical Design method) is oriented parallel to the direction of the lateral forces resisted.

_____ Section 2109.2.1.1 – The minimum <u>nominal</u> thickness of masonry shear walls (using the Empirical Design method) is 8 inches (203 mm). Shear walls of one-story buildings are permitted to have a minimum nominal thickness of 6 inches (152 mm).

_____ Section 2109.2.1.2 – The minimum cumulative length of required shear walls (using the Empirical Design method) is 0.4 times the long dimension of the building. Cumulative length of shear walls does not include openings.

- **Lateral Support (IBC Section 2109.4)**

_____ Masonry walls are laterally supported in either the horizontal or the vertical direction at intervals not exceeding those given in Table 2109.4.1.

_____ Lateral support is provided by cross walls, pilasters, buttresses or structural frame members when the limiting distance is taken horizontally; or by floors, roofs acting as diaphragms, or structural frame members when the limiting distance is taken vertically.

Concrete Shear Walls

_____ IBC Sections 1909.4 and 1909.6 – Structural plain concrete walls are designed in accordance with these code sections and ACI 318-99, Section 22.4 through 22.6

_____ IBC Section 1909.5 – Precast structural plain concrete walls are designed in accordance with this code section and ACI 318-99, Section 22.9.3.

_____ IBC Section 1910.4.1 – Concrete shear walls used to resist seismic forces in Seismic Design Category C is Ordinary Reinforced Concrete Shear Walls (see Section 1910.2.3) or Special Reinforced Concrete Shear Walls (see Section 1910.2.4)

_____ IBC Section 1910.4.1 – Structural plain concrete walls are <u>not</u> permitted in buildings or structures assigned to Seismic Design Category C.

Load Transfer

_____ Indicate the lateral unit shear value (in pounds per lineal foot, plf) being transferred to the foundation. REMINDER: the connections must be adequately designed to transfer all of the loads.

BRACED FRAMES

The IBC defines a BRACED FRAME as an essentially vertical truss, or its equivalent, of the concentric or eccentric type that is provided in a building frame system or dual frame system to resist shear.

- **Bracing members in tension**

_____ Indicate actual (calculated) axial design load on member(s)
_____ Indicate allowable axial design load on member(s)
_____ Size and type of fasteners used (e.g., A325 ¾" bolts, E70XX 3/16" fillet weld 3" long)
_____ Load-bearing capacity of each fastener (in pounds)
_____ Provisions are made to ensure that connections are initially free of slack and that these connections will not progressively deform or loosen under load reversals or repeated loading.
_____ Number of fasteners at each end of the diagonal bracing member (NOTE: the capacity of the group of fasteners at each end is not less than that required for the total calculated axial design load on the diagonal bracing member)
_____ For single diagonal bracing, load reversal on the member is considered and adequately addressed (i.e., where tension bracing member becomes compression bracing member, or vice versa)

- **Bracing members in compression**

_____ Calculated (actual) axial design load on member(s)
_____ Allowable axial design load on member(s)
_____ Size and type of fasteners used (e.g., A325 ¾" bolts, E70XX 3/16" fillet weld 3" long)
_____ Load-bearing capacity of each fastener (in pounds)
_____ Provisions are made to ensure that connections are initially free of slack and that these connections will not progressively deform or loosen under load reversals or repeated loading
_____ For single diagonal bracing, load reversal on the member is considered and adequately addressed (i.e., where compression bracing member becomes tension bracing member, or vice versa)
_____ Maximum allowable unbraced length of compression member is not exceeded

- **Load Transfer**

_____ Indicate the lateral load (in pounds) being transferred to the foundation. REMINDER: the connections must be adequately designed to transfer all of the loads.

MOMENT-RESISTING WALL FRAMES

The IBC defines a MOMENT FRAME as a structural frame in which members and joints are capable of resisting forces by flexure as well as along the axis of the members.

- **Steel**

_____ Connections for steel moment frames is in accordance with the applicable design standard listed in IBC Section 2204.1

- **Concrete**

_____ IBC Section 1910.3.1 – Concrete moment frames in buildings or structures used to resist seismic forces in Seismic Design Category B is Ordinary Moment Frames.
_____ IBC Section 1910.4.1 – Concrete moment frames in buildings or structures used to resist seismic forces in Seismic Design Category C is Intermediate Moment Frames or Special Moment Frames.

- **Masonry**

_____ Special masonry moment frames (wall frames) is designed in accordance with IBC Section 2108.9.6

- **Load Transfer**

_____ Indicate the lateral load (in pounds) being transferred to the foundation. REMINDER: the connections must be adequately designed to transfer all of the loads.

ANCHORAGE

The IBC defines an ANCHOR as a metallic element used to transmit applied loads.

- Connections of adequate size, type, strength, and spacing is provided to ensure a continuous load path from the horizontal and/or vertical lateral load-resisting members or systems to the foundation.
- **Wood construction**

  _____ Positive, horizontal anchorage is provided to prevent the walls from pulling away from the diaphragm edge (Positive anchorage means that the anchorage does not rely on such things as nail withdrawal or the lateral force on toe-nails).

  Holddowns or Tiedowns

  _____ Size and type
  _____ Calculated (actual) tensile load (in pounds)
  _____ Allowable tensile capacity (in pounds)
  _____ Locations

  Anchor Bolts

  _____ Size, type and spacing
  _____ Embedment length (inches)
  _____ Calculated (actual) shear load (in pounds)
  _____ Allowable shear capacity (in pounds)
  _____ Calculated (actual) tensile load (in pounds)
  _____ Allowable tensile capacity (in pounds)

- **Steel construction**

  _____ Size and type of anchor bolts and baseplates
  _____ Capacity and layout of anchor bolts and baseplates

- **Masonry Construction**

  _____ IBC Section 2108.6.5 - Anchor bolts is placed so as to meet the edge distance, embedment depth and spacing requirements of ACE 530/ASCE 5/TMS 402.
  _____ Empirical design of masonry anchorage is in accordance with the applicable provisions of IBC Section 2109.7. Cite the applicable portion(s) of this code section.

- **Concrete**

  _____ Concrete anchorage design and construction complies with the applicable portions of Allowable Stress Design (IBC Section 1912) or with the applicable portions of Strength Design (IBC Section 1913)
  _____ Size, type and orientation of doweling and/or hooking of reinforcing bars
  _____ Lateral tie size and development length is detailed on plans

OTHER CONNECTIONS

The IBC defines a CONNECTOR as a mechanical device for securing two or more pieces, parts or members together, including anchors, wall ties and fasteners.

- **Wood Construction**

  _____ Connections and fasteners for wood construction is in accordance with the applicable sections of IBC Section 2304.9. Cite the applicable portion(s) of this code section.
  _____ All other connections and fasteners for wood construction is designed in accordance with a recognized engineering standard (e.g., NDS). Cite the applicable portion(s) of the design standard used to obtain fastener values.

- **Steel Construction**

  _____ Connections and fasteners for steel construction is in accordance with the applicable portion(s) of AISC-ASD, AISC-LRFD, or AISC-HSS. Cite the design manual used and its applicable portion(s).
  _____ Anchor bolts is placed in accordance with IBC Section 2209.2

- **Concrete Construction**

  _____ Concrete anchorage design and construction complies with the applicable portions of Allowable Stress Design (IBC Section 1912) or with the applicable portions of Strength Design (IBC Section 1913)

STRUCTURAL DESIGN WORKSHEET

- **Design loads** must be shown on construction documents:

Floor area use	live load shown
_____	_____PSF
_____	_____PSF
_____	_____PSF
_____	_____PSF
Are live load reductions used? _____	

Building is in _____ county

Ground snow load P_g = _____ PSF (1608.2)

Snow load importance factor I_s = _____ (1608.3.3)

Snow load exposure factor C_e = _____ (1608.3.1)

Sloped roof/flat roof factor P_s = _____ (1608.4)

Roof thermal factor C_t = _____ (1608.3.2)

Roof snow load from the above ground snow times adjustments is _____ PSF = 0.7 P_g P_s C_e I C_t

- ❑ Unbalanced loads and sliding or drifting snow locations and amounts are clearly shown on plans and calculations (1608.6 to 1608.9).
- ❑ Impact or concentrated load locations & amounts are shown on plans and in calculations (1607).

- **Wind** load resistance design method used? *ASCE 7* or *IBC 1609.6 Simplified for Low Rise*

Amount of openings on each side are: North _____ East _____ South _____ West _____

Amount exterior wall on each side are: North _____ East _____ South _____ West _____

Is building Open, Partially Enclosed, or Enclosed? _____ Worst case is ____% openings

Width of end zone = _____feet edge strip calculation =

Coefficients used

C_f	Windward Wall		Leeward Wall		Windward Roof		Leeward Roof	
	End zone	Interior zone	End zone	Interior zone	End zone	Interior zone	End zone	Interior zone
MWFRS								
Components & Cladding								

Wind load importance factor (I_w) = _____ Building use is importance category _____

Exposure category

terrain is _____ North _____ K_z = _____

terrain is _____ East _____ K_z = _____

terrain is _____ South _____ K_z = _____

terrain is _____ West _____ K_z = _____

Gust effect factor G = _____ Wind directionality factor K_d = _____

- **Earthquake** design data:

Spectral response coefficients S_{DS}_____ & S_{D1}_____ (1615.1)

Seismic use group Category_____ (1616.2) Site Class_____ (1615.1.5)

Seismic Design Category_____ (1616.3)

- **Soil & Foundation** design data:

Allowable load bearing value of soil _____ PSF (1804) Presumptive or tested? (circle one)

❑ Soil report is *provided* or soil report is *needed* (1802.6) to verify design.

❑ Frost protection minimum depth of footings is met (1805.2.1).

❑ Slope protection or setback is met for footings (1805.3).

❑ Footing design & construction of permitted materials is met (1805.4).

❑ Piles or piers meet all general requirements (1807.2.8 to 1811).

Thickness & height of foundation wall supporting unbalanced backfill (1805.5.1.2) _____.

- **Concrete** strength specified _____psi Designed per ACI 318? *Yes* or *No* (circle one)

- **Masonry** properties [material, thickness, and type (hollow or solid)] _____

Lateral supports of masonry wall (2109.4)_____ mortar type _____

❑ Masonry veneers bonding with wall ties meets spacing & materials? (2109.6.3.1)

❑ Anchorage of masonry to structural elements (roof or floor to masonry) adequate? (2109.7)

❑ Details of bearing on masonry or of masonry bearing on other materials (type & size needed).

❑ If using engineered masonry, then complete masonry calculations are to be submitted. (2107 & 2108)

❑ **Fireplaces** (2111) materials, construction, and exterior air (2111.16) requirements met.

❑ Masonry **Chimneys** (2113) materials, construction, lining, and termination requirements met.

❑ Flue area (2113.15 & 2113.16), multiple flues (2113.14), chimney clearances, and locations of fireblocking (2111.14 & 2113.20) are met.

- **Steel**

Construction design? *LRFD* (load & resistance factor) or *ASD* (allowable stress) or *AISC-HSS*

❑ Steel joists (2206) follow SJI specifications showing series, bearing conditions, and bracing.

❑ Welding (2208) and bolting (2209) details followed are noted on plans or in specifications.

❑ Tables 2211.1(1)&(2) steel studs shear wall values are met.

- **Wood Construction**

Yes or *No*

❑ Wood construction quality and labeling of materials used shown on plans as required (2303).

❑ Computations for sizing is based on net dimensions, not nominal member sizes (2304.2).

❑ Wall, floor & roof framing meets provisions of Section 2308 unless a design is specified.

❑ Sheathing Table 2304.6.1 (wall) and floor & roof Tables 2304.7(1), (2), (3), (4)&(5) are met.

❑ Follow fastener schedule 2304.9.1 for minimum number & size of nails (staples allowed).

❑ Heavy timber connections are properly detailed on the plans (2304.10).

❑ Decay and/or termite protection where required for wood (2304.11).

Uses *conventional light-frame construction* method of Section 2308, while meeting all seven limitations:

- ❑ maximum 3 stories
- ❑ maximum 10' floor-to-floor height
- ❑ average dead load < 15 PSF
- ❑ floor live load does not exceed 40 PSF
- ❑ ground snow load does not exceed 50 PSF
- ❑ trusses do not span over 40' between supports
- ❑ seismic category D building meets Section 2308.12.6 limits.

Limitations of wood shear walls & diaphragms to resist wind, seismic & other lateral loads meet:

- ❑ Principals of mechanics (2305.1.1).
- ❑ Boundary elements [chord & collector framing] (2305.1.2).
- ❑ Openings in shear panels (2305.1.3).
- ❑ Positive shear panel connections provided (2305.1.4).

❑ Exception met permitting wood assembly to resist horizontal seismic forces from masonry.

❑ Deflection is considered in wood diaphragm designs (2305.2).

❑ Shear panel construction

Diaphragm aspect ratio (length to width) of horizontal or sloped diaphragm is ____ (Table 2305.2.3).

Diaphragm aspect ratio (length to width) of shear wall diaphragm is ____ (Table 2305.3.3).

- ❑ Shear wall width (2305.3.5) is measured between overturning restraints (2305.3.6) in load path.
- ❑ Shear wall openings clearly show force transfer around openings (2305.3.7.1) or not (2305.3.7.2).
- ❑ Summing of shear capacities has been limited per section 2305.3.8 (or an exception specified).
- ❑ Using Load and Resistance Factor design in accordance with ASCE 16? (2307)

Section 2306 Allowable Stress Design special provisions are as follows:

- ❑ Table 2306.2.1 values were substituted for 1.15 repetitive member factor for 16"o.c. 2x studs.
- ❑ Shear capacities of Table 2306.3.1 may be increased by 40% in wind design only (2306.3.1).
- ❑ Panel sheathing joints in shear walls shall occur over studs or blocking (2306.4).
- ❑ Shear capacities of Table 2306.4.1 may be increased by 40% in wind design only (2306.4.1).
- ❑ Particleboard shear walls attachment and allowable values designed per Table 2306.4.3.
- ❑ Fiberboard shear walls attachment and allowable values designed per Table 2308.9.3(4).
- ❑ Gypsum board or lath & plaster shear wall design values per Table 2306.4.5 (& Chapter 25 construction).