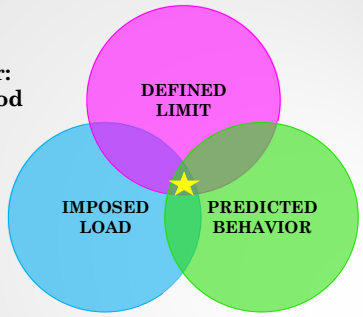
Serviceability for the Practicing Engineer

Emily Guglielmo, SE

1

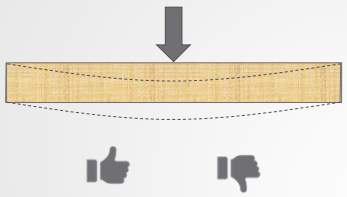
Topics:

1. **Imposed loads**
2. **Predicted behavior: steel, concrete, wood**
3. **Acceptable limits**
4. **Serviceability and building codes**



2

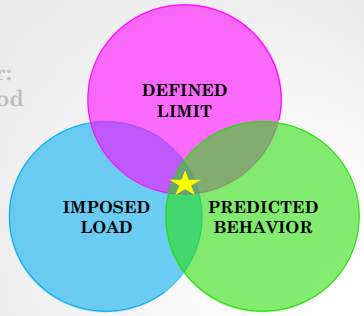
Serviceability



3

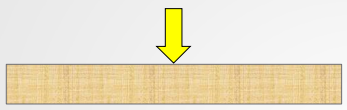
Topics:

1. **Imposed loads**
2. Predicted behavior: steel, concrete, wood
3. Acceptable limits
4. Serviceability and building codes



4

Imposed Loads



5

Three Load Limit States

1. Ultimate Loads
2. Nominal Loads
3. Service Loads

6

Three Load Limit States: Ultimate Loads

- Utilized for strength design in the IBC/ ASCE 7.
- Intended to be maximum loads imposed on the structure during its life.

$1.4(D + F)$ **(Equation 16-1)**

$1.2(D + F) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$ **(Equation 16-2)**

$1.2(D + F) + 1.6(L_r \text{ or } S \text{ or } R) + 1.6H + (f_1 L \text{ or } 0.5W)$ **(Equation 16-3)**

$1.2(D + F) + 1.0W + f_1 L + 1.6H + 0.5(L_r \text{ or } S \text{ or } R)$ **(Equation 16-4)**

$1.2(D + F) + 1.0E + f_1 L + 1.6H + f_2 S$ **(Equation 16-5)**

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Three Load Limit States: Nominal Loads

Loads specified in Chapter 16 (except wind and seismic)

- Live loads: Panel of experts
- Snow loads: 50-year mean recurrence interval
- Rain loads: Amount of rainwater retained if the primary drainage system fails

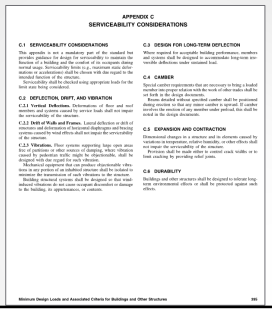
TABLE 1607.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS[a]

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)
1. Apartments (see residential)	—	—
2. Access floor systems Office use Computer use	50 100	2,000 2,000
3. Armories and drill rooms	150[e]	—
4. Assembly areas Fixed seats (fastened to floor) Follow spot, projections and control rooms Lobbies Movable seats Stage floors Platforms (assembly) Other assembly areas	60[m] 50 100[e] 100[e] 150[e] 100[e] 100[e]	—
5. Balconies and decks[k]	1.5 times the live load for the area served, not required to exceed 100	—
6. Catwalks	40	300
7. Cornices	60	—

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Three Load Limit States: Service Loads

- Service loads = loads at an arbitrary point in time
- Not defined or used in IBC.
- See ASCE 7, Appendix C Commentary



APPENDIX C
SERVICEABILITY CONSIDERATIONS

C.1 SERVICEABILITY CONSIDERATIONS

This appendix is not a mandatory part of the standard but provides guidance for design for serviceability to maintain the function of a building and the comfort of its occupants during normal use. Serviceability limit states, vibration, and wind oscillation or accelerations shall be chosen with due regard to the intended function of the structure.

Serviceability shall be checked using appropriate loads for the limit state being considered.

C.2 DEFLECTION, DRIFT, AND VIBRATION

C.2.1 Vertical Deflections. Deformations of floor and roof members and systems caused by service loads shall not impair the serviceability of the structure.

C.2.2 Drift of Walls and Frames. Lateral deflection or drift of structures and deformations of horizontal diaphragms and bracing systems caused by wind effects shall not impair the serviceability of the structure.

C.2.3 Vibrations. Floor systems supporting large open areas free of partitions, and which are sensitive to vibrations caused by pedestrian traffic might be objectionable, shall be designed with due regard for such vibrations.

Mechanical equipment that may produce objectionable vibrations in any portion of an inhabited structure shall be isolated to minimize the transmission of such vibrations to the structure. Building structural systems shall be designed so that inadvertent vibrations will not cause occupant discomfort or damage to the building, its appurtenances, or contents.

C.3 DESIGN FOR LONG-TERM DEFLECTION

Where required for acceptable building performance, members and systems shall be designed to accommodate long-time service deflections under sustained load.

C.4 CAMBER

Special camber requirements that are necessary to bring a loaded member into proper relation with the work of other trades shall be noted on the design documents.

Beams detailed without specified camber shall be positioned during erection so that any camber is upward. If camber involves the erection of any member under preload, this shall be noted on the design documents.

C.5 EXPANSION AND CONTRACTION

Dimensional changes in a structure and in elements caused by variations in temperature, relative humidity, or other effects shall not impair the serviceability of the structure.

Provisions shall be made either to control crack widths or to limit cracking by providing relief joints.

C.6 DURABILITY

Buildings and other structures shall be designed to tolerate long-term environmental effects or shall be protected against such effects.

Minimum Design Loads and Associated Criteria for Buildings and Other Structures 391

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Three Load Limit States: Comparison

Ultimate	Nominal	Service
Small Probability of Being Exceeded in **50 Years**	Small Probability of Being Exceeded in **1 Year**	Loads Acting at an **Arbitrary Point in Time**

10

Vertical Loads: Dead, Live, Snow

- For serviceability short-term effects, recommended load combinations:

$$D + L$$

$$D + 0.5S$$

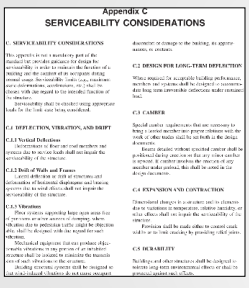
- For serviceability involving creep, settlement, or long-term effects, recommended load combination:

$$D + 0.5L$$

Dead Load "D" may be portion of dead load that occurs after attachment of nonstructural elements.

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Horizontal Loads: Wind



Appendix C
SERVICEABILITY CONSIDERATIONS

C. SERVICEABILITY CONSIDERATIONS

This appendix is not a mandatory part of the standard but provides guidance for design for serviceability to maintain the function of a building, the comfort of its occupants during normal use, the durability, limit state, resistance to wind oscillations, acceleration, etc.) that be chosen with due regard to the intended function of its structure.

Serviceability shall be checked using appropriate loads for the limit state being considered.

C.1 DEFLECTION, VIBRATION, AND DRIFT

C.1.1 Vertical Deflections

Deformations of floor and roof members and systems due to service loads shall not impair the serviceability of the structure.

C.1.2 Drift of Walls and Frames

Lateral deflection or drift of structures and deformations of horizontal diaphragms and bracing systems due to wind effects shall not impair the serviceability of the structure.

C.1.3 Vibrations

Floor systems supporting large open areas free of partitions or with moveable partitions, and which are sensitive to pedestrian traffic might be objectionable, shall be designed with due regard for such vibrations.

Mechanical equipment that may produce objectionable vibrations in any portion of an inhabited structure shall be isolated to minimize the transmission of such vibrations to the structure. Building structural systems shall be designed so that inadvertent vibrations will not cause occupant discomfort or damage to the building, its appurtenances, or contents.

C.2 DESIGN FOR LONG-TERM DEFLECTION

Where required for acceptable building performance, members and systems shall be designed to accommodate long-time service deflections under sustained load.

C.3 CAMBER

Special camber requirements that are necessary to bring a loaded members into proper relations with the work of other trades shall be noted on the design documents.

Beams detailed without specified camber shall be positioned during erection so that any camber is upward. If camber involves the erection of any member under preload, this shall be noted on the design documents.

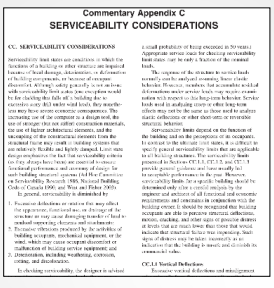
C.4 EXPANSION AND CONTRACTION

Dimensional changes in a structure and in elements caused by variations in temperature, relative humidity, or other effects shall not impair the serviceability of the structure.

Provision shall be made either to control crack widths or to limit cracking by providing relief joints.

C.5 DURABILITY

Buildings and other structures shall be designed to tolerate long-term environmental effects or shall be protected against such effects.



Commentary Appendix C
SERVICEABILITY CONSIDERATIONS

CC. SERVICEABILITY CONSIDERATIONS

Serviceability limit states are conditions in which the functions of a building or other structure are impaired because of local damage, deterioration, or deformation of building components, or because of occupant discomfort. All design safety is not an issue with serviceability limit states you can allow would be for checking that falls off a building due to excessive sway and under wind loads, they nonetheless may have severe economic consequences. The increasing use of the computer in a design tool, the use of stronger but not softer construction materials, the use of lighter architectural elements, and the reduction in the mass of buildings all have the intended result may create a building system that are relatively flexible and lightly damped. Lower state design requirements the fact that no serviceability criteria for long design have been are essential to ensure functional performance and economy of design for such building structural systems (Ad Hoc Committee on Serviceability Research 1986, National Building Code of Canada 1990, and West and Fisher 1993).

In general, serviceability is dominated by:

1. Excessive deflections or rotation that may affect the appearance, functional use, or drainage of the structure or may cause damaging transfer of load to nonload-supporting elements and attachments.
2. Excessive vibrations produced by the activities of building occupants, mechanical equipment, or the wind, which may cause occupant discomfort or which may interfere with the proper operation of sensitive equipment.
3. Deterioration, including weathering, corrosion, rotting, and disintegration.

In checking serviceability, the designer is advised to select long-term environmental effects so that its appearance, durability, and good performance will be maintained for the intended life of the structure with little or no unforeseen maintenance. Also, the designer is advised to select a small probability of being exceeded in 50 years as appropriate service limit for checking serviceability limit states can be only a fraction of the ultimate loads.

The response of the structure to service loads normally can be analyzed assuming linear elastic behavior. However, members that accumulate a risk of deformations under service loads may require examination with respect to the long-term behavior. Service loads used in analyzing creep or other long-term effects may not be the same as those used for analyses of static deflections or other short-term or reversible structural behavior.

Serviceability limits depend on the function of the structure and the perception of its occupants. In contrast to the ultimate limit states, it is difficult to specify general serviceability limits that are applicable to all building structures. The serviceability limits presented in Sections CC.1.1, CC.1.2, and CC.1.3 provide general guidance and may usually be in acceptable performance in the past. However, serviceability limits for a specific building should be determined only after careful analysis by the engineer and architect of all functional and economic requirements and constraints in connection with the owner or other future occupants. Most building occupants are able to perceive structural deflections, motion, cracking, and other signs of excessive distress at levels that are much lower than those that would indicate that structural failure was imminent. Such signs of distress may be taken incorrectly as an indication that the building is unsafe and evidence its commercial value.

CC.1.1 Vertical Deflections

Excessive vertical deflections and misalignment

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Horizontal Loads: Wind

Use of the nominal (700-year mean recurrence interval (MRI) or 1,700-year MRI) wind load in checking serviceability is excessively conservative. The following load combination, derived similarly to Eqs. CC-1a and CC-1b, can be used to check short-term effects:

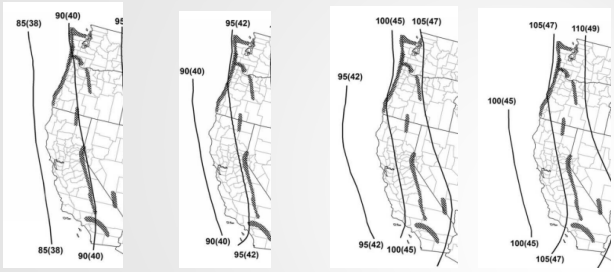
$$D + 0.5L + W_s \quad \text{(CC-3)}$$

in which W_s is wind load based on serviceability wind speeds in Figs. CC-1 through CC-4. Some designers have used a 10-year MRI (annual probability of 0.1) for checking drift under wind loads for typical buildings (Griffis 1993), whereas others have used a 50-year MRI (annual probability of 0.02) or a 100-year MRI (annual probability of 0.01) for more drift-sensitive buildings. The selection of the MRI for serviceability evaluation is a matter of engineering judgment that should be exercised in consultation with the building client.

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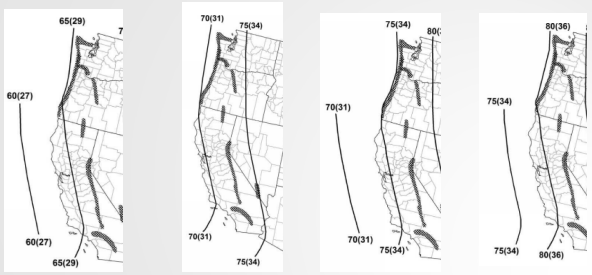
Horizontal Loads: Wind

Risk Category I — 300-year return period
Risk Category II — 700-year return period
Risk Category III — 1,700-year return period
Risk Category IV — 3,000-year return period



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Horizontal Loads: Wind



10-year return period | 25-year return period | 50-year return period | 100-year return period

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Horizontal Loads: Wind

TABLE 1604.3
DEFLECTION LIMITS[a, b, c, h, i, j]

CONSTRUCTION	L	L_r or W^e	$D + L^{d,g}$
Roof members[f]			
Supporting plaster or stucco ceiling	*l*/360	*l*/360	*l*/240
Supporting nonplaster ceiling	*l*/240	*l*/240	*l*/180
Not supporting ceiling	*l*/180	*l*/180	*l*/120
Floor members	*l*/360	—	*l*/240
Exterior walls:			
With plaster or stucco finishes	—	*h*/360	—
With other brittle finishes	—	*h*/240	—
With flexible finishes	—	*h*/120	—
Interior partitions[k]			
With plaster or stucco finishes	*h*/360	—	—
With other brittle finishes	*h*/240	—	—
With flexible finishes	*h*/120	—	—
Farm buildings	—	—	*l*/180
Greenhouses	—	—	*l*/120

For SI: 1 foot = 304.8 mm.

a. For structural roofing and siding made of formed metal sheets, the total load deflection shall not exceed *l*/60. For secondary roof structural members supporting formed metal roofing, the live load deflection shall not exceed *l*/150. For secondary wall members supporting formed metal siding, the design wind load deflection shall not exceed *l*/90. For roofs, this exception only applies when the metal sheets have no roof covering.

b. Flexible, folding and portable partitions are not governed by the provisions of this section. The deflection criterion for interior partitions is based on the horizontal load defined in Section 1607.14.

c. See Section 2403 for glass supports.

d. The deflection limit for the *D* + *L* load combination only applies to the deflection due to the creep component of long-term dead load deflection plus the short-term live load deflection. For wood structural members that are dry at time of installation and used under dry conditions in accordance with the AWC NDS, the creep component of the long-term deflection shall be permitted to be estimated as the immediate dead load deflection resulting from 0.5*D*. For wood structural members at all other moisture conditions, the creep component of the long-term deflection is permitted to be estimated as the immediate dead load deflection resulting from *D*. The value of 0.5*D* shall not be used in combination with AWC NDS provisions for long-term loading.

e. The above deflections do not ensure against ponding. Roofs that do not have sufficient slope or camber to ensure adequate drainage shall be investigated for ponding. See Section 1611 for rain and ponding requirements and Section 1503.4 for roof drainage requirements.

f. The wind load is permitted to be taken as 0.42 times the "component and cladding" loads for the purpose of determining deflection limits herein. Where manufacturer-supported glass is in accordance with Section 2403 using the deflection limit therein, the wind load shall be no less than 0.6 times the "component and cladding" loads for the purpose of determining deflection limits herein.

g. For steel structural members, the dead load shall be taken as zero.

h. For aluminum structural members or aluminum panels used in skylights and sloped glazing framing, roofs or walls of sunroom additions or patio covers not supporting edge of glass or aluminum sandwich panels, the total load deflection shall not exceed *L*/90. For continuous aluminum structural members supporting edge of glass, the total load deflection shall not exceed *l*/175 for each glass line or *l*/90 for the entire length of the member, whichever is more stringent. For aluminum sandwich panels used in roofs or walls of sunroom additions or patio covers, the total load deflection shall not exceed *l*/120.

i. For cantilever members, *l* shall be taken as twice the length of the cantilever.

"Wind load 0.42 C&C for deflection"

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Horizontal Loads: Wind

115 mph, Exposure C, Ht= 80 ft, Risk Category II, Zone 4

ASCE 7 x 0.42
$p = p_{table}(EAF)(RF)K_{zt} = (0.97)(37.5psf) = 36.4$ psf

W=.42x36.4=15.3 psf

Serviceability Maps:
10-year: 36.4 psf (76/115)^2= 15.9 psf
25-year: 36.4 psf (84/115)^2= 19.4 psf
50-year: 36.4 psf (90/115)^2= 22.3 psf
100-year: 36.4 psf (96/115)^2= 25.4 psf

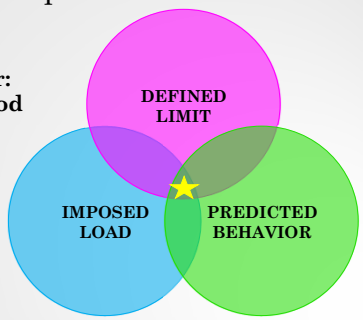




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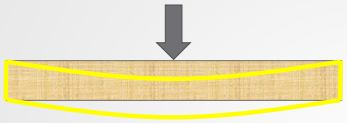
Topics:

1. Imposed loads
2. **Predicted behavior: steel, concrete, wood**
3. Acceptable limits
4. Serviceability and building codes



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Predicted Behavior



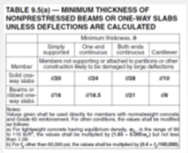
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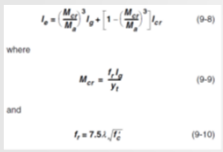
Concrete: Immediate Deflections

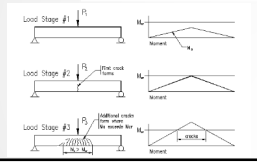
Two Options (One-Way, Non-Prestressed):

1) Minimum thickness from table

2) Calculate deflections per equations.





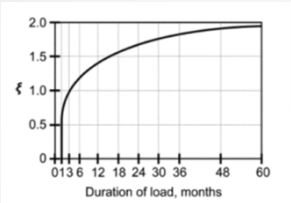


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Concrete: Creep and Shrinkage

- Time Effects: Creep and shrinkage

$$\lambda_\Delta = \frac{\xi}{1 + 50\rho'}$$



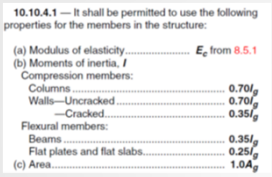
21

21

Concrete: Lateral Drift

Problem: "EI" for strength design assume cracked sections

- Very conservative for wind drift



10.10.4.1 — It shall be permitted to use the following properties for the members in the structure:

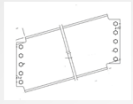
(a) Modulus of elasticity	E_c from 8.5.1
(b) Moments of inertia, I	
Compression members:	
Columns	$0.70I_g$
Walls—Uncracked	$0.70I_g$
—Cracked	$0.35I_g$
Flexural members:	
Beams	$0.35I_g$
Flat plates and flat slabs	$0.25I_g$
(c) Area	$1.0A_g$

- Unless a more accurate estimate of the degree of cracking at service load level is available, it is satisfactory to use I= 1.43I_{cr}.

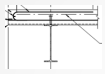
22

Steel

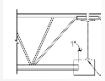
- Rolled structural steel



- Composite steel



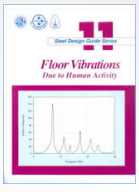
- Open-web joists



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Steel: Non-Composite

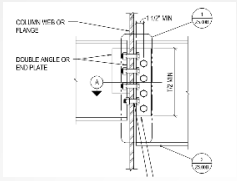
- Deflection
- Vibration
- No significant time effects
- Assumed to act elastically at service level



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Steel: Connections

- At *ultimate* level:
  - Bolted connections behave as pinned.
- At *service* levels:
  - Bolted connections in WF framing provide restraint to reduce deflections up to 80% of a pin-connection.



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Steel: Composite

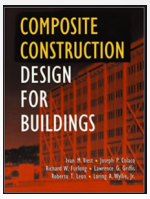


- Like non-composite design
  - Camber: Counteract deflections due to self-weight of structure
- AISC 360 Section L.3: "additional deflections due to shrinkage and creep of the concrete should be considered."
- AISC 360 Commentary L3.2: "in the US shrinkage and creep of the concrete flange is generally not considered."

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Steel: Composite

- Long-term deflection due to shrinkage significant?
  - L/1200 to L/1000
- Simplified method to predict additional deflection due to beam shrinkage by modeling shrinkage strain as a compressive force in the slab.
- Suggestion: Long-term deflections due to creep/ shrinkage are usually small and can be ignored.
  - Consideration for long spans, high sustained loads, high composite action.

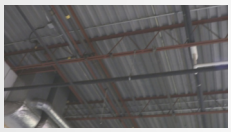


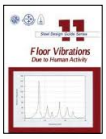
27

Steel: Open Web Joists

- Vibration: High stiffness to mass ratio
  - See SJI, AISC references
- Deflection
  - Connection flexibility: Pinned
  - Camber



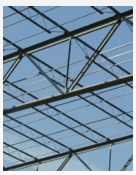




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Steel: Open Web Joists

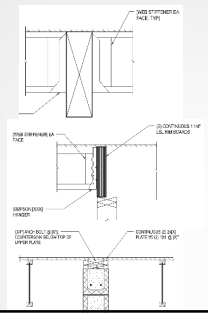
- Supplied with standard camber unless otherwise specified.
- Camber is related to the dead load deflections based on the capacity of the joist.
  - Uniform depth joists?
  - Heavy live loads?



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Steel: Wood

- Natural Wood
- Engineered Wood
- Compatibility of Wood with Other Systems



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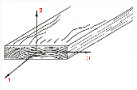
Steel: Natural Wood

- Wood is not isotropic and not stable over time
  - Shrinkage, creep depend on moisture content and drying of material
    - Typical creep ~ equal to initial deflection
  - NDS increase short term deflections to account for creep

$$\Delta_t = K_{cr}\Delta_{LT} + \Delta_{ST}$$

– 1.5 for seasoned lumber, structural glued laminated timber, prefabricated wood I-joists, or structural composite lumber used in dry service conditions as defined in 4.1.4, 5.1.5, 7.1.4, and 8.1.4, respectively.

– 2.0 for unseasoned lumber or for seasoned lumber used in wet service conditions as defined in 4.1.4.



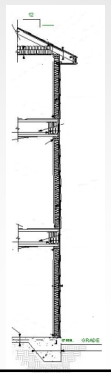
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Steel: Natural Wood

- IBC 2304.3.3: Prescriptive requirements to limit differential shrinkage.

2304.3.3 Shrinkage. Wood walls and bearing partitions shall not support more than two floors and a roof unless an analysis satisfactory to the *building official* shows that shrinkage of the wood framing will not have adverse effects on the structure or any plumbing, electrical or mechanical systems, or other equipment installed therein due to excessive shrinkage or differential movements caused by shrinkage. The analysis shall also show that the roof drainage system and the foregoing systems or equipment will not be adversely affected or, as an alternate, such systems shall be designed to accommodate the differential shrinkage or movements.



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Steel: Natural Wood

- Wood Trusses: Time dependent effect- "set".
  - Experience, engineering judgment



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Steel: Engineered Wood

- Glulams, parallams, LVLs, plywood, I-joists, composite lumber, wood panels.



Serviceability design: See product data along with engineering judgment.

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Steel: Compatibility of Wood and Other Systems

1. Wood floor/ roof in parallel with steel.
2. Load bearing wood walls adjacent to CMU/ concrete walls.
3. Load bearing wood walls adjacent to steel columns.
4. Adjacent wood walls of varying height due to basement walls.



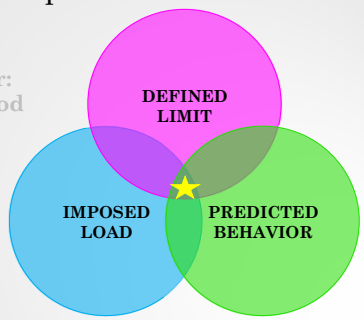


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Topics:

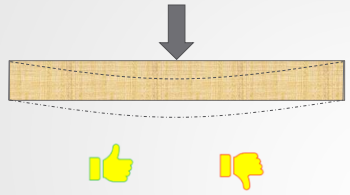
1. Imposed loads
2. Predicted behavior: steel, concrete, wood
3. **Acceptable limits**
4. Serviceability and building codes



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Acceptable Limit



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Acceptable Limits

1. Short Term:
   - Vertical Deflections
   - Drift of Walls and Frames
   - Vibrations
2. Long-Term Deflections
3. Expansion and Contraction
4. Durability

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Acceptable Limits: Vertical Deflections

IBC Table 1604.3:
Limits deflection based on the type of structure, detailing, and intended use.



General:
D+L → L/240
L → L/360

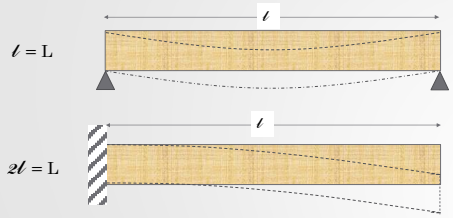
TABLE 1604.3
DEFLECTION LIMITS[a, b, c, h]

CONSTRUCTION	L or L_r	S or W[f]	D + L[d, e]
Roof members:[g]			
Supporting plaster or stucco ceiling	*l*/360	*l*/360	*l*/240
Supporting nonplaster ceiling	*l*/240	*l*/240	*l*/180
Not supporting ceiling	*l*/180	*l*/180	*l*/120
Floor members	*l*/360	—	*l*/240
Exterior walls:			
With plaster or stucco finishes		*l*/360	
With other brittle finishes	—	*l*/240	—
With flexible finishes		*l*/120	
Interior partitions:[i]			
With plaster or stucco finishes	*l*/360	—	—
With other brittle finishes	*l*/240	—	—
With flexible finishes	*l*/120	—	—
Farm buildings			*l*/180
Greenhouses	—	—	*l*/120

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Acceptable Limits:

What is 'L':
Limits are based on curvature when evaluating out-of-plane movements.



ℓ = Length of the member between supports. For cantilever members, *l* shall be taken as twice the length of the cantilever.

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Acceptable Limits: Vertical Deflections

D+L: L/240

CONSTRUCTION	D + L[d, e]
Roof members:[g]	
Supporting plaster or stucco ceiling	*l*/240
Supporting nonplaster ceiling	*l*/180
Not supporting ceiling	*l*/120
Floor members	*l*/240
Exterior walls:	
With plaster or stucco finishes	
With other brittle finishes	—
With flexible finishes	
Interior partitions:[i]	
With plaster or stucco finishes	—
With other brittle finishes	—
With flexible finishes	—
Farm buildings	*l*/180
Greenhouses	*l*/120



Except:

Specific finishes may require alternate criteria:
Members supporting marble, granite or ceramic
→ L/720 guidelines (verify with manufacturer)
Metal roofing
→ L/60 (footnote 'a')

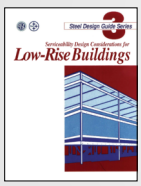


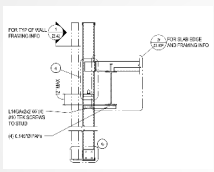
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Acceptable Limits: Vertical Deflections

D+L: L/240

AISC design guide 3: More restrictive limits to mitigate non-structural damage to partitions, window frames.
- Partitions butting into perimeter walls
- Spandrel panels supported by floor framing





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Acceptable Limits: Vertical Deflections

D+L: L/240

L/480 for concrete floors supporting brittle non-structural elements.

TABLE 9.5(b) — MAXIMUM PERMISSIBLE COMPUTED DEFLECTIONS

Type of member	Deflection to be considered	Deflection limitation
Flat roofs not supporting or attached to nonstructural elements likely to be damaged by large deflections	Immediate deflection due to live load L	$\ell/180^a$
Floors not supporting or attached to nonstructural elements likely to be damaged by large deflections	Immediate deflection due to live load L	$\ell/360$
Roof or floor construction supporting or attached to nonstructural elements likely to be damaged by large deflections	That part of the total deflection occurring after attachment of nonstructural elements (sum of the long-term deflection due to all sustained loads and the immediate deflection due to any additional live load)[b]	$\ell/480^{c,d}$
Roof or floor construction supporting or attached to nonstructural elements not likely to be damaged by large deflections		$\ell/240^{b}$

[a]Limit not intended to safeguard against ponding. Ponding should be checked by suitable calculations of deflection, including added deflections due to ponded water, and considering long-term effects of all sustained loads, camber, construction tolerances, and reliability of provisions for drainage.
[b]Long-term deflection shall be determined in accordance with 9.5.2.5 or 9.5.4.3, but may be reduced by amount of deflection calculated to occur before attachment of nonstructural elements. This amount shall be determined on basis of accepted engineering data relating to time-deflection characteristics of members similar to those being considered.
[c]Limit may be exceeded if adequate measures are taken to prevent damage to supported or attached elements.
[d]Limit shall not be greater than tolerance provided for nonstructural elements. Limit may be exceeded if camber is provided so that total deflection minus camber does not exceed limit.

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Acceptable Limits: Vertical Deflections

L: L/360 Except

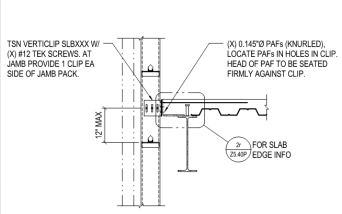
- Supporting plaster, stucco ceiling
  → L/360
- Supporting other ceilings (suspended ceilings)
  → L/240
- No ceiling
  → L/180 for typical roofing
  → L/150 for metal roofing (footnote 'a')
- Concrete roofs with brittle non-structural elements
  → L/480

CONSTRUCTION	L or L_r
Roof members:[a]	
Supporting plaster or stucco ceiling	$l/360$
Supporting nonplaster ceiling	$l/240$
Not supporting ceiling	$l/180$
Floor members	$l/360$
Exterior walls:	
With plaster or stucco finishes	
With other brittle finishes	—
With flexible finishes	
Interior partitions:[a]	
With plaster or stucco finishes	$l/360$
With other brittle finishes	$l/540$
With flexible finishes	$l/120$
Farm buildings	
Greenhouses	—

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Acceptable Limits: Vertical Deflections

Spandrels with bypass exterior wall:
→ Live Load: L/360 but not more than 3/8"

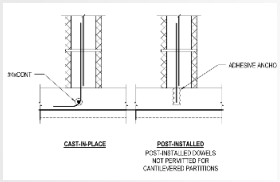


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Acceptable Limits: Vertical Deflections

L: L/360 Except

- Members supporting unreinforced masonry, brick or stucco:
  → L/600
  → Consider added control joints to capture cracks.
- Members supporting reinforced masonry can be relaxed.
  → L/600 is often still used to limit cracking.

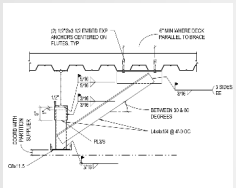


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Acceptable Limits: Vertical Deflections

L: L/360 Except

- Members supporting folding partitions should come from the partition manufacturer.





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Acceptable Limits: Vertical Deflections

L: L/360 Except

- Elevator sheave beams and members supporting sheave beams
  → L/1666
- Elevator rails supports
  → Maximum deflection of 1/8" (Laterally under horizontal rail load)

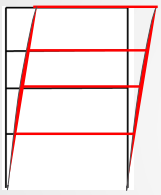




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Acceptable Limits: Drift

- Drift limits in common usage for building ~**1/600 to 1/400** of the *building* or *story* height.
- Absolute limit on *story drift* may be needed due to reduce damage (nonstructural partitions, cladding, and glazing) which may occur if the story drift > **3/8 in.**



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Acceptable Limits: Drift

- Members supporting anchored veneer
  → L/600 (BIA TEK note 28B).
  Do not reduce to 0.42W based on BIA recommendations
- Members supporting Portland cement or Gypsum Stucco
  → L/600
- Members supporting adhered veneer, synthetic (flexible) stucco/EFIS, gyp board and tile
  → L/360
- Members supporting metal wall panels
  → L/180

CONSTRUCTION	S or W[1]
Roof members:[2]	
Supporting plaster or stucco ceiling	*l*/360
Supporting nonplaster ceiling	*l*/240
Not supporting ceiling	*l*/180
Floor members	—
Exterior walls:	
With plaster or stucco finishes	*l*/360
With other brittle finishes	*l*/240
With flexible finishes	*l*/120
Interior partitions:[3]	
With plaster or stucco finishes	—
With other brittle finishes	—
With flexible finishes	—
Farm buildings	
Greenhouses	—

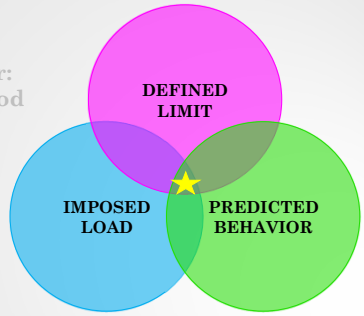




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Topics:

1. Imposed loads
2. Predicted behavior: steel, concrete, wood
3. Acceptable limits
4. **Serviceability and building codes**



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Poll:

Should the building code include a more thorough treatment of serviceability?



- Yes
- No

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"Why should the building code include a more thorough treatment of serviceability."

1
2
3
4

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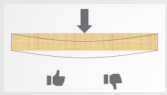
"Why should the building code NOT include a more thorough treatment of serviceability."

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Summary

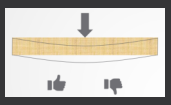
- Serviceability considerations vary by building type, construction material, client, usage, analysis method.
  - Discuss early with client, PM/ PIC
- Many of the serviceability requirements are in material standards and/or design guides.
- Serviceability is only partially addressed in the building code, and the direction of serviceability requirements in the code is evolving.



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Questions?

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