MAGNUSSON KLEMENCIC ASSOCIATES

Structural + Civil Engineers

Embodied Carbon Reduction

Floor Loading Assumptions – the Low Hanging Fruit

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TABLE 1607.1 MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o AND MINIMUM CONCENTRATED LIVE LOADS⁹

AND MINIMUM CONCEN			AND MINIMUM CONCENTR		
OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)	OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATE (pounds)
1. Apartments (see residential)	_	-	23. Penal institutions		
2. Access floor systems Office use	50	2,000	Cell blocks Corridors	40 100	_
Computer use	100	2,000			
3. Armories and drill rooms	150 ⁿ	_	24. Recreational uses:		
 Assembly areas Fixed seats (fastened to floor) 	60 ^m		Bowling alleys, poolrooms and similar uses Dance halls and ballrooms	75 ^m 100 ^m	
Follow spot, projections and control rooms Lobbies Movable seats Stage floors	50 100 ^m 100 ^m 150 ⁿ	-	Gymnasiums Ice skating rink Reviewing stands, grandstands and bleachers Roller skating rink	100 ^m 250 ⁿ 100 ^{c, m} 100 ^m	-
Platforms (assembly) Other assembly areas	100 ^m 100 ^m		Stadiums and arenas with fixed seats (fastened to floor)	60 ^{c, m}	
5. Balconies and decks ^h	1.5 times the live load for the area served, not required to exceed 100	_	25. Residential One- and two-family dwellings Uninhabitable attics without storagei	10	
6. Catwalks	40	300	Uninhabitable attics with storage ^{1,j,k}	20	
. Comices	60		Habitable attics and sleeping areas ^k Canopies, including marquees	30 20	
3. Corridors	00		All other areas	40	
First floor Other floors	100 Same as occupancy served except as indicated	_	Hotels and multifamily dwellings Private rooms and corridors serving them Public roomsm and corridors serving them	40 100	
9. Dining rooms and restaurants	100 ^m				
0. Dwellings (see residential)			26. Roofs All roof surfaces subject to main-		
 Elevator machine room and controlroom grating (on area of 2 inches by 2 inches) 	-	300	All root surfaces subject to main- tenance workers Awnings and canopies: Fabric construction supported by a	5"	300
 Finish light floor plate construction (on area of 1 inch by 1 inch) 	-	200	skeleton structure All other construction, except one-		
. Fire escapes On single-family dwellings only	100 40	-	and two-family dwellings Ordinary flat, pitched, and curved roofs (that are not occupiable)	20 20	
 Garages (passenger vehicles only) Trucks and buses 	40° See Sect	Note a tion 1607.7	Primary roof members exposed to a work floor		
5. Handrails, guards and grab bars	See Sec	tion 1607.8	Single panel point of lower chord of roof trusses or any point along		
6. Helipads	See Sec	tion 1607.6	primary structural members		
 Hospitals Corridors above first floor Operating rooms, laboratories 	80 60	1,000 1,000	supporting roofs over manufac- turing, storage warehouses, and repair garages		2,000
Patient rooms	40	1,000	All other primary roof members Occupiable roofs:		300
8. Hotels (see residential)	-	-	Roof gardens	100	
9. Libraries			Assembly areas	100 ^m	
Corridors above first floor Reading rooms	80 60	1,000 1,000	All other similar areas 27. Schools	Note 1	Note 1
Stack rooms	150 ^{b, n}	1,000	27. Schools Classrooms	40	1,000
0. Manufacturing Heavy Light	250 ⁿ 125 ⁿ	3,000 2,000	Corridors above first floor First-floor corridors	80 100	1,000 1,000
Light I. Marquees, except one- and two-family dwellings	75	-	 Scuttles, skylight ribs and accessible ceilings 	_	200
2. Office buildings Corridors above first floor	80	2,000	29. Sidewalks, vehicular driveways and yards, subject to trucking	250 ^{d, n}	8,000°
File and computer rooms shall be designed for heavier loads	-	-	30. Stairs and exits One- and two-family dwellings All other	40	300 ^f 300 ^f
based on anticipated occupancy Lobbies and first-floor corridors	100	2.000	An outer (continue		500

TABLE 1607.1—continued MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS⁹

TABLE - MINIMUM UNIFORMLY DIST AND MINIMUM CONCEN	RIBUTED LIVE		м	TABLE 1607.1— INIMUM UNIFORMLY DISTRI AND MINIMUM CONCENT	BUTED LIVE	LOADS, <i>L</i> ₀ , LOADS ⁹		
OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)		OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)		
1. Apartments (see residential)			23. Pen	al institutions				
2. Access floor systems				Il blocks	40			
Office use	50	2,000	Co	rridors	100			
Computer use	100	2,000	24 . D	reational uses:				
3. Armories and drill rooms	150 ⁿ	-		wling alleys, poolrooms and				
4. Assembly areas				similar uses	75 ^m			
Fixed seats (fastened to floor) Follow spot, projections and	60 ^m			nce halls and ballrooms	100 ^m			
control rooms	50			mnasiums skating rink	100 ^m 250 ⁿ			
Lobbies	100 ^m	-		ie in stindt, grandstende			•	L .
Movable seats	100 ^m			and bleachers	100 ^{-, m}			Т
Stage floors Platforms (assembly)	150 ⁿ 100 ^m			ller skating rink	100 ^m			- F
Other assembly areas	100 ^m			idiums and arenas with fixed seats (fastened to floor)	60 ^{c, m}			
				seats (fastened to floor)	00			
	1.5 times the live load for the		25. Res					
5. Balconies and decksh	area served, not	-		- and two-family dwellings				
	required to			ninhabitable attics without storagei	10			
	exceed 100			storagei ninhabitable attics with storage ^{i, j, k}	20			
6. Catwalks	40	300	H	abitable attics and sleeping areask	30			
7. Comices	60		Ci	anopies, including marquees	20			
8. Corridors				ll other areas	40			
First floor	100			els and multifamily dwellings ivate rooms and corridors				
Other floors	Same as occupancy			serving them	40			
	served except as		Pu	blic roomsm and corridors				
	indicated			serving them	100			
9. Dining rooms and restaurants	100 ^m		26. Roo	fe				
Dwellings (see residential)				roof surfaces subject to main-				
11. Elevator machine room and			ten	ance workers		300		
controlroom grating		300	Aw	nings and canopies:	5"		-	
(on area of 2 inches by 2 inches) 12. Finish light floor plate construction			Pa	bric construction supported by a skeleton structure	5		•	
(on area of 1 inch by 1 inch)	-	200		other construction, except one-				
13. Fire escapes	100			and two-family dwellings	20			
On single-family dwellings only	40			inary flat, pitched, and curved ofs (that are not occupiable)	20			
14. Garages (passenger vehicles only)	40°	Note a	Prin	nary roof members exposed to a	20			
Trucks and buses		tion 1607.7		work floor				
15. Handrails, guards and grab bars		tion 1607.8		igle panel point of lower chord				
16. Helipads		tion 1607.6		f roof trusses or any point along rimary structural members				
17. Hospitals	or see		SI	apporting roofs over manufac-				
Corridors above first floor	80	1,000	tı	iring, storage warehouses, and				
Operating rooms, laboratories	60	1,000		pair garages l other primary roof members		2,000		
Patient rooms	40	1,000		piable roofs:		300	× -	
Hotels (see residential)			Ro	of gardens	100		*****	
19. Libraries	80	1.000		sembly areas	100 ^m			
Corridors above first floor Reading rooms	80 60	1,000	AI	other similar areas	Note 1	Note 1		
Stack rooms	150 ^{0, n}	1,000	27. Sch					
20. Manufacturing				assrooms	40	1,000 1,000		
Heavy	250 ⁿ	3,000		rridors above first floor st-floor corridors	80 100	1,000		
Light	125 ⁿ	2,000		ttles, skylight rib, and accessible	100	,		
21. Marquees, except one- and	75	-	26. SCU	eilings	-	200		
22. Office buildings			20 Side	walks vehicular driveways and	250 ^{d.n}	0.0005	-	
Corridors above first floor	80	2,000		ards, subject to trucking	250	8,000°		
File and computer rooms shall be	-	_	30. Stai	rs and exits				
designed for heavier loads			On	e- and two-family dwellings	40	300 ^f		
based on anticipated occupancy Lobbies and first-floor corridors	100	2,000	AI	lother	100	300 ^f		
		2,000						

ontinuea)

 4. Assembly areas Fixed seats (fastened to floor) Follow spot, projections and	60^{m} 50 100^{m} 100^{m} 150^{n}	_
Stage floors	150 ⁿ	
Platforms (assembly) Other assembly areas	100 ^m 100 ^m	

m. Live load reduction is not permitted.

22. Office buildings							
Corridors above first floor	80	2,000					
File and computer rooms shall be	_	_					
designed for heavier loads							
based on anticipated occupancy							
Lobbies and first-floor corridors	100	2,000					
Offices	50	2,000					
(continued)							



MEETING ROOM CAPACITY 10 PEOPLE

11.3 PSF



FULL MEETING ROOM CAPACITY 23 PEOPLE

24.6 PSF



FULL STANDING CAPACITY 29 PEOPLE

29.2 PSF



29 PEOPLE OVER 96.8 SQUARE FEET

48.0 PSF



29 PEOPLE OVER 80.7 SQUARE FEET

58.5 PSF



29 PEOPLE OVER 72.6 SQUARE FEET

64.7 PSF

Minimising Energy in Construction		www.meicon.net
	Design occupancy for office building with 16 floors and 30,000m ² Calculations are approximate to illustrate variation between disciplin	
	Ventilation BSRIA Rules of Thumb Guidelines for Building Services 5th Edition, Table 3 10m ² per person = 3,000 people	3,000 people
	Space Planning BCO Specification for Offices, 2014	3,750 people
	High Density = 8m ² per person = 3,750 people Low Density = 13m ² per person = 2,308 people Fire Design	7,500 people
	BS 9999:2017 Table 9, Typical Office Floor Space Factors High Density = 4m ² per person = 7,500 people Low Density = 10m ² per person = 3,000 people	
	Structural Design BS EN 1990, BS EN 1991-1-1	85,500 people
	Ultimate Limit State, $\gamma_q = 1.5$ (partial factor for live load), $\alpha_n = 0.5$ (reduction factor >10 storeys) $q_k = 3kN/m^2$ over 95% of floor area (Typical value not including partitions or 5% more heavily loaded areas) Total load ($\gamma_q \alpha_n q_k$) = 64MN. Assuming each occupant = 0.75kN = 85,500 people <i>Without area reduction</i> α_n = 171,000 people Somicosphility Limit State, $w_n = 10$ (partial factor for live load), $\alpha_n = 0.5$ (reduction factor for multi starey)	
	Serviceability Limit State, $\gamma_{q} = 1.0$ (partial factor for live load), $\alpha_{n} = 0.5$ (reduction factor for multi-storey) Total load ($\gamma_{q}\alpha_{n}q_{k}A$) = 43MM. Assuming single occupant 0.75kN = 57,000 people Without area reduction α_{n} = 114,000 people	
CAMBRIDGE	BATH BATH	

Office Loading Design

		Π	W21x48 (16)		W21x48 (16)		1x48 (16)		8 (16)		3 (16)	W21x48 (16	»		A80x90]
[- W18x35 (11	+/C-0 (00) / CALIZAA	W18x65 (26) c=1-1/2"	W18x55 (26) c=1-1/2"	W18x65 (26) c=1-1/2"	W18x55 (26) c=1-1/2"	W18x55 (26) c=1-1/2"	W18x55 (26) C=1-1/2"	W18x55 (26) c=1-1/2"	M18x65 (26) c=1-1/2"	W18x55 (26) c=1-12"	W18x65 (26) c=1-1/2"	W18x46 (26) c=1-1/2"	W18x40 (18) c=1−1/2"	W18x40 (18) c=1-1/2"	W18x46 (20) c=1-1/2"	W21x83 (68)
			W30x148										2)H		\80x132		
W24x83 (70)			=1-=0 (91) <u>9</u> 2%81M ₩80×173	W18X35 (16) c=3/4"	W10x1@10W12x14 C1 W10x1@10W12x14 C1 W12x14	H <u>SS8x4x;5716</u> 20 4 H <u>SS8x4x;</u> 4 H <u>SS8x4x;</u> A	HSS8x4x57 00) ++ x1 	HSS8x4x516	HSS8x4x511 0 4 1 HSS8x4x511 1 HSS8x4x511 1		V21x48	WIBX/r6 (4)	(0 W18x35 (34) c=1"	W18x35 (16) c=3/4"	5000 11900	W18x35 (16) c=3/4"	W21x55 (26)
W21x83 (68)		711-1-20 (22) 05:00	W18x55 (26) c=1-1/2* 06	W18x55 (26) c=1-1/2"					.711	",71-1-15" № 198429 (56) 0=1-17", ₩211x48	",21			W18x40 (18) c=1-1/2"		W21x44 (58) c=3/4	W18x35 (10)

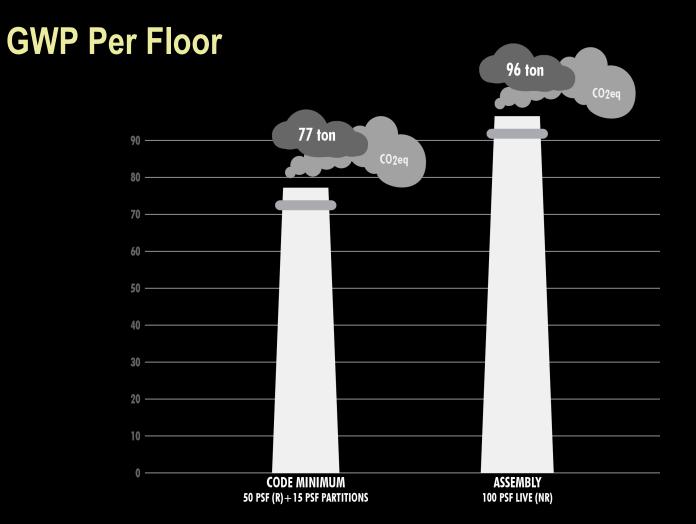
Assembly Loading Design

—	W21x48 (38)	W21x48 (38)	W21x48 (36)	W21x48 (36)	W21x48 (36)	W21x48 (38)	W30x124	1
(08) 111412(0) W18x35 (10)	W18x86 (42) c=34" W18x86 (42) c=34"	W18x86 (38) c=1* W18x76 (44) c=1*	W18x76 (44) c=1" W18x76 (44) c=1"	W18x76 (44) c=1" W18x76 (44) c=1"	W18x76 (44) c=1" W18x76 (44) c=1"	W18466 (38) c≖1* W18x60 (40) c=1-1/4*	W18x55 (26) c= 1° W18x55 (28) c= 1° W18x65 (40) c=1-1/4°	W21×101 (68)
_	W30x173	W18x35 (52)					W30x148	
W21x93 (60) W18x35 (54) c=1*	W18M0 (48) =1" W18X0 (48) =1" W18X35 (24) =3(4"	W10x1 (a) 10 W12x14 (6) W10x1 (b) 10 W10x14 (c) W10x14 (c) W10x12 (c) W10x12 (c) W10x12 (c) W10x35 (48)	8x4x5/16 HSS8x4x5/"HS 8x4x5/16 HSS8x4x5/"HS 8x4x5/16 HSS8x4x5/"HS	1x44 (21x44 21x48	(9) (9) (9) (9) (9) (9) (9) (9)	-w18k35 (16) c=3/4" W18k35 (16) c=3/4" W18k35 (24) c=3/4"	W21x83 (36)
W21x111 (124) W18x78 (34) c=1*	W18x86 (42) œ3\4" W18x86 (42) œ3\4"	W18x86 (38) c=1* W18x76 (44) c=1*	W18x78 (44) c=1° W18x76 (44) c=1°	W18x76 (44) c=1" W18x76 (44) c=1"	W18x76 (44) c=1* W18x76 (44) c=1*	W18×66 (38) œ1* W18×60 (40) œ1-14*	W18x55 (26) c=1* W18x55 (26) c=1* W21x83 (78)	W18x35 (10)
	W30x124	W21x48 (38)	W21x48 (36)	W21x48 (36)	W21x48 (36)	W21x48 (38)	W21x48 (56) c=1/2"	



Load Level	Tons per Floor	ΔTons per Floor	GWP per Floor	ΔGWP per Floor
Code Minimum 50psf Live (R) + 15psf Partitions	85 tons		77 ton CO2eq	
Assembly 100psf Live (NR)	106 tons	21 tons	96 ton CO2eq	19 ton CO2eg

GWP = Global Warming Potential R = Reducible NR = Non-reducible











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