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) |

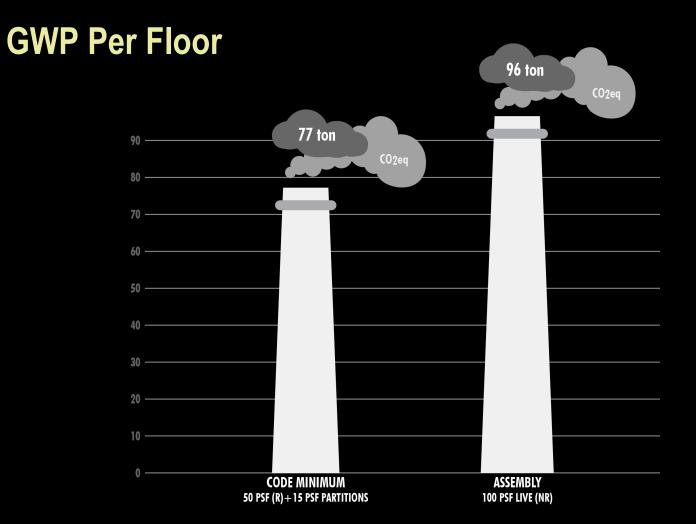
Assembly Loading Design

| — | 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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