Duration of Load Factor for Live Load

JAE (Structural) **(OP)** 7 Aug 17 16:30

(location = USA - IBC building code using the NDS wood specification)
So we've got an exterior wood framed deck that is adjacent to and serves a dining room in a commercial building.

Per code - dining room's live load = 100 psf. Per code, the deck "serves" the dining room so it's live load is 100 psf as well.

The design of the wood joists supporting the composite decking of this deck structure would typically use a duration of load factor of 1.0 for "live loads".

However, typical live loads, say in an office or residence, are usually somewhat sustained over time much more than a deck area serving a dining area.
We can imagine multiple uses of the deck over time where the actual live load would be on the order of 30 to 50 psf. However, for a 100 psf load application,
it seems that the duration of that type of load (large crowd of people gathered at an event) would be more like a snow load application - not occurring all that often or for all that much time.

Would it be appropriate to utilize the actual load duration curve from the NDS commentary and apply perhaps a Cd factor of 1.10 or 1.15 to this 100 psf live load?
And then perhaps look at Cd = 1.0 with a live load of 50 psf as well?

SlideRuleEra (Structural) 7 Aug 17 18:08

JAE - I consider your assumption to be reasonable on it's own. There may be an additional outside-the-box reason, too. (Based on memory) You could have used live load reduction for 100 lb/ft^2... but (assume) that is not the case. (Believe live load reduction is not allowed by ASCE 7 for **greater than** 100 lb/ft^2).
Would that approach be of more help, and just as valid, as a duration factor adjustment?

www.SlideRuleEra.net
www.VacuumTubeEra.net

msquared48 (Structural) 7 Aug 17 19:54

To play the devil's advocate here, I have always thought of "duration of load" as applicable to wind, seismic, and snow events, not parties, although I can see the logic here.

As a matter for further consideration, the first edition of the AITC, on page 3-8, agrees with Sliderule to a point, but goes further in stating that "...**except that no reduction should be made for areas to be occupied for public assembly**."

Although the same verbage is not in the 2012 NDS, I would tend to be conservative here and go with 1.0, knowing the damage parties can do to a structure. Maybe it's just my age here talking though...

Mike McCann, PE, SE (WA)

appot (Structural) 7 Aug 17 20:21

One additional thing to consider:

Some dining rooms have very heavy solid wood furniture such as a buffet or hutch filled with that fine china that you are not allowed to use. These items are usually against a wall, so they should not be contributing much to your bending or deflections. These loads do not leave after the party.

Triangled (Structural) 7 Aug 17 20:51

reminds of lunch in the cafe at the high end of the tram above Juneau AK sound in May on a beautiful afternoon. The interior dining area was pretty much empty, whereas all the tables on the

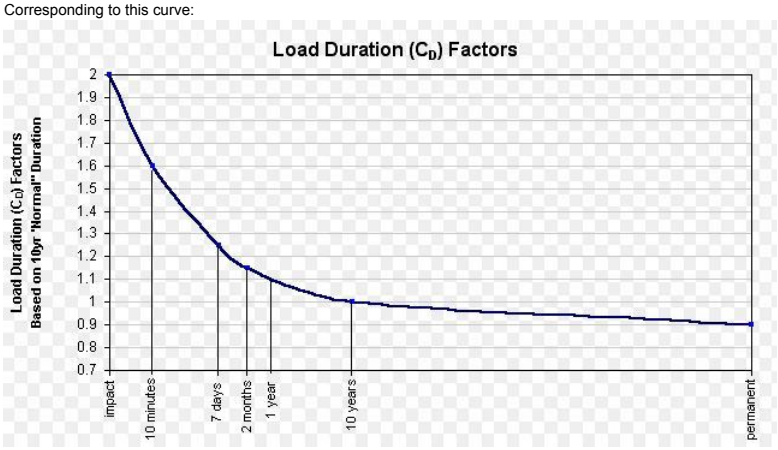
deck overlooking infinite were occupied and the places between were milling with people moving towards the handrails for photographs.

JAE (Structural) **(OP)** 7 Aug 17 22:58

Not interested in live load reduction as the tributary area for a single deck joist is small so LL reduction just isn't applicable here. (we're talking 2x10's @ some spacing)

Specifically the duration of load for wood for live load per the NDS.
They specifically show:
combinations with Dead only - Cd = 0.9
Combinations with Live load - Cd = 1.0
Combinations with Snow - Cd = 1.15
Combinations with wind/seismic - Cd = 1.6

Corresponding to this curve:



For an exterior deck of about 12 ft. x 20 ft. - it must be designed for LL = 100 psf.
I get that - no problem.

But for the actual wood joist design we just don't see how a Cd = 1.0 (for live load per the commentary in NDS) applies.
Just seems like Cd = 1.15 would be more in line with the "large party of people" duration.

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msquared48 (Structural) 8 Aug 17 00:51

JAE... You can split hairs here, but a 1.15 factor is an LLR in my book even though dead load is included in the factor.

Mike McCann, PE, SE (WA)

racookpe1978 (Nuclear) 8 Aug 17 02:13

Well, depending on the roof cover/awning involved, even the threat of of any presence of snow and rain/wind "nature" live loads outside on the deck will cause the "people" live loads to go inside.
If there is no overhead rainproof cover, I would not expect both live loads to occur at the same time.

JAE (Structural) **(OP)** 8 Aug 17 02:22

Mike
Not splitting hairs.
LLR is based on statistical aspects of the variability of the live load vs area served.
Duration of load factor is NOT based on statistics but on the unique ability of wood to resist sustained loads vs short term loads.

One is a load variability thing and the other is a material property thing.

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Triangled (Structural) 8 Aug 17 04:33

interesting, is it a parallel argument that my 100 psf exit corridor serving my 50 psf office floor is only briefly so loaded?

JAE (Structural) **(OP)** 8 Aug 17 04:38

That's the sense I get when I think about it but haven't been able to find any commentary on it.

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Triangled (Structural) 8 Aug 17 12:58

kinda like m^2 I think is thinking, I've never considered mixing the two, that is LL and C_D. at a gut level it doesn't feel right, as though mixing apples and oranges, the one being probabilities and the other being materials science. but I cannot quote research chapter and verse at present. I suppose one could argue that essentially all live loads, excepting perhaps light/heavy storage etcetera, are impermanent and therefore some sort of C_D tempts. but I've never seen a text or code invite this consideration.

Ron (Structural) 10 Aug 17 13:39

JAE....your logic is reasonable. NDS commentary notes a 10 minute load duration factor of 1.6 and a one-day load duration factor of 1.33. Your 1.15 is reasonable, maybe up to 1.25. If the deck is elevated I'd be conservative. If lower than 30 inches above grade (18 inches in some jurisdictions), even guardrails may not be required....implying that the risk of injury to people is low for low decks.

SlideRuleEra (Structural) 10 Aug 17 15:01

How about getting to the same result by reducing (but not eliminate) the number of assumptions to get there. Two defined loads, totaling 100 PSF, that can occur simultaneously:

1. Installed fixtures, such as outdoor tables, chairs, umbrellas, etc. Say, 40 PSF with C_D = 1.0

2. People. Say 60 PSF with C_D = 1.33

jdgengineer (Structural) 11 Aug 17 02:51

While I agree with the logic I think the intent for the code is to use a CD = 1.0. My understanding is that the live load for pretty much all uses is a worst case loading that the structure may only see once or twice in it's lifetime. Therefore, logically you should be able to use a CD greater than 1 for pretty much all live loading which is not how the code define the CD factor.

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Triangled (Structural) 11 Aug 17 18:27

although there may be some logic, it seems the concept is ruled out by NDS
TBL 2.3.2 references occupancy live load for CD=1.0
Commentary expressly addresses understanding that maximum human traffic loads "may be infrequent and of short duration"

Table 2.3.2 Frequently Used Load Duration Factors, C_D[1]

Load Duration	C_D	Typical Design Loads
Permanent	0.9	Dead Load
Ten years	1.0	Occupancy Live Load
Two months	1.15	Snow Load
Seven days	1.25	Construction Load
Ten minutes	1.6	Wind/Earthquake Load
Impact[2]	2.0	Impact Load

Table 2.3.2 Frequently Used Load Duration Factors, C_D

Permanent Loads. In addition to construction dead loads due to materials, foundation soil loads and concentrated loads from equipment designed as part of the structure should be considered long-term loads that will be applied continuously or cumulatively for more than ten years. Special continuous loadings related to the particular purpose or use of the structure, such as water loads in cooling towers or heavy machinery in industrial buildings, also may be associated with durations exceeding ten years.

Ten Year or Normal Loading. Loads traditionally characterized as normal are code specified floor loads, either uniform live or concentrated, which include furniture, furnishings, movable appliances and equipment, all types of storage loads, and all people loads. Although maximum human traffic loads may be infrequent and of short duration, such as those occurring on balconies, exterior walkways and stairways, this type of loading is considered normal loading.