California Energy Commission Dockets Office, MS-4
Re: Docket No. 14-BSTD-01
1516 Ninth Street Sacramento, CA 95814-5512

From:
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11/26/2014

Preface:

Included below is an itemized review of the November 3rd 2014 Pre-Rulemaking Draft Language. I've proceeded through the code and some of its associated support documents in a chronological order, and present my comments (and plaudits) in that order. Since I am writing on behalf of myself, I have presented my comments in a less formal tone. I hope this is generally to the reader's enjoyment, and acts as somewhat of a relief to the necessarily desiccated language of the draft standards and their collateral.

I will point out that like most consultants, I am oblivious to internal discussions and histories of most provisions of the drafted code, so I keep in mind that some of my points may not be very useful or aware of some specific legal or technical constraints. In other words, if my comments sound naïve or somehow impertinent, then I would hope that there is some opportunity in the future for us 'regulatees' to learn more about the CEC as a regulator.

As the aspirations of AB32 rattle down from aspirational speeches into specific policies and regulations, I would encourage an active educational and outreach program to engage (or further engage) stakeholders such as myself, in the process that Commissioners and Staff are forging forward with. I don't know what that would actually look like, but I know that when I understand the spirit of specific codes and standards, and the stories behind their evolution and compromise, I generally get much more buy-in from the professionals I work with. Most professionals want to do good quality work within their constraints, and I believe that the Commission needs stronger and more pervasive ambassadorship, either on your own behalf, or via trade groups and organizations which broadly share a vision of a better, more efficient future. In other words, help us help you help us.

Comments

- Section 110.3(c)7: Plumbing Isolation Valves
  - Great idea! I like it ☺
- Section 110.6 (a)1.
  - Pet Doors: YESS! This is something that has needed to be captured in the standards.
- Section 110.8 (g) Heated Slab Floors and definition of 'heated slab floor'

    - Just a point of clarification—between this section and the definition of "heated slab floor." It's not clear that this only applies to slab floors that separate conditioned and unconditioned space.
        - Situation #1: Heated Slab floor over conditioned crawlspace. The project is on a hillside where the crawlspace is installed per CRC 408 and is directly conditioned by the gypcrete topping slab floor above it. A very textualist reading of these provisions would consider this floor as a 'heated slab floor' and therefore require insulation in some way that isn't thermally meaningful (essentially between two conditioned spaces).
        - Situation #2: 2nd floor topping slab over conditioned space. Technically this is a 'heated slab floor' per the definition of one. But the requirements of insulation in this section clearly don't reflect this situation since there isn't a foundation wall or grade or footing anywhere nearby.
    - It seems the easiest way to deal with this is to just clarify that you mean that a heated slab floor to be between conditioned and ambient (which is clear in the definition of 'raised floor' or between conditioned and ground (which is fairly clear in the definition of slab-on-grade).
    - If you're trying to capture the slab-edge of a radiant slab (for example—a 3 story building with all heated raised floor slabs) then just add some language which specifies insulation that clearly captures that situation without reference the grade or foundation wall. That I would also like to see.
- Section 110.8 Heated Slab Floors <u>below grade</u> in Residential Compliance Manual
    - There used to be better details/drawings. Can we get those back? …because they're nice to send to architects to give them options.
    - The one option that they most commonly used that you didn't have was the 'bed of foam' topping slab: Pour a structural slab (on or below grade), and then lay an inch or two of foam, and lay the hydronic tubing and topping slab. The trick was the lip of foam at the edges where you had to try to get the architect to detail in at least ½" of foam 'formwork' at the edges which would add just enough insulation next to the bottom plate to equal R5 to the outside. ~R2.5 [1/2"EPS] + R3.5 (3.5" wood bottom plate) = R6.
- Section 150.0(c) 1 and 2: Mandatory insulation in framed walls
    - I think I get the gist of this, but it seems a step backward. If I were really aiming to avoid this mandatory minimum requirement, I suppose I would just use wall thickness of nominally different sizes—e.g. 2x3, 4x4, or 2x8. Or plenty of other examples of more 'exotic' wall systems.
    - It stills has to pass muster in the performance model, I suppose, so there's another fallback to really prevent dumb walls that are shirking through loopholes.
- Section 150.0(g) vapor retarders:
    - Just curious as to why it's apparently prudent to replicate the requirements of CRC here in Energy Code.

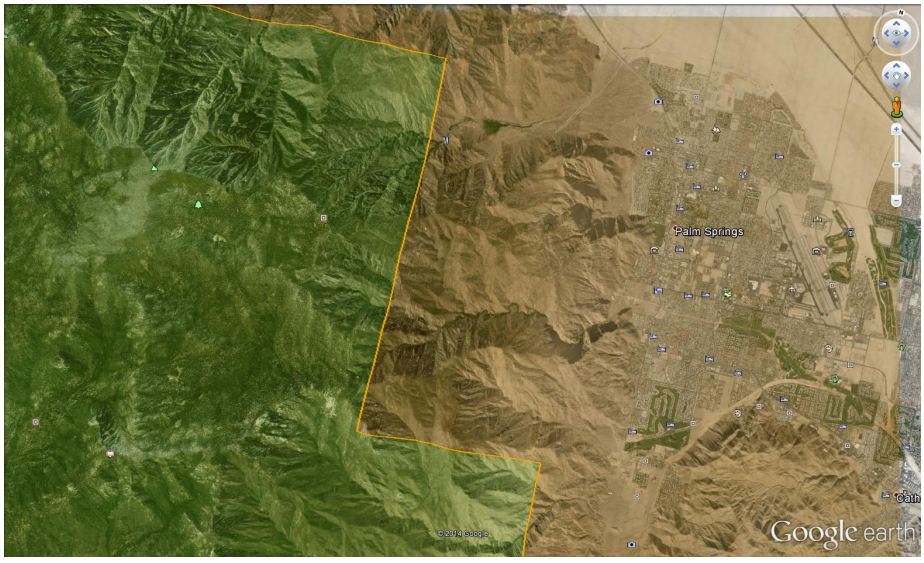
    - I didn't catch your previous error/incongruity with CRC 408/702.7 (etc.) until you corrected in this 2016 version. I appreciate that your quoting the direct requirements, (as opposed to just including another reference, which is pretty frustrating) but sometimes when you don't get it quite right and there's conflicts between part 6 and others parts, it's embarrassing for you and frustrating for us. Maybe you can include a cross-referencing link/note for your and our sakes? (I expect there's some official reason you don't do this)
- Section 150.0(k)3E—landscape lighting for single-family residences
    - You might notice that this section doesn't exist. And I'm proposing that it should.
    - I propose you extend high-efficacy requirements for outdoor 'mounted' fixtures into non-mounted landscape lighting.
    - Again, I expect there's some technicality to why you're not doing this, but I do plenty of energy audits where landscape lights that have nothing to do with safety are left on continuously. It's plausible that many jurisdictions don't require permitting for such items, or it's just too small of a fish. But at least provide something for us custom home people to use as rules to guide design and have some compelling reason to not do stupid as a standard of practice.
- 150.0(m)12
    - I'm still wading through all the language here, but I would like to advocate that minimum standards for filtration be reasonable to accommodate changes by inhabitants to better filtration standards.
    - Section (m)12B indicates a MERV 6, which is just enough to protect the coil and AHU. It is not uncommon that I see homeowners/inhabitants that would like to have higher levels of air-filtration, and they have only 1" of width in their AHU to accommodate filters. So they get an aftermarket MERV-10 1" filter and it just kills their air flow.
    - I can see that you're getting at this problem with Section (m)12D, and have probably discussed/debated lots of other options, including the one I'll advocate below
    - **Proposal: include some minimum filter box width—e.g. 3".** If they want to start off with a 1", then you can get a 1" filter, and then a 2" 'blank' or something to fill in the rest of the box while still firmly framing in the filter.
- 150.0(p)
    - HERS verification for pools?
        - Pools are just an ongoing nightmare for energy use.
        - **Proposals:**
            - Some kind of HERS testing and verification for pools? If you're not working on some kind of flow/measurement standards (e.g. Watts/gpm, similar to W/CFM in forced air systems), then that would be nice. Everywhere I look, it's small pipes and big pumps. That, and do you expect the AHJ's inspector to really look at if each elbow has an equivalent length of 30' or less? Yeah…right. That's why you've created the HERS industry in the first place.

- Demand Response capacity for Pool Pumps?
    - I know you guys have looked at this. I helped write one of the reports for ADR for the IOU's about 10 years ago and it seemed like a no-brainer at the time. On the other hand, I can understand how in the grand scheme of things, this is way down on your list.

- 150.1(c)1.C Raised Floor insulation
    - From the way I read this—conditioned crawlspaces might not comply with this? All the language here is around Controlled Ventilation crawlspaces, which refers to louvers and vents and automagically closing holes.
    - **Proposal:** Maybe you can just make it clear that Unvented/Conditioned Crawlspaces (with no vents) is also acceptable (see 150.0(g)1A).
    - Or maybe there was some sneaky reason why you wanted to specifically omit conditioned crawlspaces from Prescriptive compliance and force them into Performance path. Whatevs. I don't use the Prescriptive path much anyway (though it's a really nice option to have).

Climate Zone 16 for one of my off-grid survivalist projects:

(Not really important to my comments--I mostly just wanted too add little more color and variety to my outline)



- 150.1 (c)8A—non-fossil fuel based hot water?
    - I expect you'll be getting a lot of comments on this, so I'll pile on: C'mon! no prescriptive path for electric water heating? For a state that's got AB32 on the books, it seems counterproductive to have <u>only</u> fossil fuel based water heating available for Prescriptive compliance. That said, I don't really have a dog in this fight because I do Performance calcs and this is all easily modeled and passed. It still sets the baseline building DHW budget and my clients get uppity when I mention that the CEC prescribes (which sounds synonymous with 'recommends') propane for their carbon-free mountain home out in CZ16 outside of Palm Springs.

- **Proposal**: Demand-Response-ready water heaters? To eliminate those peak TDV impacts, why don't you just carve out some allowance for electric water heaters of whatever Energy Factor that would comply. If electric resistance weren't good enough in the end to meet your budgets, then you could at least carve out some realm for HPWH.
    - By my crude analysis of the E3 TDV spreadsheet (2011 TDV Spreadsheet from E3 on the CEC General Documents Listing), a COP of 4 should just about cover it. While difficult, it's not technically impossible.
    - And, if you could create a demand-response system for large appliances that could shut them off for the days April 24th, May 28th, June 5th, July 8th and 9th, Labor Day weekend (and all those other 'Super Critical Peak' days in the TDV matrix) between the hours of 10am and 8pm, that should take care of those peak events, right? (I'm obviously not serious here) ☺

- **HPWH:** You should figure out some EF that would provide a reasonable pathway for them too (I know you've heard that from lots of folks). By my calcs, a COP of about 4 should be equivalent to natural gas in annual TDV.
- In other words, there's gotta be a more cost-effective way to create a prescriptive standard in DHW than prescribing propane. What was wrong with Solar Hot Water? Afraid of stagnation? Fine—prescribe drain-down systems.
- It all sounds so easy in my head… ☺

More color: Carpet chart of Time Dependent Valuation (electricity during critical peak hours

Date/Time	Electricity TDV (CZ1; kBtu/therm-Electricity)	Electricity TDV (CZ2; kBtu/therm-Electricity)	Electricity TDV (CZ3; kBtu/therm-Electricity)	Electricity TDV (CZ4; kBtu/therm-Electricity)	Electricity TDV (CZ5; kBtu/therm-Electricity)	Electricity TDV (CZ6; kBtu/therm-Electricity)	Electricity TDV (CZ7; kBtu/therm-Electricity)	Electricity TDV (CZ8; kBtu/therm-Electricity)	Electricity TDV (CZ9; kBtu/therm-Electricity)	Electricity TDV (CZ10; kBtu/therm-Electricity)	Electricity TDV (CZ11; kBtu/therm-Electricity)	Electricity TDV (CZ12; kBtu/therm-Electricity)	Electricity TDV (CZ13; kBtu/therm-Electricity)	Electricity TDV (CZ14; kBtu/therm-Electricity)	Electricity TDV (CZ15; kBtu/therm-Electricity)	Electricity TDV (CZ16; kBtu/therm-Electricity)
09-01-09 03:00	264.95	264.95	264.95	264.95	264.95	251.76	262.75	252.20	250.00	249.85	264.95	264.95	264.95	249.71	250.00	249.12
09-01-09 04:00	272.42	272.42	272.42	272.42	272.42	259.38	270.37	259.82	257.62	257.47	272.42	272.42	272.42	257.33	257.47	256.74
09-01-09 05:00	279.60	279.60	279.60	279.45	279.45	266.41	277.26	266.71	264.51	264.36	279.45	279.45	279.60	264.21	264.51	263.77
09-01-09 06:00	283.41	283.41	283.41	283.41	283.26	270.08	282.39	270.52	268.32	268.17	283.26	283.26	283.41	268.02	268.17	267.44
09-01-09 07:00	282.53	282.39	282.39	282.39	282.39	270.08	282.39	270.52	268.32	268.17	282.39	282.39	282.39	268.02	268.17	267.44
09-01-09 08:00	290.30	290.30	290.30	290.30	290.30	280.48	291.62	280.77	278.58	278.43	290.30	290.30	290.30	278.28	278.58	277.84
09-01-09 09:00	554.95	291.32	291.32	291.32	291.32	478.90	2,090.56	583.82	284.29	284.14	291.32	291.32	291.32	284.00	284.29	283.56
09-01-09 10:00	296.75	296.60	296.60	296.60	296.60	3,001.76	2,108.00	1,326.49	2,311.55	1,024.77	296.60	296.60	296.60	301.44	441.38	301.00
09-01-09 11:00	1,003.22	1,003.22	1,003.22	1,003.22	1,108.44	4,001.61	2,293.96	2,549.53	3,312.13	2,389.36	1,003.22	1,003.22	1,003.22	1,001.47	1,189.62	1,000.88
09-01-09 12:00	1,982.27	1,975.23	2,555.39	1,164.42	1,269.64	4,258.79	1,970.98	2,765.09	3,715.56	2,667.20	1,164.42	1,343.79	1,355.36	1,151.52	1,452.52	1,151.08
09-01-09 13:00	1,772.27	2,878.66	3,369.58	2,320.63	1,613.86	4,605.07	3,556.42	3,045.87	4,125.00	3,050.56	1,982.71	2,130.86	1,795.13	1,510.11	1,810.23	1,497.22
09-01-09 14:00	2,050.70	3,262.75	3,712.34	3,256.89	1,786.93	4,656.65	4,225.82	3,311.69	4,454.13	3,316.38	2,506.15	2,626.17	2,254.54	1,850.97	2,076.06	2,480.36
09-01-09 15:00	2,193.29	3,359.91	3,974.65	3,577.23	1,929.51	4,612.54	4,427.90	3,460.29	4,539.42	3,464.98	2,926.58	2,930.83	2,397.13	1,912.22	2,181.27	3,011.87
09-01-09 16:00	2,317.12	3,483.88	4,052.46	3,724.94	2,053.49	5,026.96	4,514.95	3,527.26	4,654.02	3,542.35	3,050.56	3,054.81	2,571.81	2,186.99	2,295.87	2,743.55
09-01-09 17:00	2,138.77	3,245.02	3,699.00	3,522.71	1,875.00	4,744.72	4,192.12	3,233.29	4,383.94	3,292.79	2,872.07	2,876.32	2,342.61	1,851.55	2,074.15	1,851.11
09-01-09 18:00	1,752.93	2,632.62	3,000.15	3,048.07	1,489.30	4,182.15	3,675.26	2,792.06	3,934.94	2,821.81	2,208.53	2,490.62	1,877.20	1,481.68	1,652.55	1,481.24
09-01-09 19:00	1,130.13	1,623.68	2,042.06	2,179.22	1,130.13	2,003.08	2,948.12	1,973.18	3,280.92	1,867.67	1,130.13	1,607.56	1,130.13	1,144.34	1,224.36	1,143.90
09-01-09 20:00	970.25	970.25	970.25	970.25	970.25	991.50	2,793.52	991.79	2,841.15	989.45	970.25	970.25	970.25	989.30	989.60	988.86
09-01-09 21:00	294.84	294.70	294.70	294.70	294.70	304.37	1,879.54	304.66	302.46	302.32	294.70	294.70	294.70	302.17	302.46	301.73
09-01-09 22:00	295.43	295.28	295.28	295.28	295.28	292.64	1,583.09	292.94	290.74	290.59	295.28	295.28	295.28	290.45	290.74	290.01
09-01-09 23:00	288.25	288.10	288.10	288.10	288.10	283.70	577.67	284.14	281.80	281.65	288.10	288.10	288.10	281.51	281.80	281.07
09-02-09 00:00	284.88	284.88	284.88	284.88	284.88	280.33	291.18	280.77	278.58	278.43	284.88	284.88	284.88	278.28	278.58	277.70
09-02-09 01:00	280.63	280.63	280.63	280.63	280.63	271.40	282.24	271.83	269.49	269.34	280.63	280.63	280.63	269.20	269.49	268.76
09-02-09 02:00	259.96	259.96	259.96	259.96	259.82	250.29	261.28	250.73	248.39	248.39	259.82	259.82	259.96	248.09	248.39	247.66
09-02-09 03:00	263.34	263.34	263.34	263.34	263.19	254.69	265.68	255.13	252.78	252.64	263.19	263.19	263.34	252.49	252.78	252.05

ACM Algorithms:

Domestic Hot Water Engine:

DHW Tank and Distribution losses:

If the Hot water tank and plumbing is inside the thermal envelope, then Hot Water Tank and Distribution losses should end up in the building energy model. That means if its wintertime, then that Water Heater is gonna end up heating the space (albeit maybe not very efficiently). Or if it's outside, or in an attic or in a crawlspace, then you're gonna have (or already have) models (and temperatures for Fourier heat transfer calcs) for those locations too, right?

And yes—that means it might be somewhat benign in a heating climate, and a substantial penalty in a cooling one, but it's time to update that. That goes for HPWH's too.

Recirculation Pumps and distribution losses:

Now that tank and distribution is better tied to the envelope model, then we can get a more accurate accounting of recirc pumps and their impact on both DHW and the envelope.

Recirc Pumps and overall water usage

With recirc pumps and some refined distribution multipliers—like some weighted average of 'reduced' hot water usage due to recirc pump, you should be able to better evaluate potential water heating energy savings because you're recirculating lukewarm

water back to the heater. And that which is left in the pipe is bleeding off into conditioned space, perhaps.

Maybe it's a HERS credit where you capture the distance of the DHW Tank from the kitchen faucet and the Master bathroom faucet. I dunno…

Space Heating/Cooling via Hydronic Distribution

I can't find any accounting of pumping energy for hydronic space heating and cooling (e.g. radiant ceilings and floors). I believe this gives radiant/convective based space conditioning systems an unfair advantage over more traditional forced air systems, and I want to advocate here for some kind of evaluation on pumping energy for these systems. I suspect that these systems weren't overlooked but merely left out of the ACM algorithms for some sufficiency reasons. They're clearly only a niche market.

Perhaps I'm also just responding to the notion that designers/architects have that these systems are inherently much more efficient than forced air systems. In the context of effectively mandatory duct testing, that efficiency benefit compared to standard duct systems is shrinking fast.

Anecdotally, I see a lot of wasted energy from hydronic systems. It's the standard issue of one pump that serves 12 zones that seems to be 'on' 24/7 for the heating season and much of the cooling season, as long as 1 or more zones is calling. Of course, anecdotes don't (or shouldn't) make a rule. I'm just arguing that the pumping energy is non-zero and non-trivial.

Variable speed pumps are gradually coming into the market, but they are offered by hydronic system leaders and not yet a clear default standard of practice for design/build.

Proposal: *I'd like to advocate for pumping energy for hydronic-based space conditioning systems to be incorporated into the ACM.*

Secondly, I'd would at least study the option of refining that Performance model to make variable speed pumping, and good system design available for some kind of HERS verifications.

Thermal Bridging

One of oft-mentioned topics and articles of research at building science conferences (e.g. BEST, Passive House, ASHRAE, etc.) is the topic of thermal bridging. This is because what was before considered 'de minimus' is no longer reasonable to ignore given the advent of high performance wall systems. To wit, thermal bridging is now the weak link in overall wall performance. ASHRAE is actively evolving methods (e.g. ASHRAE 1365-RP) and standard details to give practitioners standard and reasonable values for beyond 1-D thermal transmittance.

In my cursory review of research documents and consultant reports, as well as the current ACM algorithms and Ref. Appendices, I see no mention of thermal bridging, even in some general way. I'd like to advocate for a change in that. Engage the research consults, work with ASHRAE, and build some pathways to account for thermal bridging into the ACM.

Here's a resource I've found useful for non-Title 24 modeling

http://www.morrisonhershfield.com/ashrae1365research/Documents/MH_1365RP_Final_%20small.pdf

An example of a specific problem I've had:

Butterfly House

I had a project with a very large overhang that created a porch area outside. Let's imagine it's somewhat like this house here on the right. Now imagine all the structural beams that hold up both the floor of the porch, as well as the overhang both are created with steel W beams. There is a layer of continuous insulation on the roof, and one on the underside, but nothing to prevent any heat transfer through the steel beam into the porch area. Doing so would compromise structure, obviously.

1- Photo by Sean Guy-- Source: wikipedia

On this particular project, I triggered QII, because the house needed it due to its non NFRC glazing. The HERS Rater dutifully came out to review it and asked me to model the thermal bridges of the beams, which was a good call. The closest I had available to me was several square feet of uninsulated metal as a 1D heat transfer, which I calculated by summing the combined cross-sectional area of the Wide Flange beams. I labeled it 'thermal bridge' and discussed my quandary with HERS Rater and we both shrugged our shoulders and she approved the QII.

I didn't feel that the solution I came up with reasonably captured the actual thermal performance of the assembly, but I have no sanctioned (contronym intended) recourse in the ACM or modeling guidelines for capturing what is effectively a complex 3D heat transfer problem.

Of course, while the house was not duly penalized on Title 24 for having such thermal bridges, I warned the project team about potential condensation issues on the beams during cold extremes, and possible (albeit modest) impacts on comfort.

FIN

Luke Morton

11/23/2016