

Envelope Backstop Methodology

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ASHRAE 90.1 Committee Presentation
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Background

Goal: Limit envelope trade-offs for projects that document compliance following ASHRAE Standard 90.1 Section 11 or Appendix G

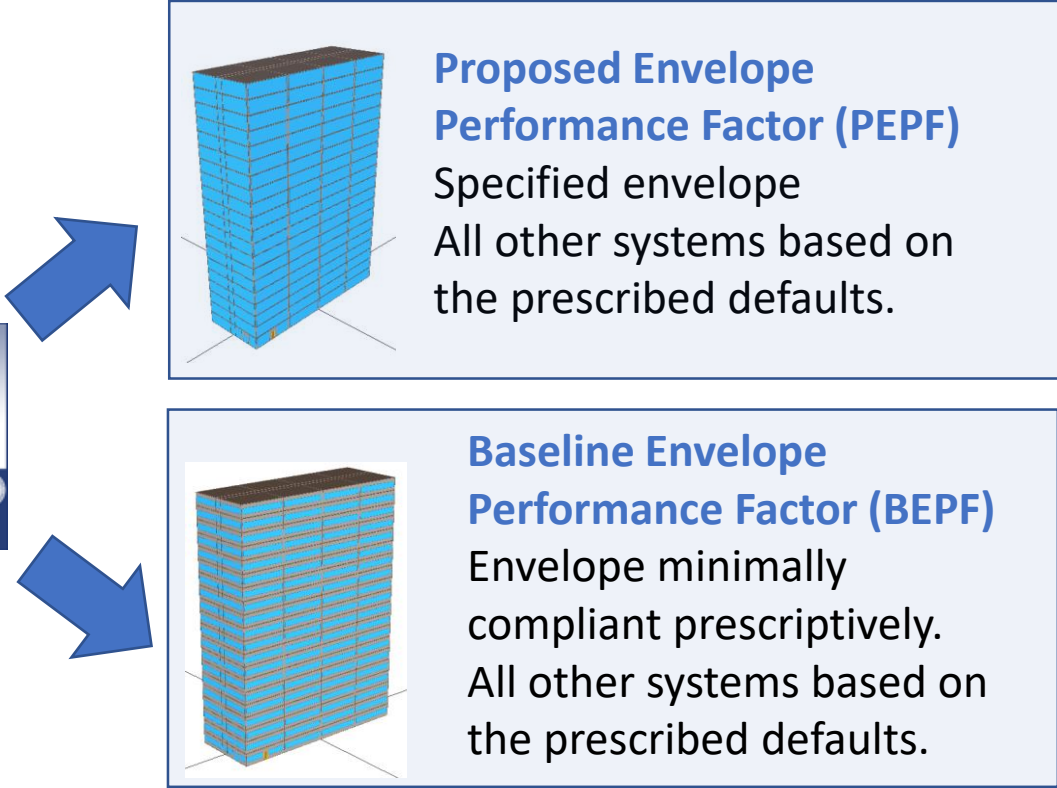
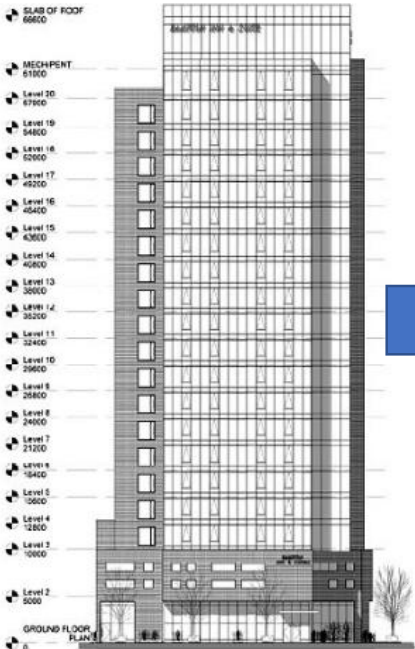
Reasoning:

- Once building is constructed, envelope is difficult or impossible to retrofit
- 90.1 performance options allow unlimited “trade offs” between envelope and systems with much shorter equipment life

NY Stretch Energy

- The method was incorporated into NY Stretch Energy Code.
- The following slides are based on the work in support of NY Stretch development.

90.1 Appendix C Method



\$ PEPF

Project Passes Envelope Backstop if $\$ PEPF / \$ BEPF-1 < ?? \%$

\$ BEPF

Account for the envelope thermal and solar properties, building shape, orientation, construction, impact of windows on daylighting, etc.

COMcheck Inputs

HRMF-NM Code-4A-55.cck - COMcheck 4.0.7.2 Review Code: 90.1 (2016) Standard

File Edit View Options Code Help

1. Only Project and Envelope tabs must be filled

2. Enter Proposed Envelope

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Roof Skylight Exterior Wall Semi-Exterior Wall Window Door Basement Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
	▼ Building													
1	Roof 1	Insulation Entirely Abo...	1 - Multifamily ...				8436	ft2		30.0	0.032			
2	▼ Exterior Wall 1	Steel-Framed, 16" o.c.	1 - Multifamily ...	North			11100	ft2	13.0	7.5	0.064			
3	Window 1	Metal Frame:Operable			Product ID: NM C...		6105	ft2			0.310	0.35	0.00	0.39
4	▼ Exterior Wall 2	Steel-Framed, 16" o.c.	1 - Multifamily ...	South			11100	ft2	13.0	7.5	0.064			
5	Window 2	Metal Frame:Operable			Product ID: NM C...		6105	ft2			0.310	0.35	0.00	0.39
6	▼ Exterior Wall 3	Steel-Framed, 16" o.c.	1 - Multifamily ...	East			30400	ft2	13.0	7.5	0.064			
7	Window 3	Metal Frame:Operable			Product ID: NM C...		16720	ft2			0.310	0.35	0.00	0.39
8	▼ Exterior Wall 4	Steel-Framed, 16" o.c.	1 - Multifamily ...	West			30400	ft2	13.0	7.5	0.064			
9	Window 4	Metal Frame:Operable			Product ID: NM C...		16720	ft2			0.310	0.35	0.00	0.39
10			1 - Multifam			Insulation...								

5. Envelope Fails

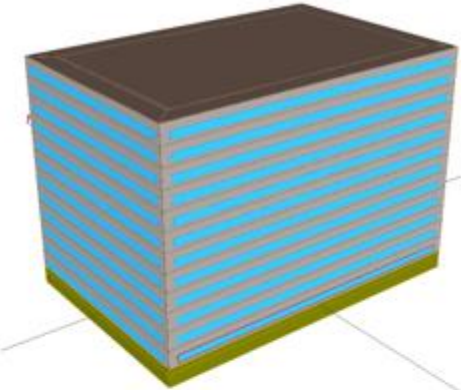
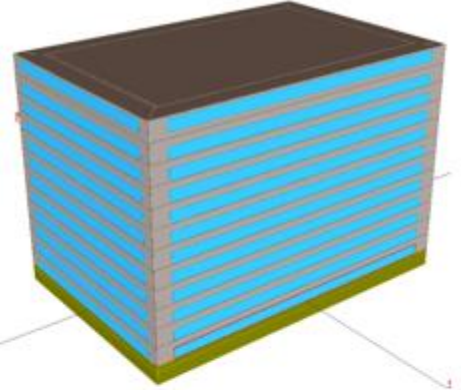
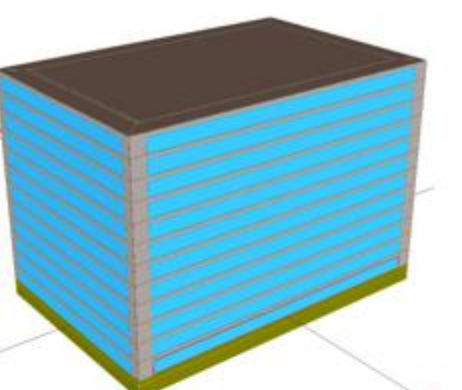
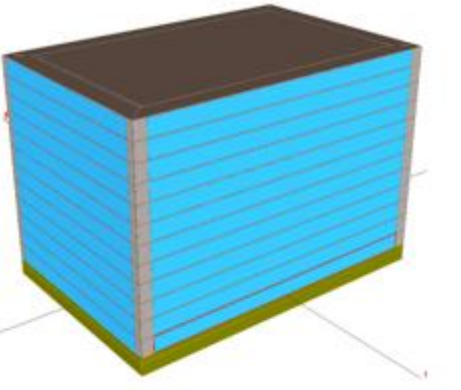
3. Run the analysis

4. $(BEPF - PEPF) / BEPF = -6\%$

✓ Check Envelope Compliance Help Envelope -6% Interior Lighting TBD Exterior Lighting TBD

Envelope FAILS

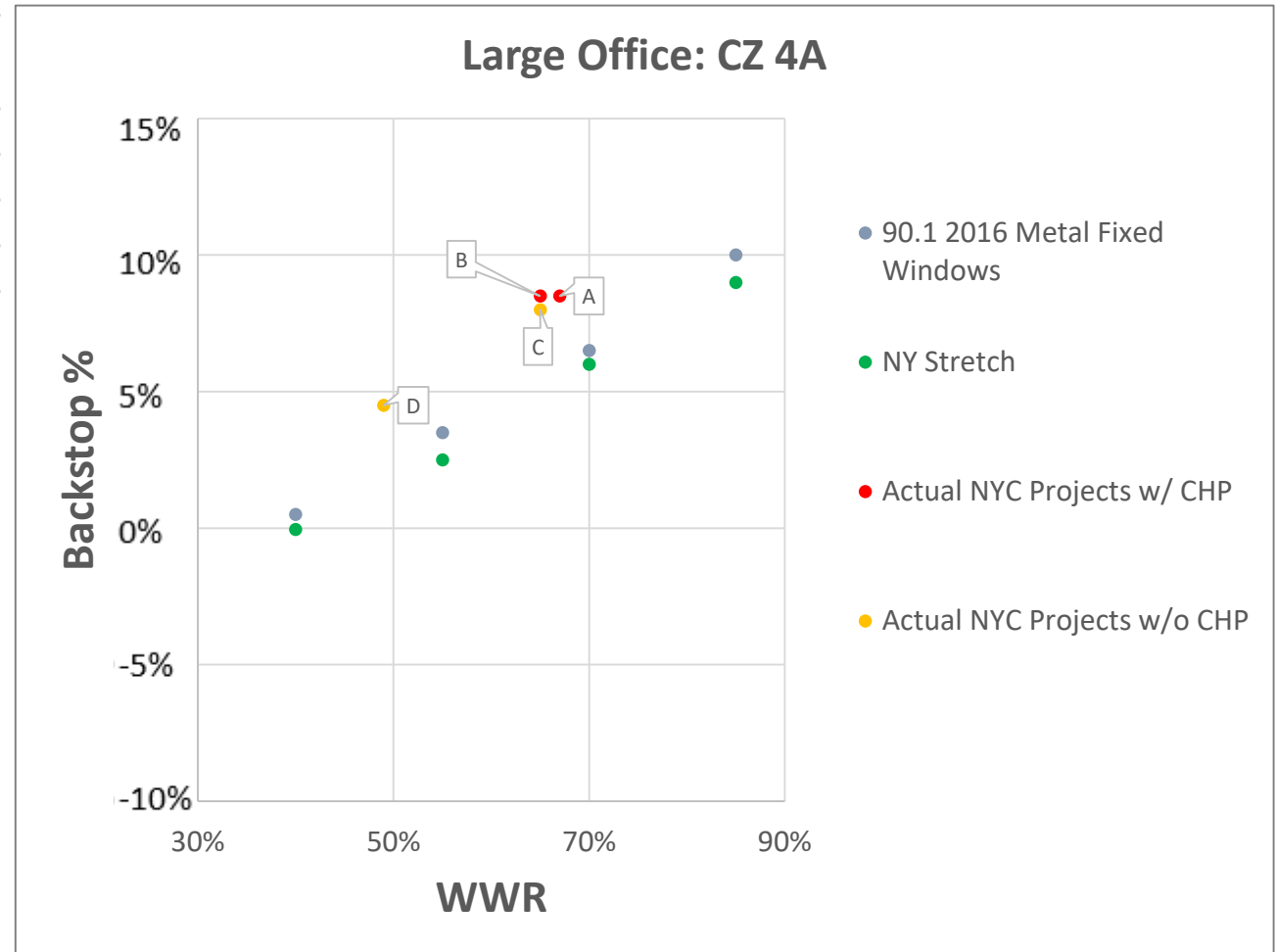
Large Office Configurations

			
40% WWR	55% WWR	70% WWR	85% WWR
<p>ASHRAE 90.1 2016 Climate Zone 4A: U-0.032 Flat roof U-0.064 Steel-frame walls U-0.38 / 0.4 SHGC metal frame fixed windows</p>			
<p>Proposed NY Stretch Climate Zone 4A: U-0.030 Flat roof U-0.061 Steel-frame walls U-0.36 / 0.4 SHGC metal frame fixed windows</p>			

* WWR = Window to Wall Ratio is the ratio of window area to gross wall area

Large Office Results

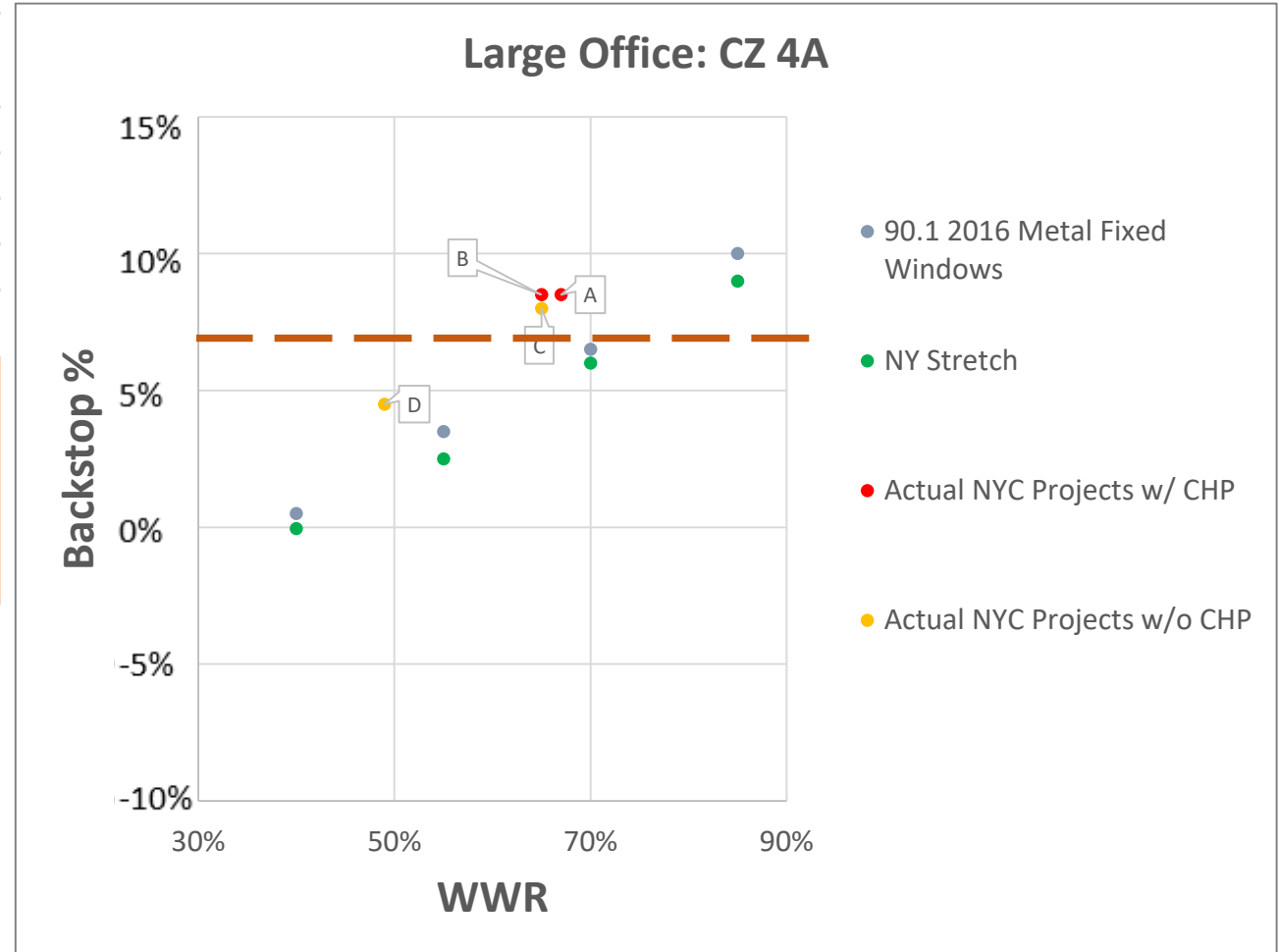
Project #	Type	WWR	U-value Wall	U-value Windows
A	Office	67%	0.16	0.45
B	Office	65%	0.211	0.45
C	Office	65%	0.185	0.45
D	Office	49%	0.175	0.40





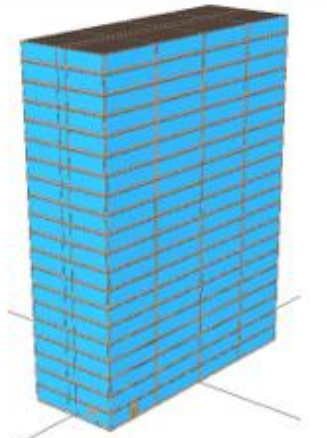
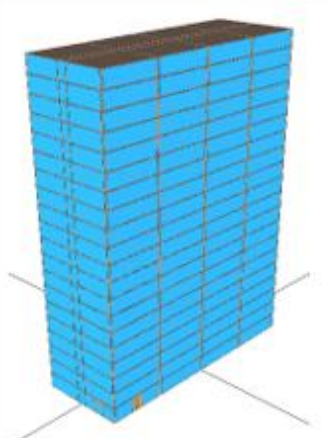
Large Office Results

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D	Office	49%	0.175	0.40

7% Envelope Backstop can be met by non-residential projects with up to 70% WWR and envelope components minimally meeting 90.1 2016



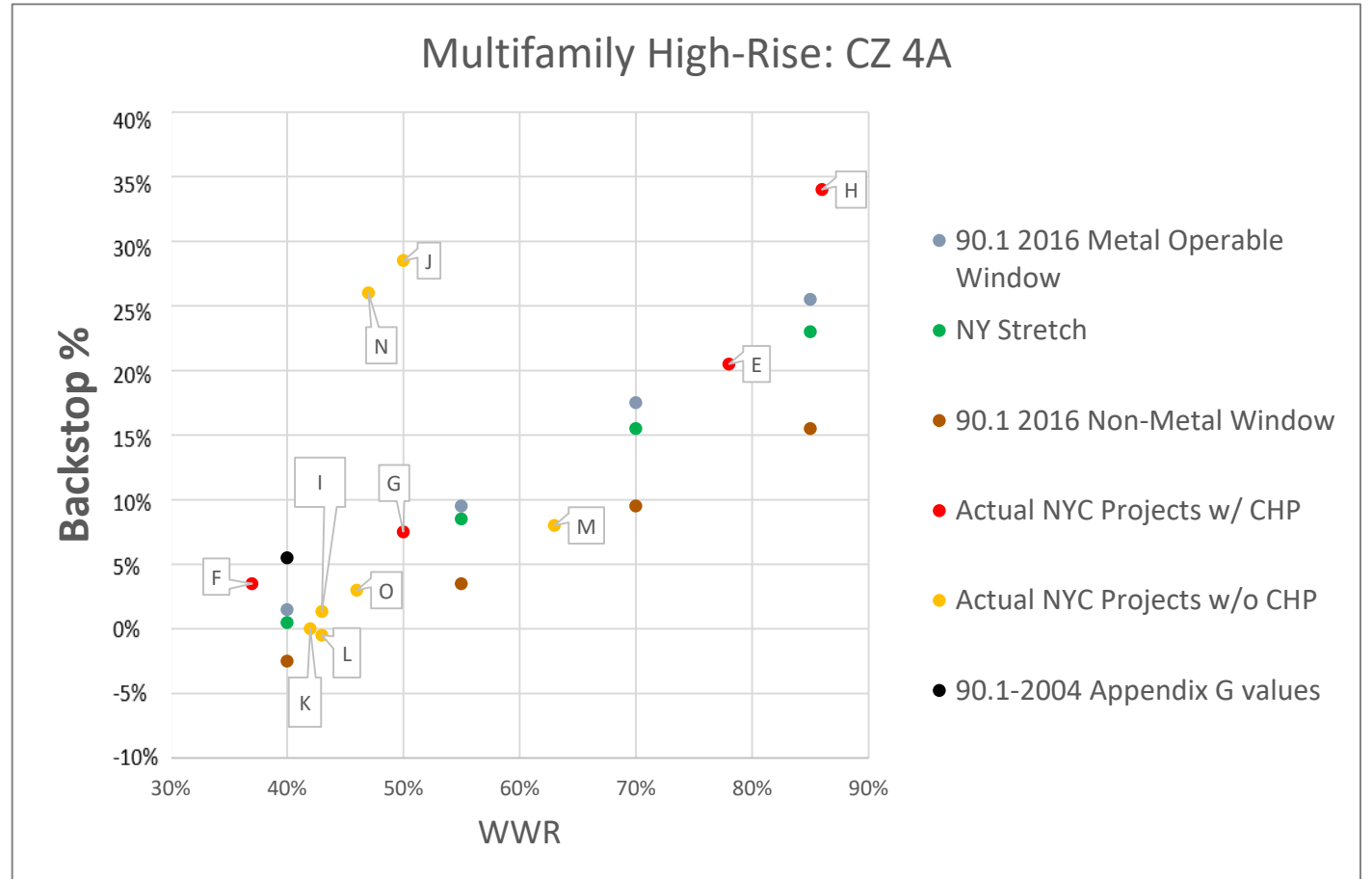
High-Rise Multifamily Configurations

			
40% WWR	55% WWR	70% WWR	85% WWR
<p>ASHRAE 90.1 2016 Climate Zone 4A Metal Frame Operable Windows U-0.032 flat roof; U-0.064 steel-frame walls; U-0.46 / 0.4 SHGC windows</p>			
<p>Proposed NY Stretch Climate Zone 4A U-0.030 flat roof; U-0.061 steel-frame walls; U-0.43 / 0.4 SHGC windows</p>			
<p>ASHRAE 90.1 2016 Climate Zone 4A Non-metal Operable Windows U-0.032 flat roof; U-0.064 steel-frame walls; U-0.31 / 0.4 SHGC windows</p>			

* WWR = Window to Wall Ratio is the ratio of window area to gross wall area

High-Rise Multifamily Results

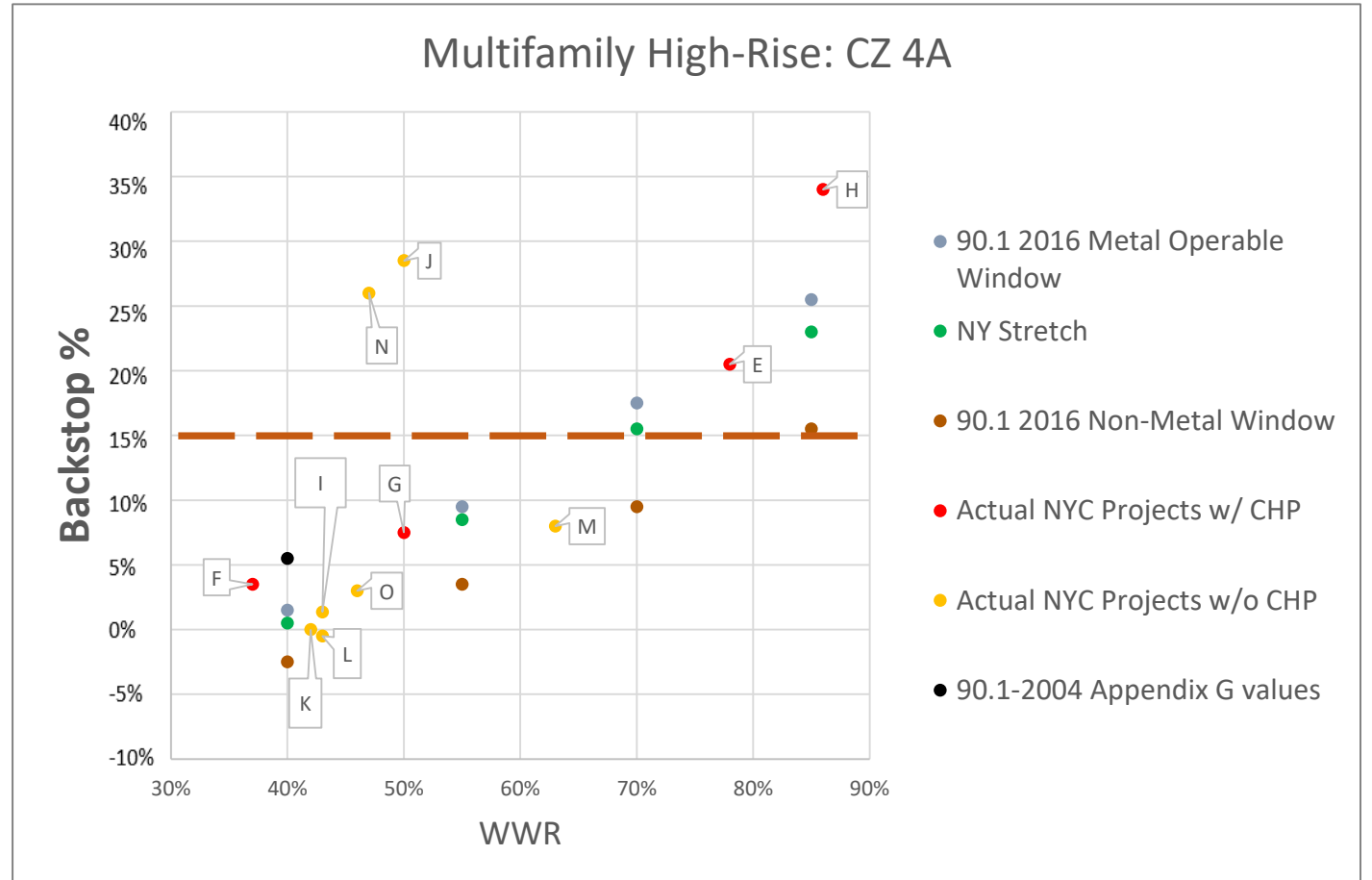
Project #	Type	WWR	U-value Wall	U-value Windows
E	Multifamily	78%	0.075	0.43
F	Multifamily	37%	0.096	0.47
G	Multifamily	50%	0.07	0.47
H	Multifamily	86%	0.352	0.53
I	Multifamily	43%	0.067	0.40
J	Multifamily	50%	0.066	0.90
K	Multifamily	42%	0.044	0.41
L	Multifamily	43%	0.054	0.34
M	Multifamily	63%	0.054	0.34
N	Multifamily	47%	0.067	0.90
O	Multifamily	46%	0.089	0.38



High-Rise Multifamily Results

Project #	Type	WWR	U-value Wall	U-value Windows
E	Multifamily	78%	0.075	0.43
F	Multifamily	37%	0.096	0.47
G	Multifamily	50%	0.07	0.47
H	Multifamily	86%	0.352	0.53
I	Multifamily	43%	0.067	0.40
J	Multifamily	50%	0.066	0.90
K	Multifamily	42%	0.044	0.41
L	Multifamily	43%	0.054	0.34
M	Multifamily	63%	0.054	0.34
N	Multifamily	47%	0.067	0.90
O	Multifamily	46%	0.089	0.38

15% Envelope Backstop can be met by residential projects with up to 70% WWR and envelope components minimally meeting 90.1 2016

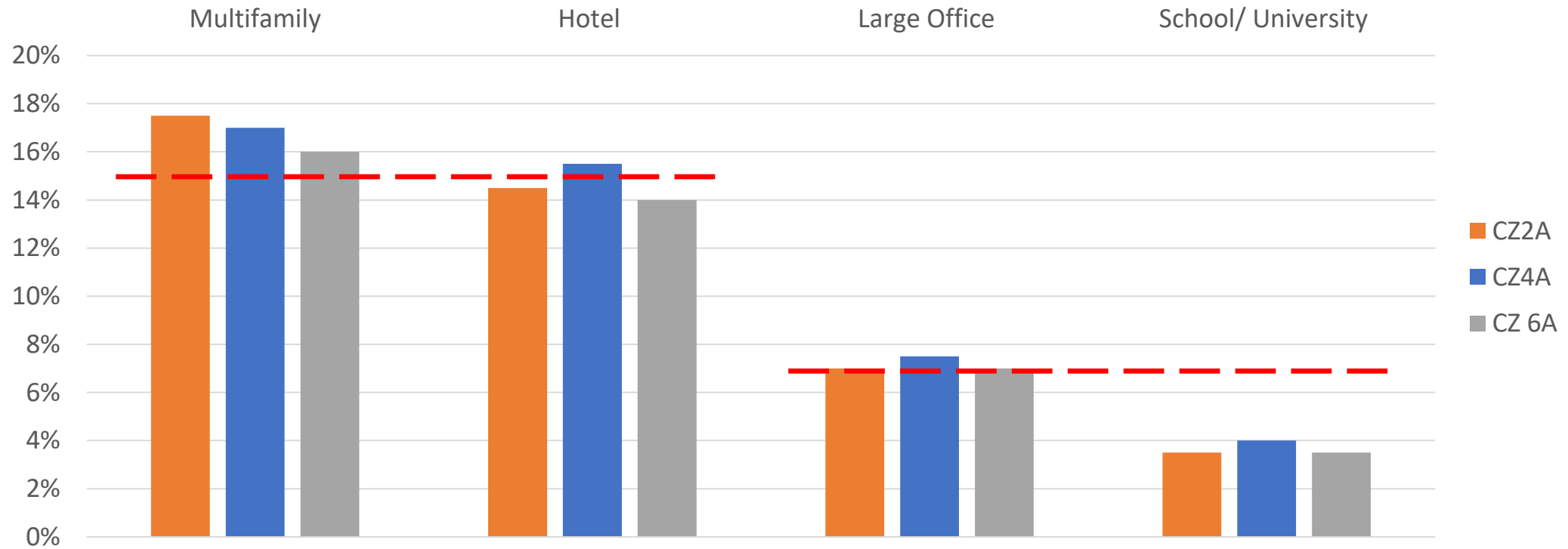


Additional Analysis by ECB+ESC Working Group

Envelope Backstop Method Evaluation Criteria

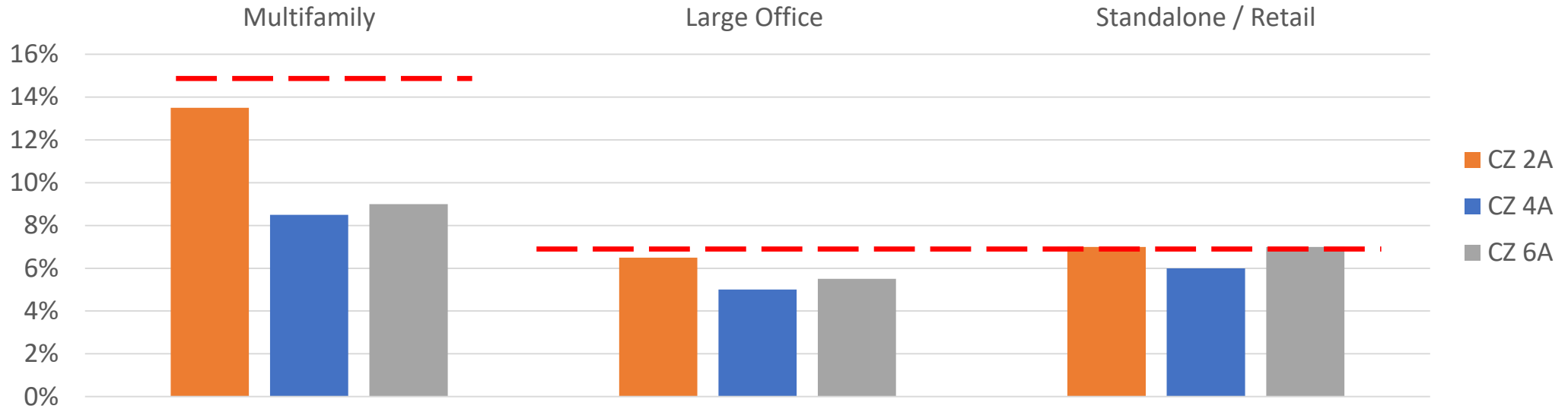
- The same method can be used for both Appendix G and Section 11
- Easy for modelers to document
- Manageable development effort
- Easy to maintain
- Considers all aspects of the proposed envelope
 - U-values, SHGC, VT, thermal mass, orientation, attached shades, site shading
- Allows trade-offs between different aspects of the proposed envelope to preserve design flexibility

High WWR + Code Compliant Envelope



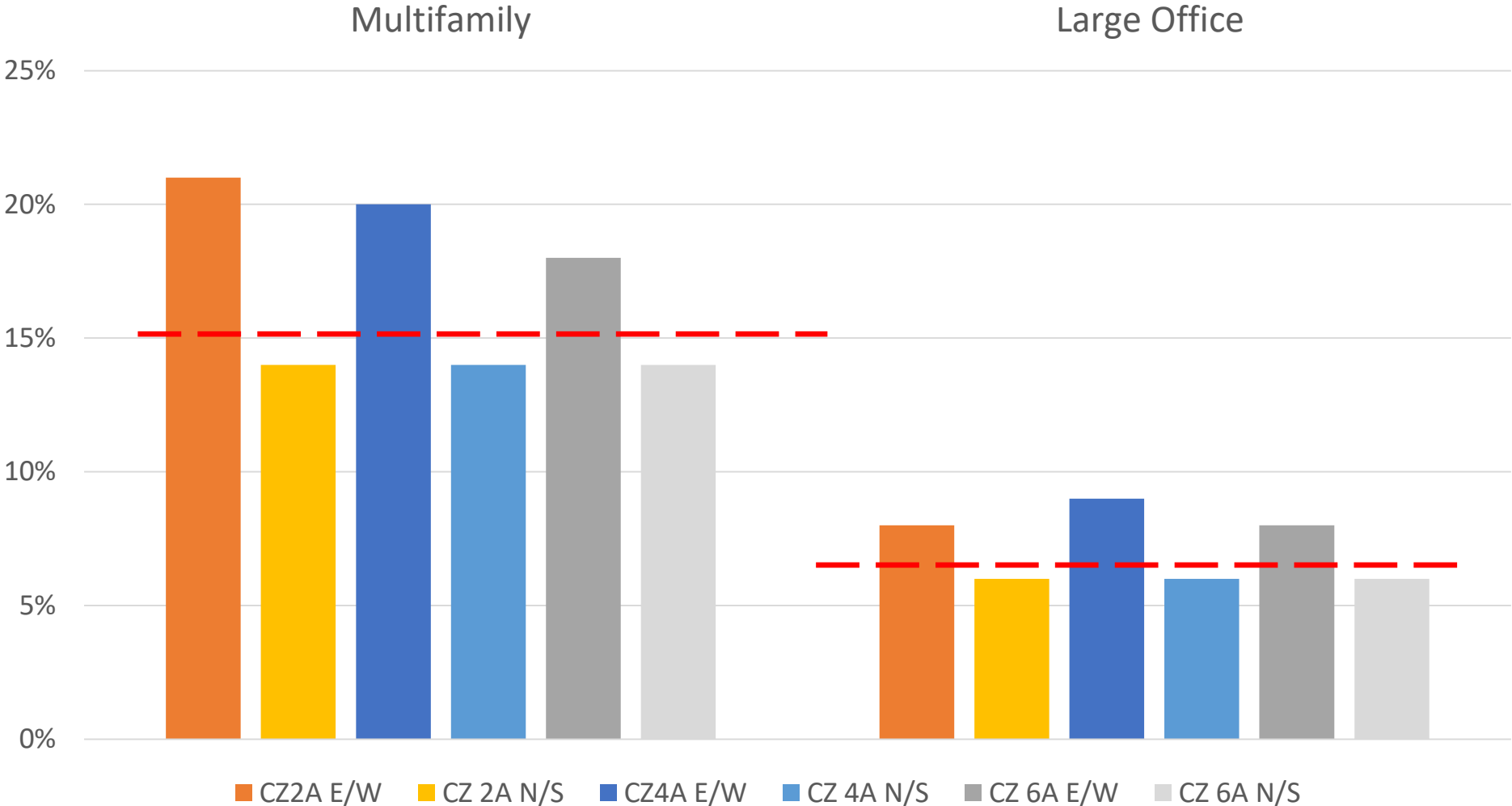
- Envelope Complies with 90.1 2016, steel-frame walls, fixed metal frame windows, 70% WWR
- Hotel has same envelope shape as Multifamily
- School/University has the same envelope shape as Large Office
- Exposure-neutral

Low WWR + Below Code Envelope

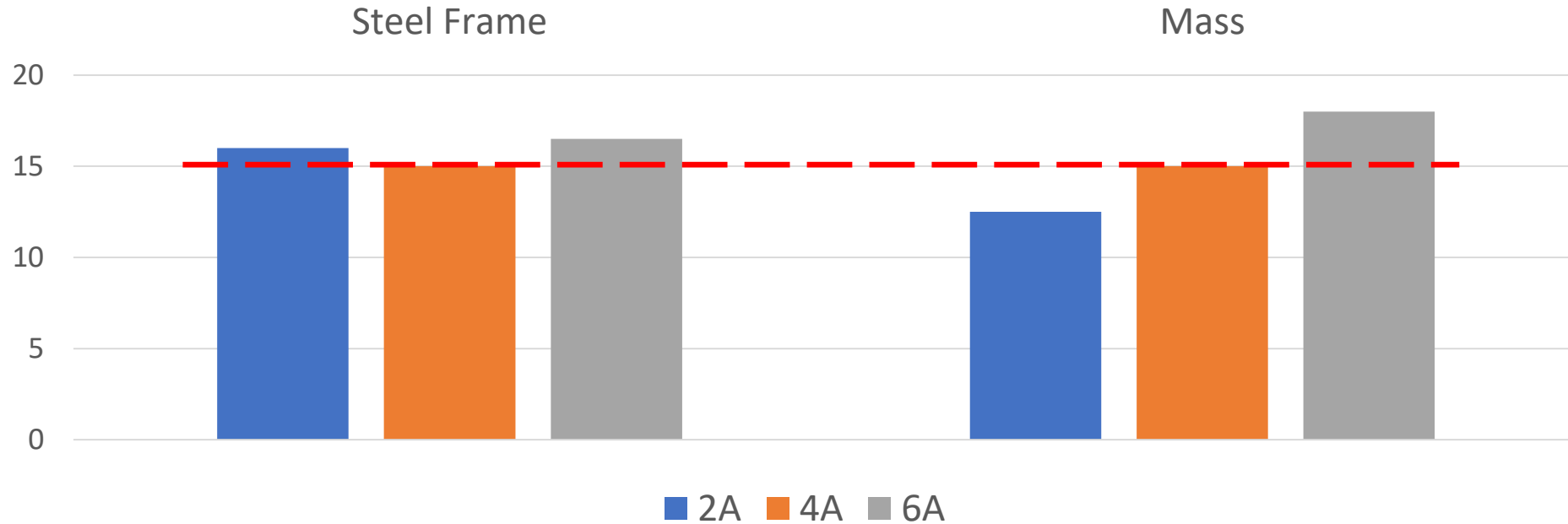


	Wall U-factor (steel-frame)	Roof R-value	WWR	Window U-Factor (metal fixed)	SHGC	VT
Large Office CZ 2A/4A/6A	0.124	15/20/20	20%	0.65/0.45/0.45	0.68	0.75
Retail CZ 2A/4A/6A	0.124	15/20/20	7%	0.65/0.45/0.45	0.68	0.66
Multifamily CZ 2A/4A/6A	0.096	15/20/20	20%	0.65/0.45/0.45	0.68	0.75

70% WWR Code Compliant Envelope: Impact of Exposure



Low WWR Steel Frame vs Mass Walls



CZ 2A / 4A / 6A	Wall type	Wall U	Roof R	WWR	Window U (metal fixed)	SHGC
Multifamily	Steel-frame	0.124	15/20/20	20%	0.65	0.68
Multifamily	Mass	0.189	15/20/20	20%	0.65	0.68