

September, 2017

To whom it may concern;

The Building Science Team at Demilec have completed a Heat, Air Moisture (HAM) analysis for Boston, MA utilizing various thickness' of closed cell foams, with and without vapor barrier.

The conclusion of the analysis is two fold;

- 1) The incorporation of 6 mil polyethylene vapor barrier is critical when closed cell foam thickness' in the back of the cavity (exterior side) are less than 2.5 inches.
- 2) If a vapor barrier is not installed, or is not installed correctly, the thickness of ccSPF must be greater than 2.5 inches in order to minimize the potential for condensation forming along the interior face of the SPF.

F CLIMATE CONDITION

	T			⊙ Wi Tmp(°C	nter) RH(%)	т	○ Su mp(°C)	mmei) RH(r (%)					
	CON	Ind	oor	21	25		24	50)					
\subseteq		Outd	loor	-14	80		33	53	3					
мате	BIALS		i			-								
batt ir	hattins 102 mm								, ма			_		
			Lieih	JIAN		1				POUR				
Add Delete Move up			Move <u>d</u> n	Conv	/ert	(Pa)	PRESSURE GRADIENTS							
<u>C</u> a	<u>Calc</u> <u>Graph</u> <u>Print</u>		WallLyb	TOOLBOX		4000	Ext	8				Int.	4000	
								18						
Layer	Descrip	RVap	V Drp	VpCc	3500							3500		
1	air film (ext), 19	mm	0.0000	0	14	3000							3000	
2	siding, wood, (v	ented), 19 m	nr 0.0018	2	14			-18		++				
3	cavity, 25 mm		0.0001	0	14	2500			Sat.				2500	
4	plywood shtg., 1	2.7mm	0.0184	24	17	2000							2000	
5	ureth.(int.) insul.	, 25 mm	0.0256	33	20					++				
6	ureth.(int.) insul.	, 25 mm	0.0256	33	23	1500		-18					1500	
7	batt ins., 102 mm	1 <u> </u>	0.0007	1	23	1000							1000	
8	poly film, 0.15 m	m (6mil)	0.2941	382	62				Vap	++				
9	9 gypsum bd., 12.7 mm, (#2)			1	62	500			Cont.	+			500	
10 air film (int), 19 mm			0.0000	0	62	0	1				1		0	
11								0 200	400	500	800	: 1 :		
12							N	o Conden	satio	on				
TOTAL or (Layer 0) 0.367 477 (14							~ ~	an dar d	Wall	» т	hieke-'			
4					•		0.21	angara	waii	9 I.	nic <u>k</u> er	wall		

Here are a few examples of our output;

A vapor barrier is included in this analysis - No condensation



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				CLIMATE CONDITIONS										
			Í	• W	nter		O Su	u <u>m</u> me	ər					
	TOOL NO 2) RH(%) I	Tmp(°C) R⊦	ł(%)
	~	Ind	loor	21	25		24	5	0					
				14	00	1	22		2					
								0						
MATE	MATERIALS								Boston, MA			-		
batt ir	ns., 102 mm	•	<u>H</u> elp	<u>S</u> TART	7CLR									
	1	- 1					(n)		WALL SECTION & VAPO				POUR	
Ac	dd Dele	ete	Move <u>u</u> p	Move <u>d</u> n	Conv	/ert	(Pa)		PRES	SURE G	RAD	DIENTS		(Pa)
							4500					-1		4500
<u>C</u> a	ile <u>G</u> ra	ph	Print	WallLyb		BOX	4000	EXT	1 X				Int.	4000
									- 8					-
Layer	De	escrip	tion	RVap	V Drp	VpCc	3500		-1 \times					3500
1	air film (ext)), 19 r	nm	0.0000	0	14	3000		18					3000
2	siding, woo	d, (ve	ented), 19 mn	0.0018	12	15			-18					-
3	cavity, 25 r	nm		0.0001	1	15	2500		- 8	Vap Sat.	+		+ +	2500
4	plywood sh	tg., 13	2.7mm	0.0184	121	27	2000		18					2000
5	ureth.(int.) i	insul.	, 25 mm	0.0256	168	44								
6	ureth.(int.) i	insul.	, 25 mm	0.0256	168	61	1500		-18					1500
7	batt ins., 10	2 mm	I	0.0007	5	61	1000		-1 \times					1000
8	gypsum bd	., 12.7	7 mm, (#2)	0.0005	3	62				Van				
9 air film (int), 19 mm			0.0000	0	62	500		- 8	Cont.				500	
10											1		0	
11							Ů		0 200	400	600	800		ľ
12									Con	1. 0.3	g/(r	n²·d)		
	TOTAL or (0.0728	477	(14				342 - II	~ 7					
4						•		O S	la <u>n</u> dard	Wall	•	hicker	Wall	

2 inches of ccSPF – no VB marginally sufficient thickness to eliminate condensation

								CLIMATE CONDITIONS					
		T(CON		D. 2 ATION		Ind	• Winter Tmp(*C) RH(%) • Summer Tmp(*C) RH(%) door 21 25 24 50						
						Outo	door -14 80 33 53						
MATE	ERIALS	;			City Boston MA								
batt ir	ns., 76	i mm	•	Help	START	7CLR							
· · · · · ·								WALL SECTION & VAPOUR					
Ac	Add Delete Move up			Move <u>d</u> n	C <u>o</u> nv	vert	(Pa)	PRESSURE GRADIENTS (Pa)					
							4500	4500					
<u>C</u> a	alc	<u>G</u> raph	Print	WallLyb	TOOL	вох	4000	Ext Int. 4000					
Layer	r	Descrip	tion	RVap	V Drp	VpCc	3500	3500					
1	air filr	n (ext), 19 r	nm	0.0000	0	14	3000	3000					
2	siding	j, wood, (ve	ented), 19 mi	τ 0.0018	9	15							
3	cavity	, 25 mm		0.0001	1	15	2500	Sat. 2500					
4	plywo	od shtg., 12	2.7mm	0.0184	89	24	2000	2000					
5	ureth	(int.) insul.,	, 25 mm	0.0256	124	36							
6	ureth	.(int.) insul.,	, 25 mm	0.0256	124	49	1500	1500					
7	ureth	(int.) insul.,	25 mm	0.0256	124	61	1000	1000					
8	batt ir	ns., 76 mm		0.0006	3	62		Vap					
9	9 gypsum bd., 12.7 mm, (#2)			0.0005	2	62	500	Cont. 500					
10	10 air film (int), 19 mm			0.0000	0	62	0						
11	11							0 200 400 600 800					
12								Cond. 0.2 g/(m ² ·d)					
	TOTAL or (Layer 0) 0.0984 477 (14							Standard Wall & Thicker Wall					
4						Stalluaru wali Minicker Wali							

3 inches of ccSPF with no VB does work.....



For a typical roof application in which a "hybrid" approach is being considered, the use of 3 inches of ccSPF and 6 inches of an open cell product works well.

				CLIMATE CONDITIONS									
TOOL NO. 2									© Winter Tmp(°C) RH(%)	○ Su <u>n</u> Tmp(°C)	nmer RH(%)		
CONDENSATION									21 23	24	00		
									Outdoor -14 80 33 53				
MATE	MATERIALS								Boston, MA		•		
air filr	n (int)	, 19 mm	•	<u>H</u> elp	START	7CLR							
Add Delete Move up			Move <u>d</u> n	Conv	vert	(Pa) 4500		WALL SECTION 8 PRESSURE GR/		(Pa)			
<u>C</u> a	<u>C</u> alc <u>G</u> raph <u>P</u> rint		WallLyb	TOOLBOX		4000	Ext		[Int. 4000			
Layer	Layer Description			RVap	V Drp	VpCc	3500				3500		
1	air fili	m (ext), 19 r	nm	0.0000	0	14	3000				3000		
2	coati	ng (breathei	r), 1.2 mm	0.0032	15	16	0500				0500		
3	pape	r, woven, O.	10 mm	0.0002	1	16	2500		Sat.		2500		
4	plywo	ood shtg., 1	5.9 mm	0.0227	104	26	2000				2000		
5	ureth	.(int.) insul.	, 76 mm	0.0769	353	61	4500		- XA		4500		
6	batt i	ns., 152 mm		0.0010	5	62	1000				1500		
7	air fili	m (int), 19 m	ım	0.0000	0	62	1000				1000		
8							500		Vap		500		
9						000		Cont.		500			
10						0			+	0			
12									0 200 400	600 800 [°]	1		
12	TOT	Al or (Lovor	0	0.104	477	(14			Cona. 0.2 g	g/(m*∙α)	J		
1	101/	n∟ or (Layer	0)	0.104	4//	(14		o St	a <u>n</u> dard Wall 🦷	Thic <u>k</u> er V	Vall		

Should you have any further questions, please do not hesitate to call.

Sincerely,

Demilec Building Science