Construction Industry Issues With Air Barriers

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Industry Issue 1

Why do I want to make my building air tight?

How is it supposed to dry out?

Industry Issue 2

How is the wall supposed to “ breathe “ if it has an air barrier in it?

Industry Issue 3

Don’t you need to have air leaking into the building to keep the air inside it fresh?

The Wetting Potentials

Liquid Water Ingress

Moisture Transport Due To Air Flow

Dew Point

Vapor Migration

How Do We Properly Deal With These Four Wetting Potentials???

Good HAMM!!!

What the #@$& is HAMM ?

- **HAMM is the 4 barriers needed to protect a building against the effects of weather. These barriers are:**

H	**Heat Barrier**
A	**Air Barrier**
M_L	**Water Barrier (Liquid Moisture)**
M_V	**Vapor Barrier (Gaseous Moisture)**

HAMM is the <u>WEATHER BARRIER SYSTEM</u>

HAMM Order Of Magnitude

M_L Water Barrier (Liquid Moisture)

A Air Barrier

H Heat Barrier

M_V Vapor Barrier (Gaseous Moisture)

Good HAMM effectively deals with thermal transfer, wetting and drying potentials:

Heat Barrier

- Thermal loss, gain and bridging
- Wetting potential due to a dew point (location)

Air Barrier

- Thermal loss and gain
- Wetting potential due to moisture transport via air flow

Good HAMM effectively deals with thermal, wetting and drying potentials:

Water Barrier

- Wetting potential due liquid moisture intrusion into and through the Building Enclosure System.

Vapor Barrier

-Wetting potential due to vapor diffusion into and through the Building Enclosure System.

THE WATER BARRIER

• Resists the intrusion of moisture in its liquid form (water) into and through the building enclosure system.

• Over the history of Building Enclosure System use, water barriers have been:

- Ineffective due to their inability to resist water penetration.

- Ineffective due to improper installation.

- Ineffective due to lack of longevity.

• If an air barrier is properly designed and installed in a building enclosure system and the air barrier material is also a water barrier, won't the past deficiencies of water barrier be resolved?

Why is my building leaking?

Why is my building leaking?

Why stop the flow of air into and through the BES?

First and foremost……..

1.) Air flow has the ability to transport exponentially more moisture into and through the building enclosure system than occurs through vapor migration or diffusion. Estimates range from 30 to 200 times more moisture transport occurs via air flow than vapor migration.

Excess moisture in exterior walls causes:

Corrosion of metal items

Excess moisture in exterior walls causes:

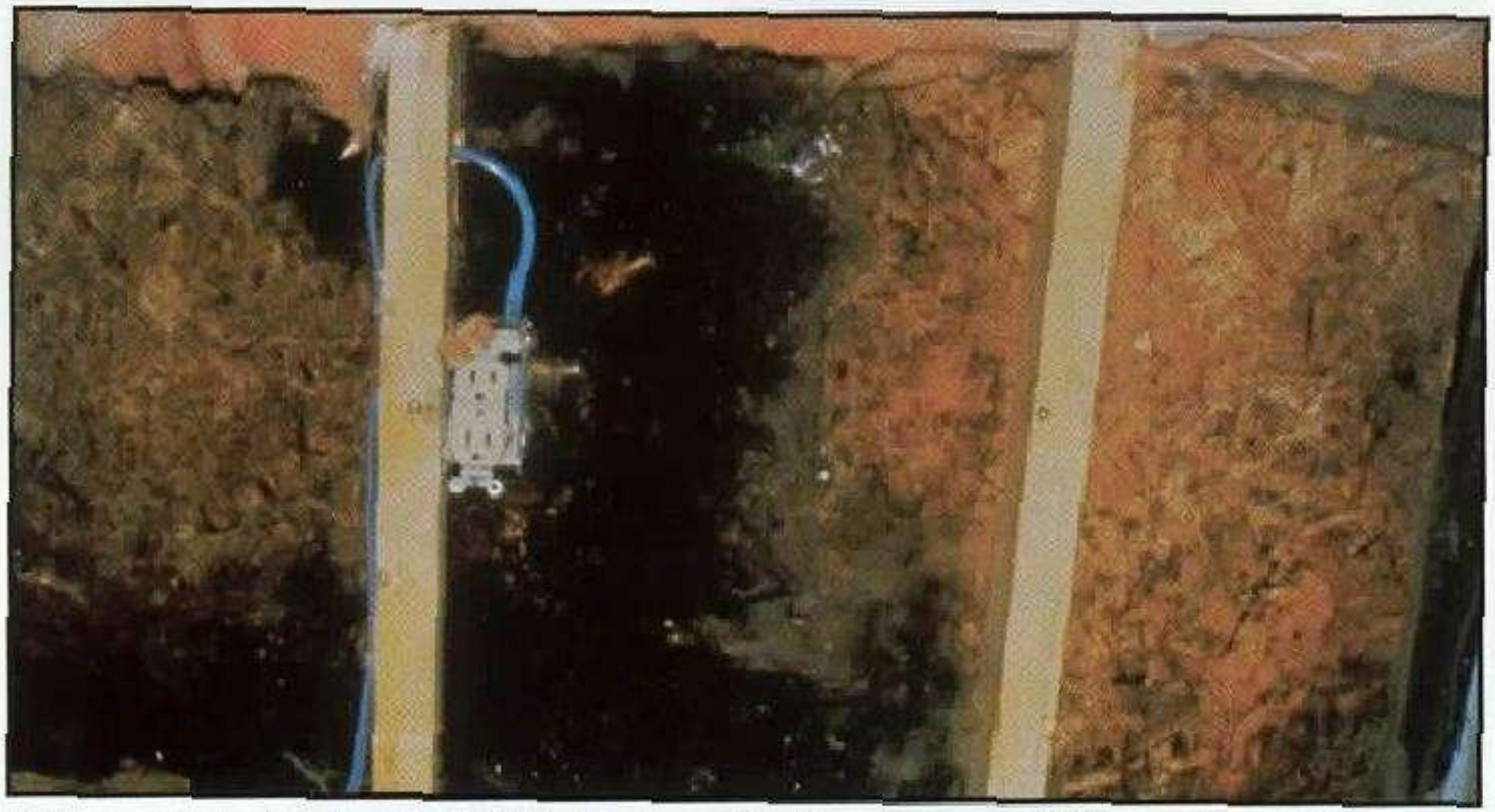


Photo of mold in wall. Photo supplied courtesy of Canadian Home Builders' Association (CHBA) and Canadian Mortgage and Housing Corp. (CMHC)

The " M " Word

Excess moisture in exterior walls causes:

Efflorescence

2.) Air flow into and out of buildings can affect the location of the dew point.

3.) Air leakage into and out of buildings causes the HVAC system to expend extraneous energy in order to maintain the building's desired temperature and humidity levels.

4.) Air flow is a vehicle by which sound travels.

5.) Air flow is a vehicle by which particulate matter travels.

6.) Air flow is a vehicle by which odors and gaseous substances travel.

THE VAPOR BARRIER

Vapor barriers are materials used in Building Enclosure Systems to retard the diffusion of vapor into and through the building enclosure system.

Why Are Vapor Barriers Needed?

By retarding the diffusion of vapor through the Building Enclosure System, conditions that create dew points within Building Enclosure Systems can be reduced or prevented and interior RH levels can be maintained.

What Is Vapor Diffusion?

Vapor diffusion is the process by which vapor seeks to equalize its content between different environments (the Ideal Gas Law).

The driving force (or “potential”) for this occurrence is vapor pressure.

Vapor pressure is a function of the vapor content of the air (RH) and the temperature.

Vapor diffusion is caused by a vapor pressure differential (ΔP) between different environments. The greater the ΔP between environments, the greater the amount of vapor diffusion that occurs.

Table 1. VAPOR PRESSURE FOR VARIOUS TEMPERATURES AND RELATIVE HUMIDITIES (POUNDS PER SQUARE INCH).

Dry bulb temperature	Relative humidity (in percent)									
	100	90	80	70	60	50	40	30	20	10
°F.										
100	0.948	0.854	0.758	0.663	0.569	0.474	0.379	0.284	0.189	0.095
90	.698	.628	.558	.489	.419	.349	.279	.209	.140	.070
80	.506	.455	.405	.357	.303	.253	.202	.152	.101	.051
75	.429	.386	.343	.300	.258	.214	.172	.129	.086	.043
70	.362	.326	.290	.253	.217	.181	.145	.108	.072	.036
65	.305	.274	.244	.213	.183	.152	.122	.091	.061	.030
60	.256	.230	.205	.179	.153	.128	.102	.077	.051	.026
55	.214	.192	.171	.149	.128	.107	.085	.064	.042	.021
50	.178	.160	.142	.124	.107	.089	.071	.053	.036	.018
45	.147	.132	.118	.111	.088	.073	.059	.044	.029	.015
40	.122	.110	.098	.085	.073	.061	.049	.037	.024	.012
35	.100	.090	.080	.070	.060	.050	.040	.030	.020	.010
30	.080	.072	.064	.056	.048	.040	.032	.024	.016	.008
25	.063	.057	.050	.044	.037	.032	.025	.019	.012	.006
20	.052	.047	.042	.036	.031	.026	.020	.015	.010	.005
10	.031	.028	.025	.022	.018	.015	.012	.009	.006	.003
0	.018	.016	.014	.013	.010	.009	.007	.005	.003	.002
−10	.011	.010	.009	.008	.007	.006	.004	.003	.002	.001
−15	.008	.007	.006	.005	.005	.004	.003	.002	.002	.001

Reference: HUD Research Paper No. 28, Moisture Migration from the Ground.

The Dew Point

The dew point is the temperature at which air that contains a certain amount of vapor can no longer hold that vapor and must exhaust itself of excess vapor by depositing it on adjacent surfaces in the form of condensation (water).

Where does the water on the outside of the glass come from?

Dew Point Calculator

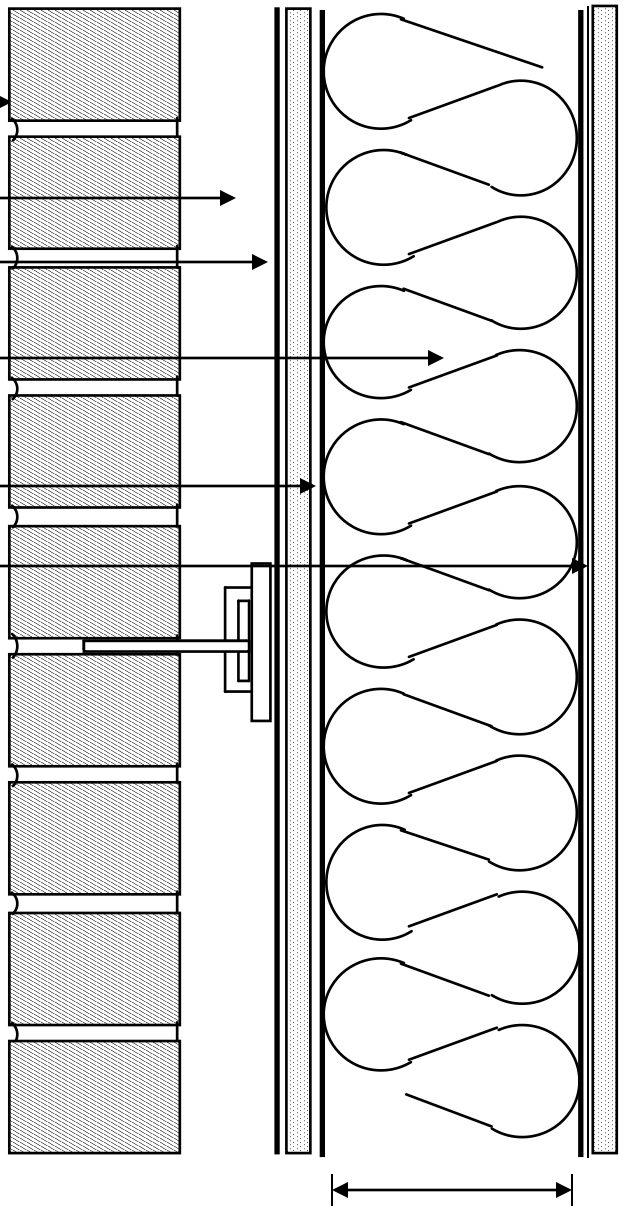
Air Temp °F	% Relative Humidity																	
	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10
110	110	108	106	104	102	100	98	95	93	90	87	84	80	76	72	65	60	51	41
105	105	103	101	99	97	95	93	91	88	85	83	80	76	72	67	62	55	47	37
100	100	99	97	95	93	91	89	86	84	81	78	75	71	67	63	58	52	44	32
95	95	93	92	90	88	86	84	81	79	76	73	70	67	63	59	54	48	40	32
90	90	88	87	85	83	81	79	76	74	71	68	65	62	59	54	49	43	36	32
85	85	83	81	80	78	76	74	72	69	67	64	61	58	54	50	45	38	32	
80	80	78	77	75	73	71	69	67	65	62	59	56	53	50	45	40	35	32	
75	75	73	72	70	68	66	64	62	60	58	55	52	49	45	41	36	32		
70	70	68	67	65	63	61	59	57	55	53	50	47	44	40	37	32			
65	65	63	62	60	59	57	55	53	50	48	45	42	40	36	32				
60	60	58	57	55	53	52	50	48	45	43	41	38	35	32					
55	55	53	52	50	49	47	45	43	40	38	36	33	32						
50	50	48	46	45	44	42	40	38	36	34	32								
45	45	43	42	40	39	37	35	33	32										
40	40	39	37	35	34	32													
35	35	34	32																
32	32																		

The dew point is the temperature at which condensation forms on condensing surfaces. When air comes into contact with a surface that is at or below the dew point temperature of that air, condensation will form on it.

EXAMPLE 1: If the interior air temperature is 70˚ F and has an RH of 30%, the infiltration of air that is 37˚ F (the dew point temperature) can cool condensing surfaces to this temperature (37 ˚) causing dew to form on these surfaces.

EXAMPLE 2: If exterior air with a temperature of 85˚ F and an RH of 70% infiltrates into the building envelope, dew will form on condensing surfaces in the system that have temperatures of 74˚ F or less.

THE DYSFUNCTIONAL BUILDING ENCLOSURE SYSTEM



VENEER (PROTECTIVE LAYER)

CAVITY (DRAINAGE SPACE)

WATER RESISTANT BARRIER

(DRAINAGE PLANE)

FIBERGLASS BATTS INSULATION

(HEAT BARRIER)

LGMF & GWB (STRUCTURAL LAYER)

VAPOR BARRIER ???

INTERIOR

HEATED, COOLED AND *HUMIDITY CONTROLLED* ENVIRONMENT

BRICK VENEER IS A " RESEVOIR " CLADDING MATERIAL. IT WILL HOLD MOISTURE AND WHEN HEATED BY SOLAR RADIATION, WILL CREATE EXTREME TEMPERATURES AND VAPOR PRESSURE LEVELS IN THE CAVITY SPACE

GWB SHEATHING IS NOT PROTECTED FROM MOISTURE INTRUSION IN ITS GASEOUS FORM

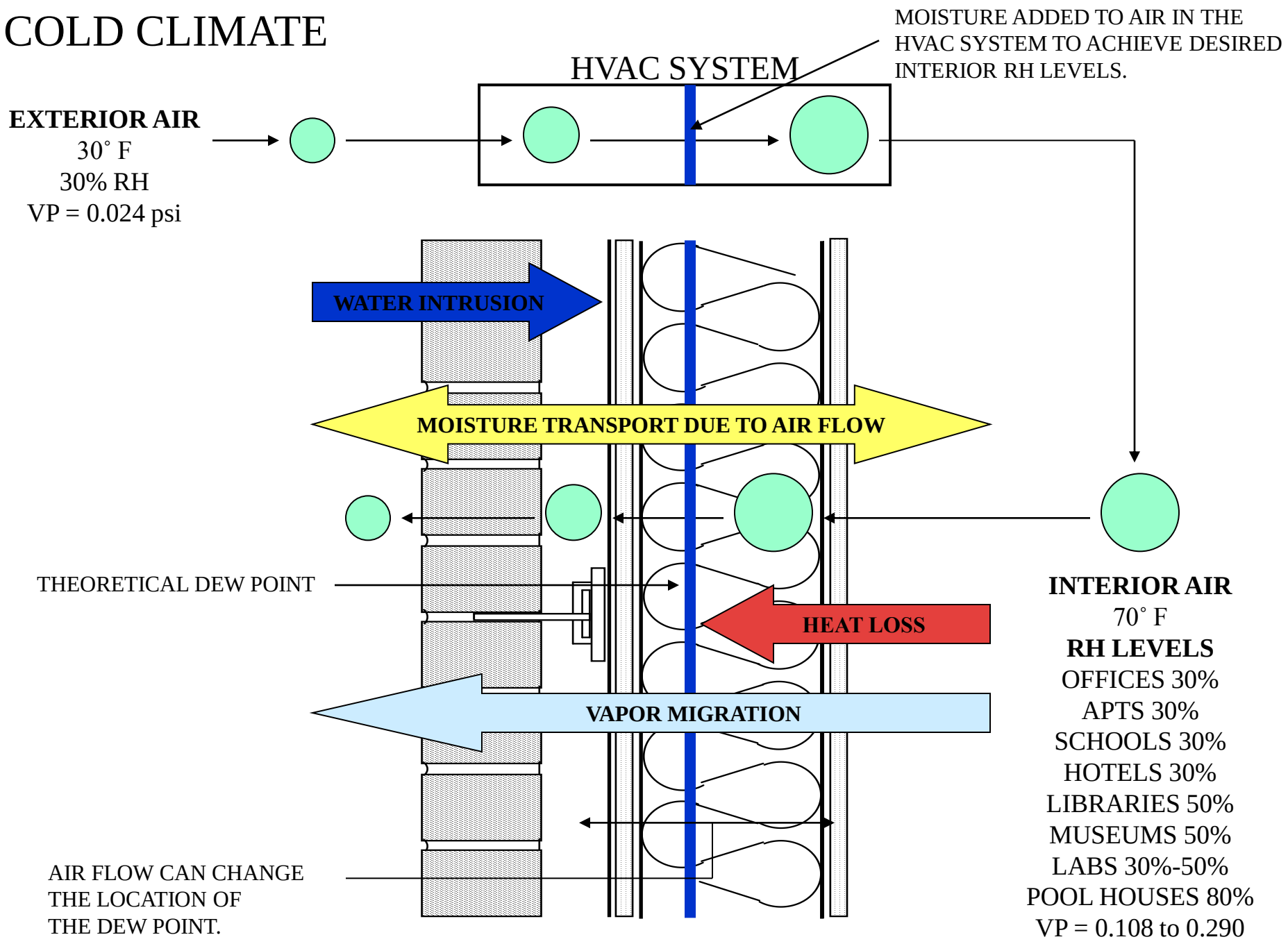
GWB ABSORBS AND RETAINS MOISTURE AND WILL DEGRADE OR DETERIORATE UNDER FAIRLY LOW MOISTURE CONTNENT LEVELS AS WELL AS HOST MICROBIAL GROWTH

LGMF SYSTEMS WITH GWB AND VAPOR BARRIERS CREATE CHAMBERS FROM WHICH VAPOR CANNOT BE EASILY VENTED

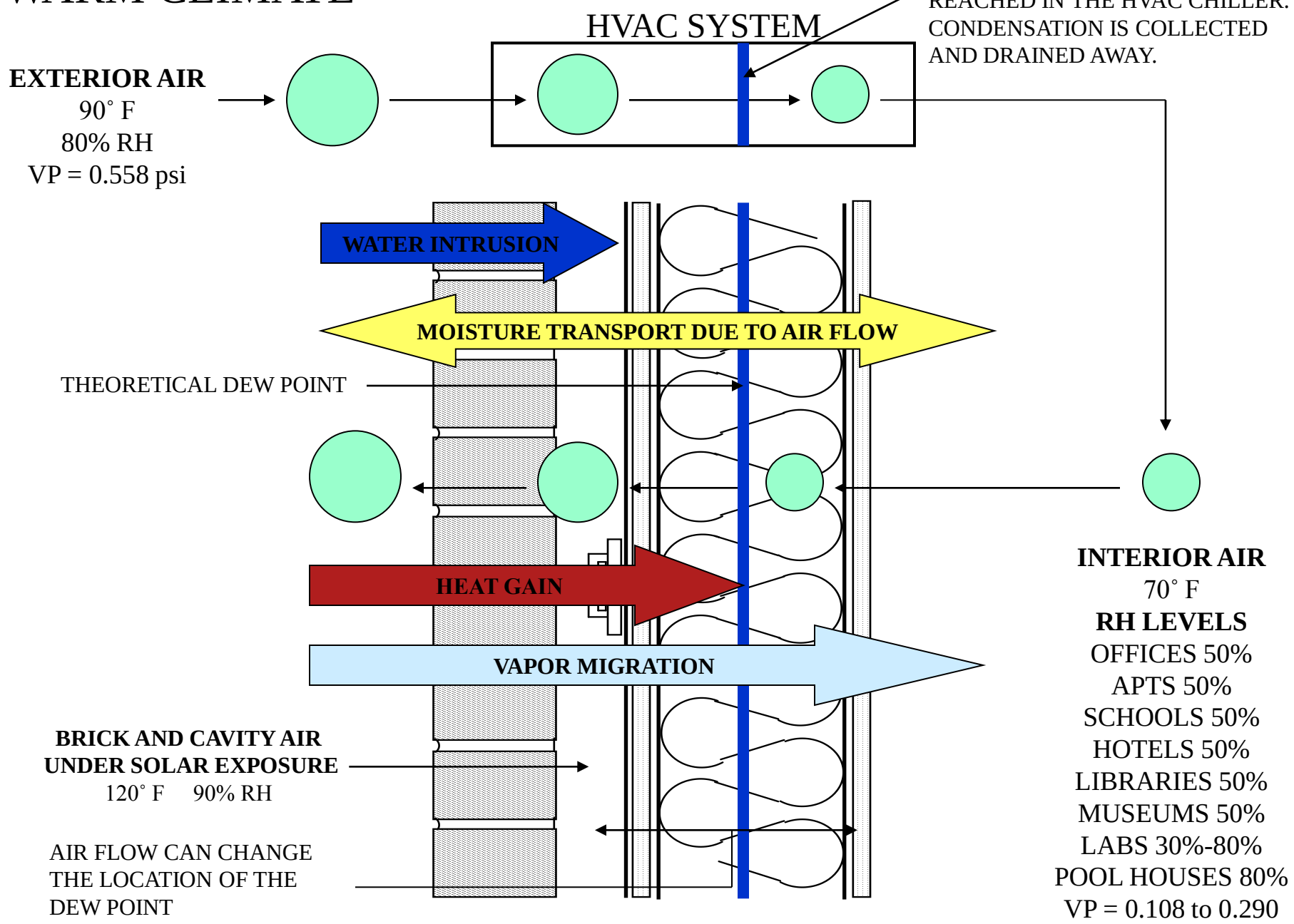
LGMF MEMBERS WILL CORRODE WHEN EXPOSED HIGH RH LEVELS

DEW POINT RANGE

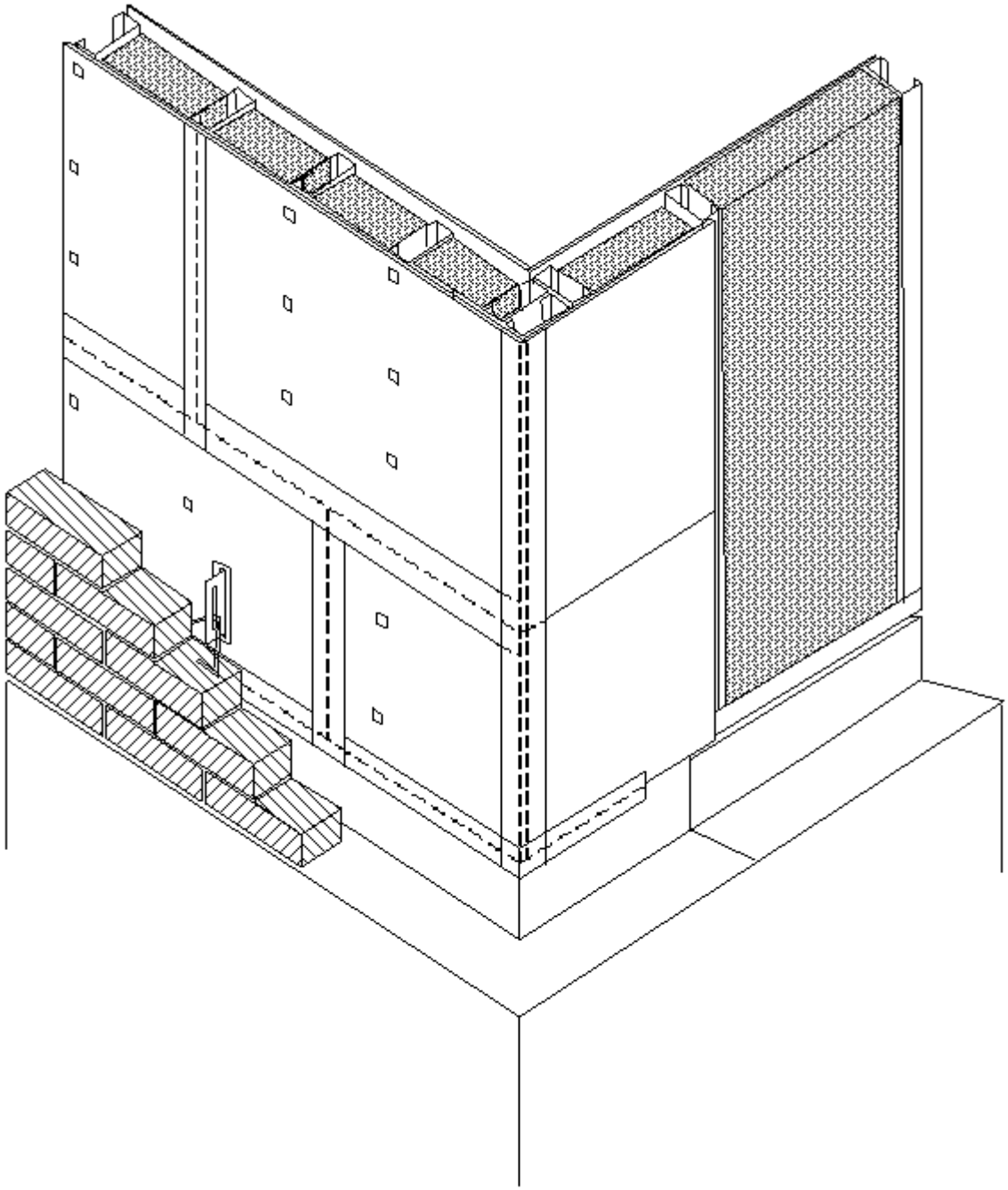
COLD CLIMATE



WARM CLIMATE



How Do Walls With Air Barrier Systems Work?



VAPOR PERMEABLE AIR BARRIER SYSTEM

BRICK VENEER

CAVITY

GYPSUM SHEATHING, RIGID POLYSTYRENE INSULATION OR POLYOLEFIN FILMS W/ TERMINATIONS AND PENETRATIONS SEALED

CAVITY INSULATION (IF REQUIRED)

LIGHT GAGE METAL FRAMING BACK UP WITH FIBERGLASS BATTS INSULATION BETWEEN STUDS

POLYETHYLENE VAPOR BARRIER

INTERIOR GYPSUM WALL BOARD

NOTES

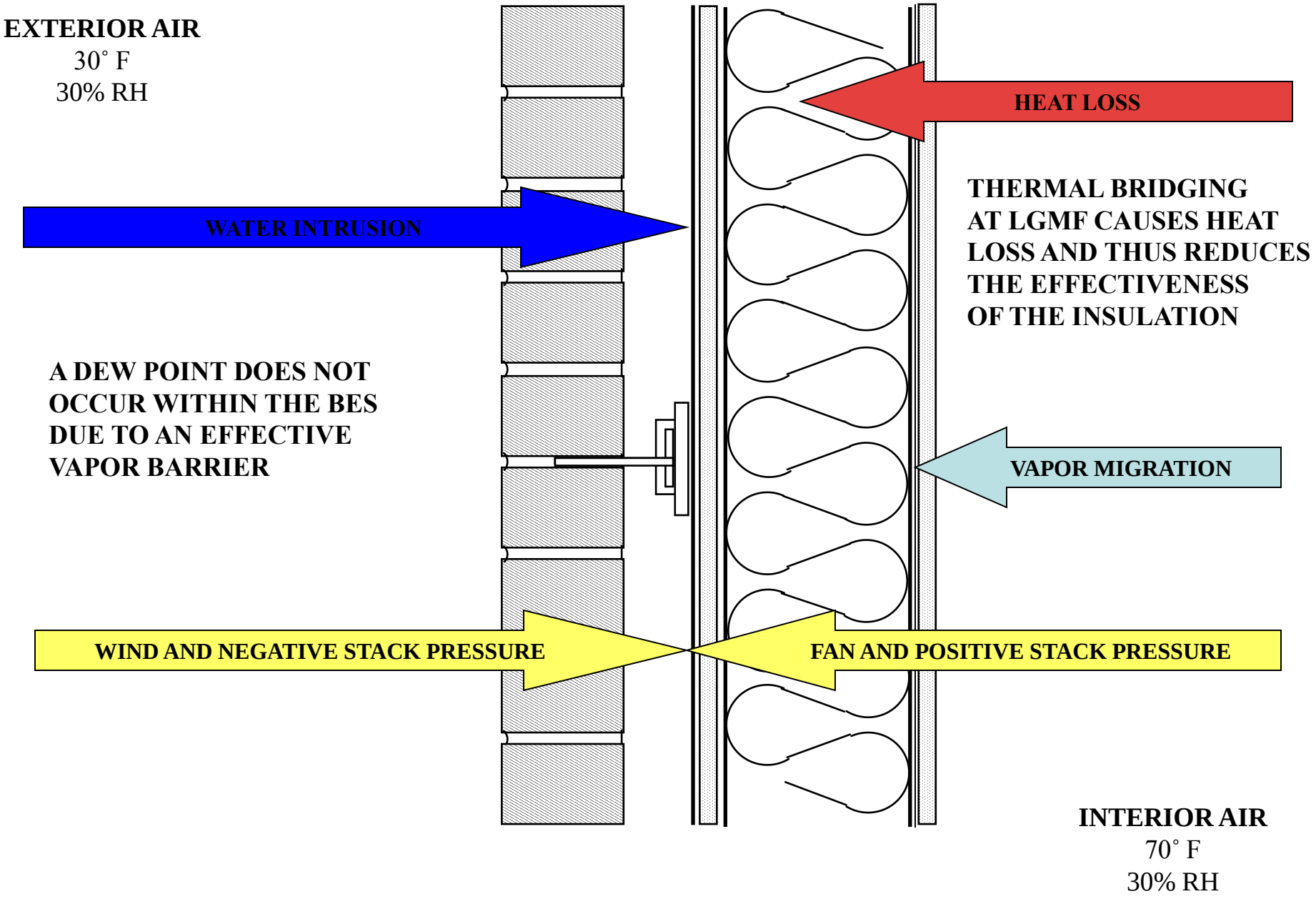
1.) ALL SCREW PENETRATIONS THROUGH EXTERIOR GWB MUST BE SEALED

2.) ALL VENEER ANCHORS MUST BE BEDDED IN SHEET OR LIQUID APPLIED AIR BARRIER TO PREVENT AIR LEAKAGE

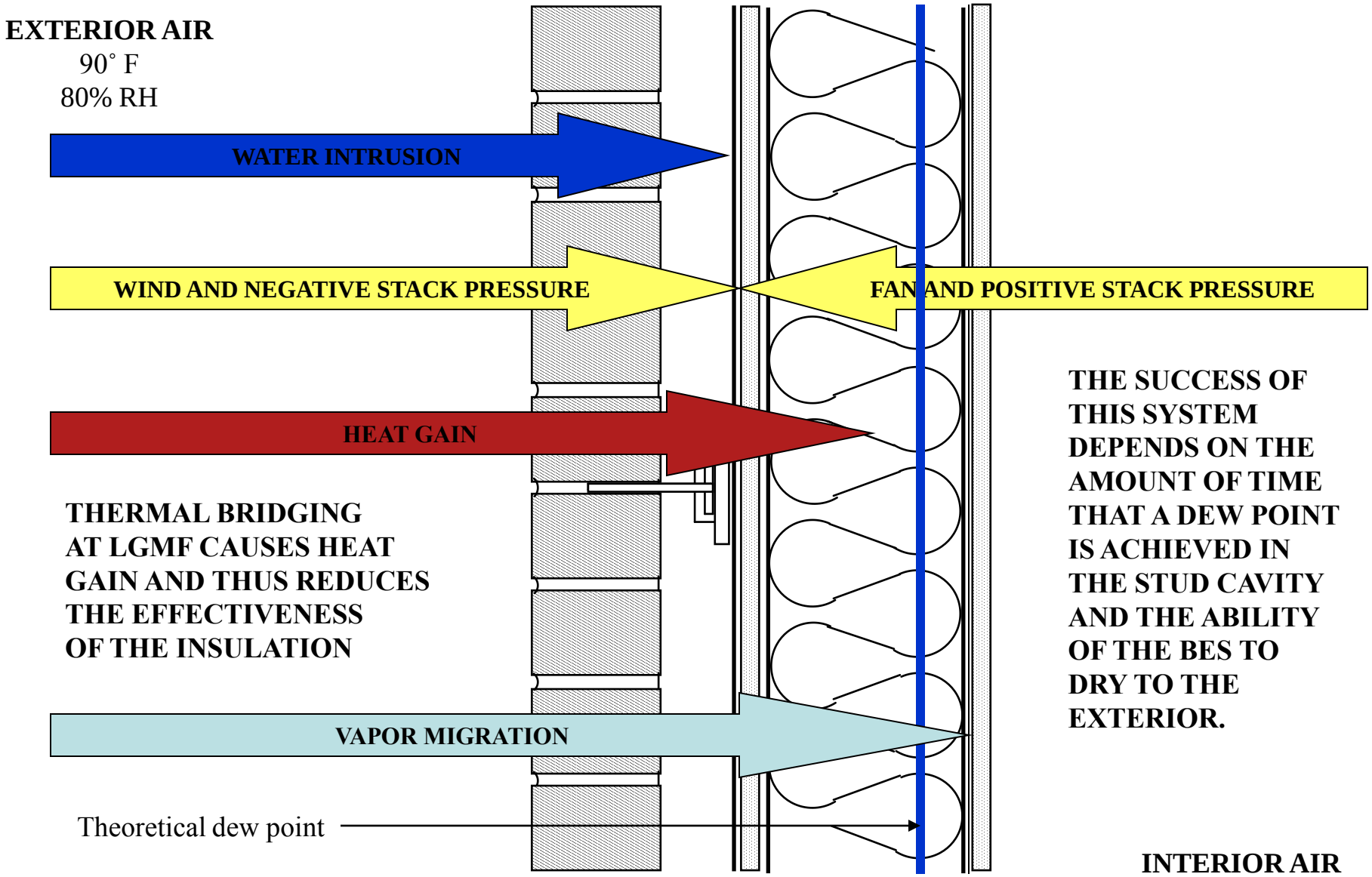
3.) TERMINATION OF EXTERIOR GWB AT THE UNDERSIDE OF RELIEVING ANGLES AND DECKS MUST BE SEALED WITH SHEET APPLIED AIR BARRIER.

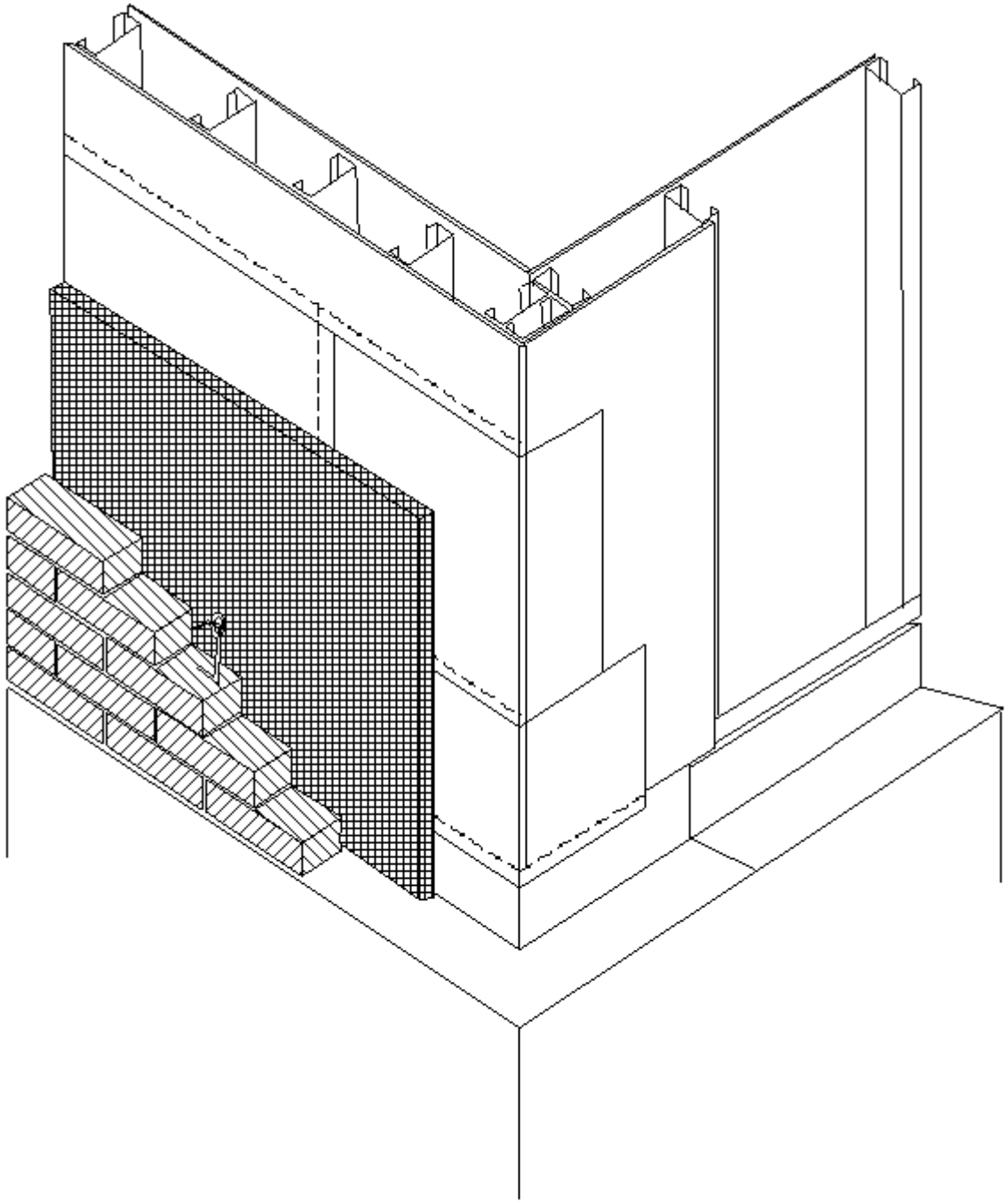
4.) TOP EDGES OF SHEET APPLIED AIR BARRIER MUST BE SEALED WITH LIQUID MEMBRANE OR MASTIC.

Cold Climate Vapor Permeable Air Barrier System: Winter



Cold Climate Vapor Permeable Air Barrier System: Summer





AIR AND VAPOR BARRIER SYSTEM

FACE BRICK

CAVITY

RIGID INSULATION

SHEET OR LIQUID APPLIED AIR BARRIER MEMBRANE

(AIR AND VAPOR BARRIER)

GYPSUM WALL BOARD

LIGHT GAGE METAL FRAMING

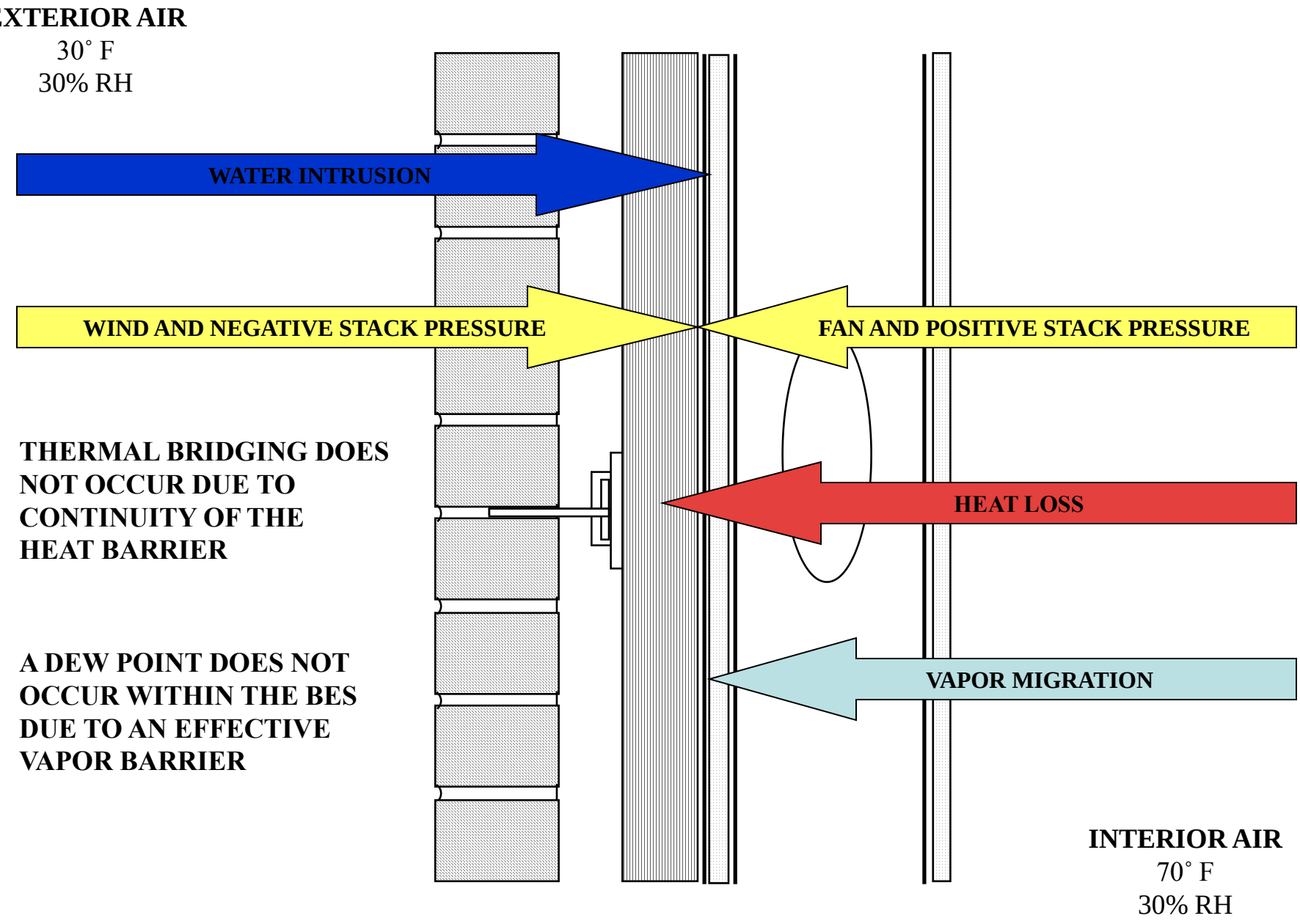
INTERIOR GYPSUM WALL BOARD

NOTES:

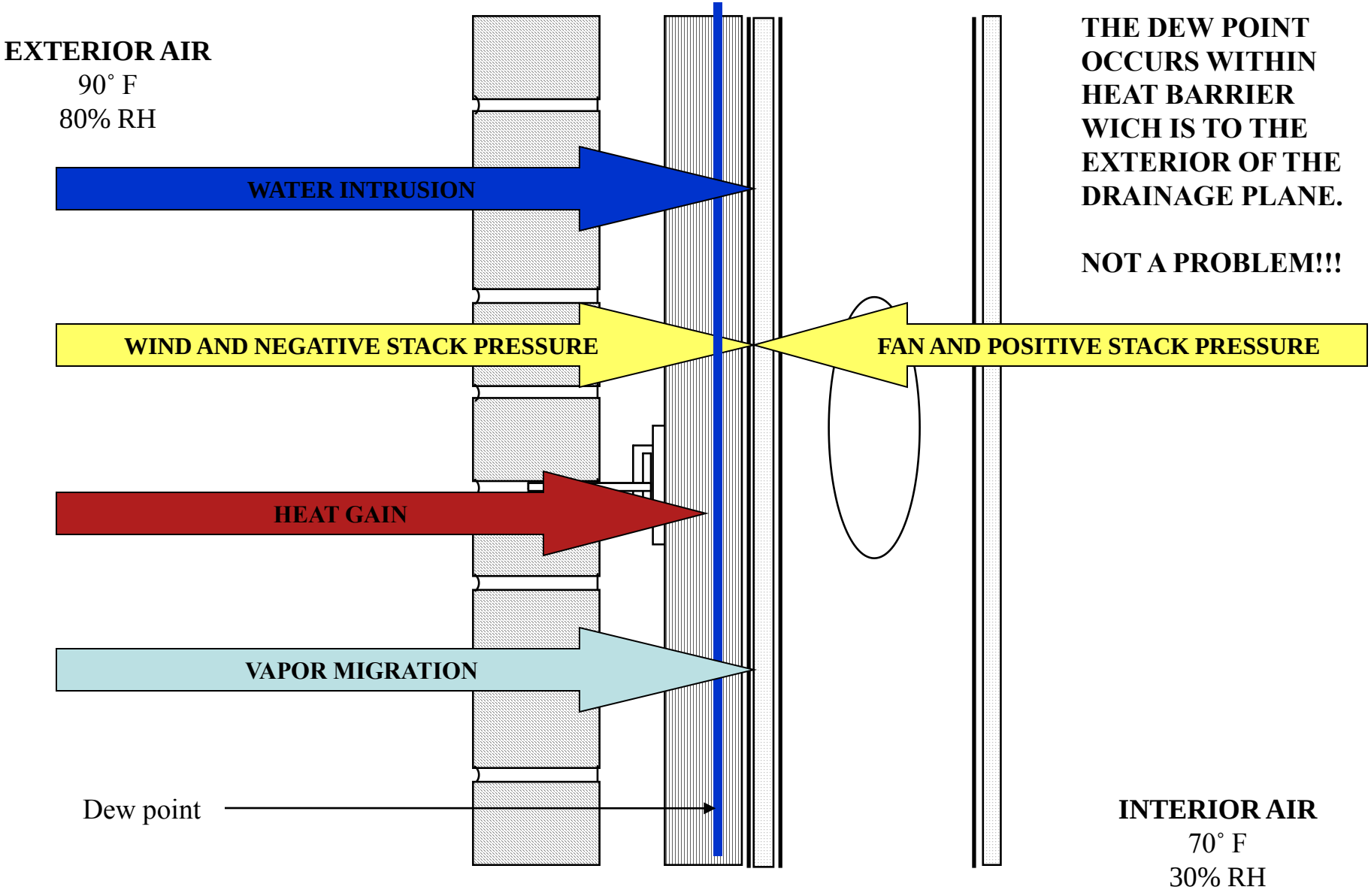
BY INSTALLING THE RIGID INSULATION IN THE CAVITY, THE VAPOR BARRIER CAN BE LOCATED AT THE EXTERIOR FACE OF THE EXTERIOR GWB SHEATHING.

RIGID INSULATION WITH BATTS INSULATION BETWEEN THE LGMF MEMBERS CAN ALSO BE USED FOR THE INSULATION LAYER AS LONG AS 2/3 OF THE R-VALUE OF THE TOTAL INSULATION LAYER IS OUTBOARD OF THE AIR AND VAPOR BARRIER.

Cold Climate Air And Vapor Barrier System: Winter

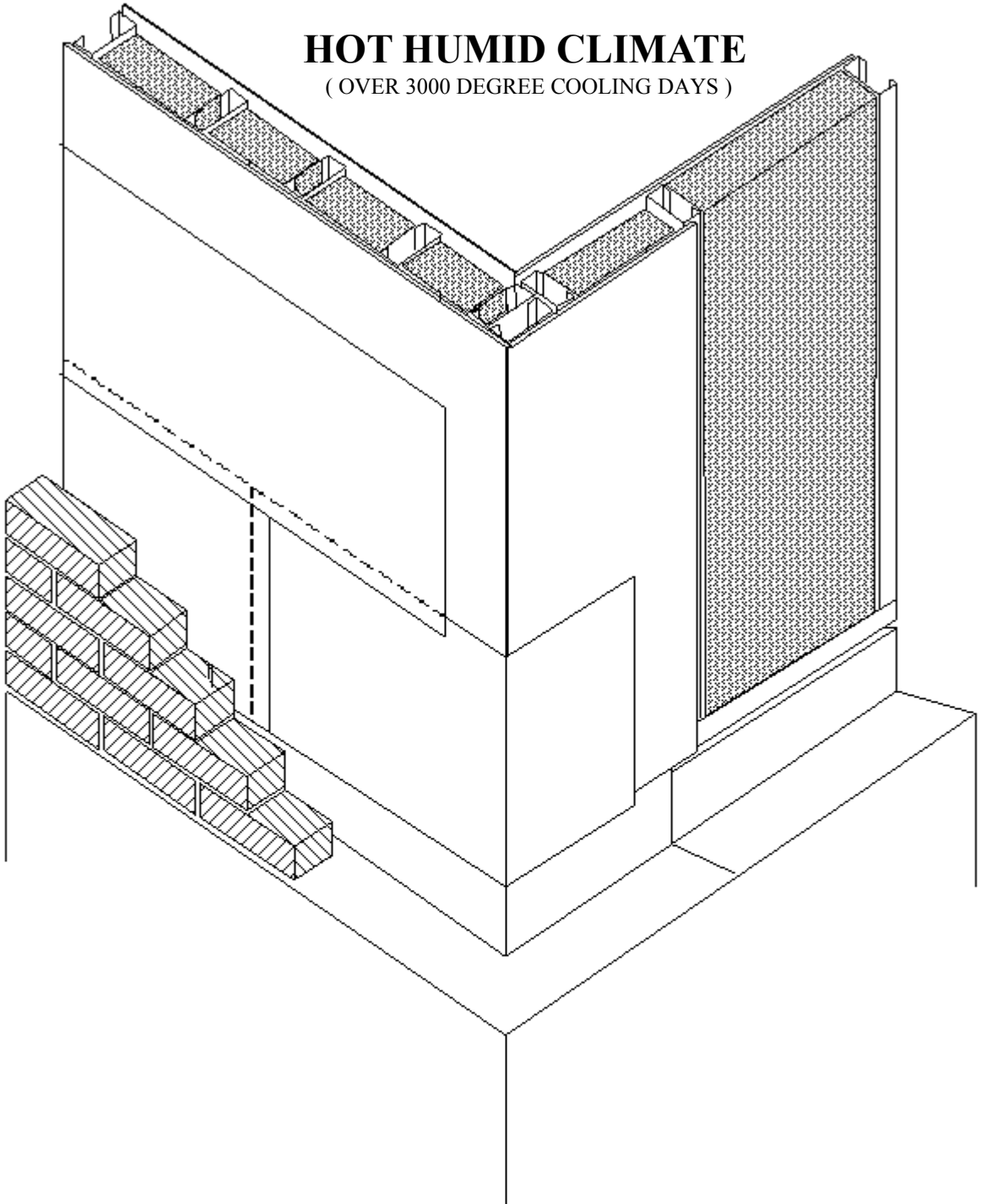


Cold Climate Air And Vapor Barrier System: Summer



HOT HUMID CLIMATE

(OVER 3000 DEGREE COOLING DAYS)



AIR AND VAPOR BARRIER SYSTEM

FACE BRICK

CAVITY

SHEET OR LIQUID APPLIED AIR BARRIER MEMBRANE

(AIR AND VAPOR BARRIER)

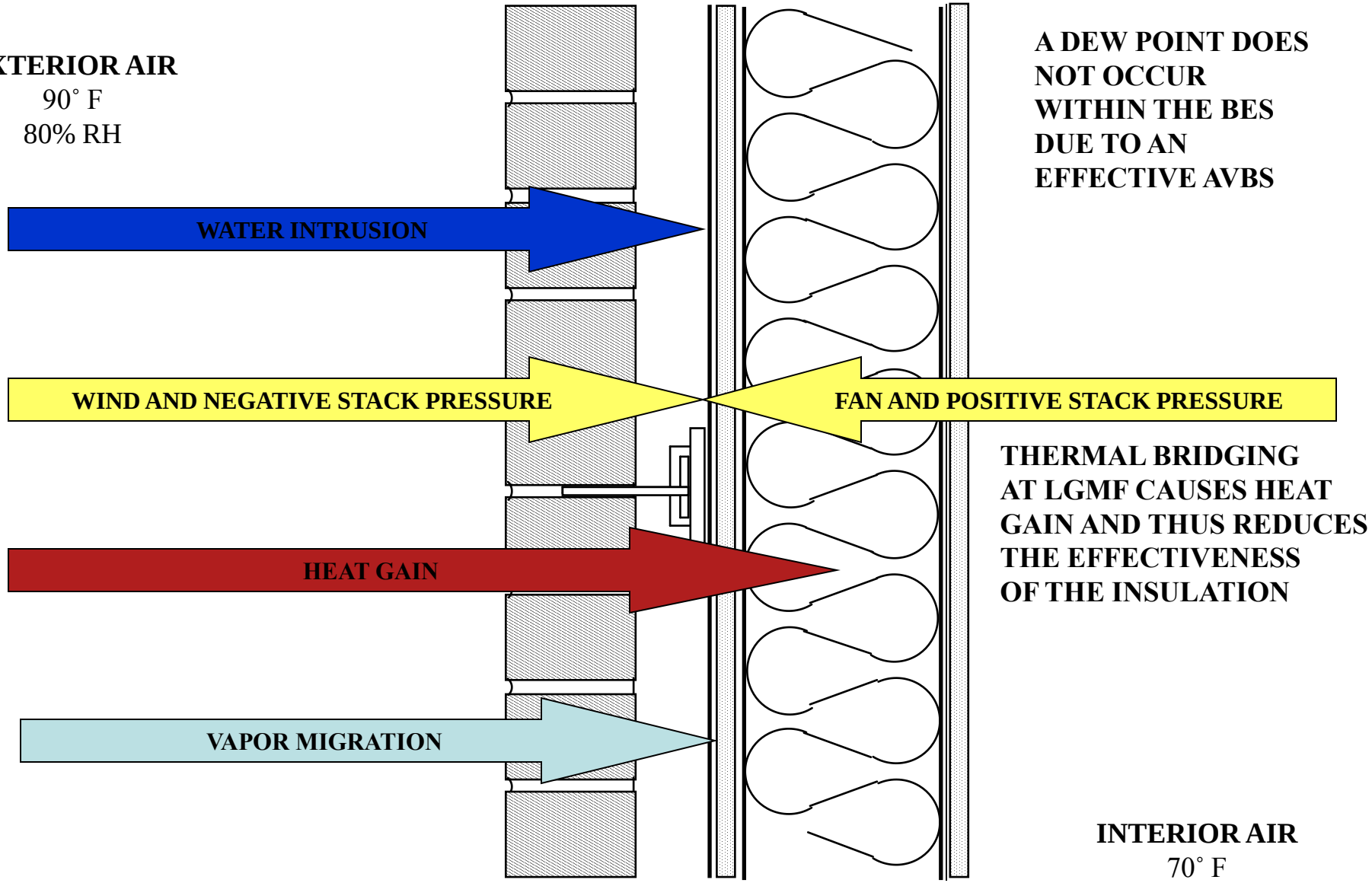
GYPSUM WALL BOARD

LIGHT GAGE METAL FRAMING BACK UP WITH FIBERGLASS BATTS INSULATION BETWEEN STUDS

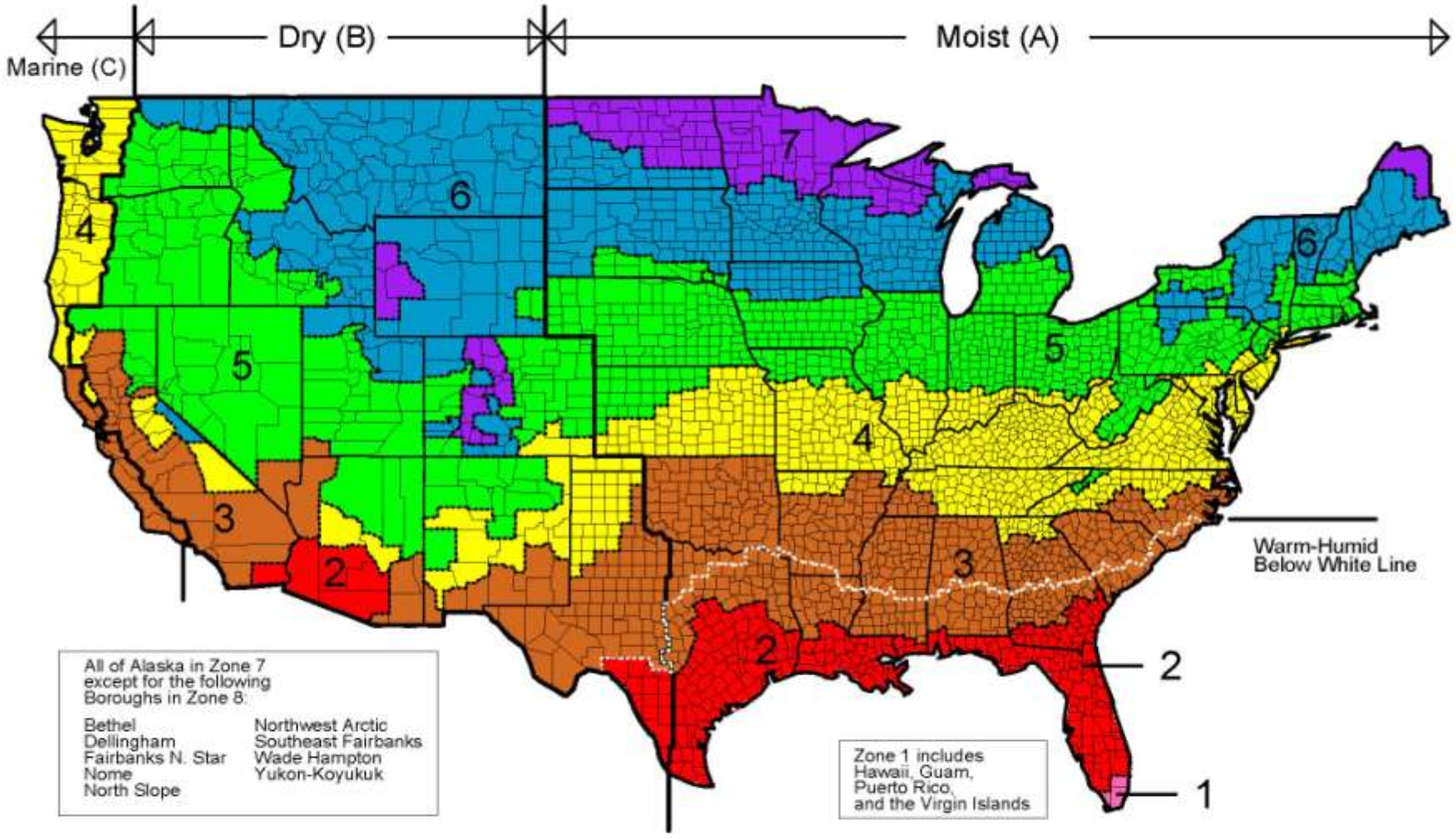
INTERIOR GYPSUM WALL BOARD

Warm Climate Air And Vapor Barrier System

3000 Cooling Degree Days or more



Map of DOE's Proposed Climate Zones



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