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Building Science

Dewatering and Decarbonizing and
Wine...

www.buildingscience.com

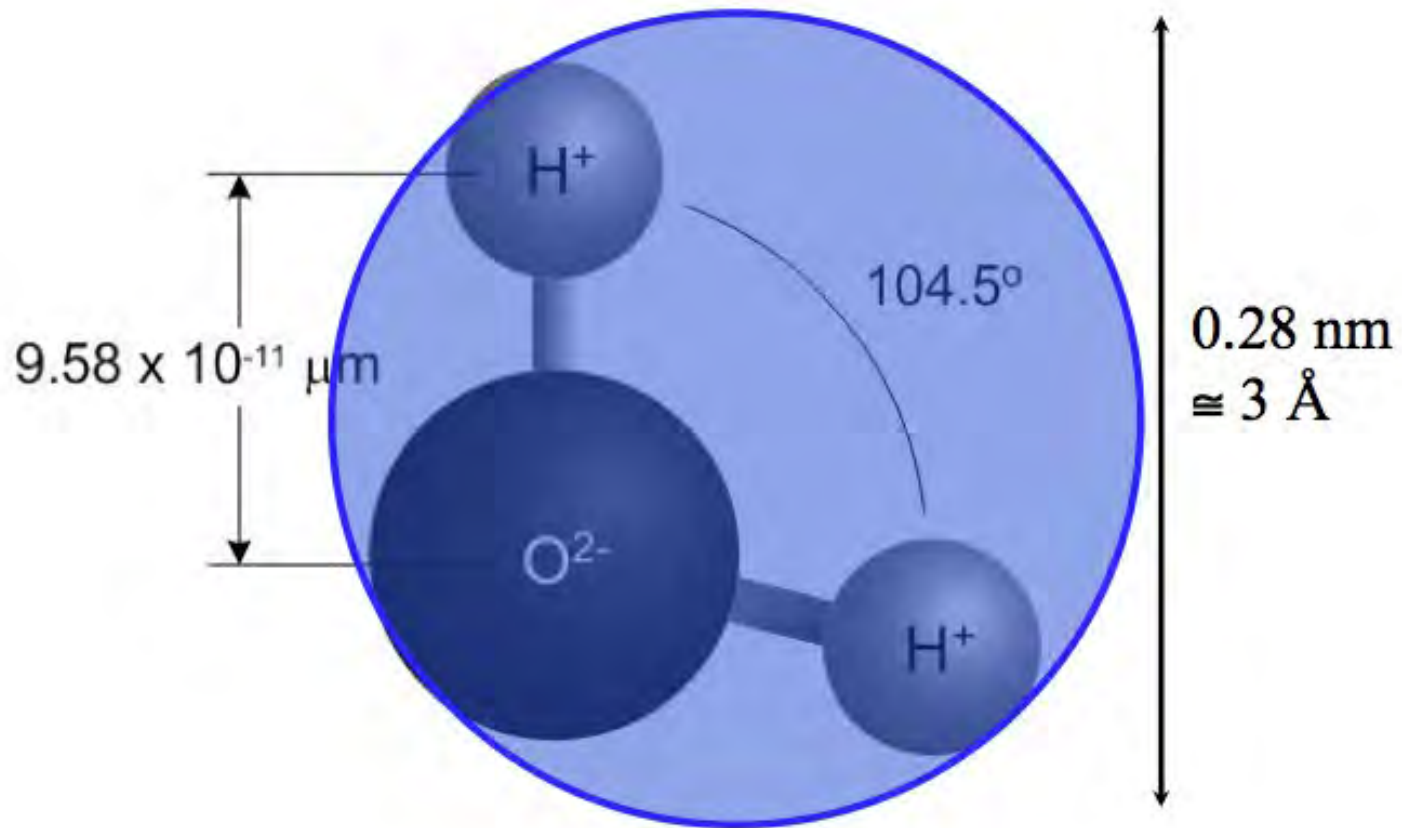
Dewatering and Decarbonizing and Wine...

Efflorescence, Spalling, Freeze-Thaw,
Sorptions, Hyperbolic Curves, Cooling
Towers and Schrodinger Meet Vin Santo's,
Ice Wines, Sauternes and Wine Glasses..

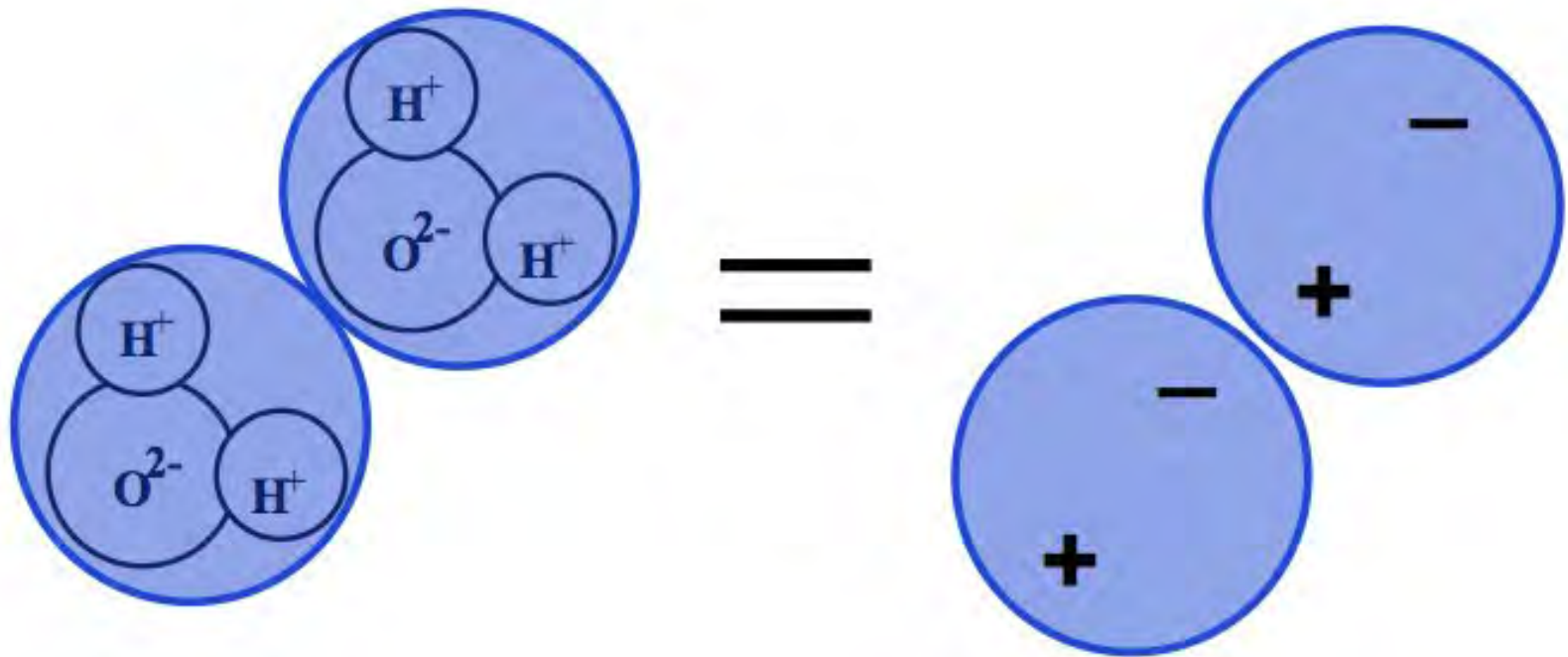
The lessons taught by the water molecule
and construction and wine...

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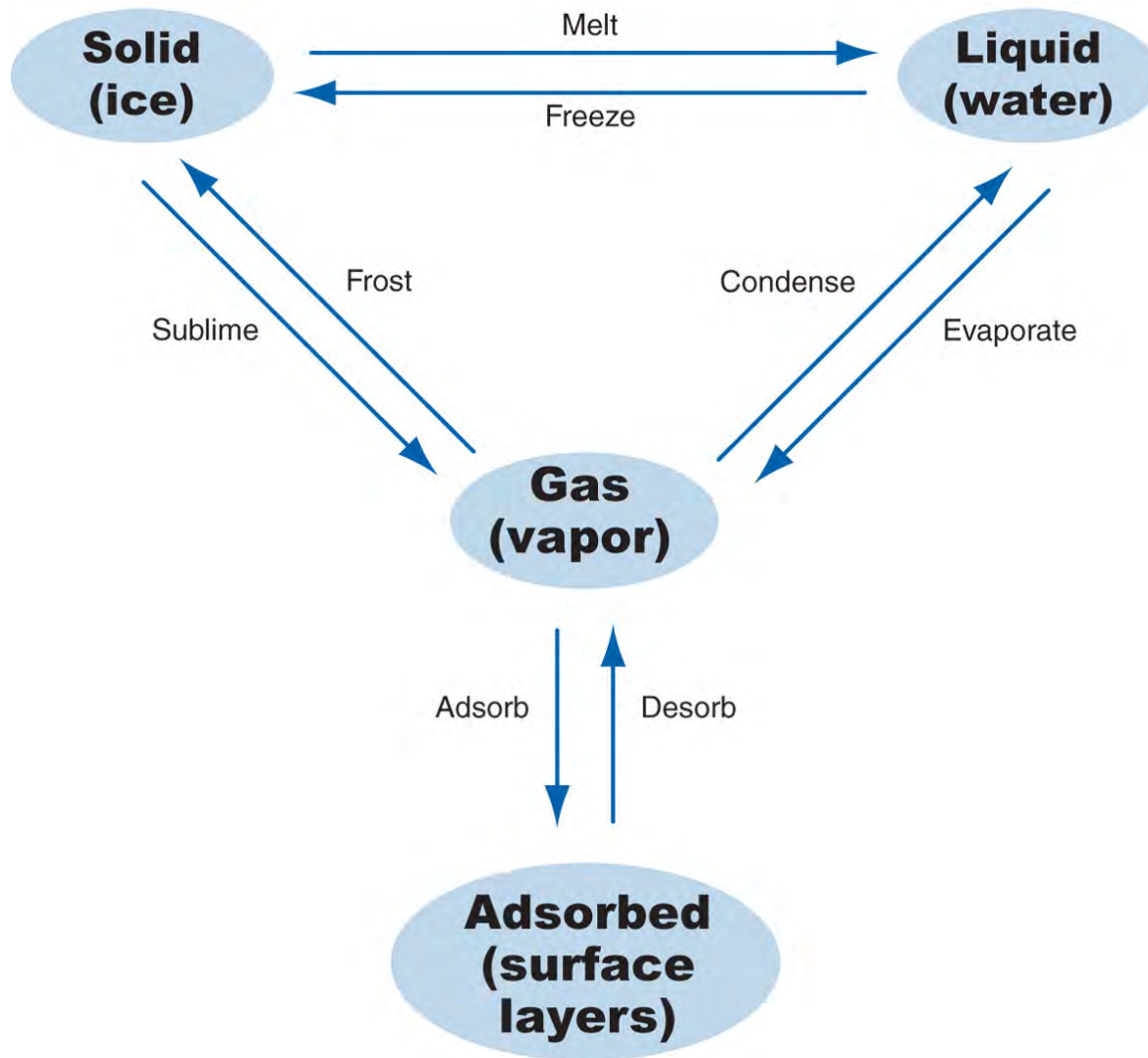
Lessons to be learned from carbon and
construction....with help from water and
wine...

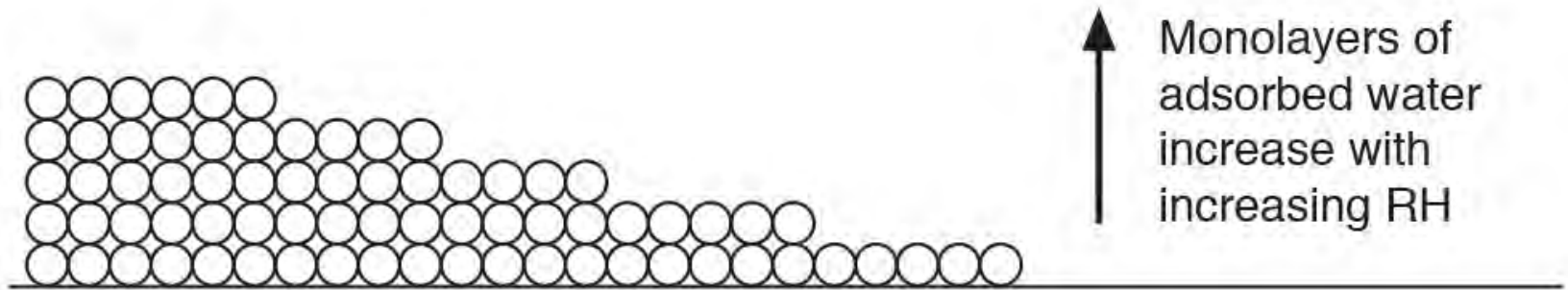


Polar Molecule



Phases of Water







Phase Change....

Liquid water to vapor water...

Evaporation

Liquid water to solid water...

Freezing

Liquid water to adsorbed water...

Sorption







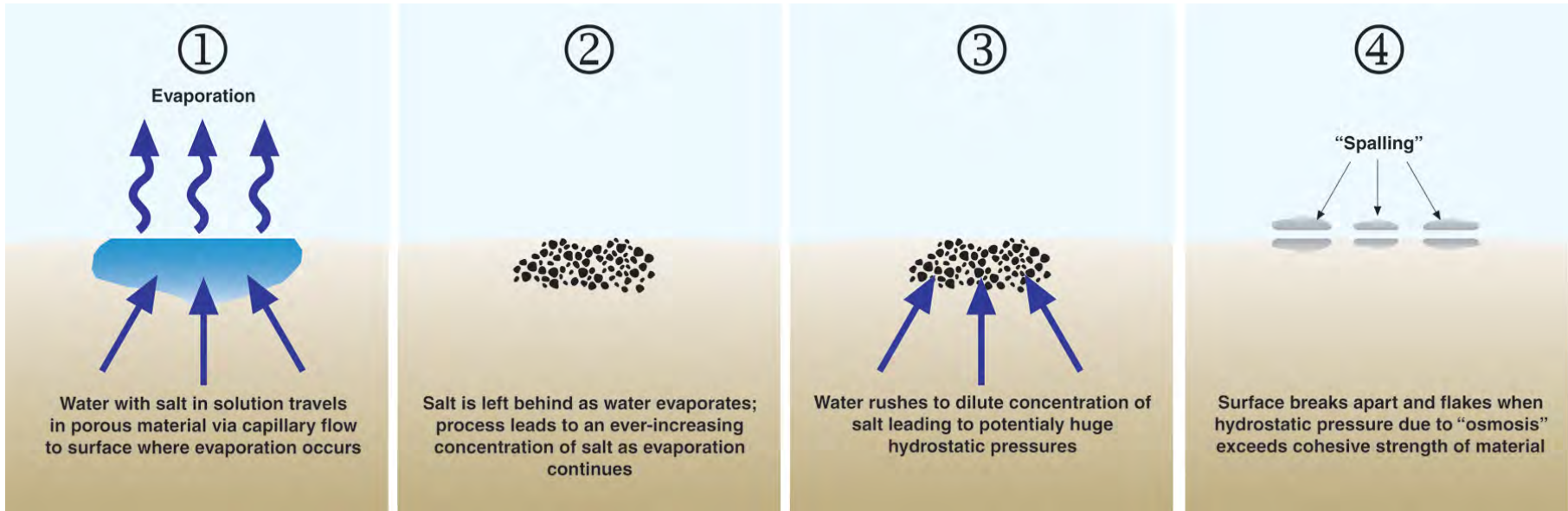
Efflorescence and Spalling

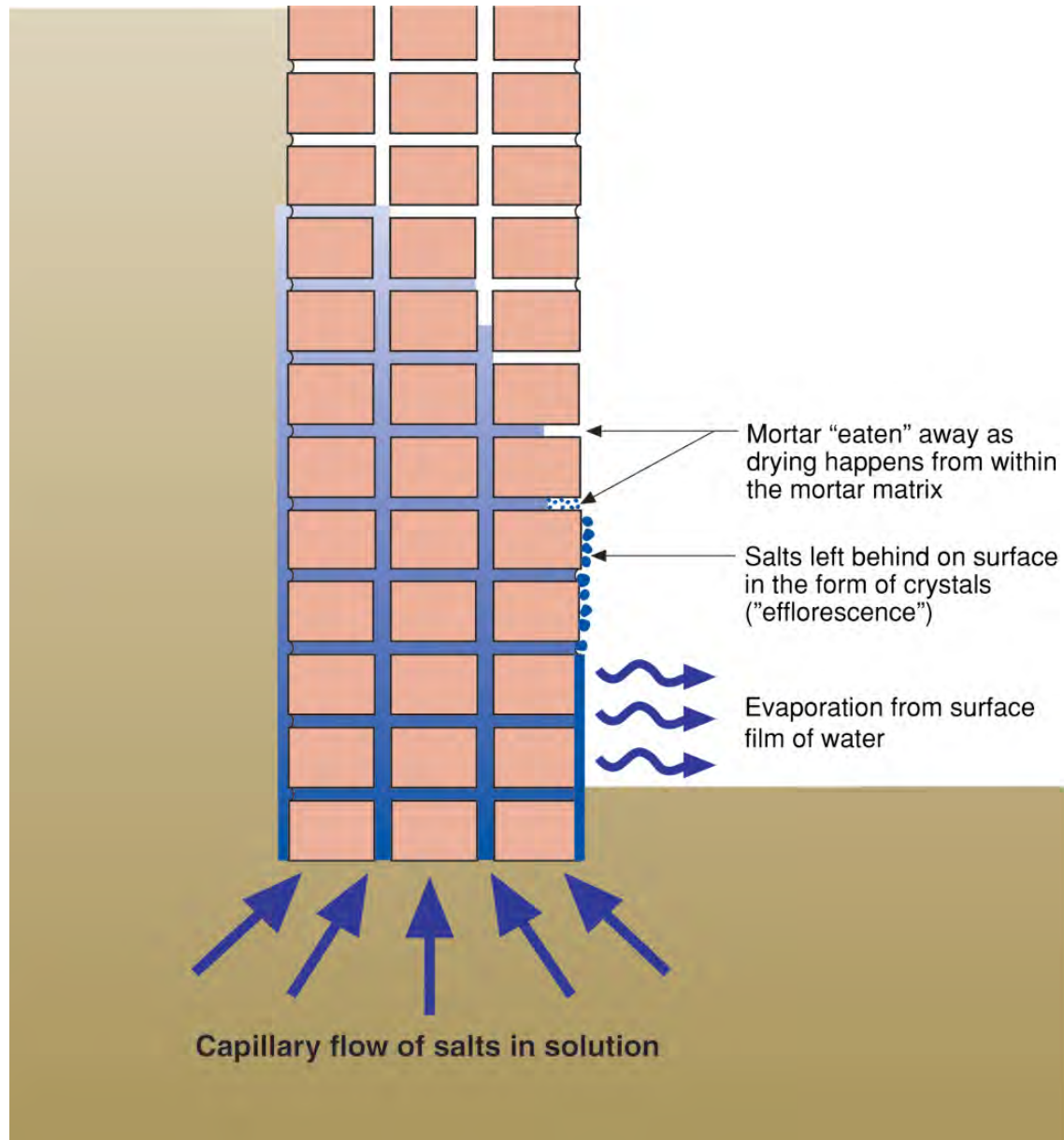


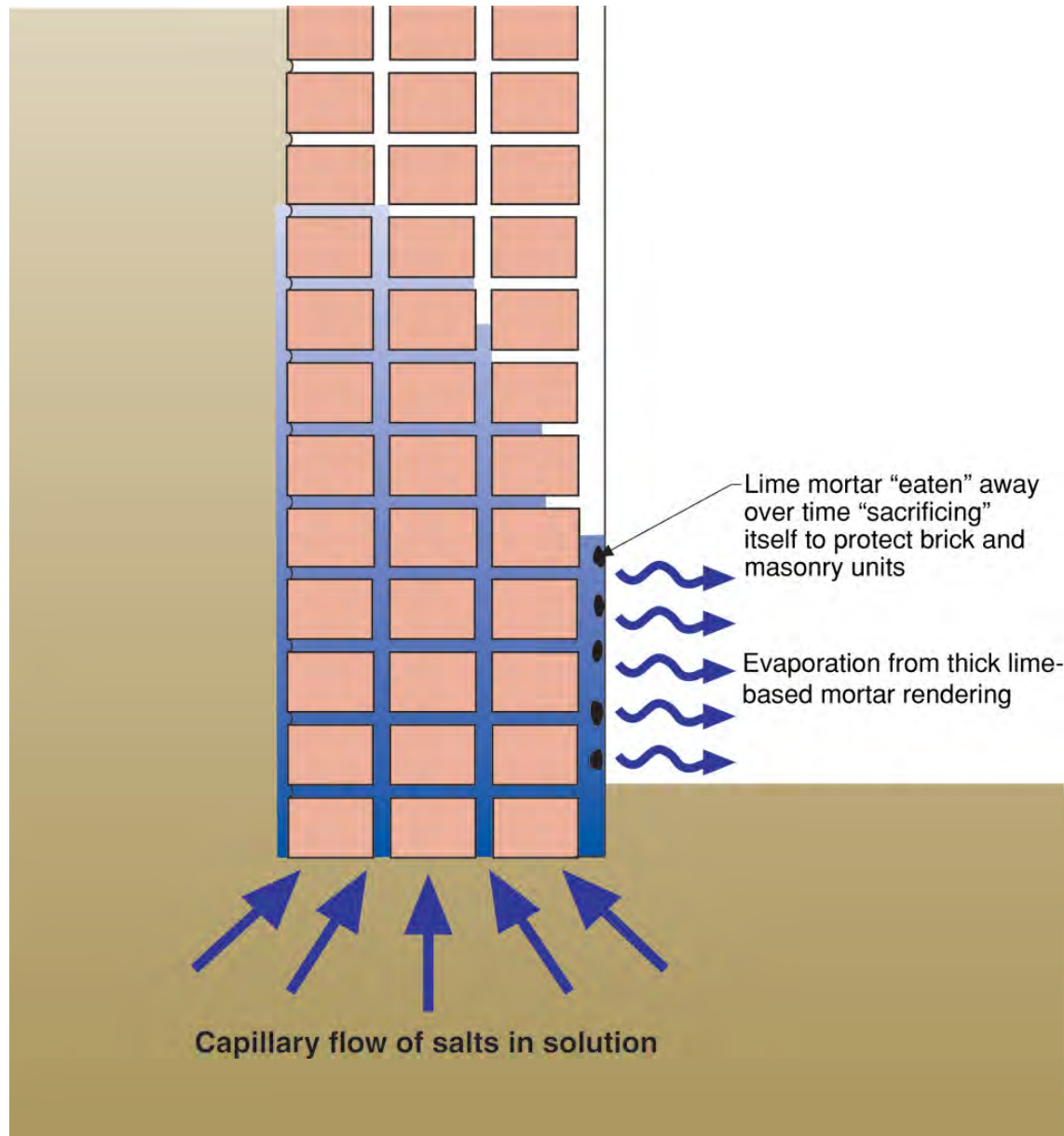
2nd Law of Thermodynamics

In an isolated system, a process can occur only if it increases the total entropy of the system

Rudolf Clausius

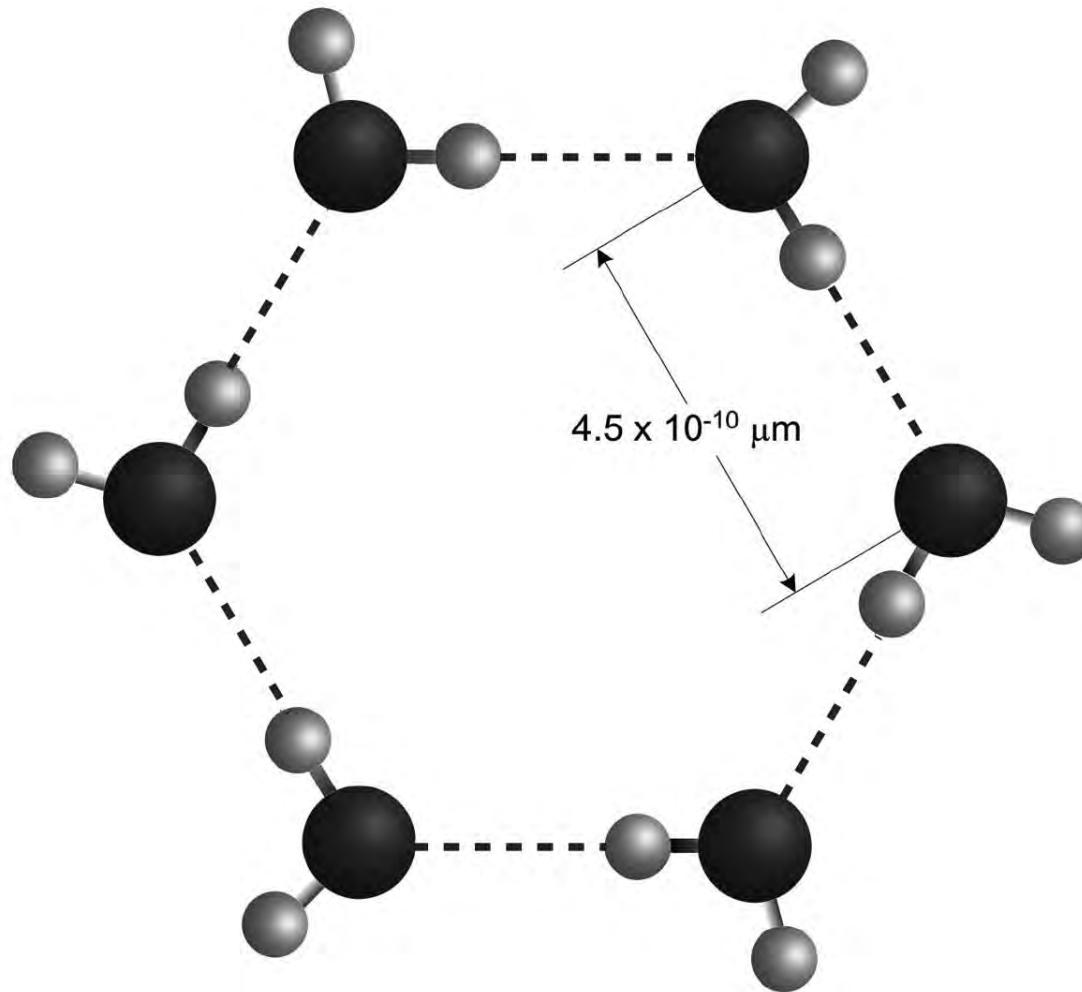


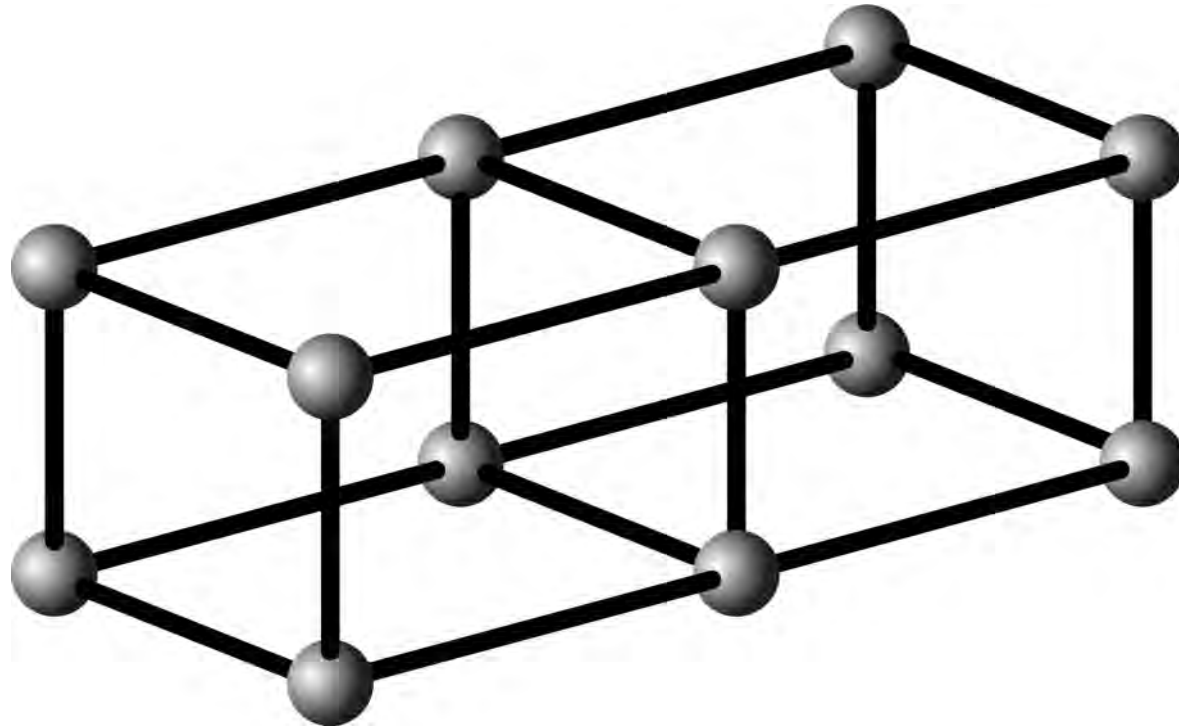




Freeze-Thaw Damage









Air entrainment

“Don Ho” effect...Tiny Bubbles

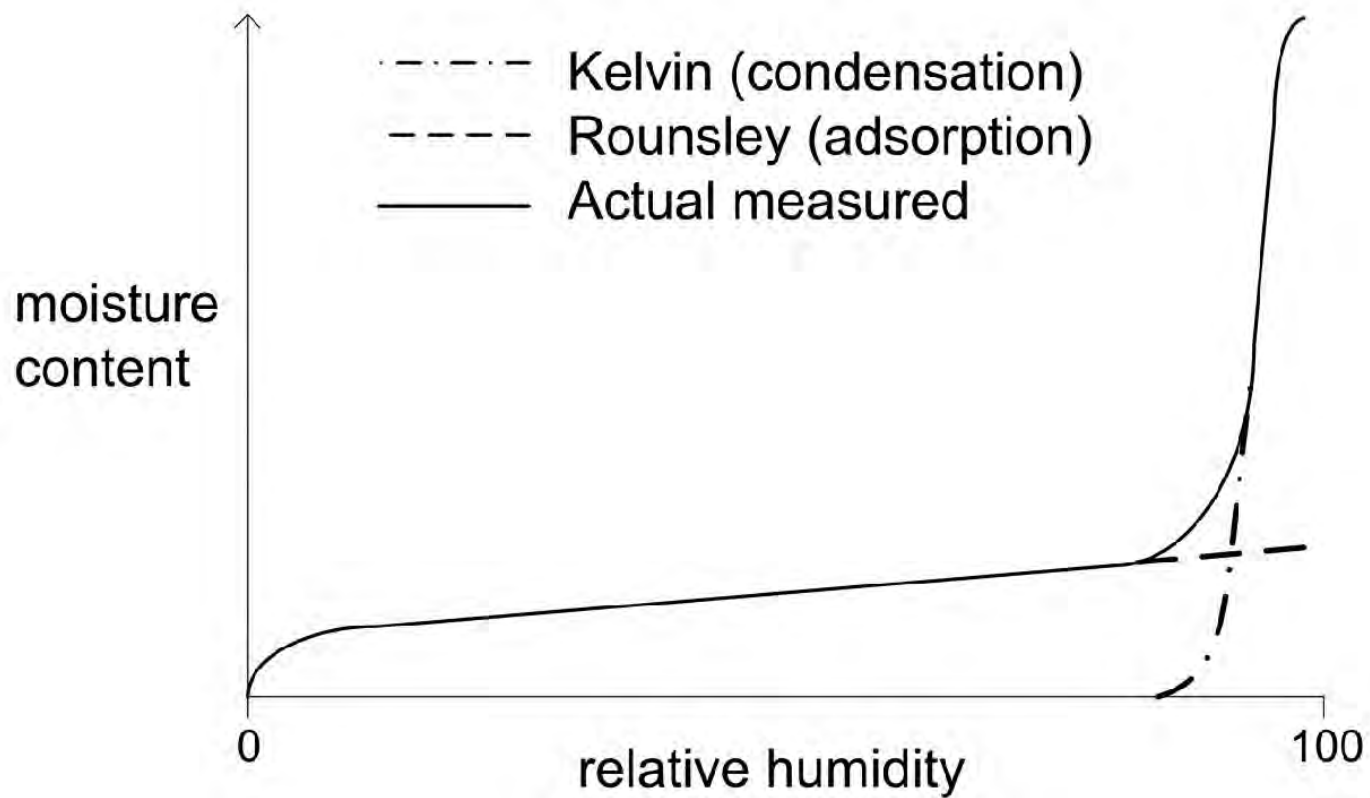
Air entraining admixtures...

Liquid detergent works....Ivory
Snow...back in the day....

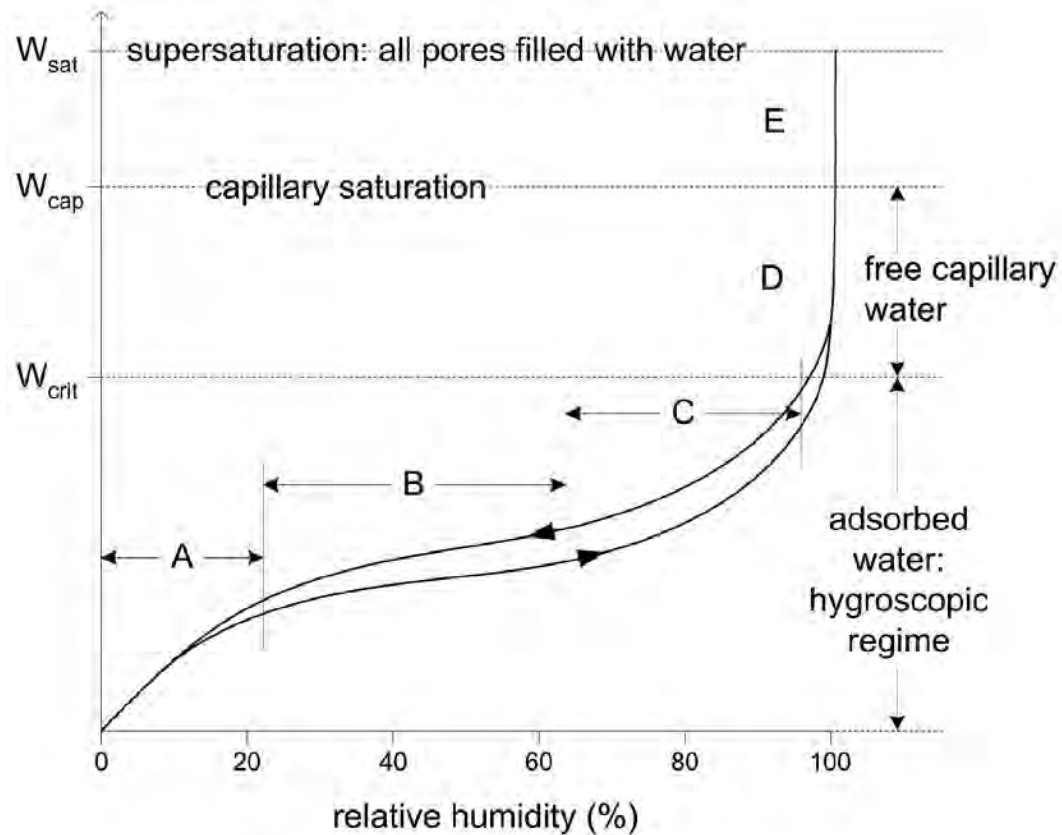
Sorption



BET Theory
Stephen Brunauer
Paul Emmett
Edward Teller



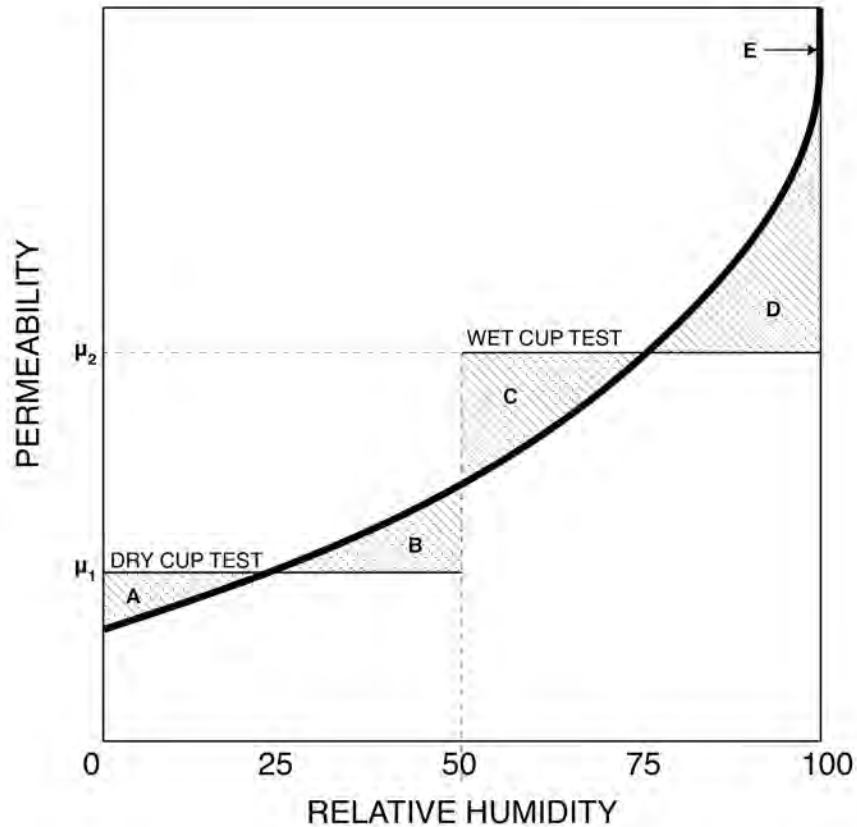
**Typical predicted sorption isotherm according to Kelvin equation
 and modified BET theory**
 From Straube & Burnett, 2005



- A: Single-layer of adsorbed molecules
- B: Multiple layers of adsorbed molecules
- C: Interconnected layers (internal capillary condensation)
- D: Free water in Pores, capillary suction
- E: Supersaturated Regime

Regimes of moisture storage in a hygroscopic porous material

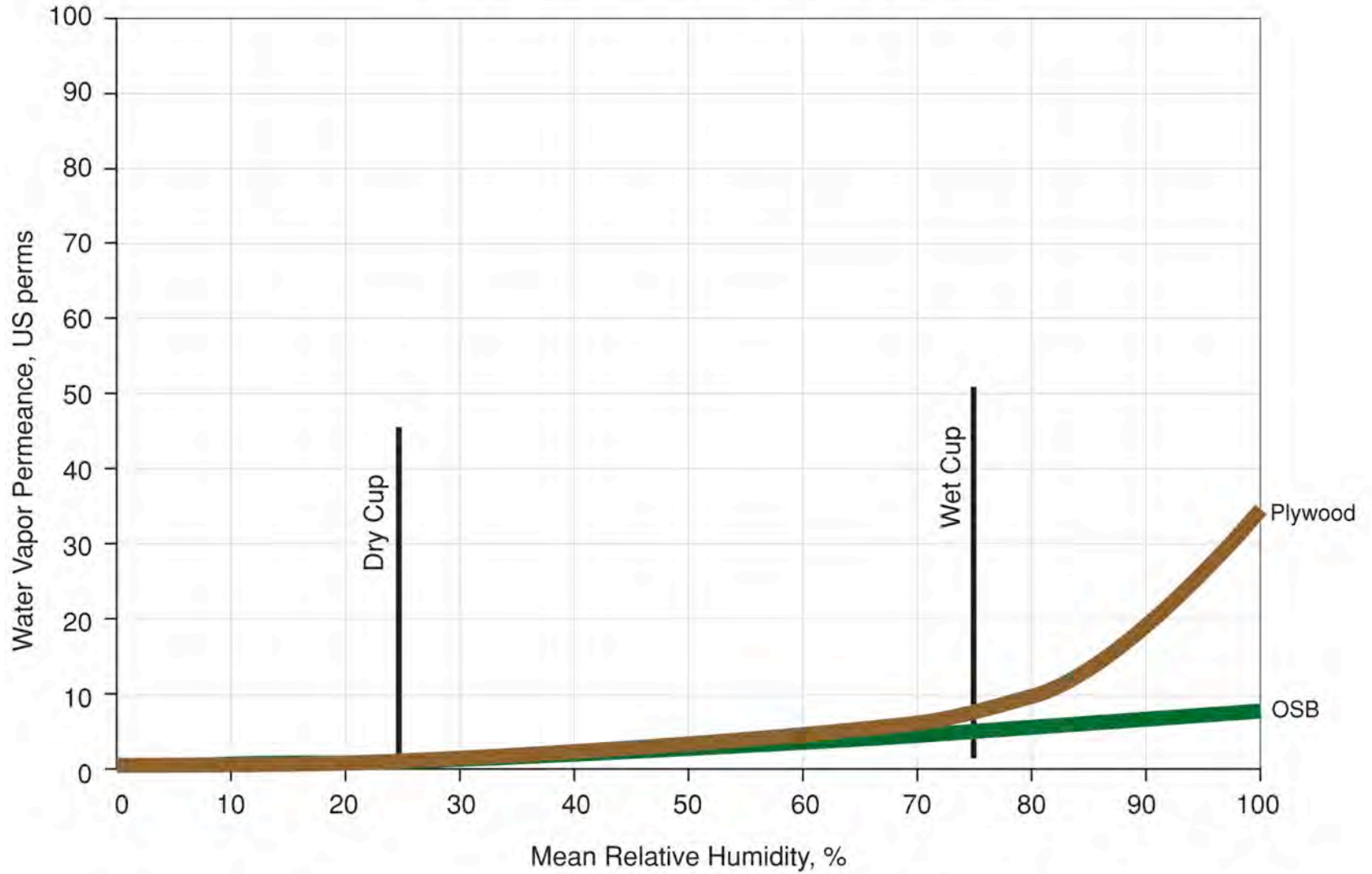
From Straube & Burnett, 2005



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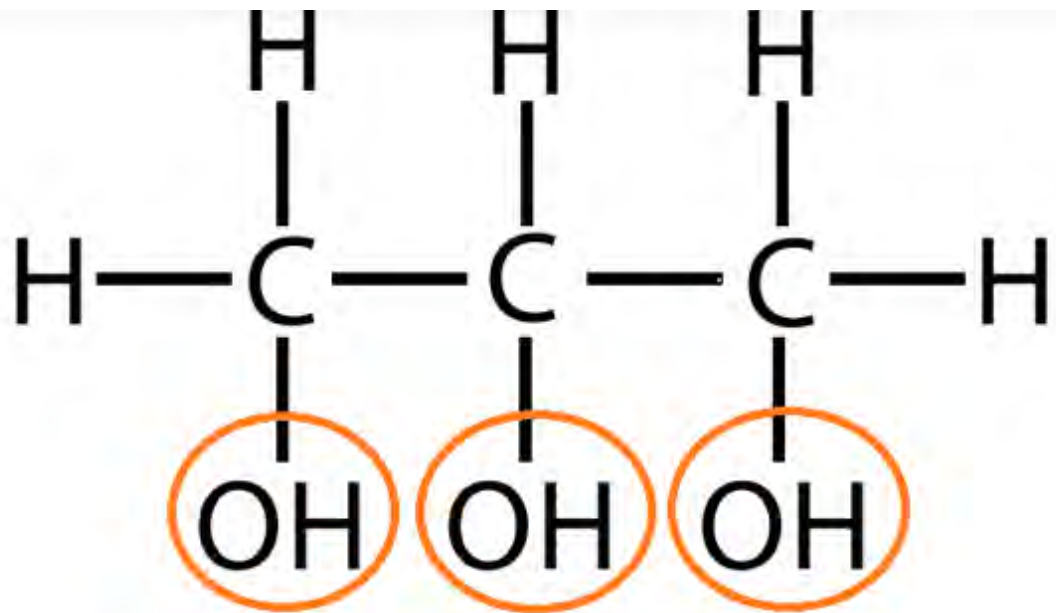
Relationship between Dry Cup and Wet Cup
Adapted from Joy & Wilson, 1963

Water Vapor Permeance of Sheathing Materials





Hydroxyl's



Hydroxyl's

Hydroxyl groups are strongly reactive oxygen groups...

Water molecules are polar and interact with hydroxyl groups.....







Erwin Schrodinger...



Erwin Schrodinger...

Austrian – Irish physicist

Quantum theory

Schrodinger equation.....

...wave function and time

$$i\hbar \frac{\partial}{\partial t} \Psi(x, t) = \left[-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} + V(x, t) \right] \Psi(x, t) .$$

...and a cat that is simultaneously
dead and alive...quantum
paradox

Erwin Schrodinger....."Austrian".....
...the quantum wave stuff comes from...
"Austria"....and so do the best wine
glasses...

Hyperbolic Curves

Hyperbolic Curves – two curves

Eccentricity greater than one

Parabolic Curve – single curve

Eccentricity of one

Hyperbolic Curves – two curves

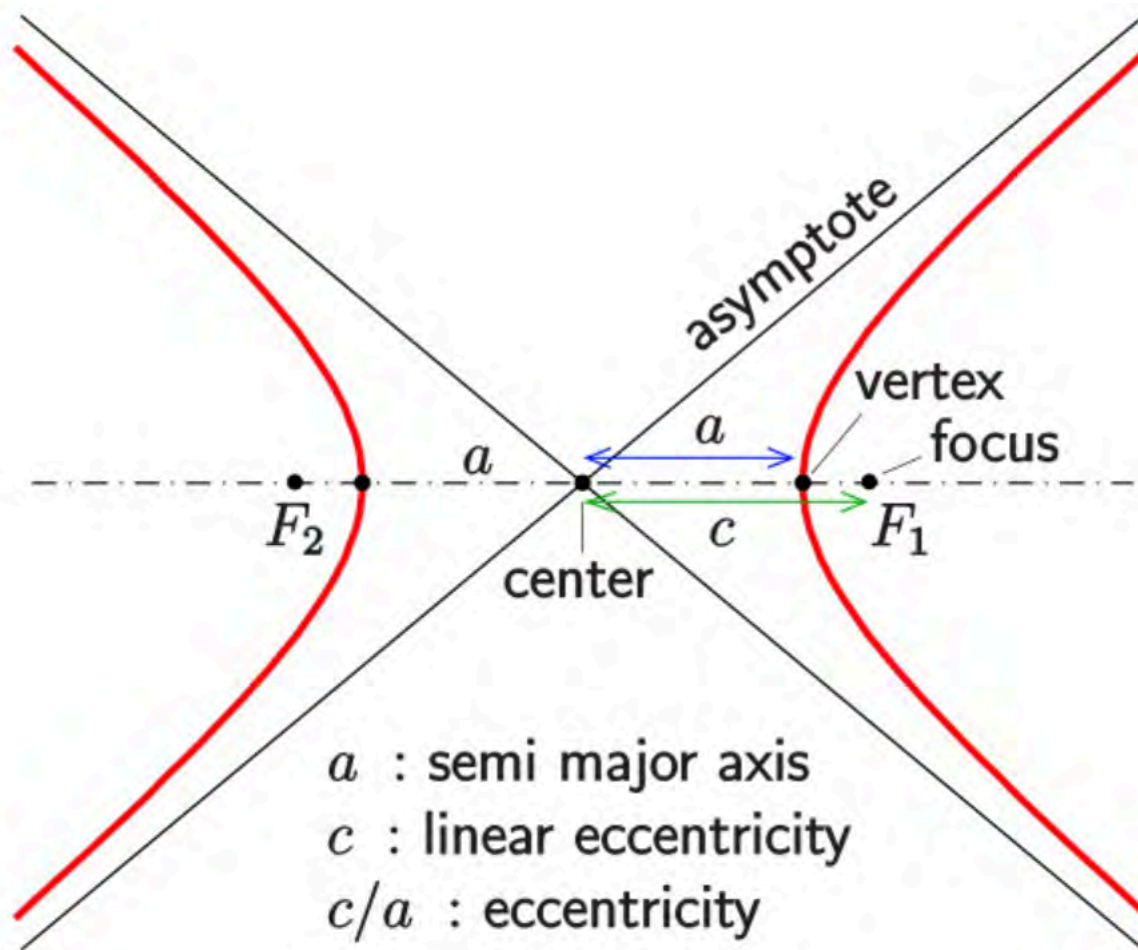
Eccentricity greater than one

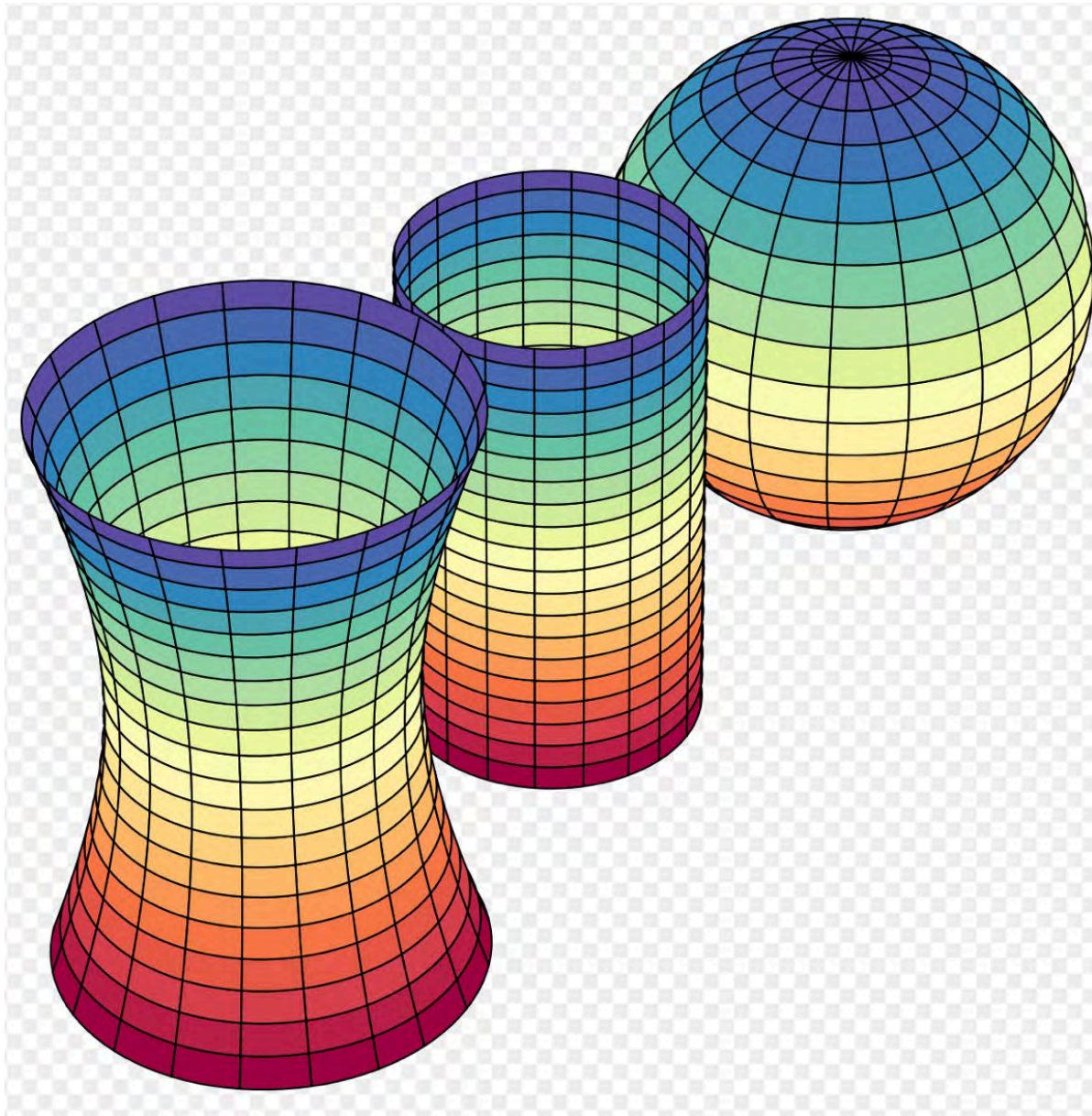
$$X^2/a^2 - y^2/b^2 = 1$$

Parabolic Curve – single curve

Eccentricity of one

$$Y = ax^2, a \text{ not equal to } 0$$



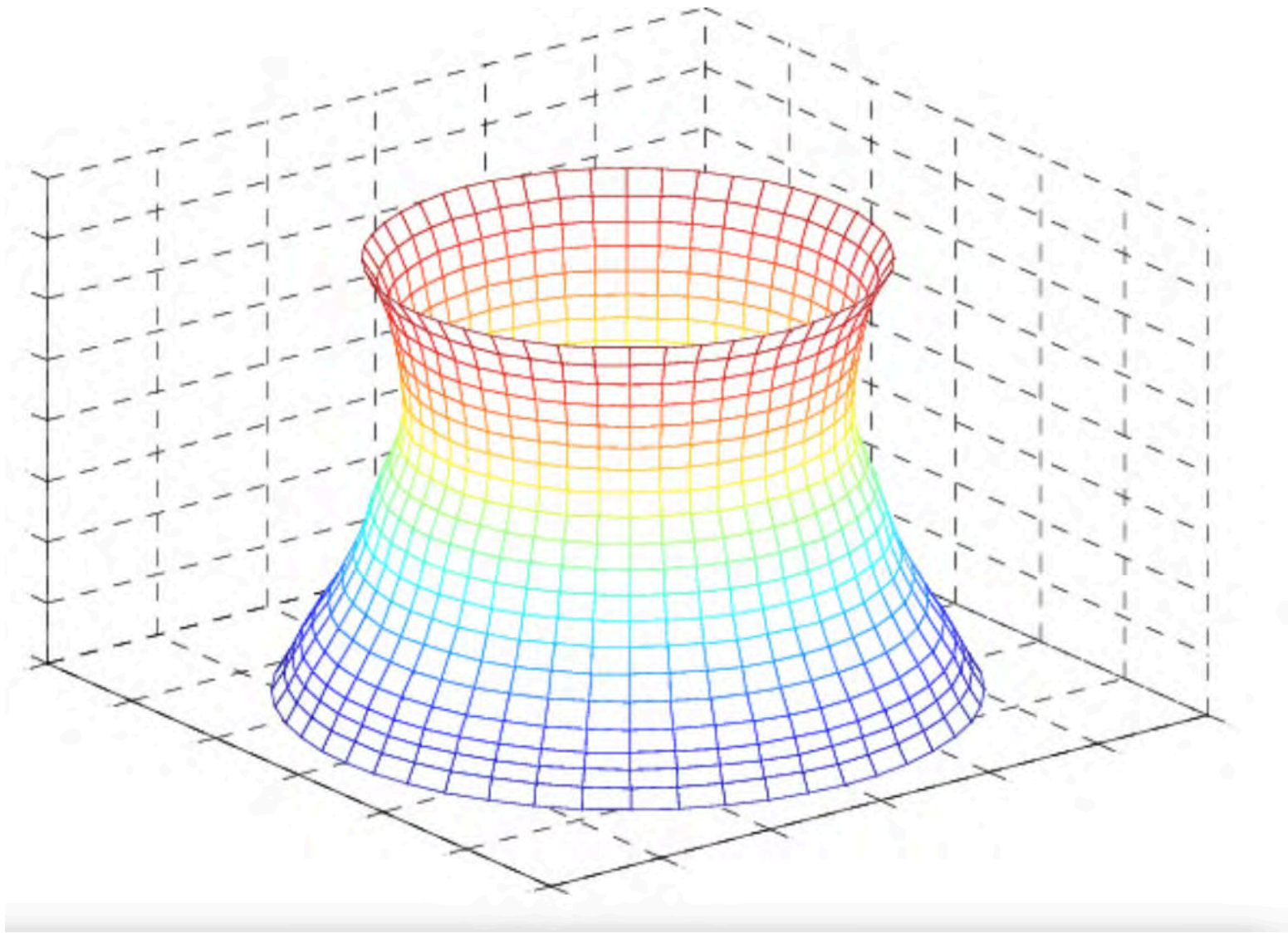


Gaussian Curvature

Negative Gaussian curvature – hyperboloid

Zero Gaussian curvature – cylinder

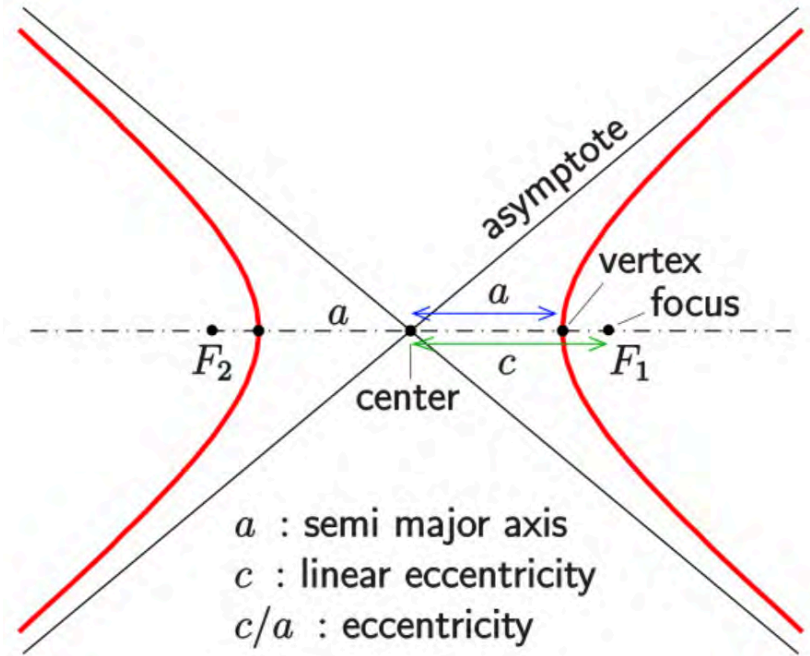
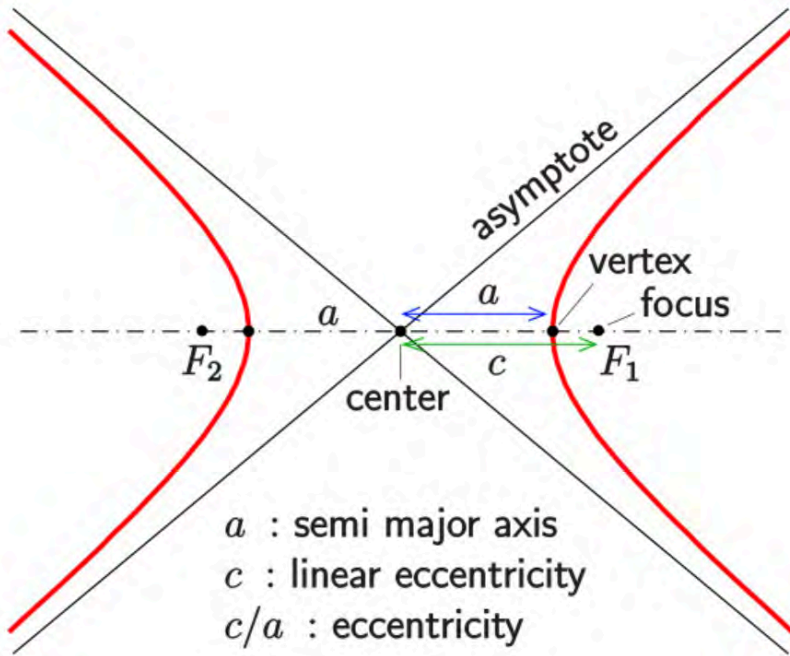
Positive Gaussian curvature – sphere

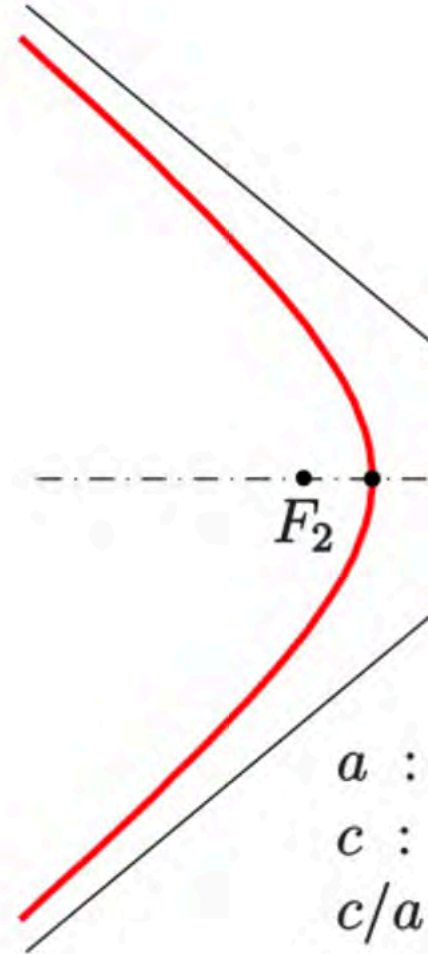
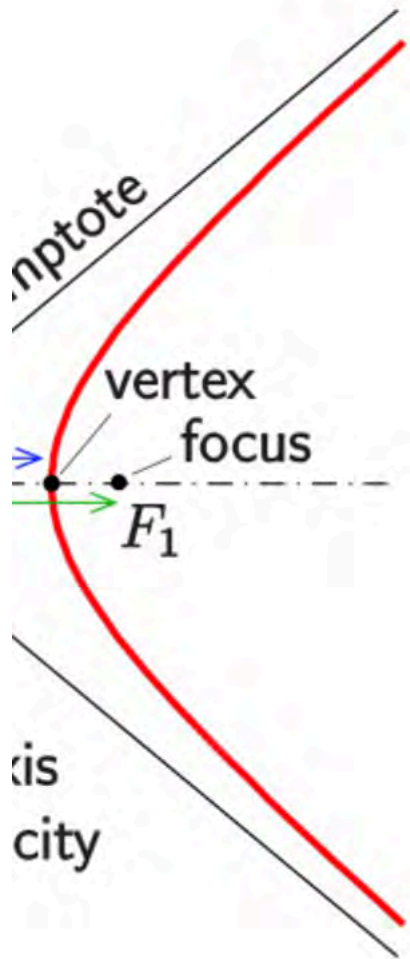




Cooling Tower Hyperboloid

Wide base promotes thin film evaporation
and the narrow top accelerates laminar
flow.....









Vin Santo's, Ice Wines, Sauternes



Vin Santo's



Liquid water removed by phase change - evaporation

Ice Wines



Liquid water removed by
phase change - freezing

Sauternes



Liquid water removed by
phase change - sorption

Hydroxyl's

Hydroxyl groups are strongly reactive oxygen groups...

When bonded with aliphatic chains they exhibit the properties of alcohol groups...

Wine Legs...



Wine Legs...

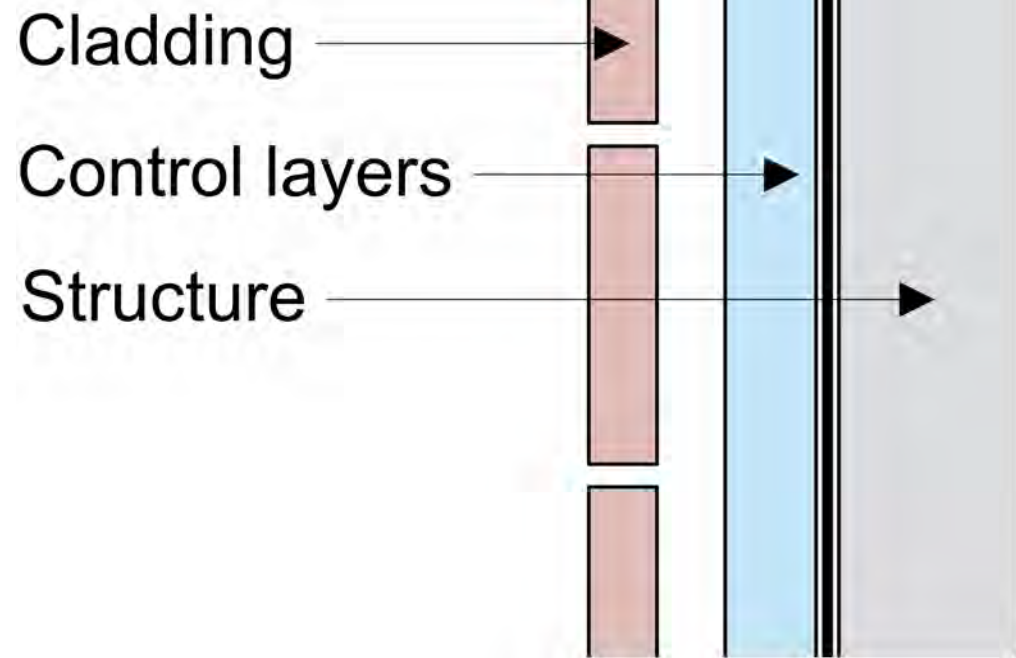
“Gibbs-Marangoni Effect”

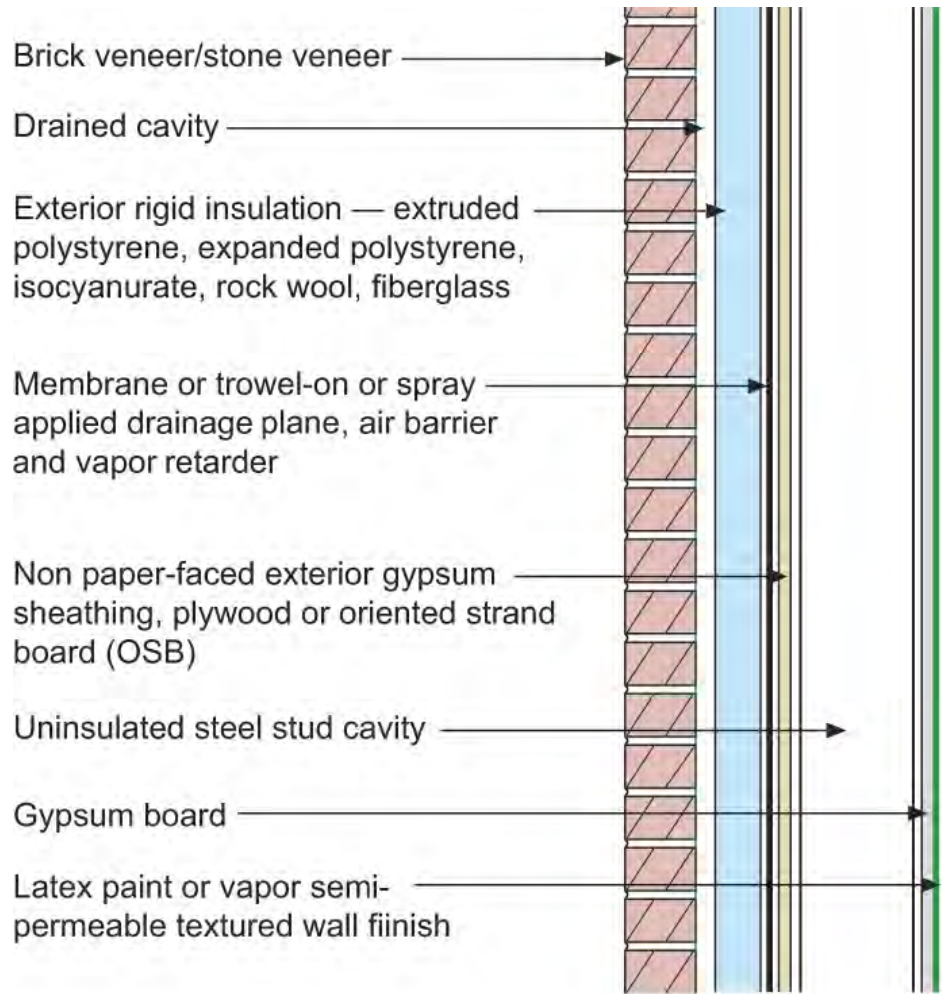
Fluid surface tension caused by the evaporation of alcohol...

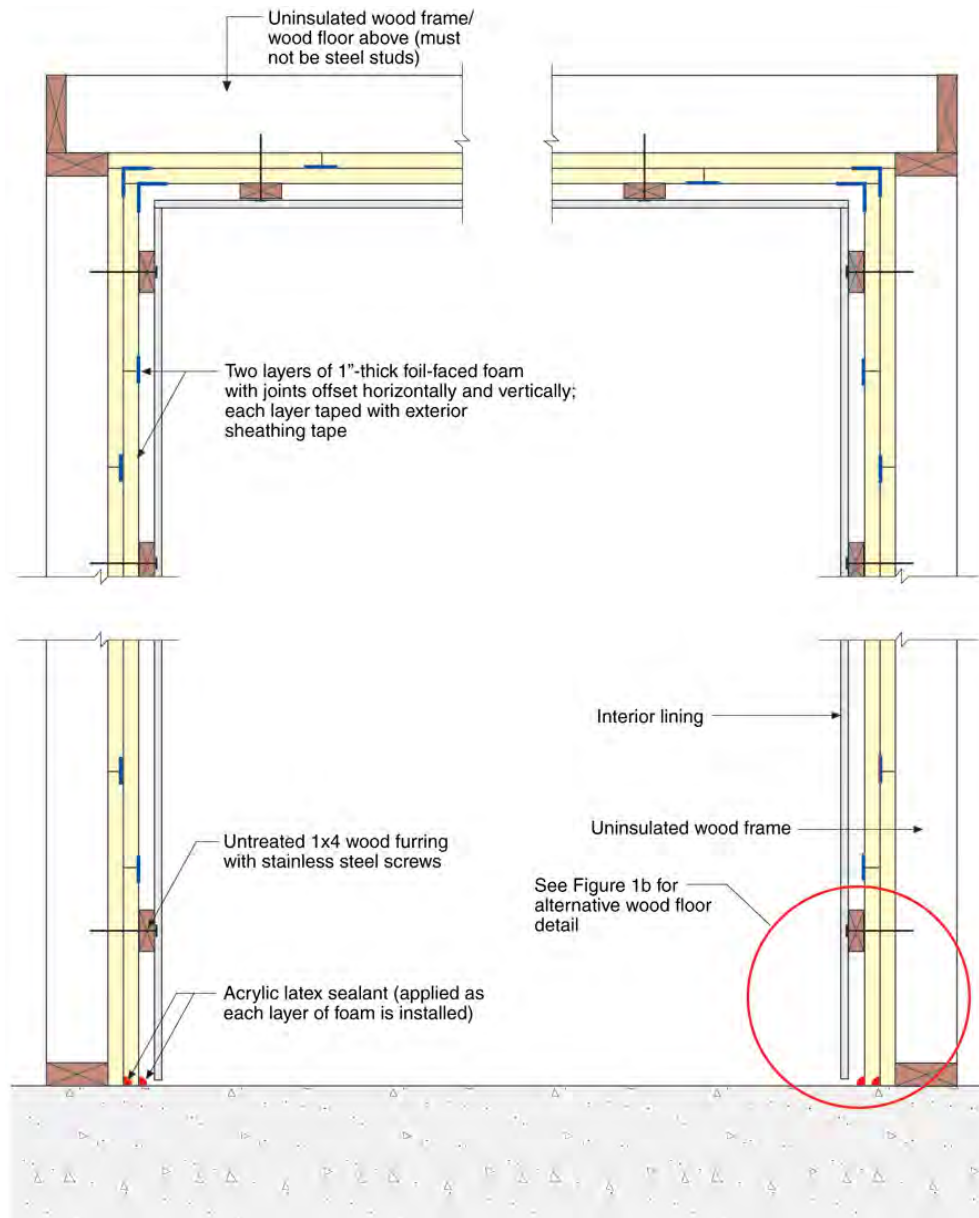
Wine Cellars...











The lessons taught by the water molecule
and construction and wine...

Lessons to be learned from carbon and
construction....with help from water and
wine...

Phases of Carbon...

Hydroxyl's

Hydroxyl groups are strongly reactive oxygen groups...

Water molecules are polar and interact with hydroxyl groups....***also with carbonyl groups...(aka "carbon"... "coal")...***

Carbon and Construction and Wine...

Wine cellars...the perfect wall

Decarbonization...the perfect house

“Passive House”