

Water: The Enemy of Construction

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Overview



Compaction



Expansive Soils



Drilled Shaft Foundations

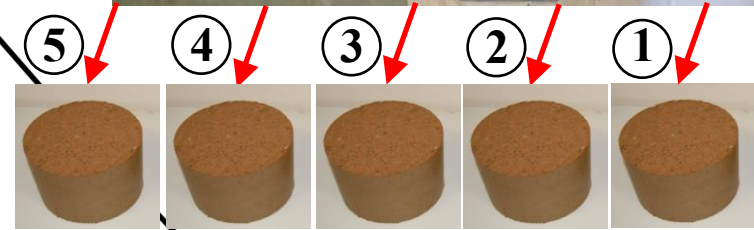


Compaction

Compaction

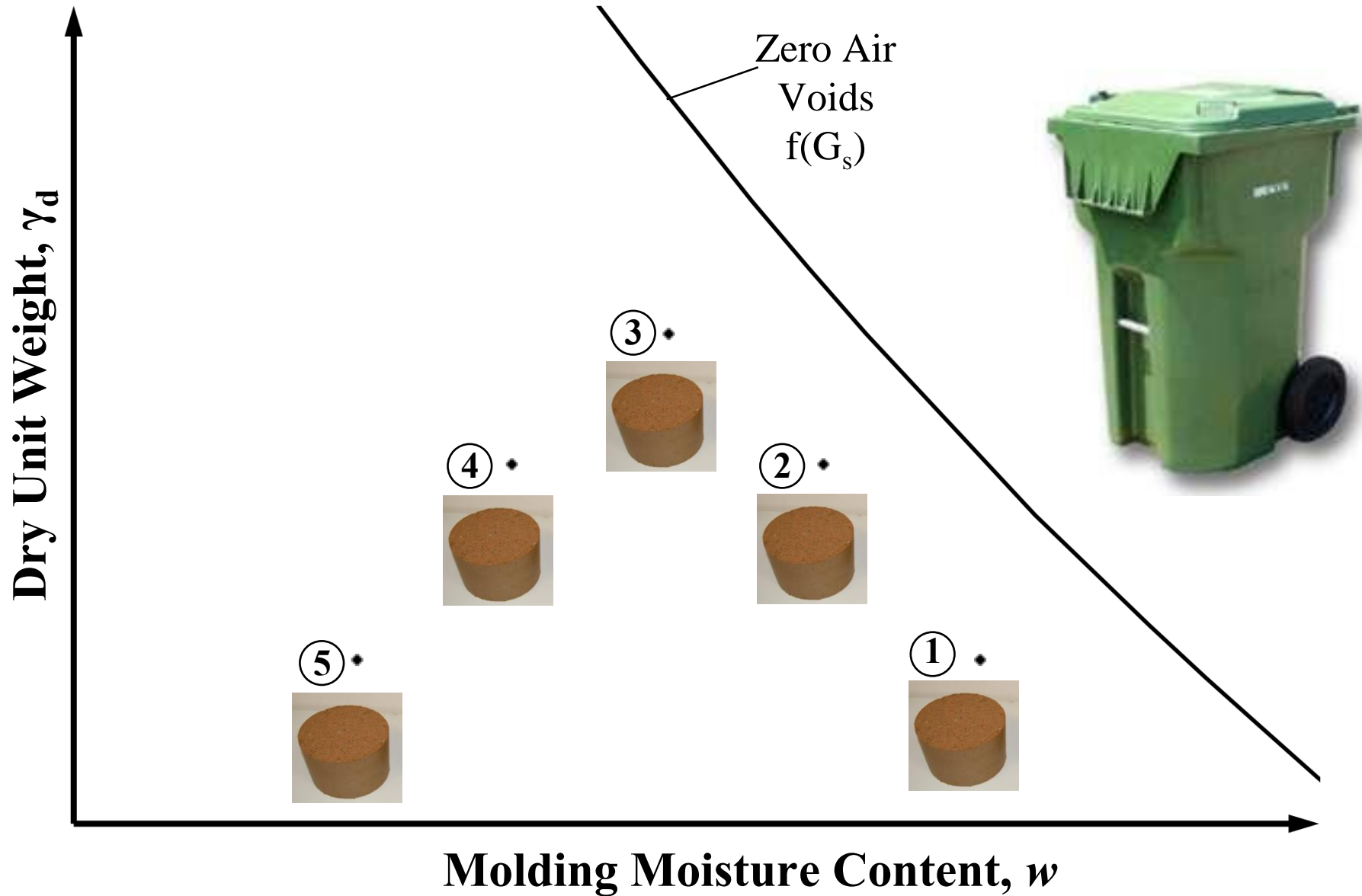
Dry Unit Weight, γ_d

Zero Air
Voids
 $f(G_s)$

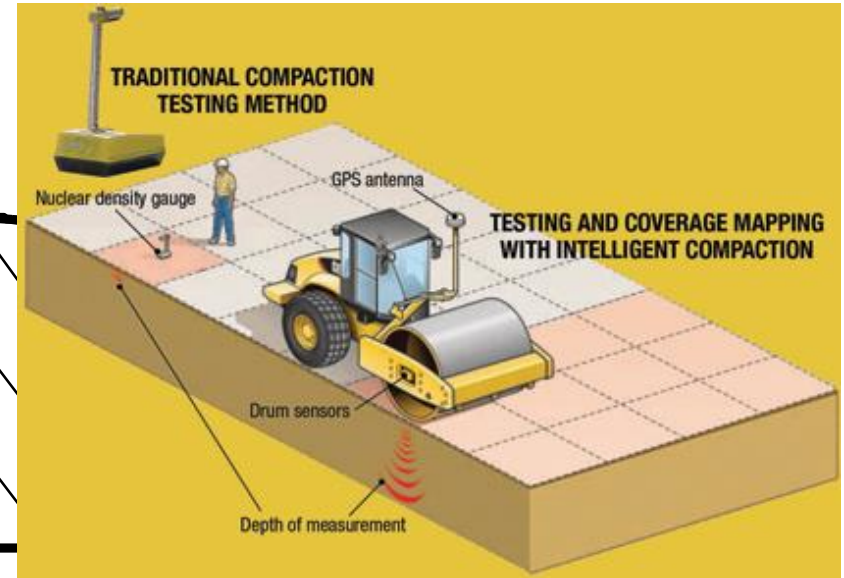
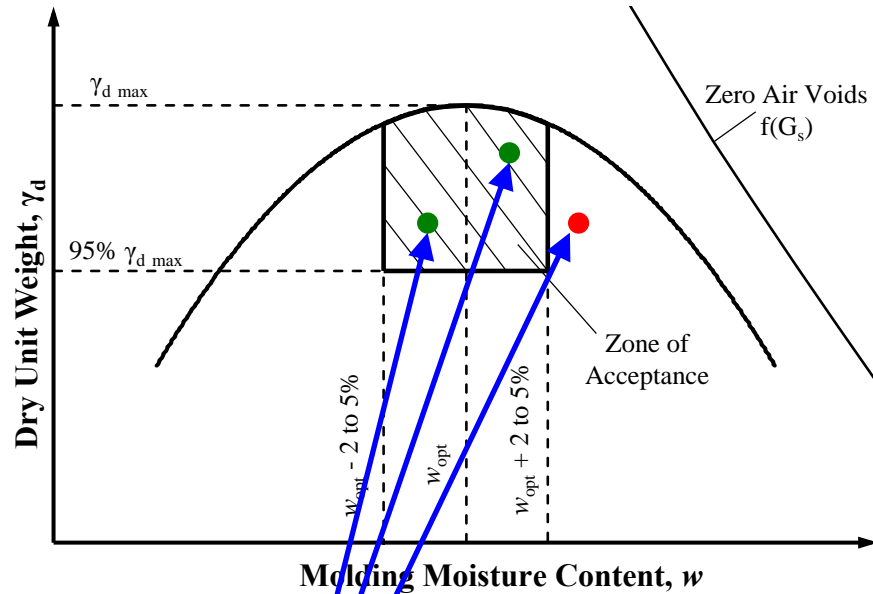


Molding Moisture Content, w

Compaction

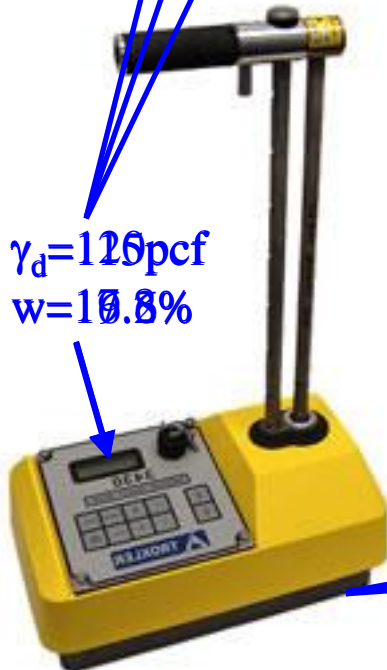


Compaction



Dry Unit W

$\gamma_d = 126 \text{ pcf}$
 $w = 10.8\%$



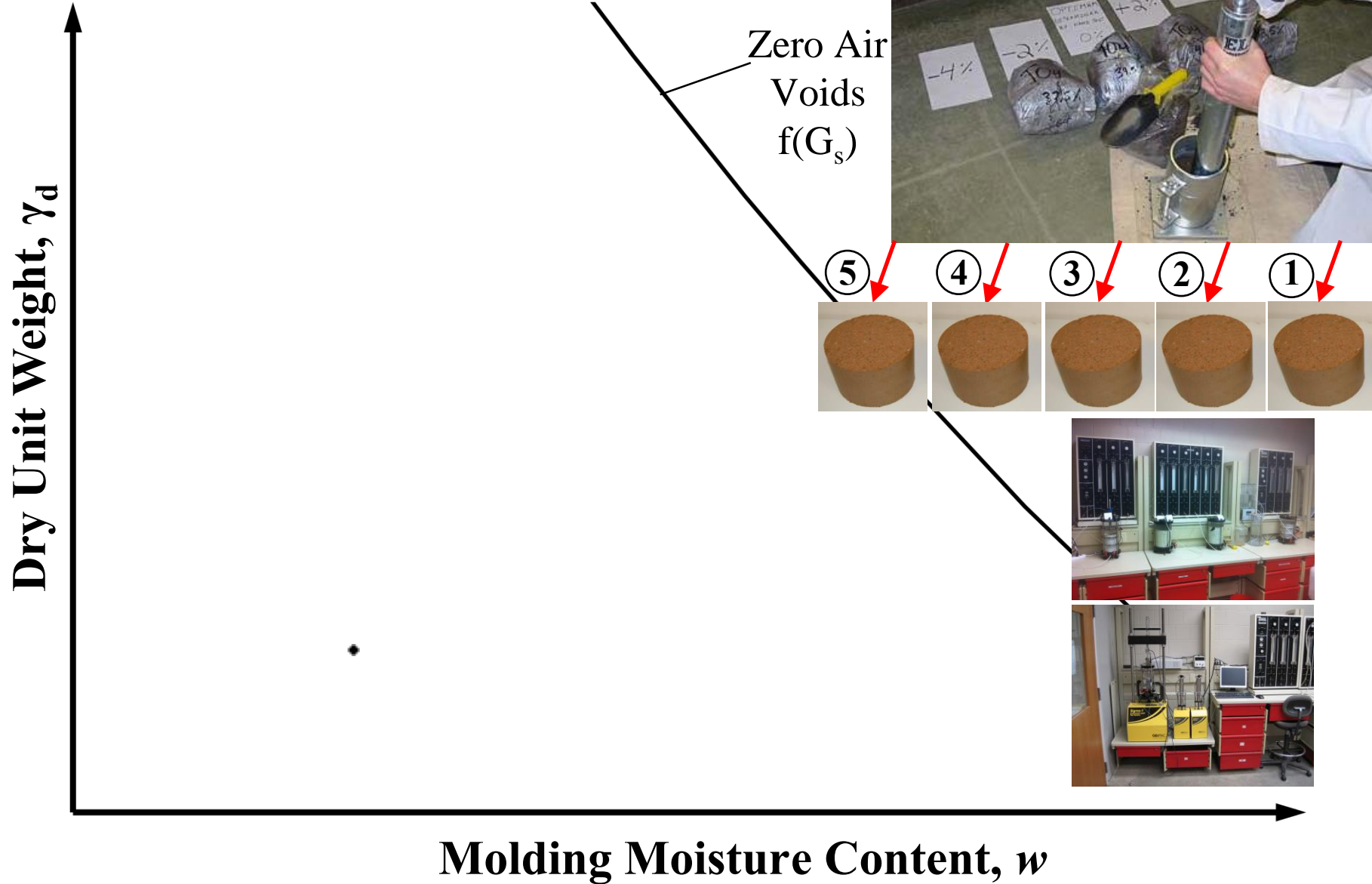
$w_{opt} - 2$ to 5%

w_{opt}

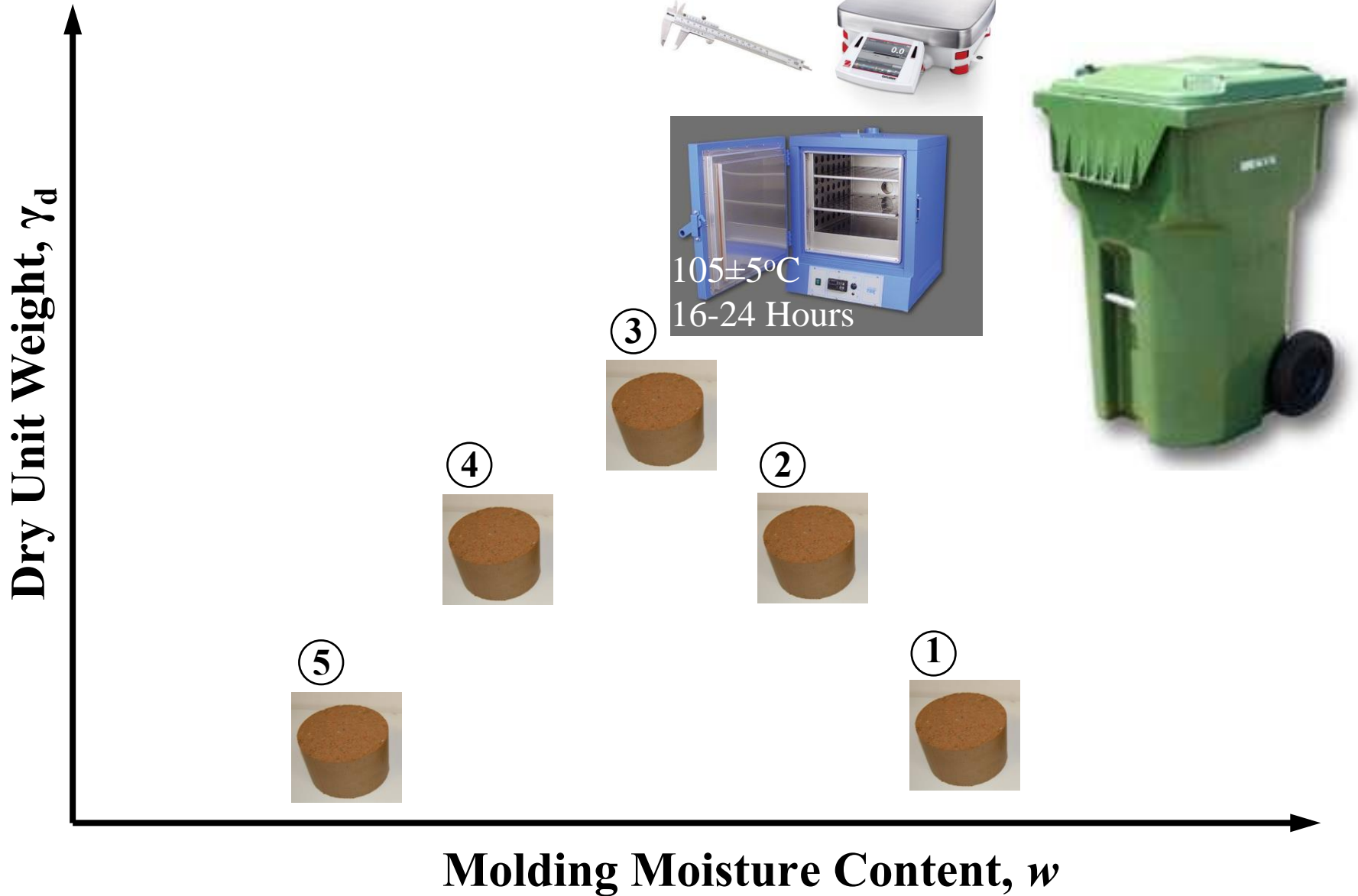
Molding Mois



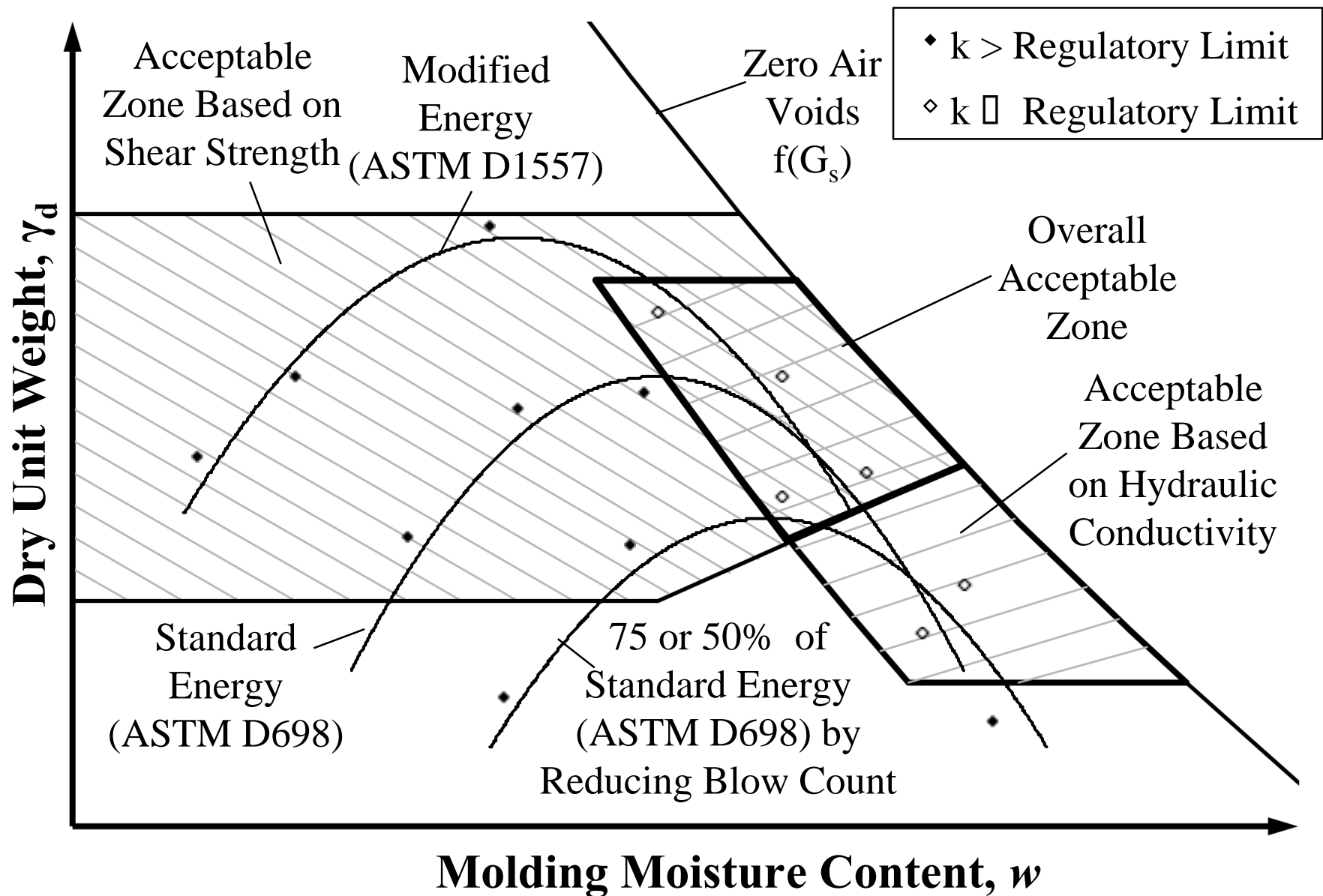
Compaction



Compaction

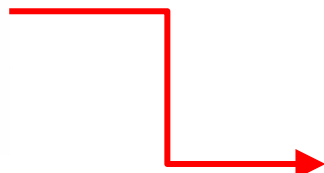


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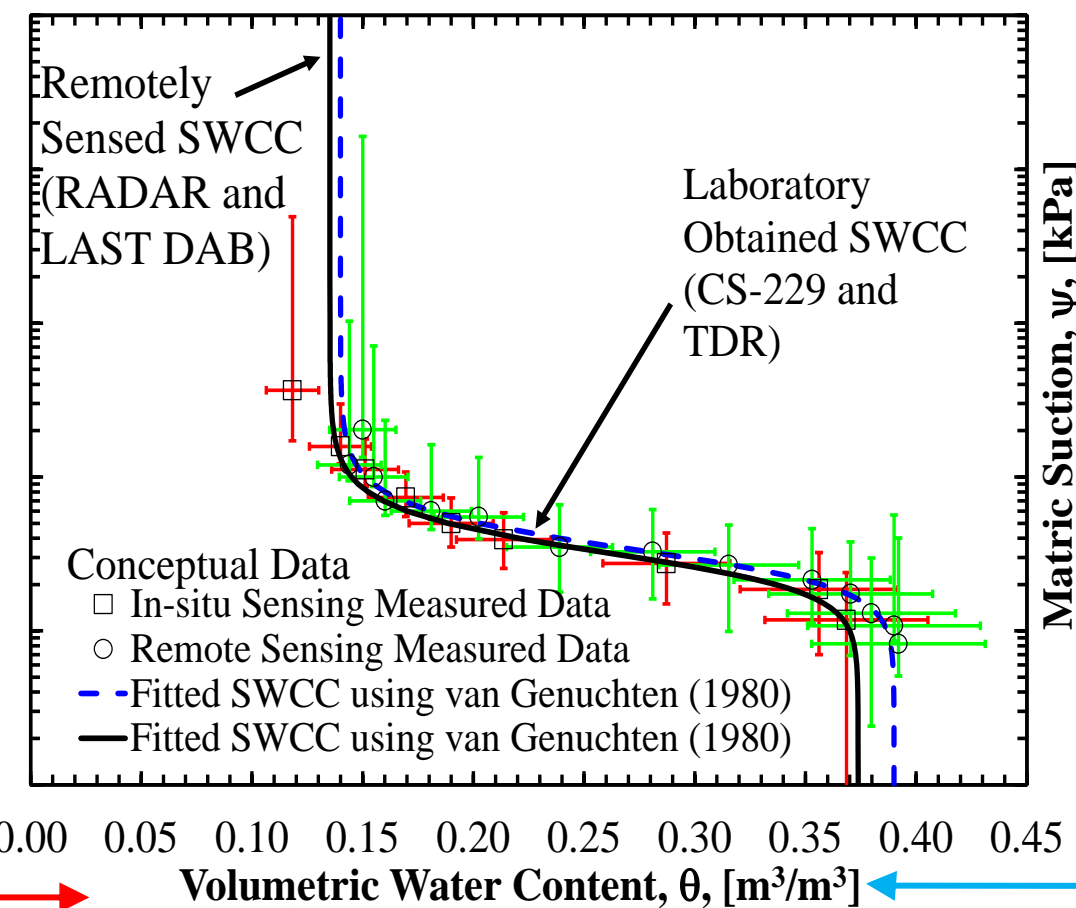




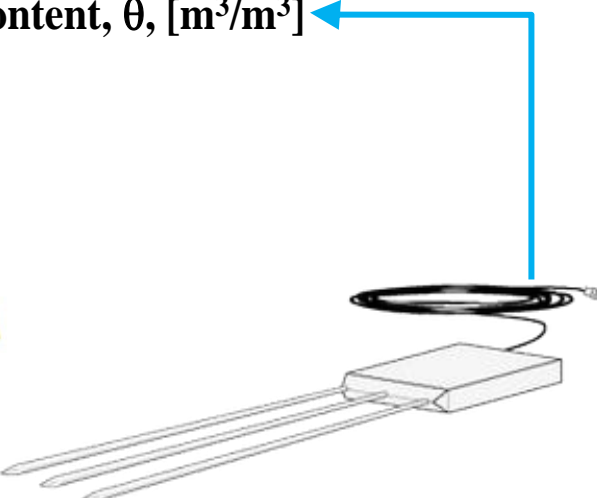
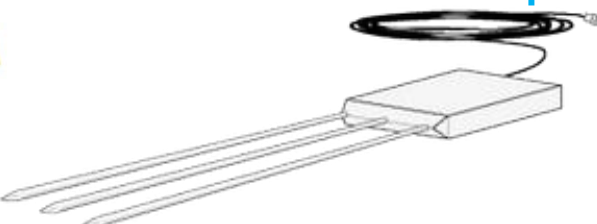
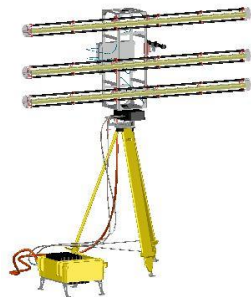
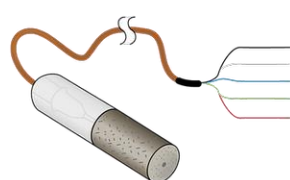
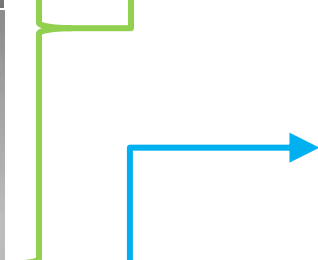
Expansive Soils

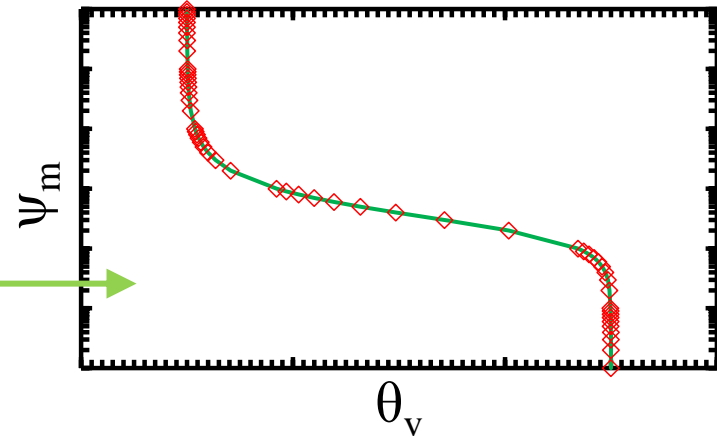


Matric Suction, ψ , [kPa]



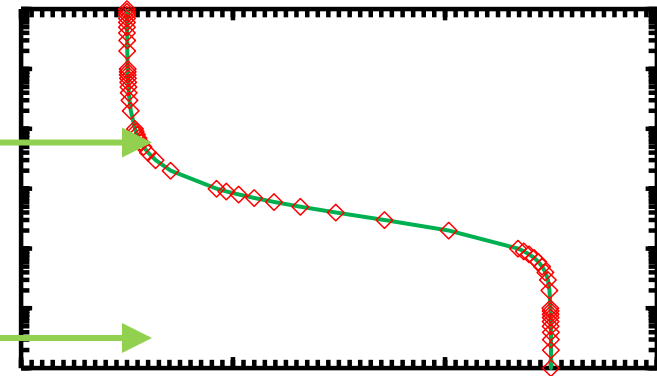
Matric Suction, ψ , [kPa]

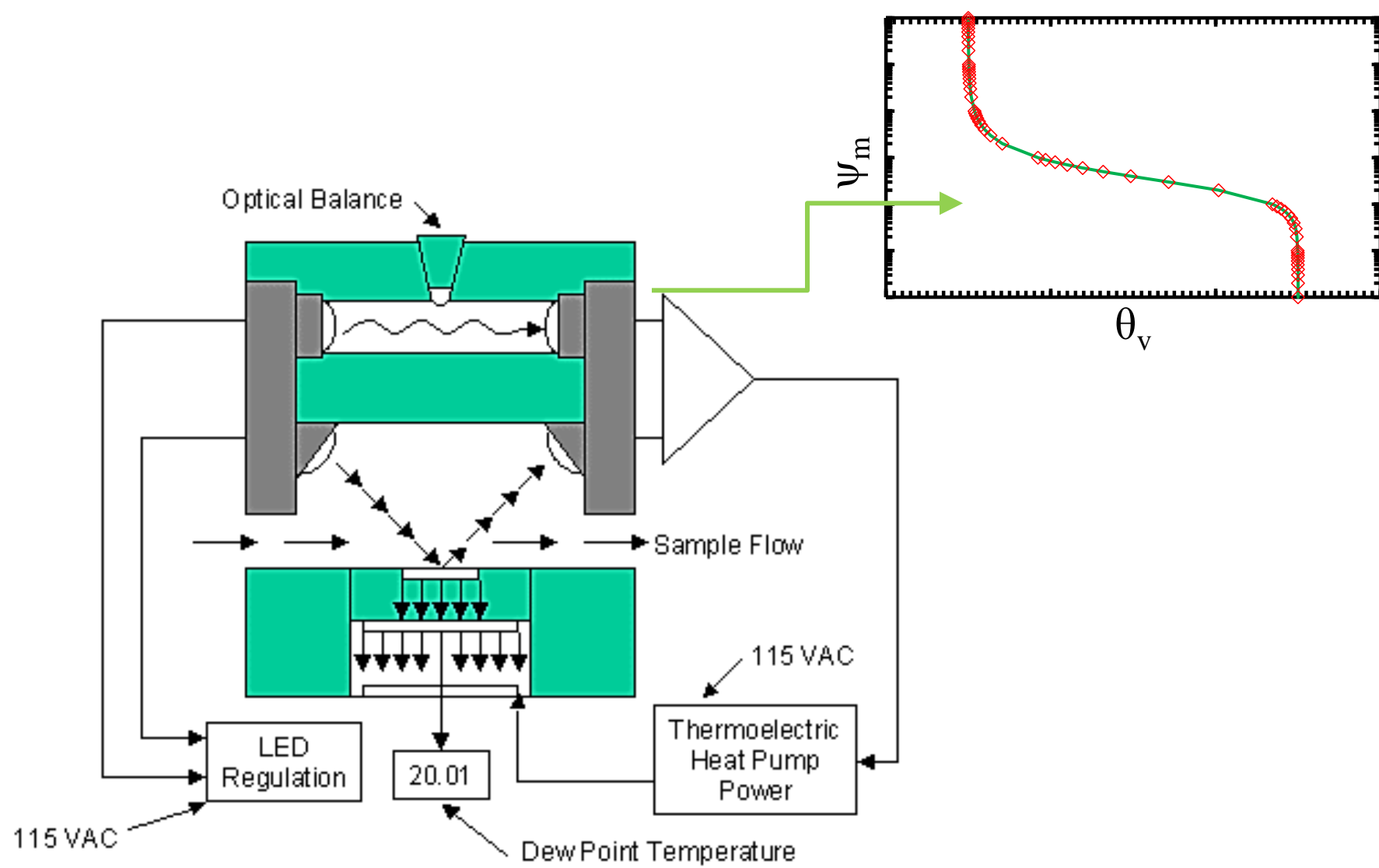




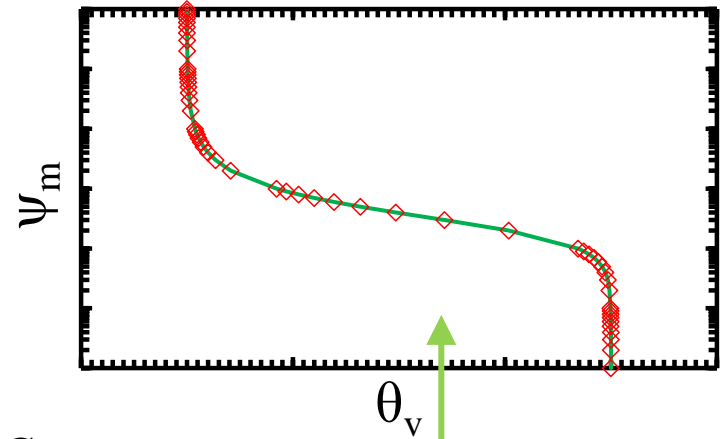
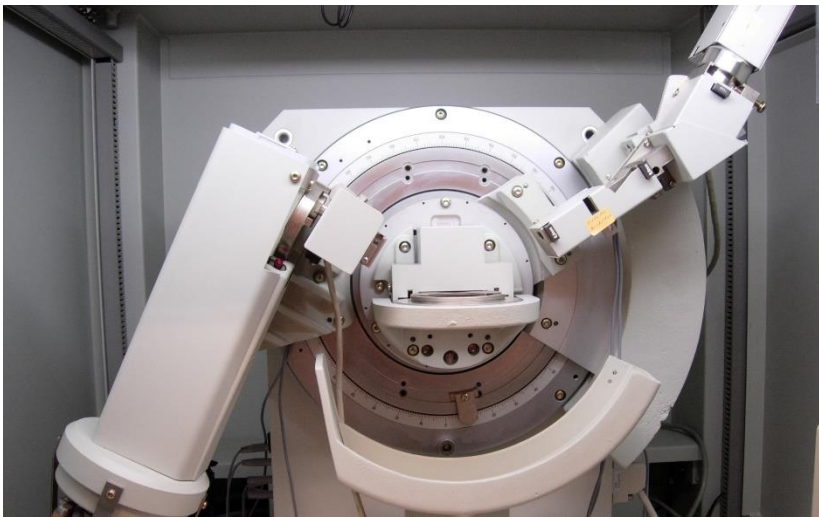
ψ_m

θ_v

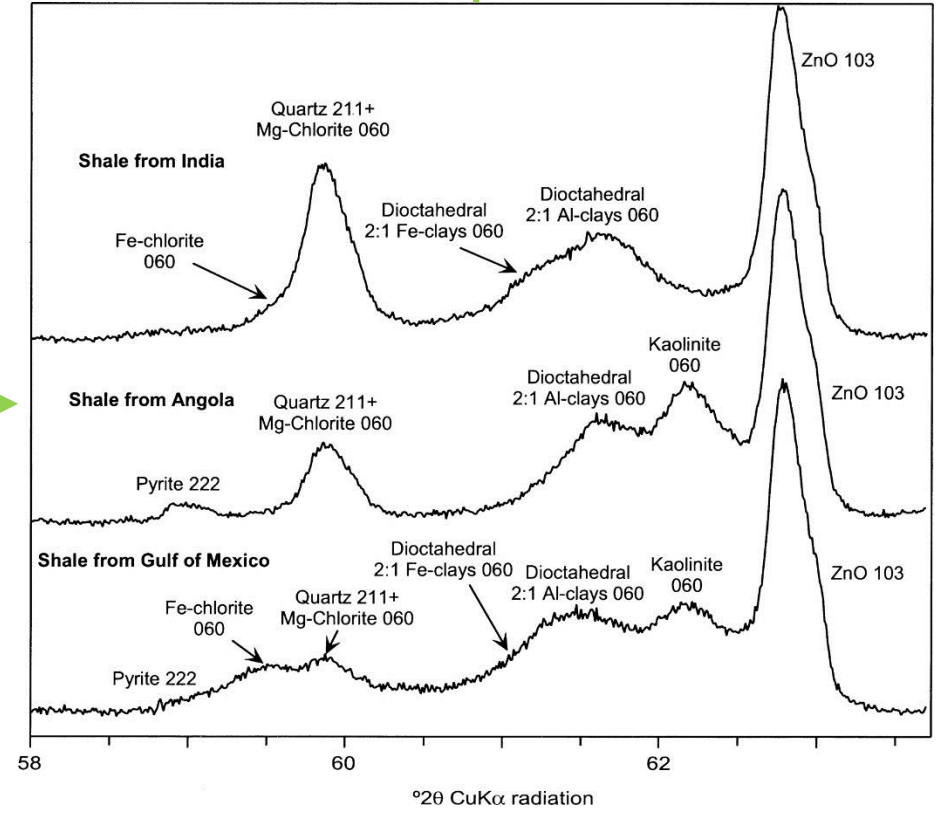
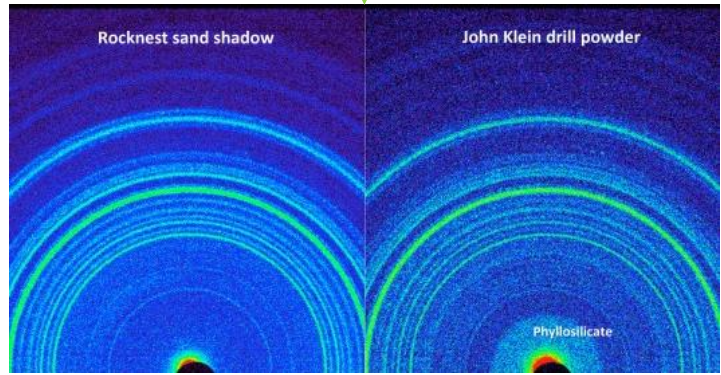


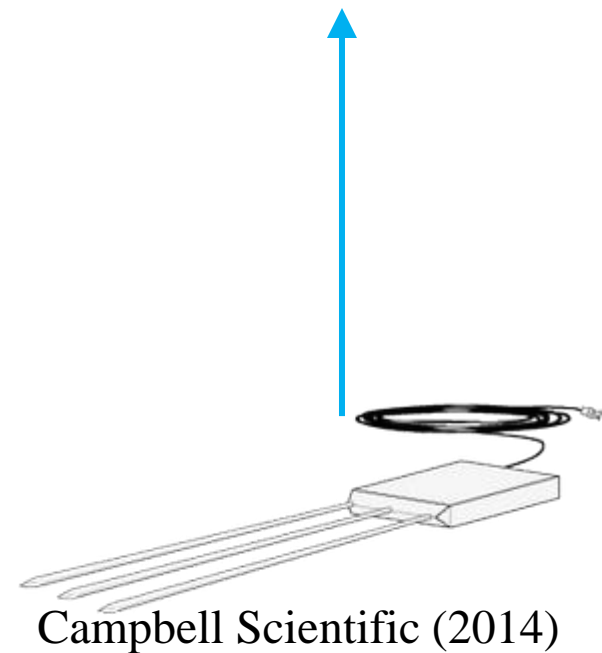
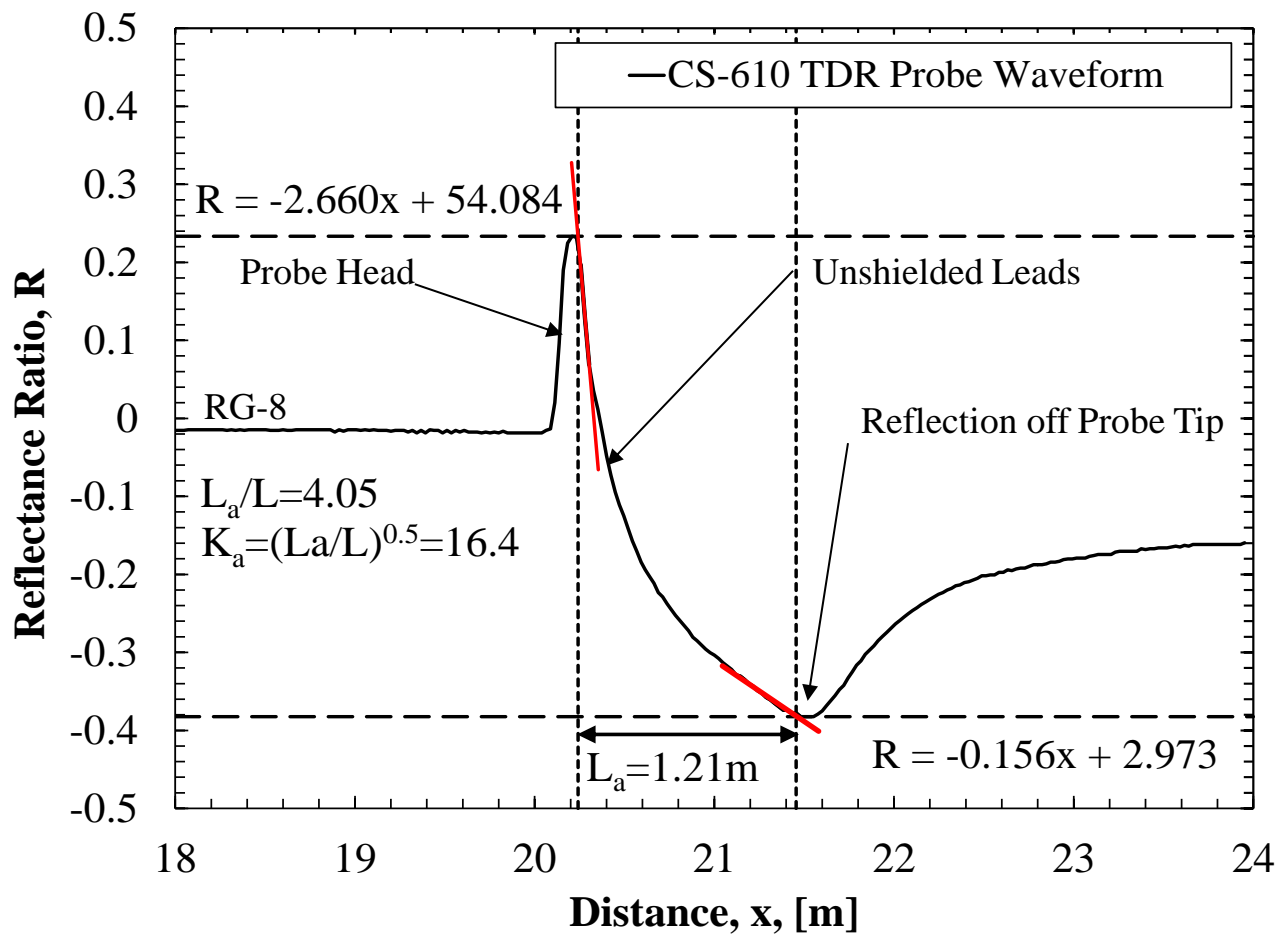
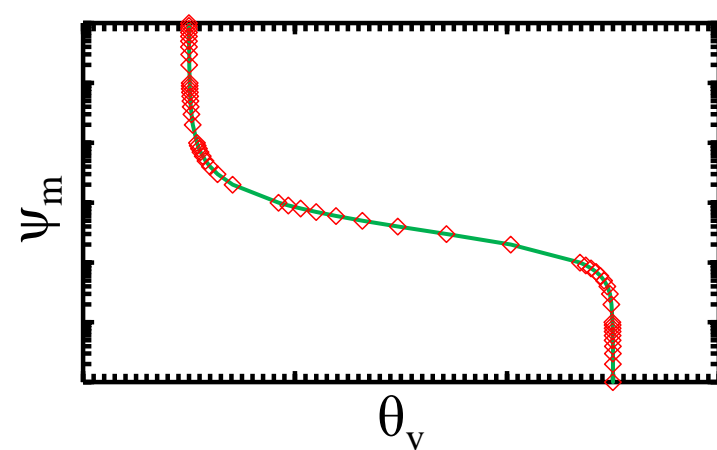


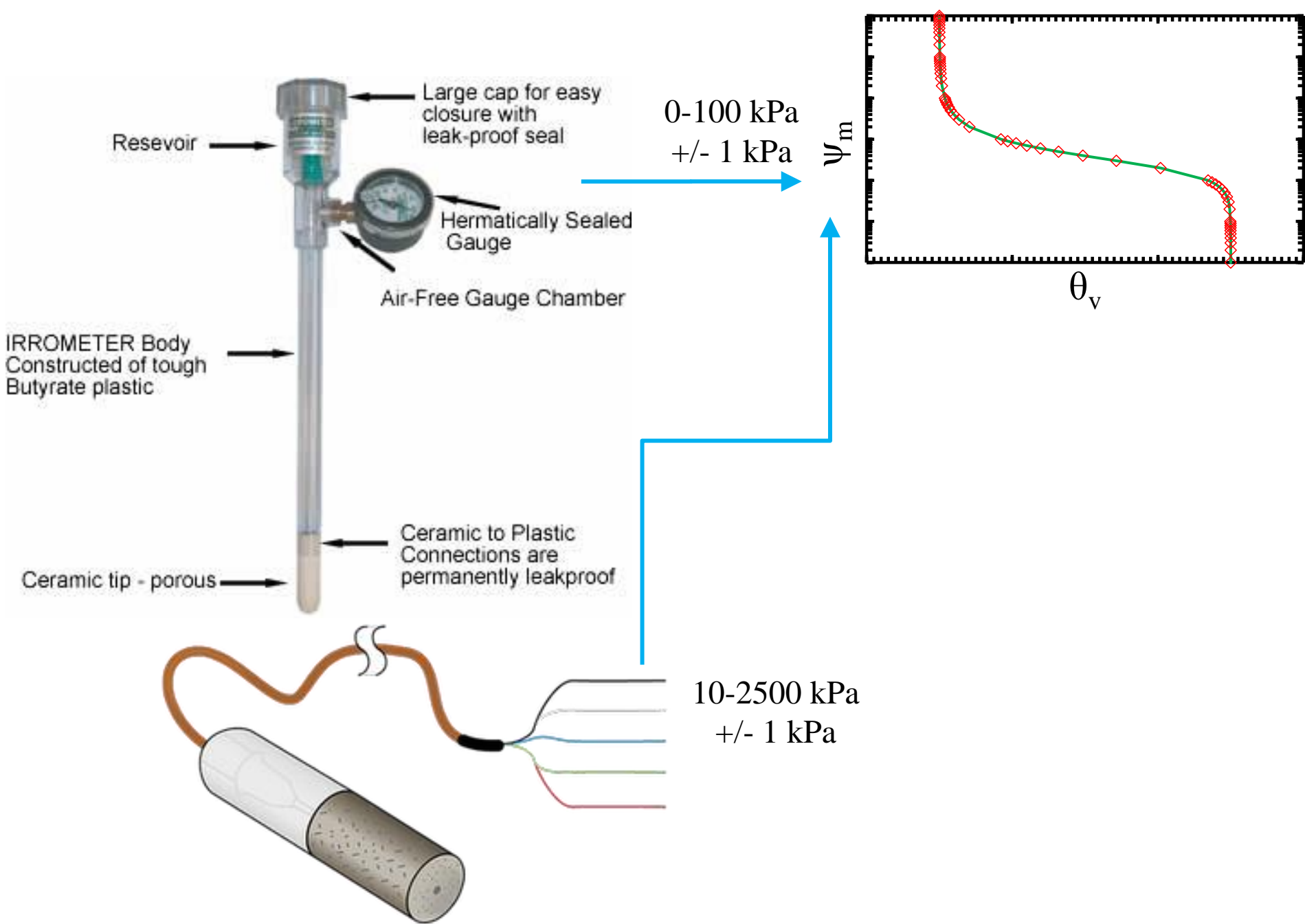
Thunder Scientific (2014)



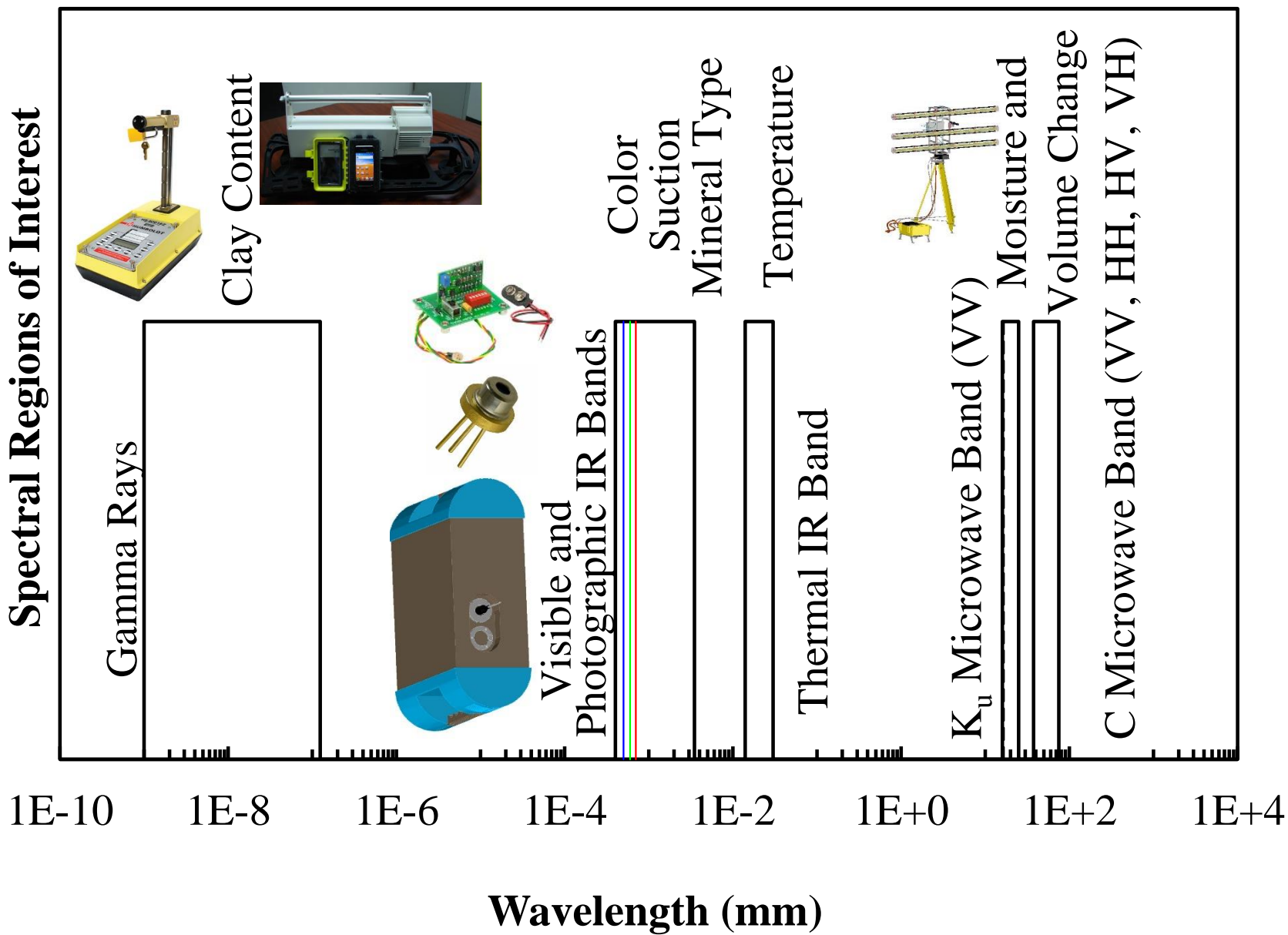
SWCC Curve
Parameters (α , m , n)

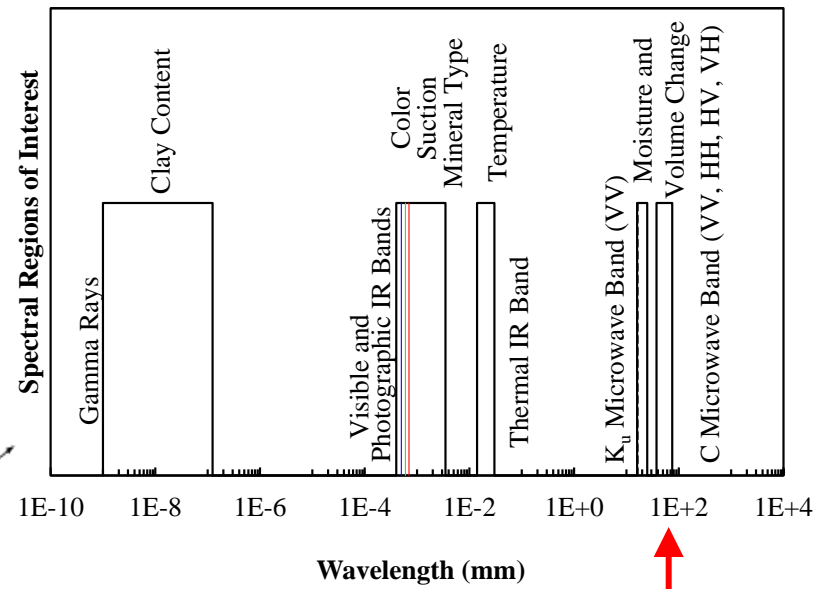
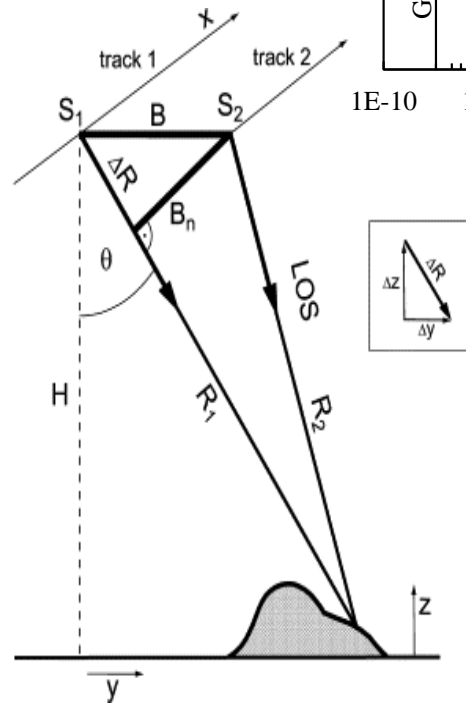
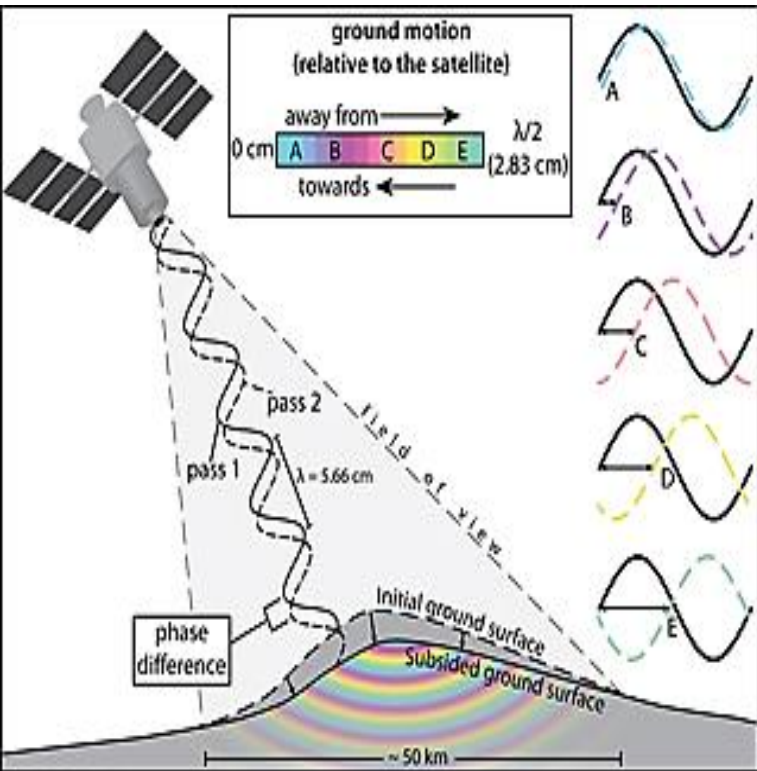






Spectral Regions of Interest





$$I = I_1 I_2^* = A_1 e^{i\phi_1} \cdot A_2 e^{-i\phi_2} = A_1 A_2 \cdot e^{i(\phi_1 - \phi_2)} = A \cdot e^{i\phi}$$

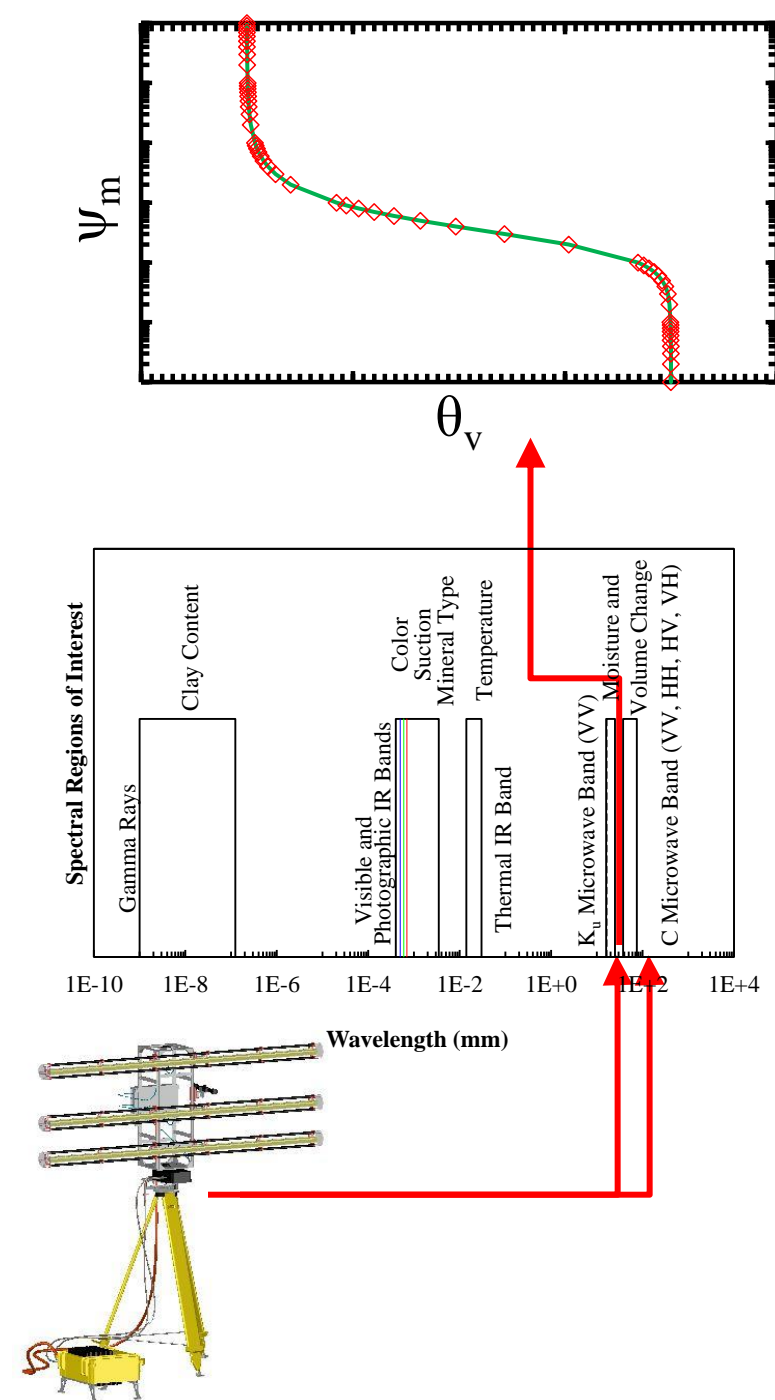
$$\sigma^0(dB) = 10 * \log(\sigma^0)(m^2 m^{-2})$$

$$m_s(t) = \frac{\sigma^0(40,t) - \sigma_{dry}^0(40,t)}{\sigma_{wet}^0(40,t) - \sigma_{dry}^0(40,t)}$$

$$m_v = m_{v.o} + 0.042(\Delta\sigma^0|dB| - \Delta\sigma_0^0|dB|)$$

$$m_v = \frac{\sigma^0 - i}{8.56 - 1.56i}$$

$$i = \frac{\sigma_0^0 - 8.56m_{v.0}}{8.56 - 1.56i}$$

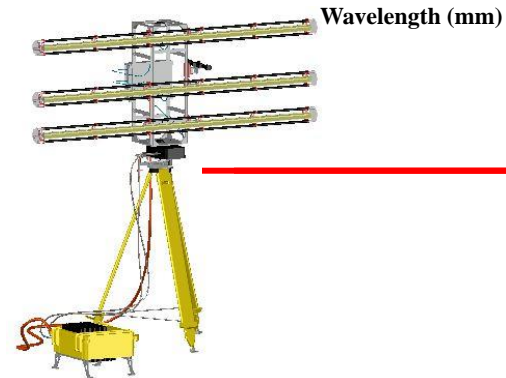
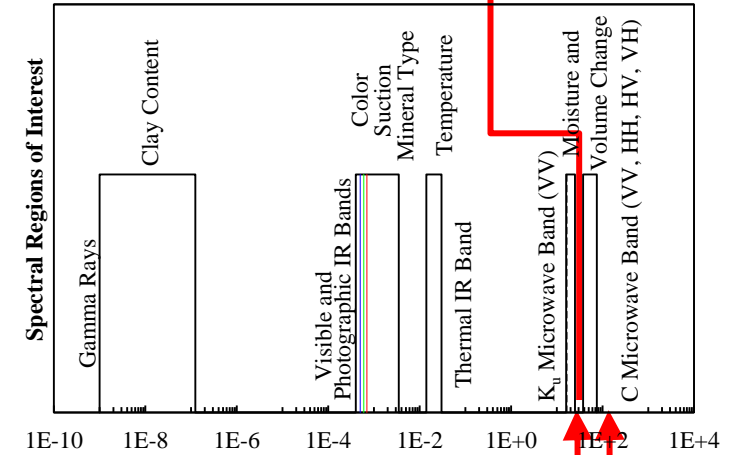
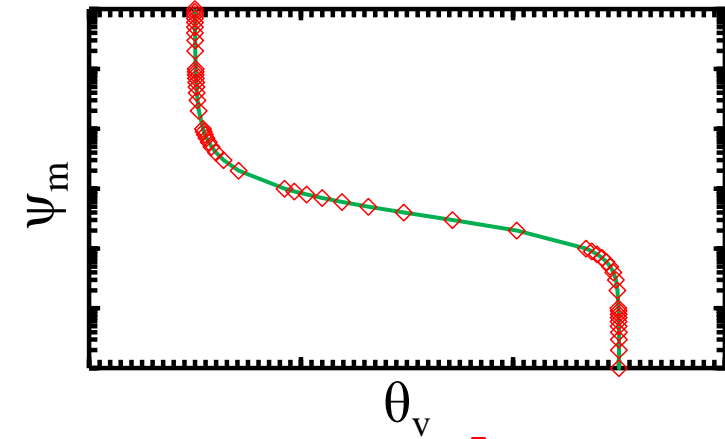


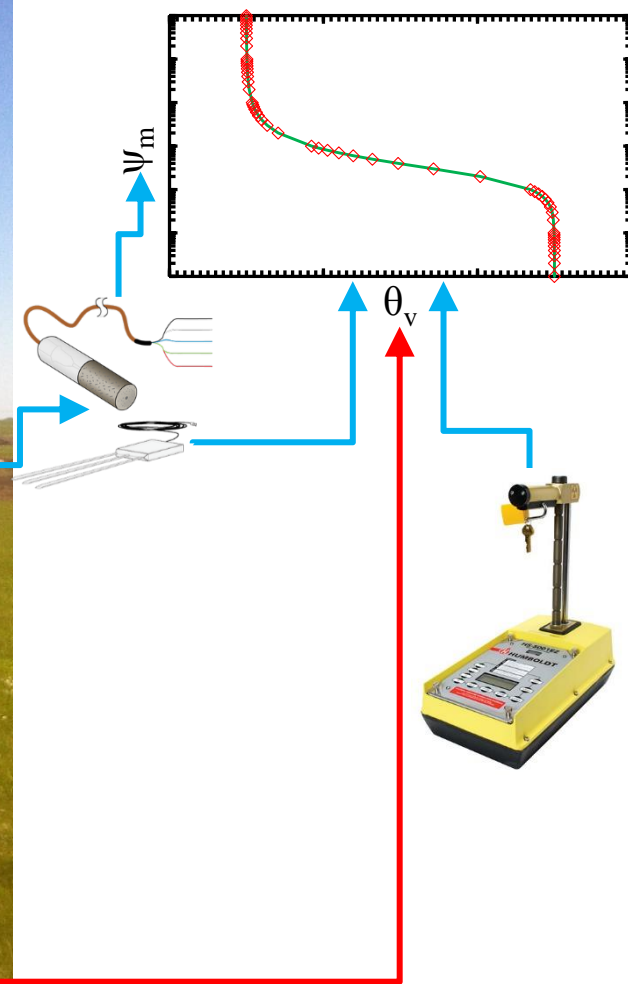
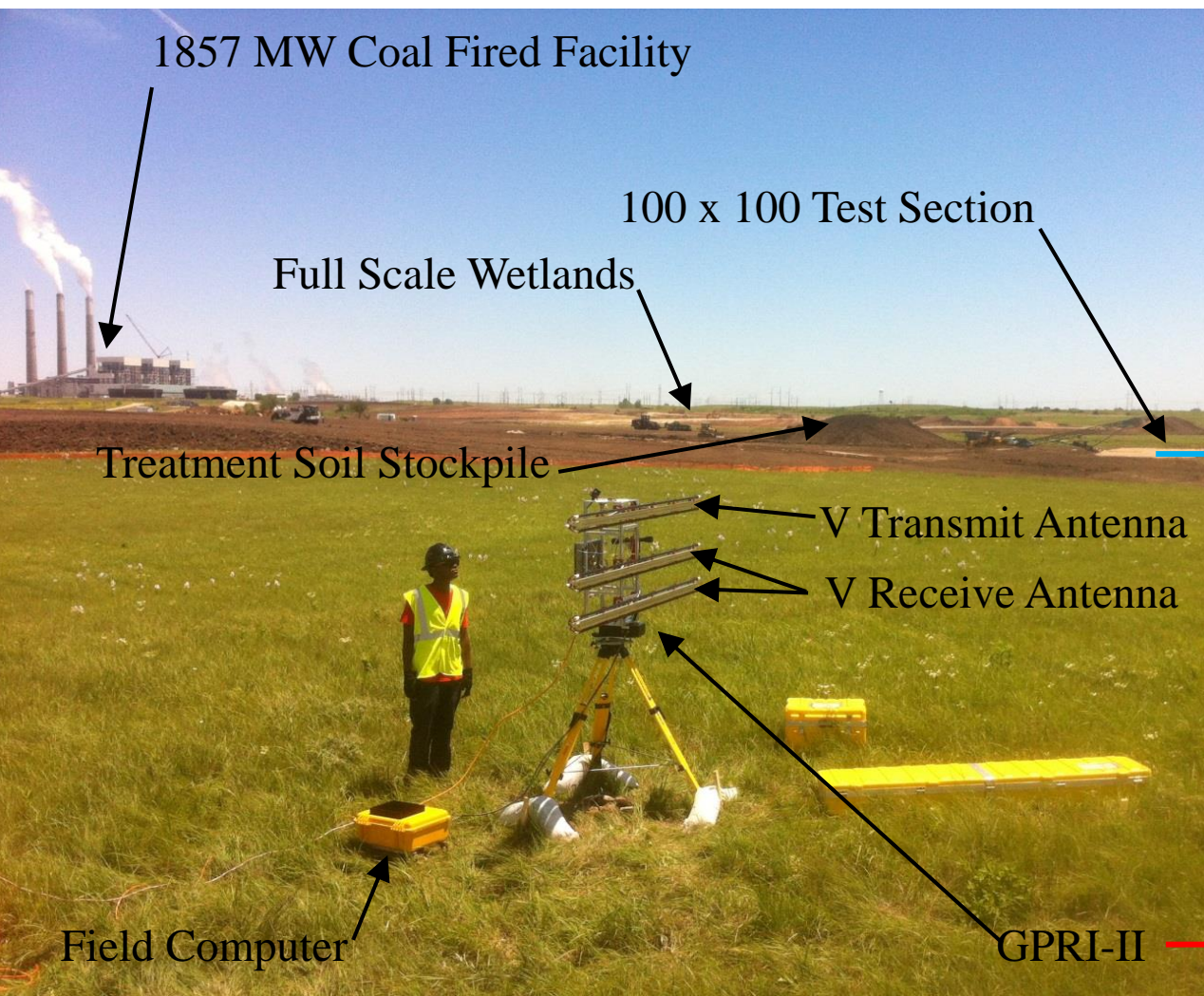
$$\sigma_{qq}^0 = 8k^4 h^2 \cos^4(\theta) W(2k \sin(\theta)) \left| \alpha_{qq}(\theta) \right|^2$$

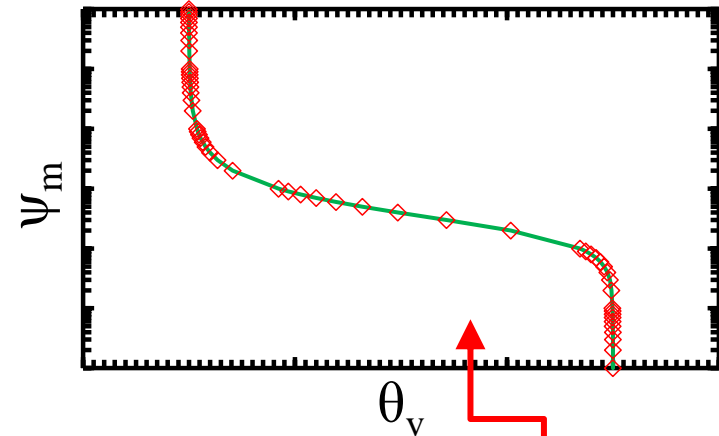
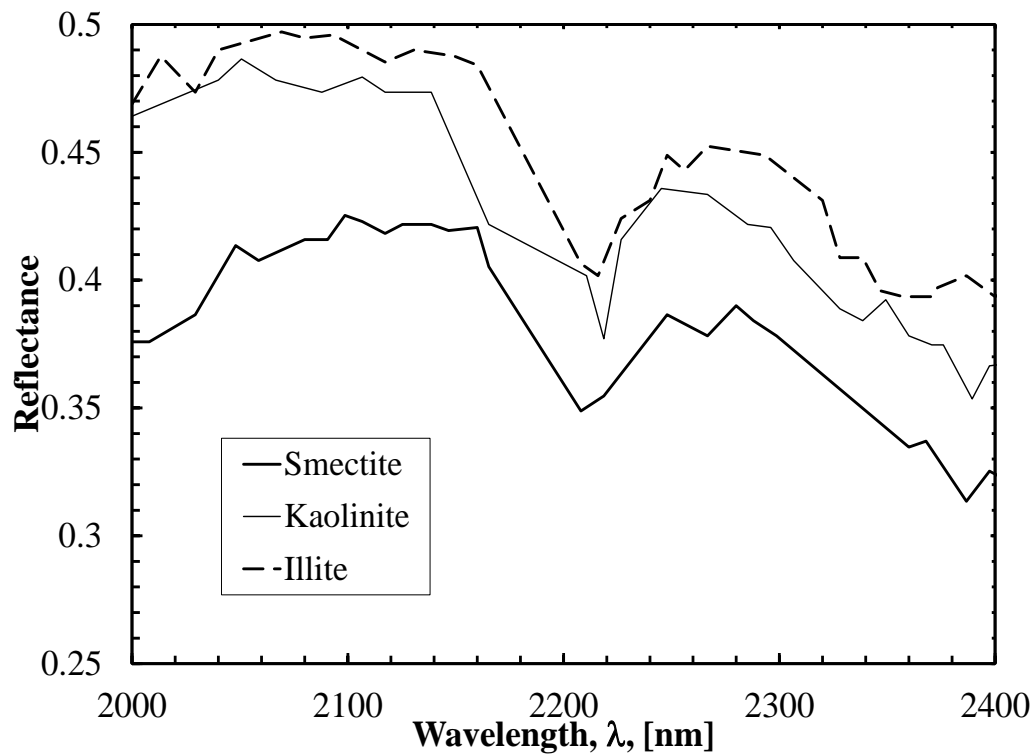
$$W(2k \sin(\theta)) = \sum_{n=1}^{\infty} \left(\frac{1}{n} \right)^2 \left[1 + \left(\frac{kl}{n} \right)^2 \right]^{-1.5}$$

$$\alpha_{HH}^0 = \frac{(1 - \varepsilon')}{\left(\cos(\theta) + \sqrt{\varepsilon' - \sin^2(\theta)} \right)^2}$$

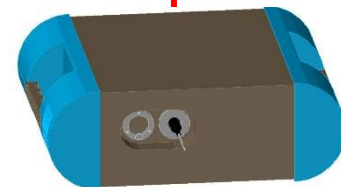
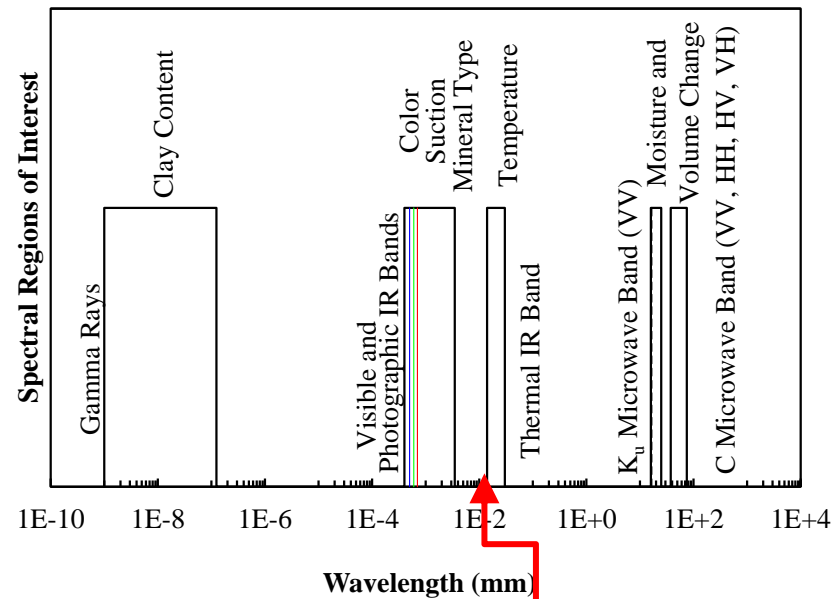
$$\alpha_{VV}^0 = \frac{(\varepsilon' - 1)(\sin^2(\theta) - \varepsilon'(1 + \sin^2(\theta)))}{\left(\varepsilon' \cos(\theta) + \sqrt{\varepsilon' - \sin^2(\theta)} \right)^2}$$

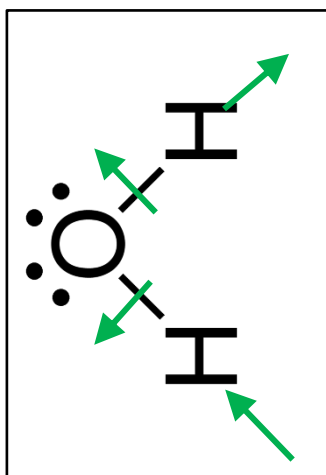
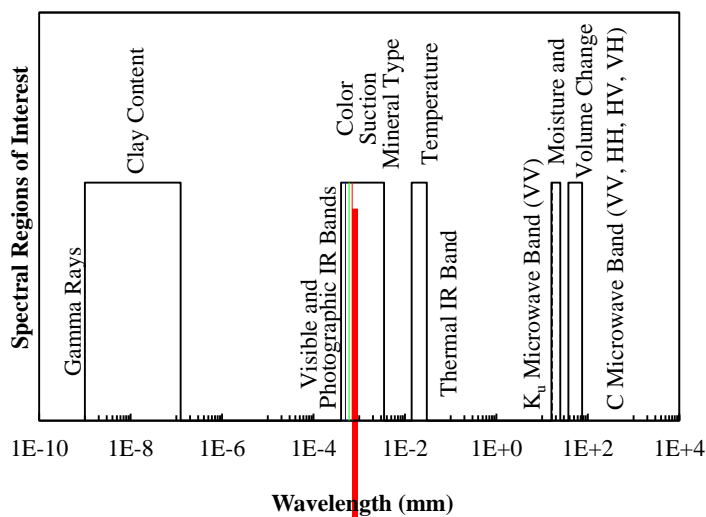




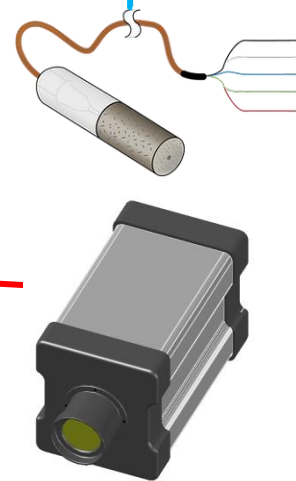
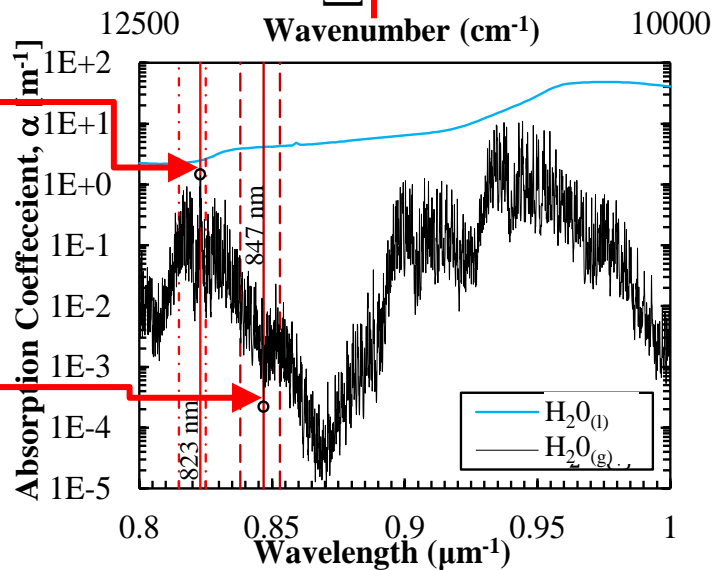
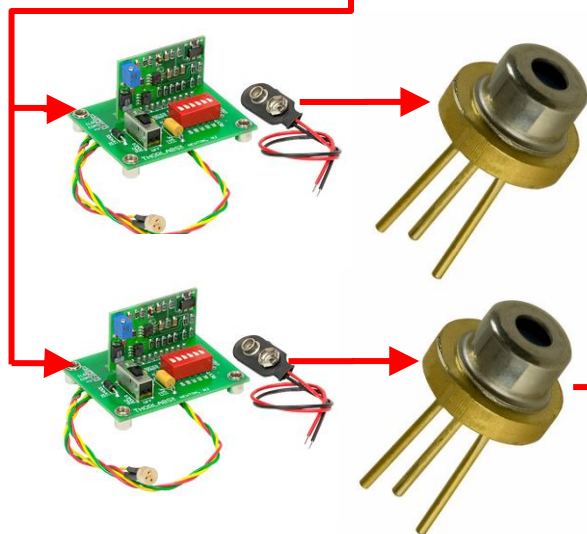
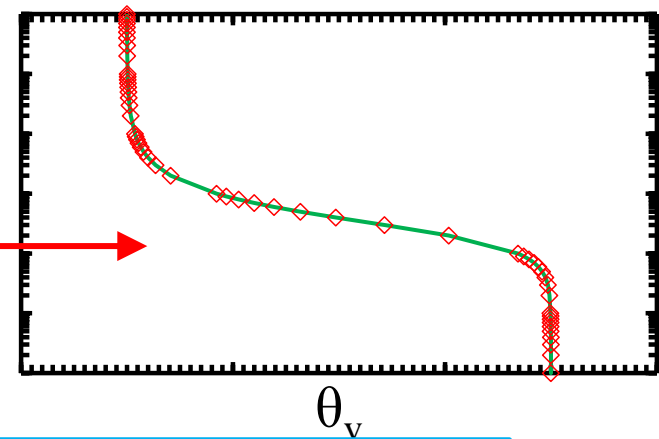


SWCC Curve
Parameters (α , m , n)



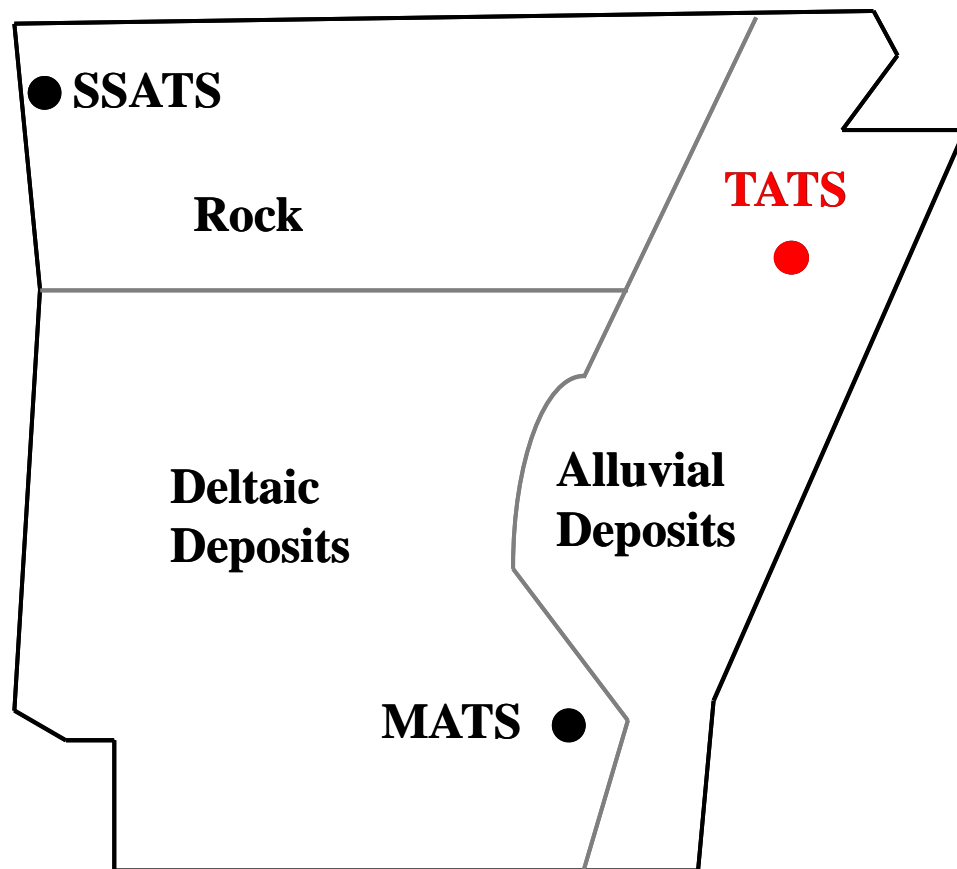


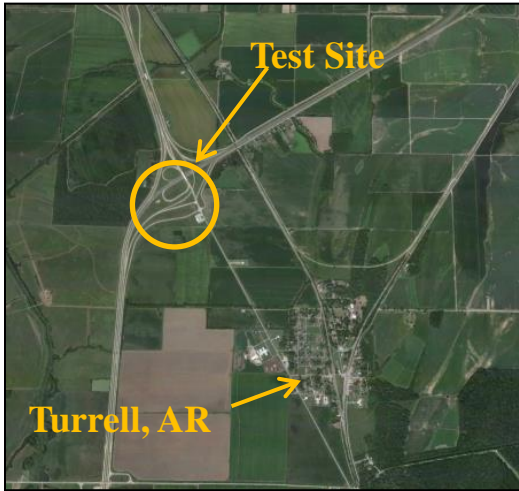
$\text{pH}_2\text{O}_{(g)}$
 $[\text{H}_2\text{O}_{(g)}]$
 $^{\circ}\text{K}$





Drilled Shaft Foundations





Movement, δ , [cm]



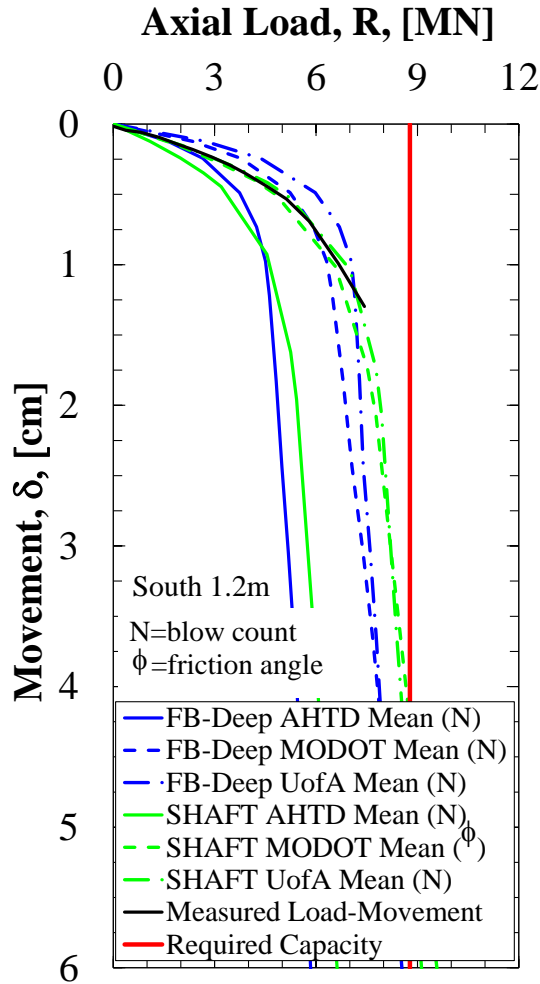
South 1.2m DSF



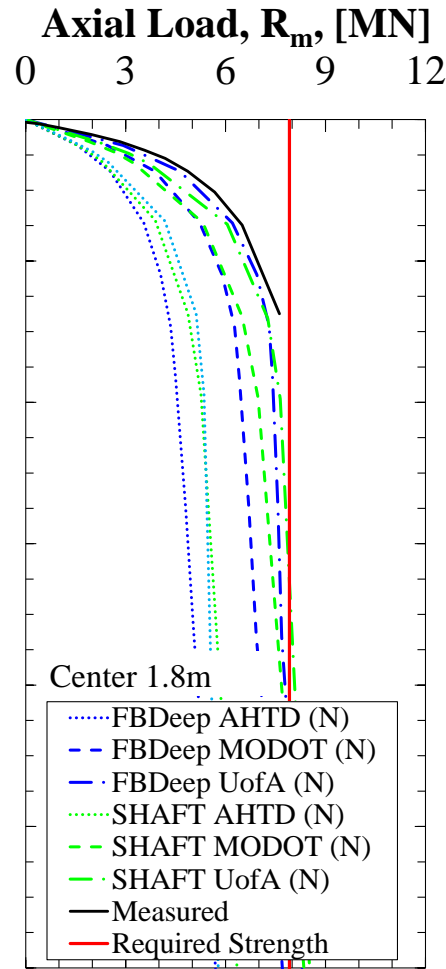
Center 1.8m DSF



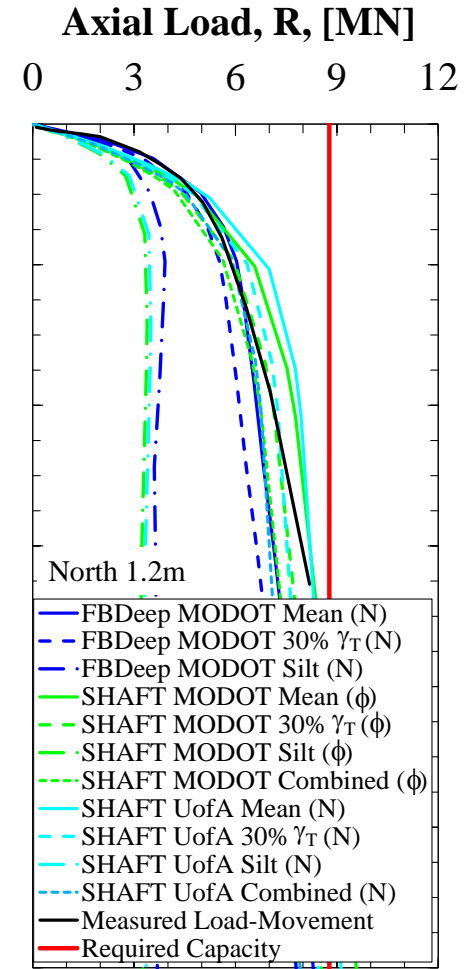
North 1.2m DSF



South 1.2m DSF

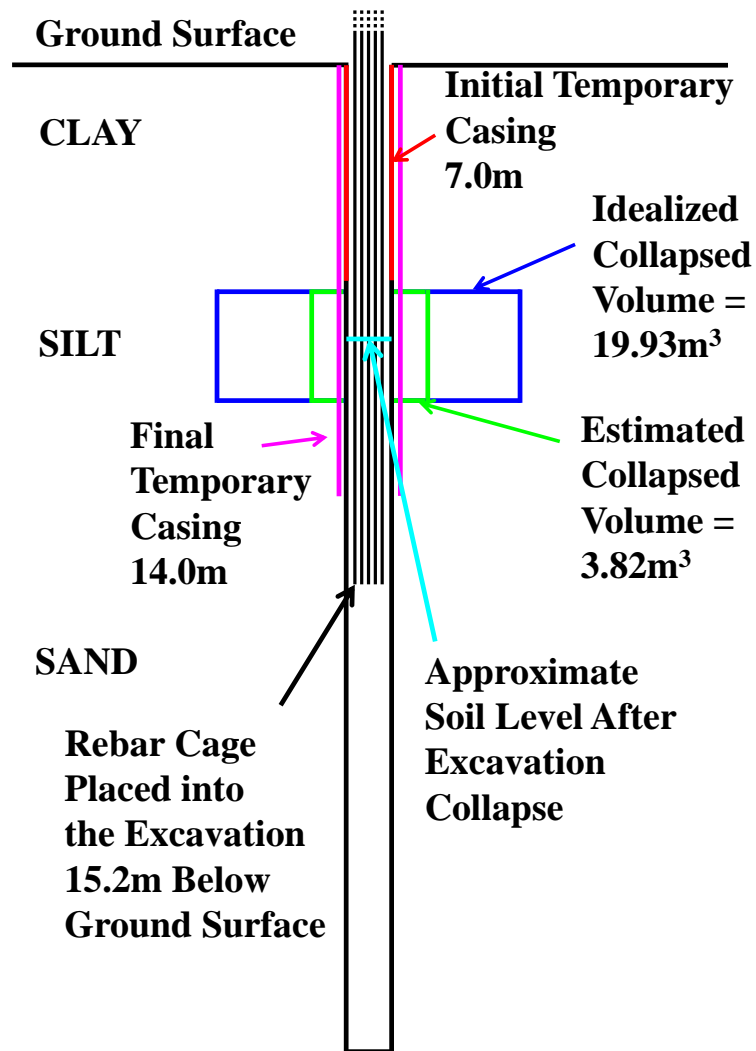


Center 1.8m DSF

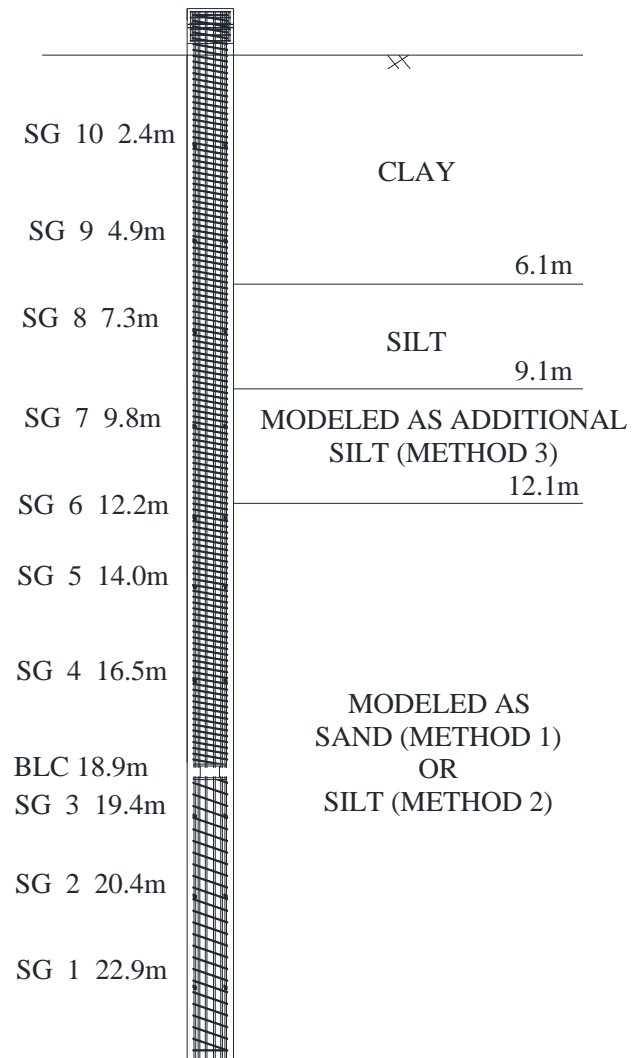


North 1.2m DSF

Collapsed Excavation



Modified Predictive Model



Conclusion



Compaction



Expansive Soils



Drilled Shaft Foundations



Compaction

Perform Additional Laboratory Tests

Develop Zone of Acceptance (based on k , c_u)

Perform Field Verification

Rework/Reject Locations Outside of Zone



Expansive Soils

Laboratory Techniques to Measure Expansive Soils

Remote Sensing Instruments to Measure Expansive Soils

Need for Unsaturated Soil Parameters

Need for Additional Full-Scale Load Tests
Slurry Density/Viscosity is Important
Plan for Contingences

