

Acqua e Suolo - Infiltrazione

Obiettivi formativi:

- conoscere le principali proprietà idrauliche del suolo
- Conoscere i meccanismi che controllano l'infiltrazione
- Saper distinguere infiltrazione potenziale ed effettiva
- Saper utilizzare i principali metodi per il calcolo dell'infiltrazione

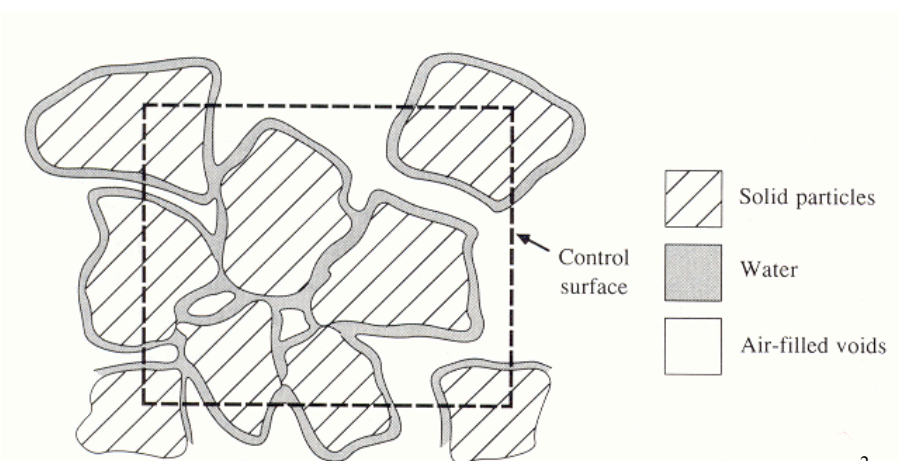
Riferimenti:

- Tarboton, Rainfall-Runoff Processes workbook chapter 4
- Maione: Le Piene Fluviali, cap 2
- Versace: Scheda didattica

1

Suolo:

- mezzo trifase
- sede di fenomeni di trasporto d'acqua in forma non satura



2

Curva granulometrica con i limiti di appartenenza alle classi tessiturali

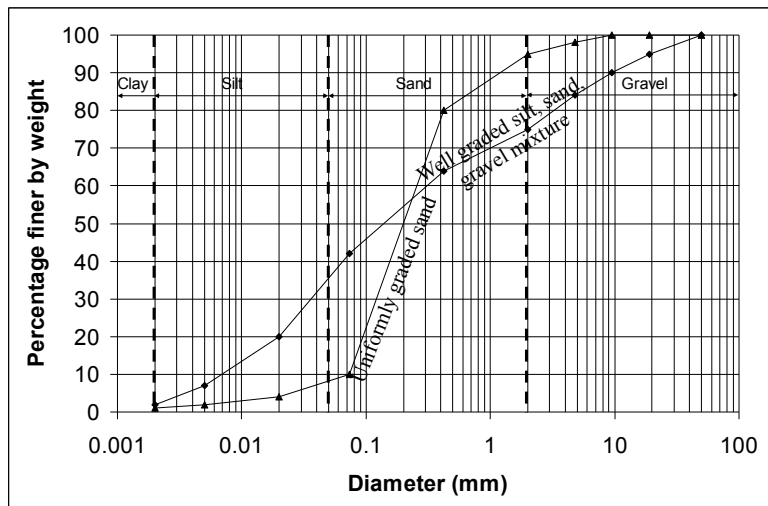
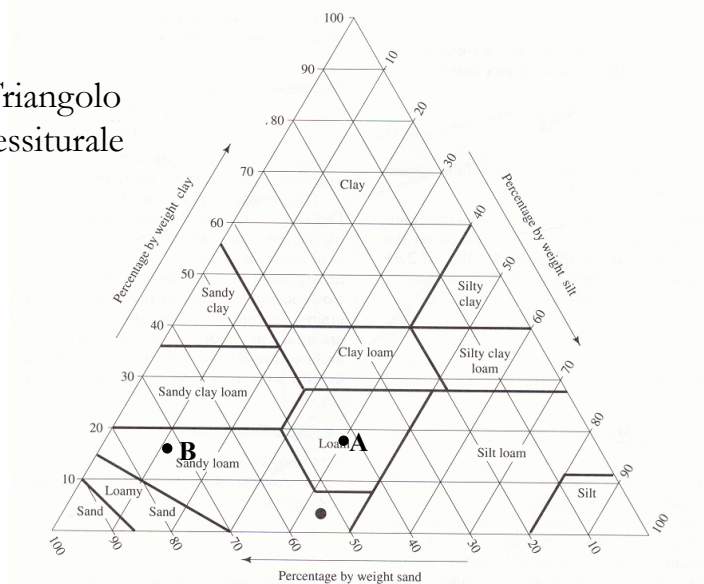


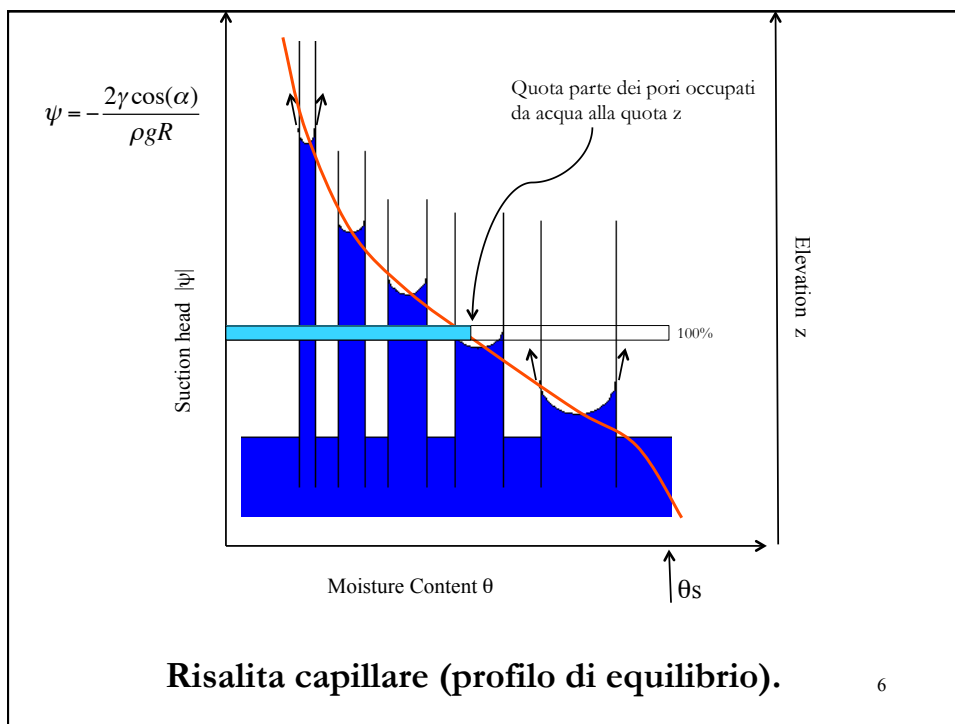
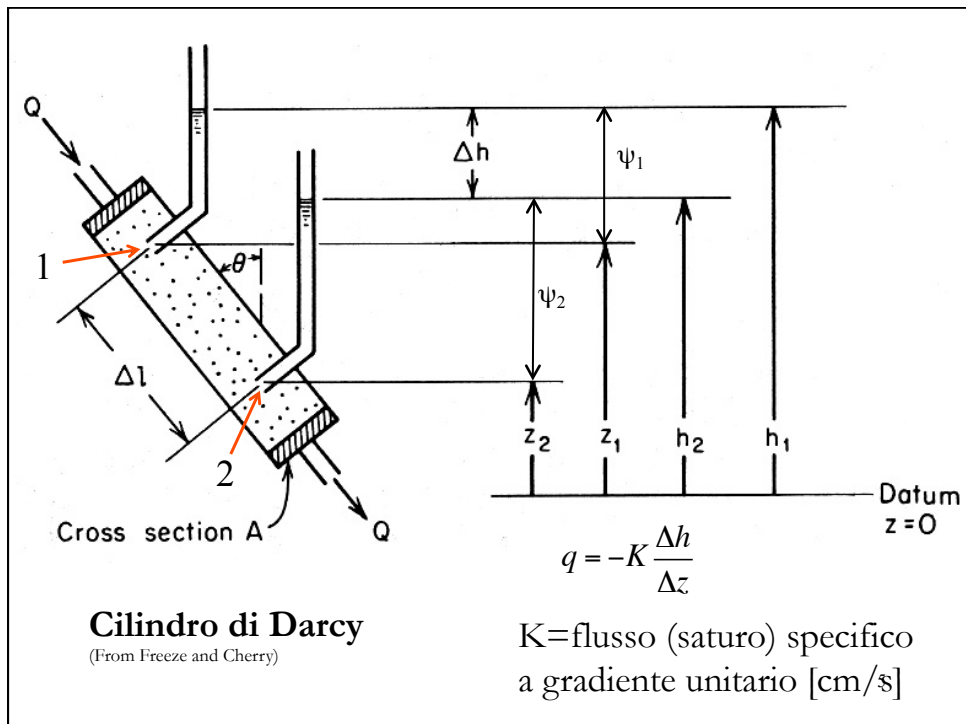
Figure 22. Illustrative grain-size distribution curves. The boundaries between size classes designated as clay, silt, sand and gravel are shown as vertical lines.

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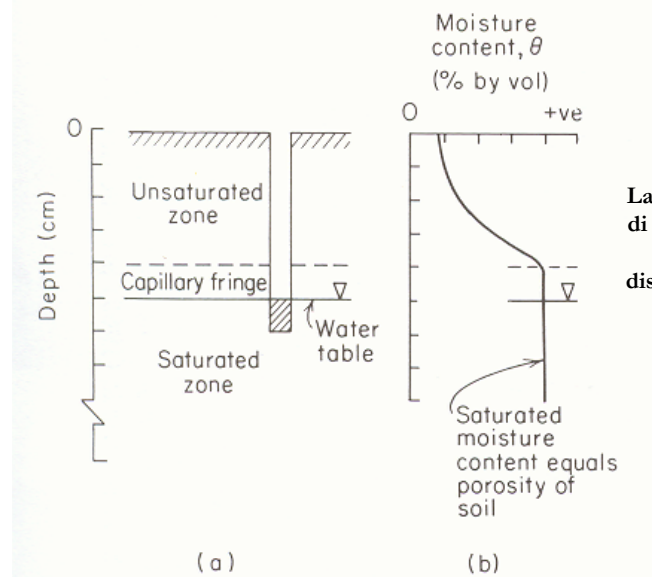
Triangolo
tessiturale



Soil texture triangle, showing the textural terms applied to soils with various fractions of sand, silt and clay. (from Dingman, 2002)



Relazione tra suzione e contenuto d'acqua

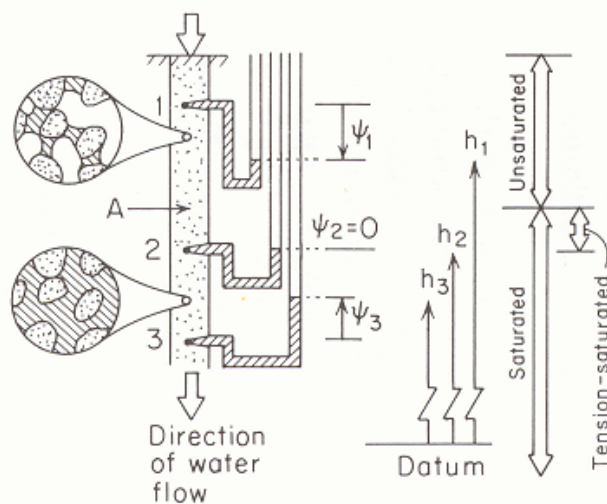


La forma della curva di ritenzione idrica è funzione della distribuzione dei pori

(from Freeze and Cherry, 1979)

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Differenza di potenziale → flusso



(from Freeze and Cherry, 1979)

8

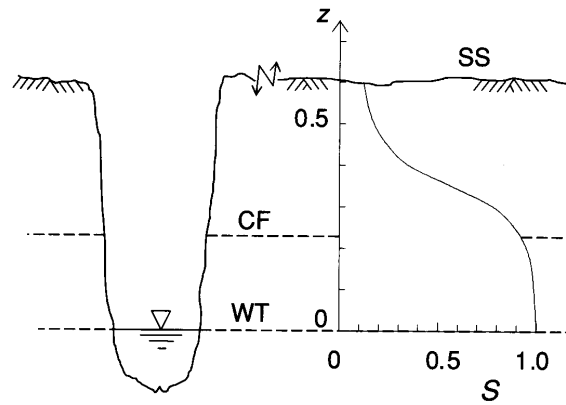
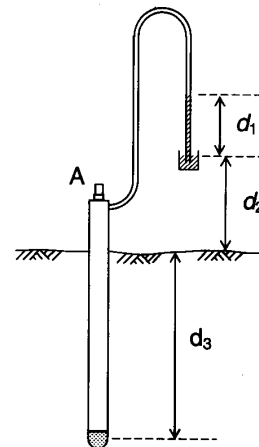


Fig. 8.7 Vertical distribution of the degree of saturation S under equilibrium conditions in a uniform soil profile. SS indicates the soil surface, WT is the position of the water table, and CF the approximate height of the capillary fringe. The height z above the water table is in meters; in this example the soil is a fine sand and the curve is the same as shown in Figure 8.5. "Equilibrium" indicates that there is no flow and that the soil water pressure distribution is hydrostatic.

From Brutsaert, 2005

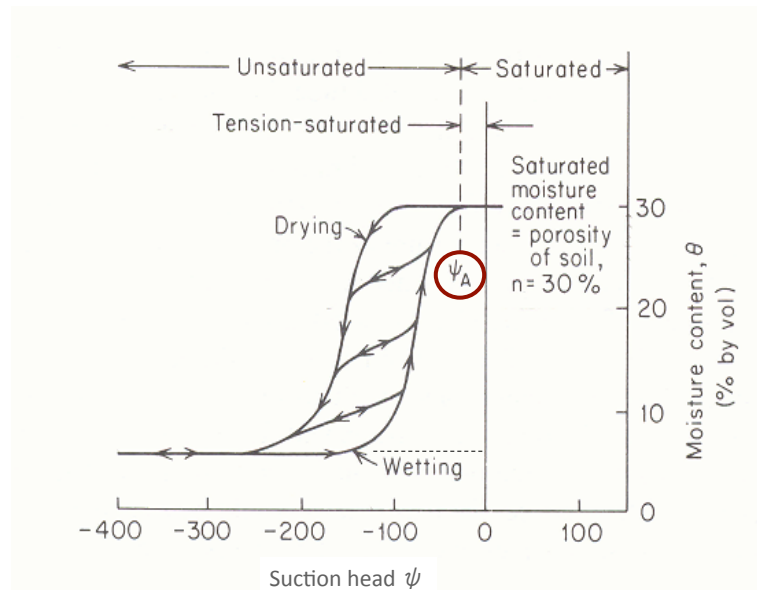
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Fig. 8.8 Sketch of a tensiometer installed in the field; a manometer fluid has a column height d_1 above that of the reservoir surface d_2 ; the porous cup at the end of the tube, which is placed at depth d_3 , is filled with water in contact with the soil water; at A, the main tube can be opened to fill it with water or to bleed it of air bubbles.



From Brutsaert, 2005

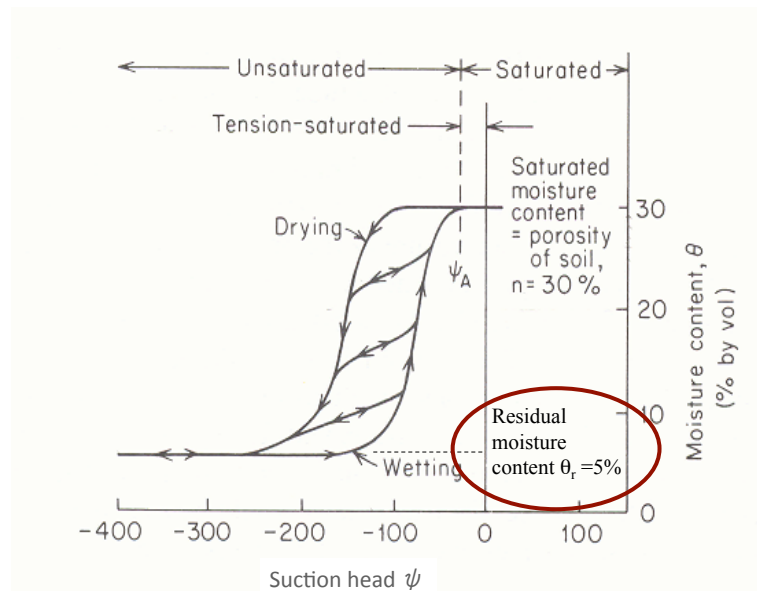
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Curve caratteristiche (ritenzione idrica) $\theta - \psi$

(from Freeze and Cherry, 1979).

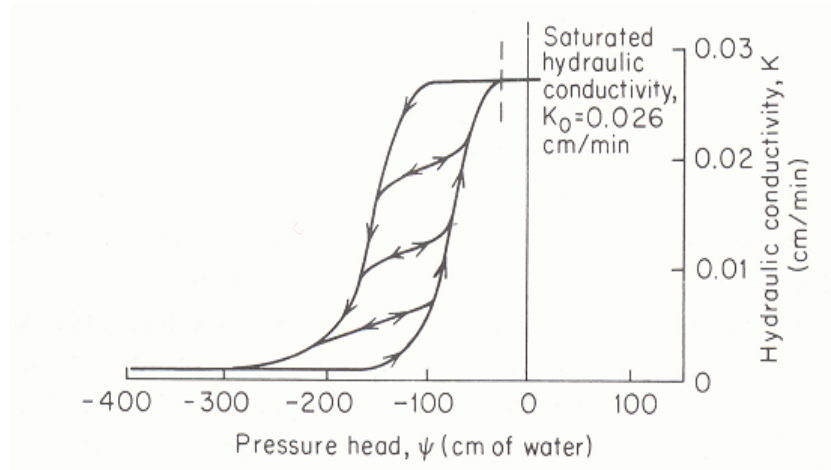
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Curve caratteristiche (ritenzione idrica) $\theta - \psi$

(from Freeze and Cherry, 1979).

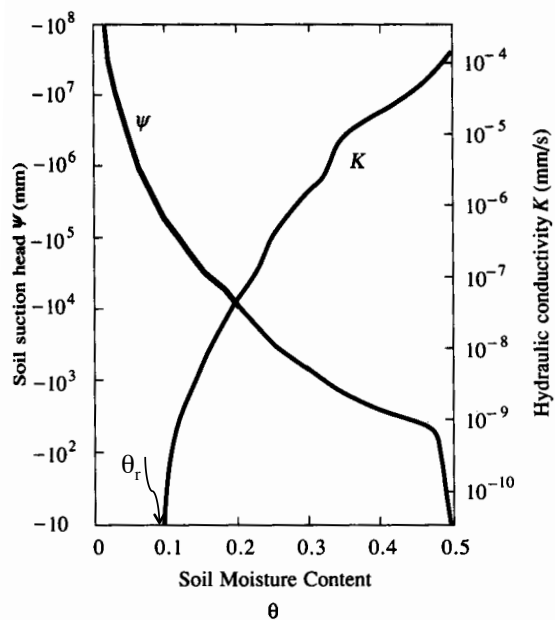
12



Curve caratteristiche (ritenzione idrica) K - ψ

(from Freeze and Cherry, 1979).

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Variation of soil suction head, $|\psi|$, and hydraulic conductivity, K , with moisture content. (from Chow et al, 1988)

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soil water characteristic functions
(funzioni di Pedo-trasferimento)

$$S_e = \frac{\theta - \theta_r}{n - \theta_r} \quad \text{Grado di saturazione effettivo}$$

Brooks and Corey (1966)

$$|\psi(S_e)| = |\psi_a| S_e^{-b}$$

$$K(S_e) = K_{sat} S_e^c$$

van Genuchten (1980)

$$|\psi(S_e)| = \frac{1}{\alpha} (S_e^{-1/m} - 1)^{l-m}$$

$$K(S_e) = K_{sat} S_e^{1/2} (1 - (1 - S_e^{1/m})^m)^2$$

Clapp and Hornberger (1978)

$$|\psi(\theta)| = |\psi_a| \left(\frac{\theta}{n} \right)^{-b}$$

$$K(\theta) = K_{sat} \left(\frac{\theta}{n} \right)^c$$

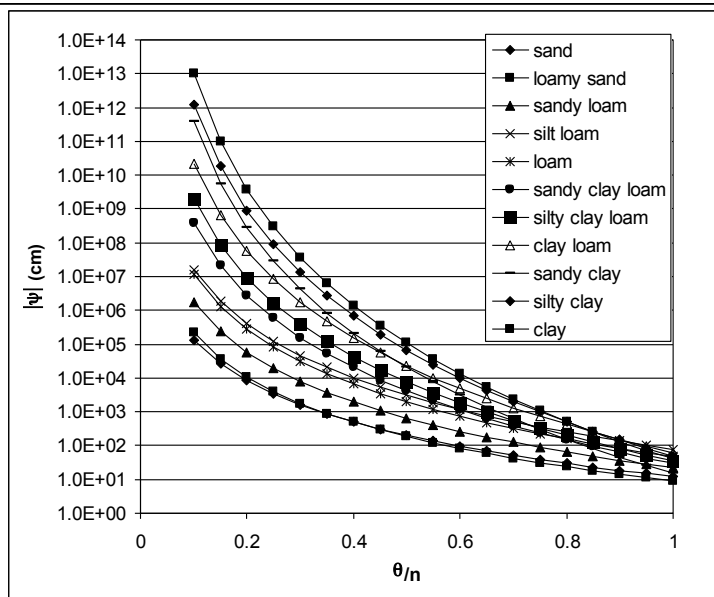
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Clapp and Hornberger (1978) parameters for Soil Moisture Characteristic functions. Values in parentheses are standard deviations.

Soil Texture	Porosity n	K_{sat} (cm/hr)	$ \psi_a $ (cm)	b
Sand	0.395 (0.056)	63.36	12.1 (14.3)	4.05 (1.78)
Loamy sand	0.410 (0.068)	56.16	9 (12.4)	4.38 (1.47)
Sandy loam	0.435 (0.086)	12.49	21.8 (31.0)	4.9 (1.75)
Silt loam	0.485 (0.059)	2.59	78.6 (51.2)	5.3 (1.96)
Loam	0.451 (0.078)	2.50	47.8 (51.2)	5.39 (1.87)
Sandy clay loam	0.420 (0.059)	2.27	29.9 (37.8)	7.12 (2.43)
Silty clay loam	0.477 (0.057)	0.612	35.6 (37.8)	7.75 (2.77)
Clay loam	0.476 (0.053)	0.882	63 (51.0)	8.52 (3.44)
Sandy clay	0.426 (0.057)	0.781	15.3 (17.3)	10.4 (1.64)
Silty clay	0.492 (0.064)	0.371	49 (62.0)	10.4 (4.45)
Clay	0.482 (0.050)	0.461	40.5 (39.7)	11.4 (3.7)

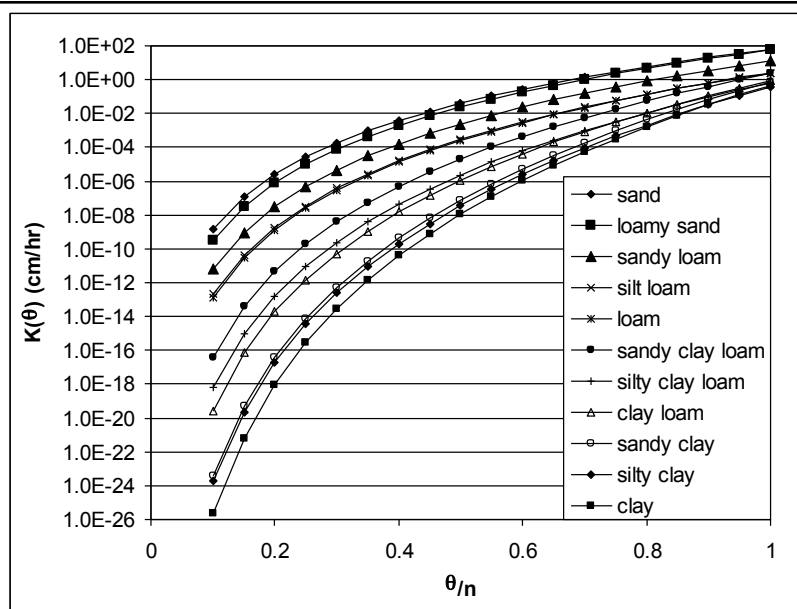
based on analysis of 1845 soils.

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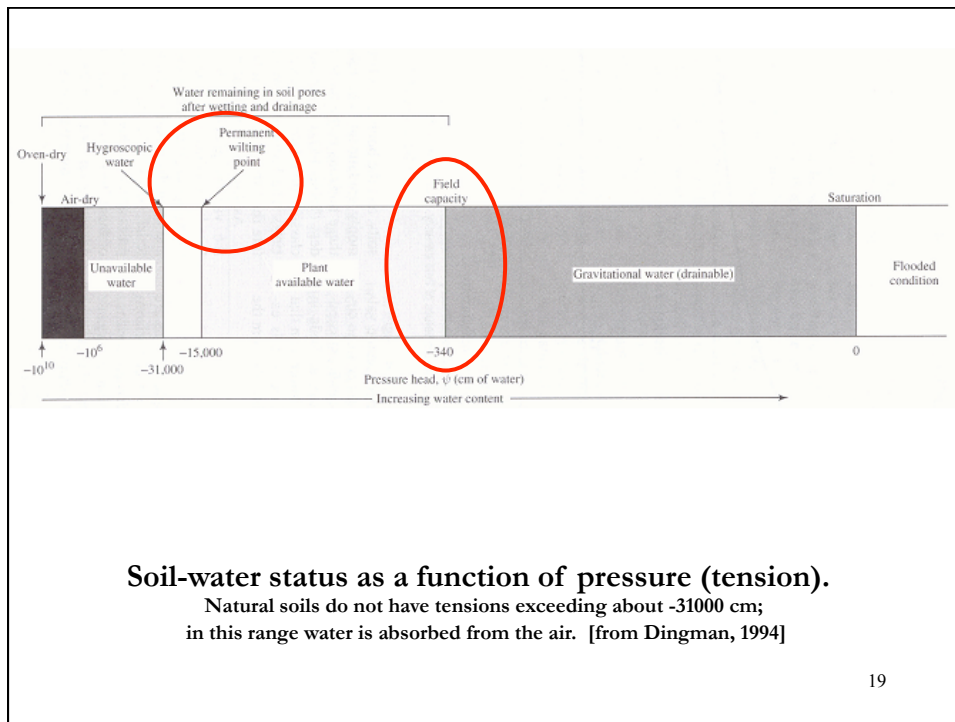
Potenziale di suzione $|\psi|$ per differenti tessiture dei suoli
[Clapp and Hornberger (1978)]

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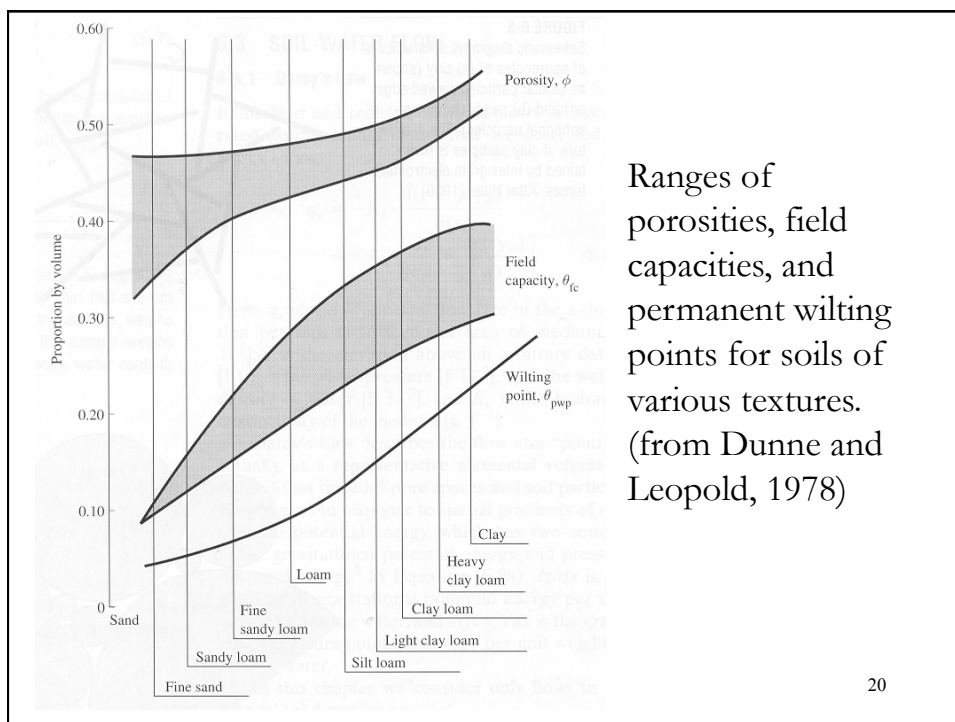


Conducibilità idraulica $K(\theta)$ per differenti tessiture dei suoli
[Clapp and Hornberger (1978)]

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