Slate

Description

Image

Caption

1. Close-up of the material. © Granta Design 2. Slate is used as a roof and wall covering as well as for construction. © Granta Design

The material

Slates are formed by the deposition of clay and mud, consolidated by pressure. Their most striking features are their ability to be cleaved, producing flat slabs or sheets, and their impermeability to water in a direction normal to the cleavage plain. Because of this, slate has been used for centuries for roof tiles, pavings and floors when laid directly on bare earth. Slate is exceptionally durable and weather resistant: if maintained, slate roofs last for hundreds of years. The fine texture and uniform subdued coloring leads also to the decorative use of slate, in stair treads, signs and grave stones.

Composition (summary)

Slate is a form of shale, a complex alumino-silicate.

General properties

Density	162	-	181	lb/ft^3
Price	* 0.308	-	0.404	USD/lb
Date first used	-10000			

Mechanical properties

Young's modulus	8.7	-	13.1	10^6 psi
Shear modulus	* 2.9	-	4.35	10^6 psi
Bulk modulus	* 7.25	-	11.6	10^6 psi
Poisson's ratio	* 0.22	-	0.3	
Yield strength (elastic limit)	* 2.18	-	4.35	ksi
Tensile strength	* 2.18	-	4.35	ksi
Compressive strength	17.4	-	25.4	ksi
Elongation	0			% strain
Hardness - Vickers	22	-	60	HV
Fatigue strength at 10^7 cycles	* 1.45	-	1.74	ksi
Fracture toughness	* 0.364	-	1	ksi.in^0.5
Mechanical loss coefficient (tan delta)	* 0.001	-	0.003	

Thermal properties

Maximum service temperature	* 662	-	932	°F
Minimum service temperature	-58	-	-22	°F
Thermal conductor or insulator?	Poor insulator			
Thermal conductivity	0.693	-	1.21	BTU.ft/h.ft^2.F

Specific heat capacity	0.203	-	0.213	BTU/lb.°F
Thermal expansion coefficient	5.56	-	6.67	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good insulator			
Electrical resistivity	* 1e12	-	1e14	µohm.cm
Dielectric constant (relative permittivity)	* 8	-	15	
Dissipation factor (dielectric loss tangent)	* 0.001	-	0.005	
Dielectric strength (dielectric breakdown)	* 127	-	305	V/mil

Optical properties

Transparency	Opaque

Processability

Machinability	3	-	4	

Eco properties

Embodied energy, primary production	126	-	140	kcal/lb
CO2 footprint, primary production	0.0698	-	0.0772	lb/lb
Recycle	✗			

Supporting information

Design guidelines

Slate is an exceptionally stable and inert material. Slate roofs last between 30 and 100 years, depending on the climate. It can be damaged by severe frost.

Technical notes

Slate cleaves easily to give surfaces that can be extremely flat -- its use as the surface of a billiard table is an example. Its fine texture allows delicate incising and carving.

Typical uses

Roof tiles, paving, floors, stair treads, table tops (including billiard and snooker tables), chalk boards, electric panels, gravestones and other monumental signs.

Further reading

Doran, D.K. (ed.) Construction materials reference book, Butterworth Heinemann, Oxford (1992)
Prices: www.stonecontact.com

Links

Reference

ProcessUniverse

Producers