Grout: Cement mortar of fluid consistency used to fill the voids and joints in masonry and to repair the cracks is known as grout. Grout differs from mortar in its fluidity as it is to be poured. It is essentially composed of cement, fine and coarse sand, water and a small amount of grouting admixture.





STONES

Rock is a natural substance, a solid aggregate of one or more minerals or mineraloids with a definite chemical composition, forming a portion of earth's crust. Being aggregations of minerals, the properties of rocks are dependent upon the character of these constituents, identified by their physical properties. Stone has been defined as the natural, hard substance formed from minerals and earth material which are present in rocks.

A mineral is a naturally occurring chemical compound, usually of crystalline form. A mineral has one

specific chemical composition, whereas a rock can be an aggregate of different minerals. There are over 5300 known mineral species. Some of the most important minerals are given in the third, fourth and fifth pages.

Some minerals feature great strength, hardness and resistance to chemical attack (quartz); others have poor strength and readily soak in water (gypsum); some minerals display a great tendency to cleavage and split readily along one or several directions (mica), thus decreasing the strength of the rock they make up. Some of the important properties of minerals are as follows:

is probably the most important property for rapid determination of hardness minerals. It is measured by scratching the mineral with a series of substances of known variation in hardness using the following scale of Mohs:

easily scratched with the thumb-nail alc 7 Month API BILGISIAMADINI MARTING POLICIES 10 sites in the strest of the AARLIN ODLOWD YILDIZ TERMIN UMINERSITES IN MINIMUM ARI VAPIBILGISIAMARILAA MARILAA MALE fluorite apatite orthc Q' DR.POLAT DARCIN'S

D. D. R. POLAT D. sapphire diamond

is the measure of the capability of cleavage some minerals to split along certain planes parallel to the crystal faces.

Cleavage in one direction. Example: MUSCOVITE

Cleavage in two directions. Example: FELDSPAR

Cleavage in three directions. Example: HALITE

Cleavage in two directions. Example: CALCITE

6

streak is the color of the mineral in powder-form. For some minerals, their color is seen to be entirely different from that of their powder, which makes streak a useful property in the identification of ore-minerals. Streak can be readily observed by scratching it on a streak plate made of unglazed porcelain or roughened glass.

1 PP BILG is a valuable characteristic of metallic minerals, but less reliable for non-metallic color minerals.

is shine on the surface of a luster RSNOTLAR mineral and its appearance under reflected light is classified as 20'JON vitreous (glassy), greasy, pearly, resinous, dull, silky and metallic.

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90 12	Les 2 the Solution	23 M/ 29	8 x V	0, 7	9 6 1 4 B	PL 91	N 6 1	
mineral	composition	image	hardness	streak	color	Juster	cleavage	1
quartz	silicon dioxide		r 7 5 9	P P	colorless, white	vitreous	no cleavage	2.
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	Les L in er		3 8	10° 20	sometimes	G t	SF 83	0
4 5	as or in o are		1 1 1 1 1 C 8	+ ~	brown to black	9 43 19	- 12 M	
- P	AL IN ES VI NE	A A VAR	4. 12	8 P	a a a	R AN GS	8 20	S
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feldspar	alumina silicates with potash		9 01	white	a the star	8 VIL 04	straight	
0 10	e.g. K ₂ O.Al ₂ O ₃ . 6SiO ₂		A X	41 12	S	91. 9	splitting	40
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A ANY A	alumina silicates with soda	and the second of the second o	20 xt	grey to	pink	pearly	oblique	N
9, 0,	e.g. $Na_2O.Al_2O_3.6SiO_2$		9 × 1	white	29. M. D.	9 8	splitting	-
mica	CaO.Al ₂ O ₃ .2SiO ₂ silicates of alumina with		2 0V	90 4	colorless or	Vitroousto	can be split	1
Inica A	hydrogen and potash		E	×8 ×	grey to brown	vitreous to pearly	along one	A.
AN C	KAl ₂ (AlSi ₃ O ₁₀)(OH) ₂		1 ar	colorless	grey to brown	transparent	plane	
9 00	silicates of alumina with		2-3 5	to grey	brown to black	vitreous to	no cleavage	2
A N	hydrogen, iron and magnesia		N 0	CO BICY	BIOWIT CO DIACK	pearly opaque	No cicavage	
6	K(Mg, Fe) ₃ (AlSi ₃ O ₃)(OH) ₂		8	8 P2	to of	Pearly opuque	20 00	~
amphibole	silicate of iron, lime, magnesia	A CONTRACTOR OF A CONTRACTOR O	0 4	30 1	dark green to	vitreous	25 00 0	2
	or alumina		19 51	1 8	black	0, 12, 90	0. 14	3
122 63	(Ca-Na) ₂₋₃ , (Mg, Fe, Al) ₅ Si ₆ ,		E CON S	E ler	8. 18 X	12 6	2 P 5 72	0
20 02	silicates of lime and magnesia		5-6	uncolored	white to grey	vitreous to silky	Ser 14	
12 22	CaMg ₅ Si ₈ O ₂₂ (OH) ₂		2 01	grey or	8 P 41	E X S	9 4	4
12 2	9 1 m 20 4 20 20		28 84	brown	N 0 14	A. A.	8 1ª 8	2
serpentine	hydrous silicate of magnesia	- Contraction	4 1	white	greenish	greasy	0 72	2
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mineral	composition	image
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4 54	(Al, Si) ₄ O ₁₀ (OH) ₈	
. 8	AN LES AV AR	
GIS HILL	AR JER IN SIN O	Pinnenn-cutoring O
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dolomite	calcium magnesium carbonate	© ge
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set is	Fe ₃ Q ₄
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\$ x	47 10 M 61
pyrite	iron disulfide
ALL AND A	FeS2
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pyroxene	silicates of lime, alumina,
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	V 0 10 10
olivine	silicate of iron and magnesia
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CAL UNIVERSITY – DEPARTMEN 2017 - 2018 ACADEMIC YEAR – SPRING SEMESTER **BUILDING MATERIALS LECTURE NOTES / Dr. Polat DARÇIN**

Classification of Rocks

The rocks may be classified on the basis of their geological formation, physical characteristics an chemical composition.

geological formation: This classification is based upon the



mode of the formation. On the basis of geological classification, rocks are classified as igneous, sedimentary and metamorphic.

igneous rocks (püskürük külteler) are of volcanic origin and are formed as a result of solidification of

molten mass¹ lying below or above the earth's surface.

- This molten mass called magma (the principal constituents of magma are quartz, mica and feldspar) is forced up as volcanic eruptions and spreads over the surface of earth where i solidifies forming basalt and trap. These are known as effusive rocks.
- If the magma solidifies below the earth's surface itself, the solid crystalline rock is termed as deep-seated plutonic rock. The examples are granite, syenite, diorite and gabbro. If the magma solidifies at a relatively shallow depth, the resultant rock possesses a finely

grained crystalline structure—and is termed as hypabyssal. Dolerite is such a rock.

% of silica example type image acid rocks granite 70-80



rhyolite rhyolite ⁴ The inner layers of the earth are at a very high temperaty melt. ARI VAPIBILGISIAMARILIAA MALE







gabbro other present present of the second o Al ARIDIA FIELDS AND ALL DR. POLAT DARGIN DERS MUMARINE BO J restanting the stand of the s

some types of dolerite

some types of basalt²

sedimentary rocks (tortul külteler): The various weathering agencies, e.g. rain, sun, air, frost, etc. break up the surface of earth. Rain water carries down these broken pieces to the rivers. As the rivers descend down to the plains, the velocity bir sifreyi sizinle paylasacagim decreases gradually and the sediments (disintegrated rock pieces, sand, silt, clay, debris, etc.) in the water settle. Due to the

sediments (disintegrated rock pieces, sand, silt, clay, debris, etc.) in the water settle. Due to the seasonal variation, sedimentation takes place in layers. With time, the sediments get consolidated in horizontal beds due to the pressure exerted by overlying material. ² When magma cools rapidly, its mass expands under the pressure on intensively evolving gases. Subsequent rapid cooling of swollen lumps of magma gives rise to glassy porous rocks. 16 ol Bild ISI AMADINI BILLIM DALL ABINA ARCINA ALLAR FAKULTES OI Spo-, to gr handler handle OR.POLAT



The properties of the sedimentary rocks vary considerably depending upon the nature of the sediment and type of bond between the sediment and grains. Usually, the rocks are well stratified and show well defined bedding planes. The rocks are soft and can be easily split up along the bedding as well as

normal planes.

The examples of sedimentary rocks resulting from the precipitation of salts in drying water basin (chemical deposits) are



Sedimentary rocks resulting from the accumulation of plant or animal remains (organogenous rocks) are limestone, shale, chalk, diatomite tripoli.



The examples of rocks resulting from the deterioration of massive magmatic or sedimentary rocks (fragmental rocks) are

sandstone, sand, grave



carbonate conglomerate

breccia.





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                                          OF
2017 - 2018 ACADEMIC YEAR – SPRING SEMESTER
BUILDING MATERIALS LECTURE NOTES / Dr. Polat DARÇIN
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metamorphic rocks (başkalaşmış külteler): are formed from igneous or sedimentary rocks as a result of the action of the earth movements, temperature changes, liquid pressures, etc. The resultant mass may have a foliated structure, e.g. slate, gneiss, schist and phyallite or non-foliated structure, e.g. marble, quartzite and serpentine.

4	original rock	sranite, syenite, conglomerate	sandstone	limestone, marl, dolomite	shale, felsite, tuff
4	metamorphic	gneiss	quartzite	marble	slate
0	rock			A March Street	



physical characteristics: The rocks may be classified as stratified, unstratified and foliated

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stratified rocks: show distinct layers along which the rocks can be split. The examples are sandstone, limestone, shale, slate, marble, etc.



unstratified rocks: do not show any stratification and cannot be easily split into thin layers. The examples of such rocks are granite, basalt, trap,





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OR. POLA

rocks: have a tendency to split up on, inite direction. Most of the metamorphic have a foliated structure, except for rtzite and marble which have granulose ructure. ave a tendency to spin inte direction. Most of the metamo. Jocks have a foliated structure, except for quartzite and marble which have granut-structure. MMARIN FAKULTESI-MIMARIN BOLDMONT

chemical characteristics: The rocks may be classified as argillaceous, silicious and calcarious.

argillaceous: The principal constituent is clay (Al₂O₃). The rocks are hard and brittle, e.g. slate, laterite, etc.



The principal calcareous: The principal siliceous: constituent is silica (SiO₂), i.e. constituent is lime, e.g. sand. The rocks are very hard limestone, marble, dolomite, and durable, e.g. granite, basalt, etc trap, quartzite, gneiss, syenite, etc.



uarrying of Stones

The only operation involved in the production of natural stone is the quarrying process. The open part of the natural rock from which useful stone is obtained is known as quarry. While selecting a quarry site, availability of sufficient quantity and desired quality, proper



transportation, cheap labor, problems associated with drainage of rain water are important. The operations involved in obtaining minerals are called mining. In the process of mining, voids formed are called excavations.

Depending upon the nature and surface of rocks and the purpose for which stones are needed quarrying is done by excavating



wedging



heating is most suitable for quarrying small, thin and regular blocks of stones from rocks, such as granite and gneiss. A heap of fuel is piled and fired on bu aslinda bir bilmece the surface of rock in small area. The two consecutive layers of the rock separate because of uneven expansion of the two layers. The loosened rock portions are broken





into pieces of desired size and are removed.

Natural Bed of Stone

It is the original bed, plane or position occupied by a stone during its formation in a sedimentary rock. The stones should be so placed that the load line is at right angles to the natural bed. In the case of metamorphic rocks, the plane of foliation or the plane of cleavage is assumed to be its natural bed. It is very difficult to trace the natural bed in the case of igneous rocks and the natural bed is not given due attention.

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Seasoning of Stones

A freshly cut stone carries some natural moisture known as quarry sap making it soft and workable. The quarry sap is a mineral solution and reacts chemically with the mineral constituents when the stone is exposed to atmosphere after quarrying. The stone becomes harder and compact. The process takes about 6 to 12 months for complete seasoning. When the quarry sap evaporates, it leaves a crystalline film on the faces of the stone and makes them weather resistant. The dressing before seasoning oves the weather resistant ssing, carving and molding, etc. should r ine as early after quarrying as possibly improves the weather resistance. As such, the dressing, carving and molding, etc. should be DALLOR.POLAT DARCINDERSNOTLARIVAPIE



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Characteristics of Good Stones

Some of the qualities of a good stone in terms of design and construction are:

appearance: for face work it should have fine, compact texture.

structure: stone should have uniform texture free from cavities, cracks and patches of loose or soft material

strength: A stone should be strong, capable of carrying loads and durable to withstand the weather.





hardness: faces of stones should be resistant against abrasion and wear.

toughness: the measure of impact that a stone can withstand.

workability: Stone should be workable so that shaping, cutting, dressing should be easy and economical.







fire resistance: Stones should be free from calcium corbonate, oxides of iron, and minerals having different coefficients of thermal expansion. Igneous rock show marked disintegration principally because of quartz dönem sonunda bu bilmecenin. çözümünü bir kâğıda yazarak bana veren öğenciler ek puan kazanacak 😳 which disintegrates into small particles at a temperature of about 575°C. Limestone, however, can withstand a little higher temperature; i.e. up to 800°C after which they disintegrate.

porosity and absorption: Porosity depends on the mineral constituents, cooling time and structural formation. A porous stone disintegrates as the absorbed rain water freezes, expands LEK MIN UNIT SSIF LEX



s, cooling time s... Itegrates as the absorbed rain water meet ses cracking. (missible water absorption for some stones olume) sandstone, limestone, shale <10% granite, gneiss, slate <1° 10% 10% 10% 1% 1% 1% ARLIN BOLDMU YILDIZ TER 5 NOTLARI VARIABILGISI



OR.POLAT

Deterioration of Stones

The various natural agents such as rain, heat, etc. and chemicals deteriorate the stones with time.

rain water acts both physically and chemically on stones.

physical: Alternate wetting by rain and drying by sun causes internal stresses in the stones and consequent disintegration.



chemical: In industrial areas the acidic rain water reacts with the constituents of stones leading to its deterioration.

• decomposition: The disintegration of alkaline silicate of alumina in stones is mainly because of the action of chemically active water. The hydrated silicate and the carbonate forms of the alkaline materials are very soluble in water and are removed in solution leaving behind a hydrated silicate of alumina (kaolinite).

 oxidation and hydration: Rocks, containing iron compounds in the forms of peroxide, sulphide and carbonate, are oxidised and hydrated when acted upon by aciduated rain water.



Since wind carries dust particles, the abrasion caused by these deteriorates the stones.

Expansion and contraction due to frequent

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temperature temperature changes cause stone to uren. of several minerals with different coefficients of linear or deteriorate especially if a rock is composed DARGIN DERS NOTLARI VARIE 80LOWO THEORY AIMARLIN FAMULTEST MIMARILE O ARCIM DERS OPROIN MIMARLINEAKULTEST

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In cold places frost pierces the pores of the stones where it freezes, expands and creates cracks.



Roots of trees and weeds that grow in the masonry joints can crack the stones, cause deplacement, keep the stones damp and also secrete organic and acidic matters which cause the stones to deteriorate. Bacteriological process starts and the resultant micro-organism producing acids attack stones which cause decay.

When different types of stones are used mutual together mutual decay takes place. For decay example when sandstone is used under limestone, the chemicals brought down from limestone by rain water to the sandstone will deteriorate it.



chemical agent

rost

vegetation

Smokes, fumes, acids and acid fumes present in the atmosphere deteriorate the stones. Stones containing CaCO₃, MgCO₃ are affected badly.





stone but act as for other stones, Molluses aken and ultimately destroy by making a series of parallel al holes in limestones and sandstones. These destroy limestone but act as



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Classification and Uses of Stones



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e sea, buildings in	depends on the color of fel
areas of the s	very low water absorption,
09 39 1	to abrasion, resistant to aci
0 N 02.	and smoke, difficult to dres
S I a	shape of shape
ing building walls,	hard, tough, high compress
or concrete	strength, resistant to abrasi
e, colored varieties	difficult to dress and shape
for decorative	YO THE ON
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e ornamental	compact, soft and easy to v
8. 4. 13	O C C' Or
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in the form of flag stone for paving, tile stone for roofing, buildings facing the sea (fine grained sandstone), arches (fine grained sandstone), face work, carved work, ornamental work (close grained sandstone), fire resisting structure (compact

characteristics

Medium compressive strength. Fine grained sandstone is not affected by the weathering action, strong and durable; compact sandstone is resistant to acid fumes and smoke and fireproof; close grained sandstone is light, soft, easy to work; coarse grained sandstone is hard and compact. Sandstone weathers well when it is free from lime and iron.

flooring, paving, roofing, manufacture of lime and

Medium compressive strength. Tough, but soft enough to be cut and shaped. Affected by frost and atmosphere.

Strong and durable, can be split into thin slabs.

ARUN BOUDAU VILOIT TERMINERSITESITE

SNOTLARI YARIBILGISI AMABILIM DALLAS



ILIM DALL DR. POLAT





characteristics suitable for monuments, statues, high compressive strength, hard and compact, takes fine polish, ornamental works, face works, High compressive strength, hard and tough, splits into thin slabs 26 TERMINERSTESTIMMARIL EST-MINARLIN BOLDMO YILDIL TEKNING BUILDING INDERS NOTLARI VAPIBILGISI AMABILIMA DARGINDERS NOTLARI VAPIBILGISIANI ARUN BOLOMO VILOIZ TERMIN UMINERSITEST. P SNOTLARI YARIBILGISI AMABILIM DALLAS

