Wuhan University of Technology

《Blasting Engineering》 quality courses

Chapter Four Blasting Engineering Geology

Main content:

4.1 The basic nature of the rock

4.2 Stress shock wave in rock

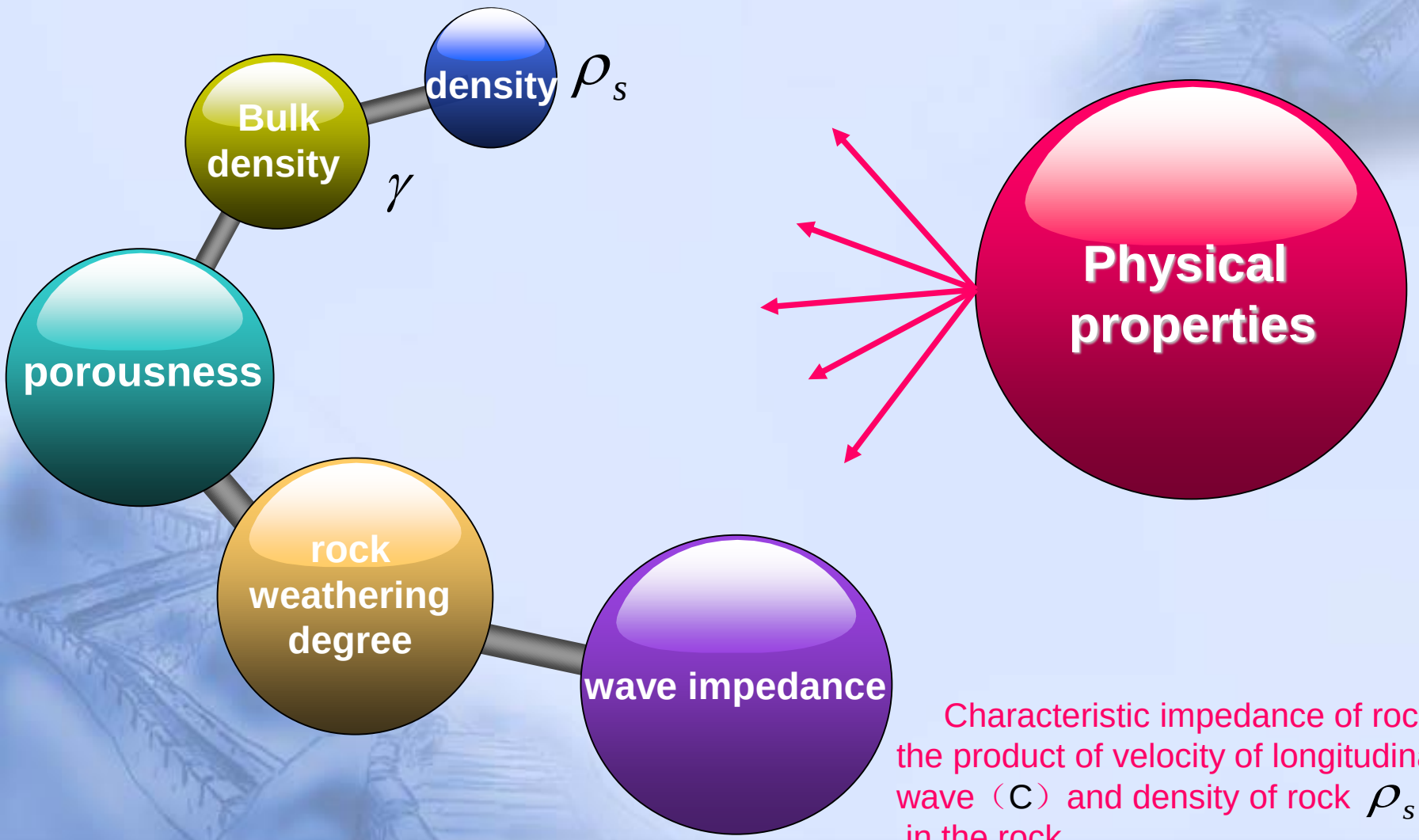
4.3 Classification of rock

4.4 Geological condition effect on blasting

4.5 effect of geological condition on Blasting

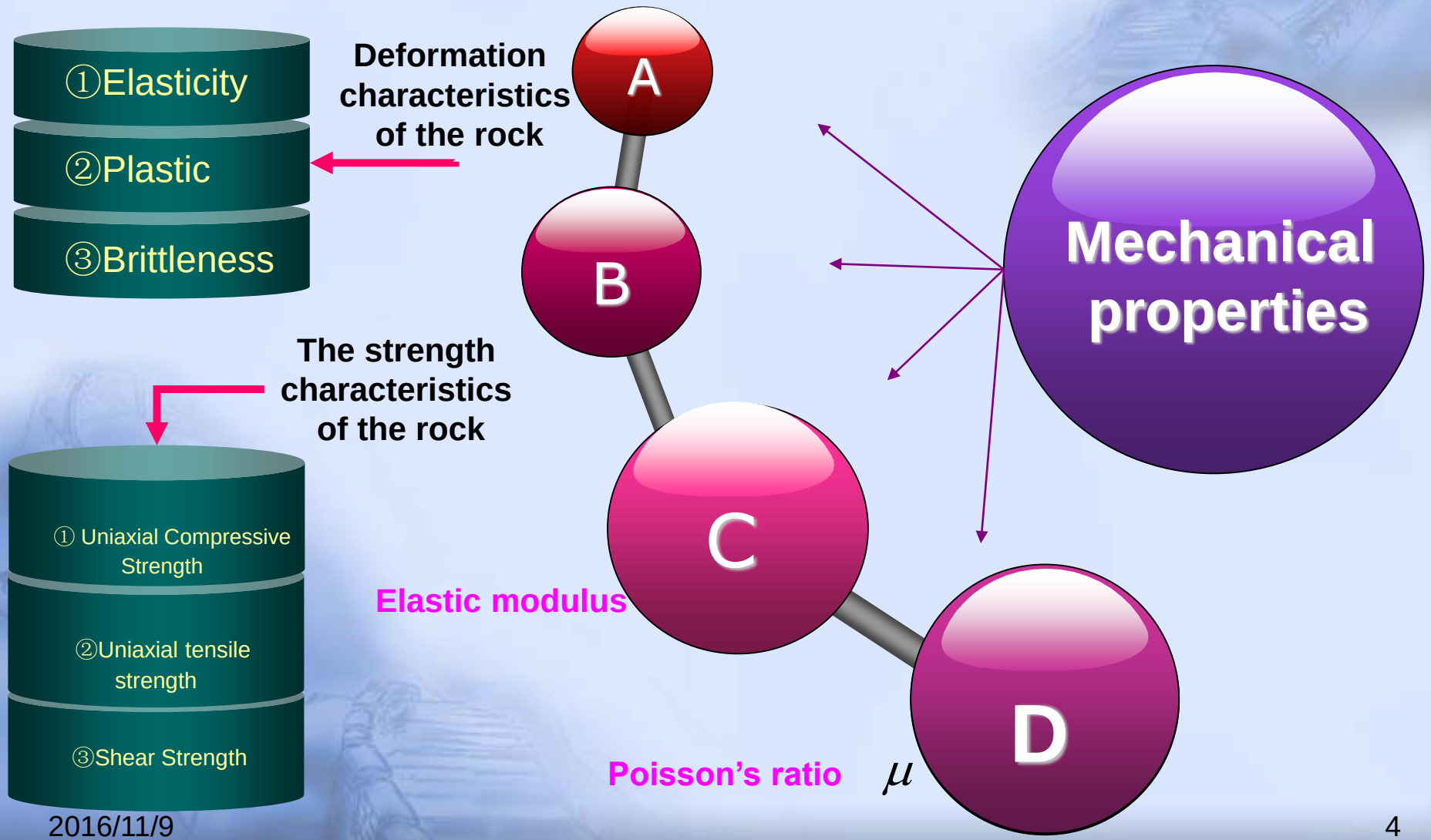
4.6 Blasting geological prospecting （omission）

Section One Basic Properties of Rock



Characteristic impedance of rock is the product of velocity of longitudinal wave（C）and density of rock ρ_s in the rock.

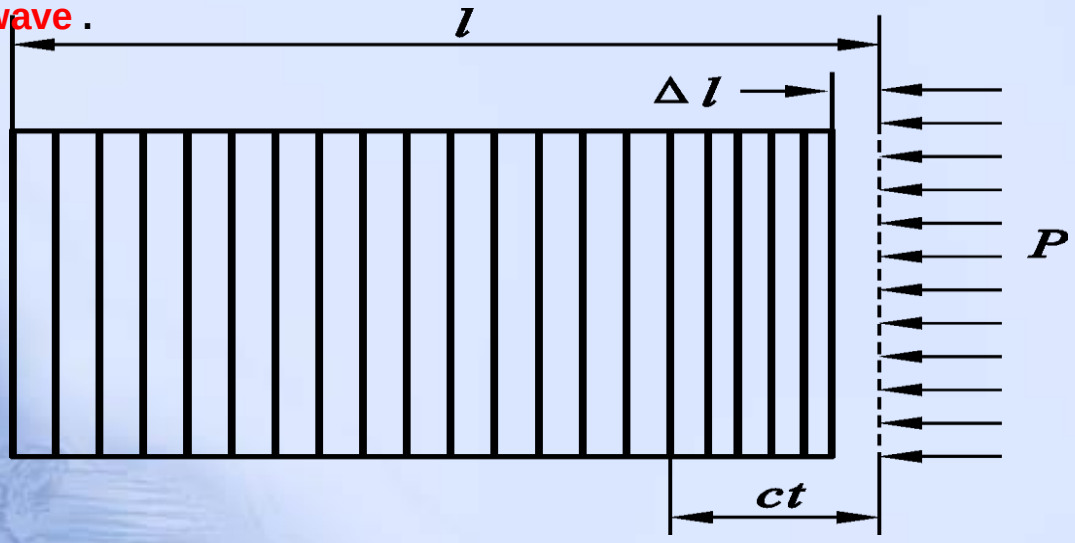
Mechanical Properties of Rocks



Section Two Stress Wave in the Rock

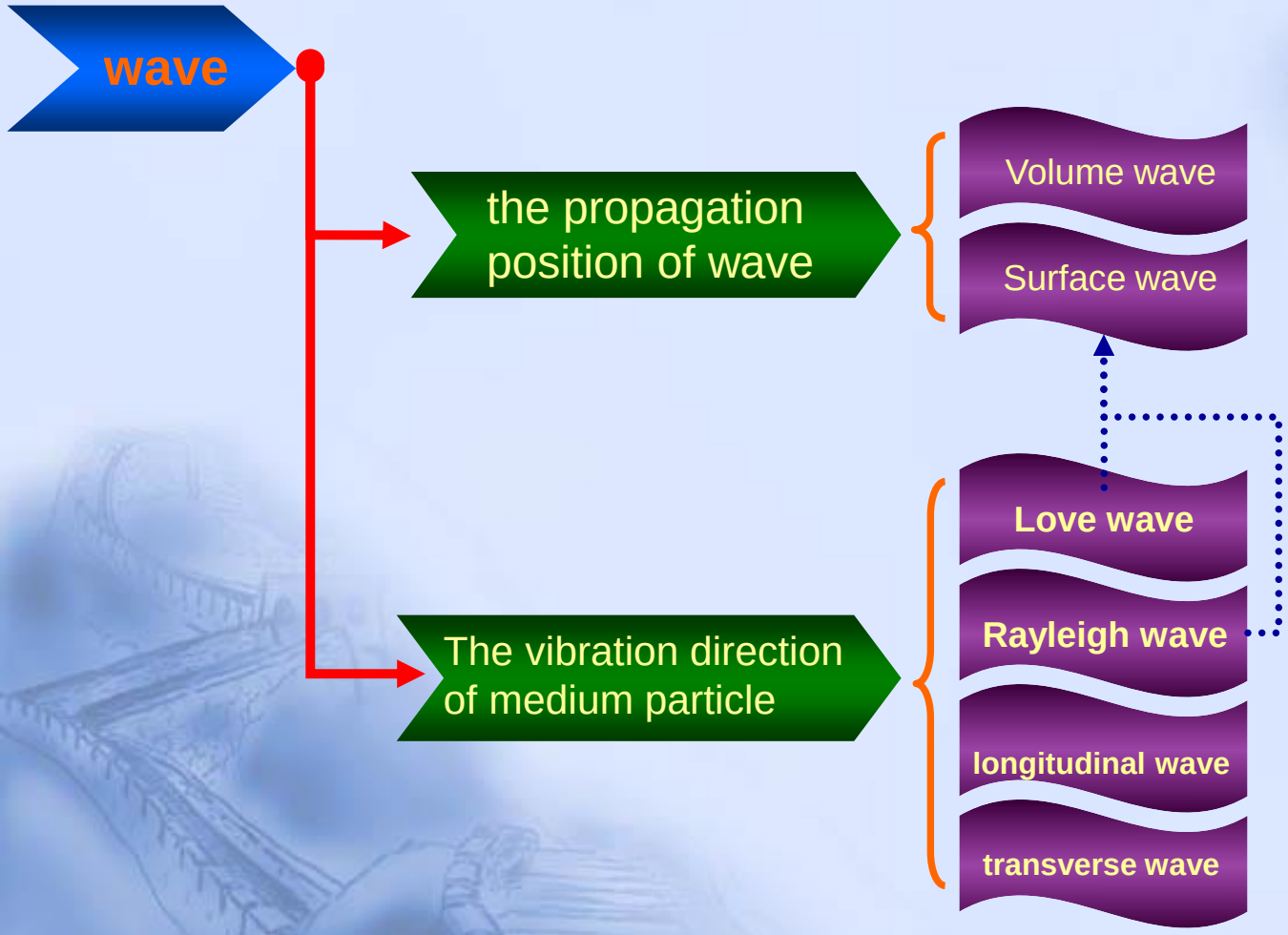
Stress wave

Rock in the rapidly changing loads, both produce movement and deformation. The particle would lose the original balance and produce deformation and displacement, form a disturbance. The disturbance of a particle is bound to cause disturbance of the adjacent particles. This disturbance is called the wave propagation; At the same time, the deformation will cause the stress and strain between the particle .The propagation of this change in stress, strain, is called the stress or strain wave .



Deformation produced by impact face

Types of Wave



Spread inside the media

Spread along the boundary of the media

Medium body surface particle makes horizontal vibration perpendicular to the wave propagation direction

Particle moves along the elliptical trajectory

With the same direction of wave propagation.

With perpendicular to the direction of disturbances propagation

Surface Waves and Seismic Waves

A

Rayleigh wave

Rayleigh wave is the surface wave of propagating along the free surface. Waves pass by, particles in free surface make reverse elliptical motion in the vertical ray plane, long axis perpendicular to the free surface, short axis parallel to the free surface.

B

love wave

love wave is the surface wave of propagating along the level in layered rock surface wave. The particles make vibration in the form of shearing in the vertical direction of propagation of transversal direction, no vertical motion component.

C

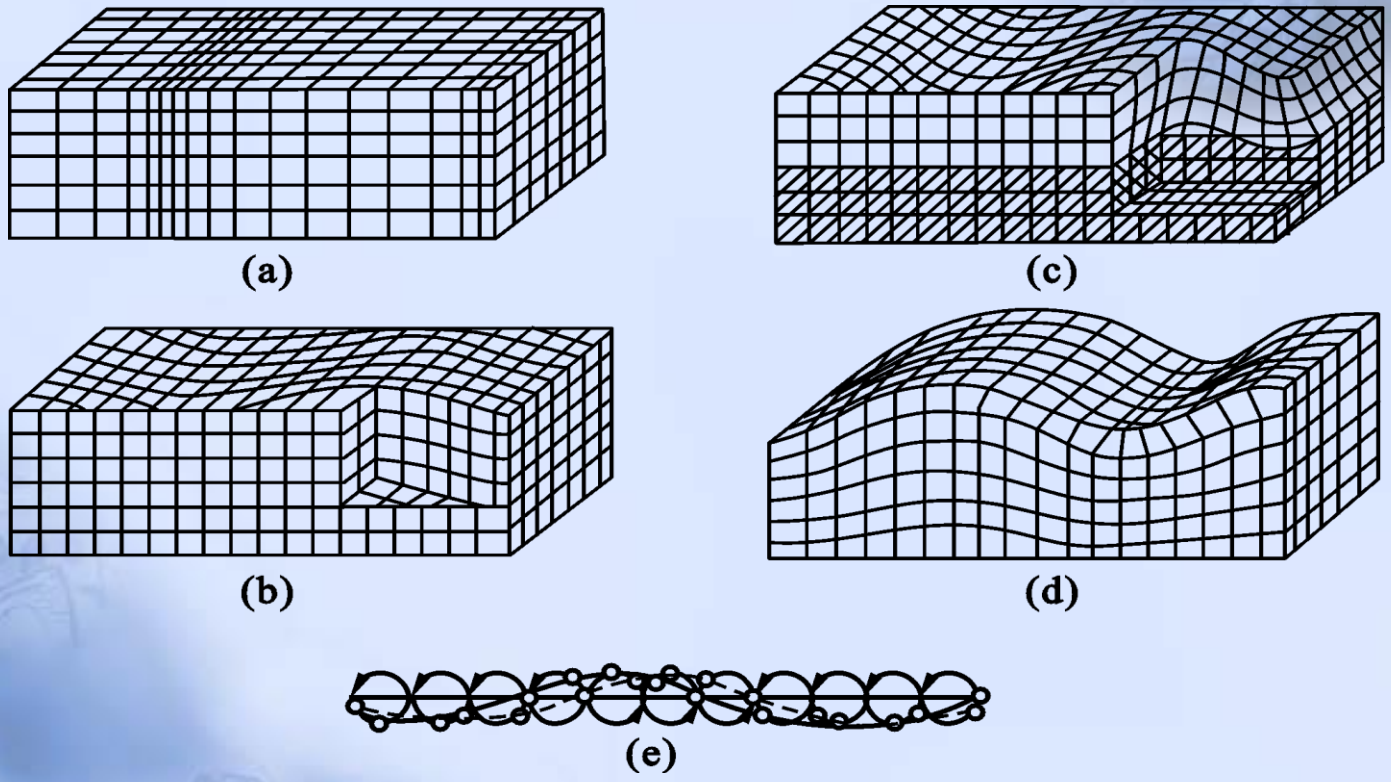
Seismic wave

Seismic wave is the elastic wave of particle making periodic vibration ,the sine wave of particle as a harmonic oscillator.

Seismic damage mainly absolute on the particle vibration velocity.

Compared with natural earthquake， the feature of explosion earthquake is :Source energy is small, Influence range is not big, the duration is short, high frequency, and its intensity, direction, and duration can forecast and control.

The Media Deformation Caused by the Stress Wave



The media deformation caused by the stress wave

（a）longitudinal wave（b）Transverse wave（c）love wave；（d）Rayleigh wave
（e）Rayleigh wave particle motion direction

Superposition of Stress Wave

Superposition of waves

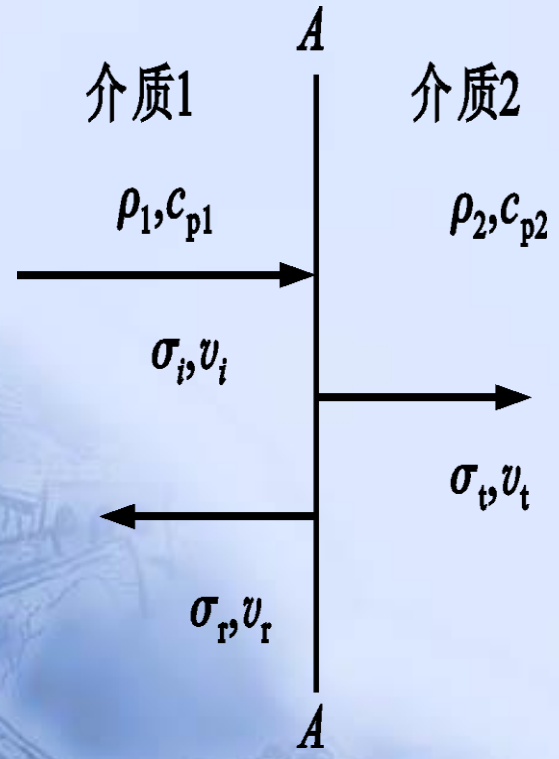
When two perturbation to a point at the same time, so that the total state parameter is equal to two disturbance reached this algebra respectively , this was called superposition of waves.

Direct and reverse superposition of two waves meet, become the state of a composite wave.

Superposition of waves

Stress Wave Reflection and Transmission (1)

(A)Normal incidence of the stress wave from the interface



Longitudinal wave vertically incident

$$\sigma_r = R_r \sigma_i \qquad \sigma_t = R_t \sigma_i$$

$$R_r = \frac{\rho_2 c_{p_2} - \rho_1 c_{p_1}}{\rho_2 c_{p_2} + \rho_1 c_{p_1}} \qquad R_t = \frac{2\rho_2 c_{p_2}}{\rho_2 c_{p_2} + \rho_1 c_{p_1}}$$

① $\sigma_r = 0 \ \sigma_t = \sigma_i$ **when** $\rho_1 c_{p_1} = \rho_2 c_{p_2}$

Does not produce a reflection of the wave。

② $\sigma_r > 0 \ \sigma_t > 0$ **when** $\rho_2 c_{p_2} > \rho_1 c_{p_1}$

The reflected wave and transmitted wave.

③ $\sigma_r = \sigma_i \ \sigma_t = 2\sigma_i$ **when** $\rho_2 c_{p_2} >> \rho_1 c_{p_1}$

The result of superposition of the cross at the interface stress value is twice that of the incident stress waves, this interface is the fixed end.

④ $\sigma_r = -\sigma_i \ \sigma_t = 0$ **when** $\rho_2 c_{p_2} << \rho_1 c_{p_1}$

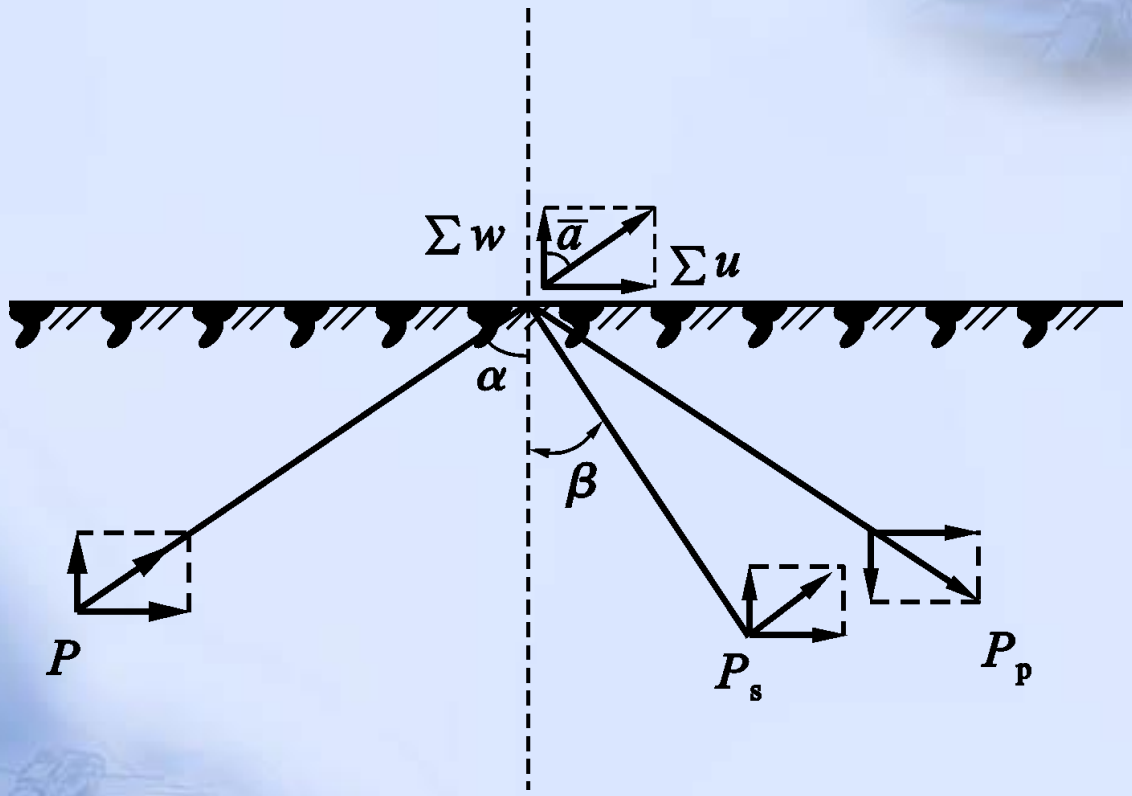
The compression wave is totally reflected tensile waves, without the transmitted wave generated.

⑤ $\sigma_r < 0 \ \sigma_t > 0$ **when** $\rho_2 c_{p_2} < \rho_1 c_{p_1}$

Both transmission compression wave and reflection stretching wave.

Stress Wave Reflection and Transmission (2)

(B)The stress wave oblique incidence to the interface



Longitudinal wave oblique incidence

Rock Subjected to Blast Loading

Explosion dynamic load impact on the rock load effect compared with the static load，there are the following features:

1

stress distribution formed under the shock load, (size of the stress field) associated with rock properties;

Static load has nothing with rock properties

2

Impact loading is instantaneity, general for millisecond;

Static load is usually more than 10 s.

3

Blast load has fluctuation characteristics.

Section Three Classification of Rock

classification

Not only can be sure of rock excavation method, the judgment to the difficulty of the rock blasting, and can be used as an contract unit price, prepare the tender on the basis of calculation.

Drillability

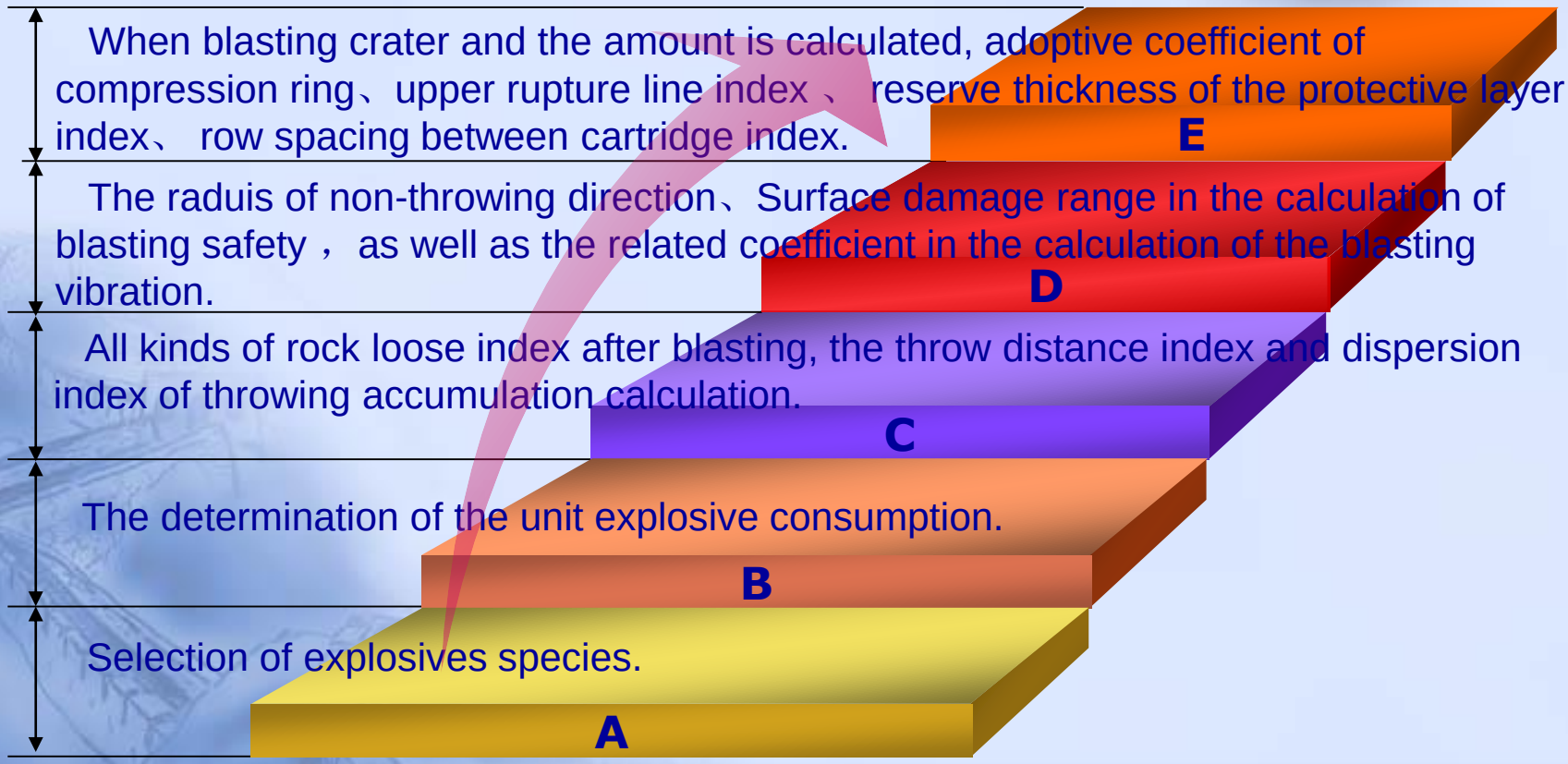
Rock drillability is a robustness index according to drilling hole.

Blastability

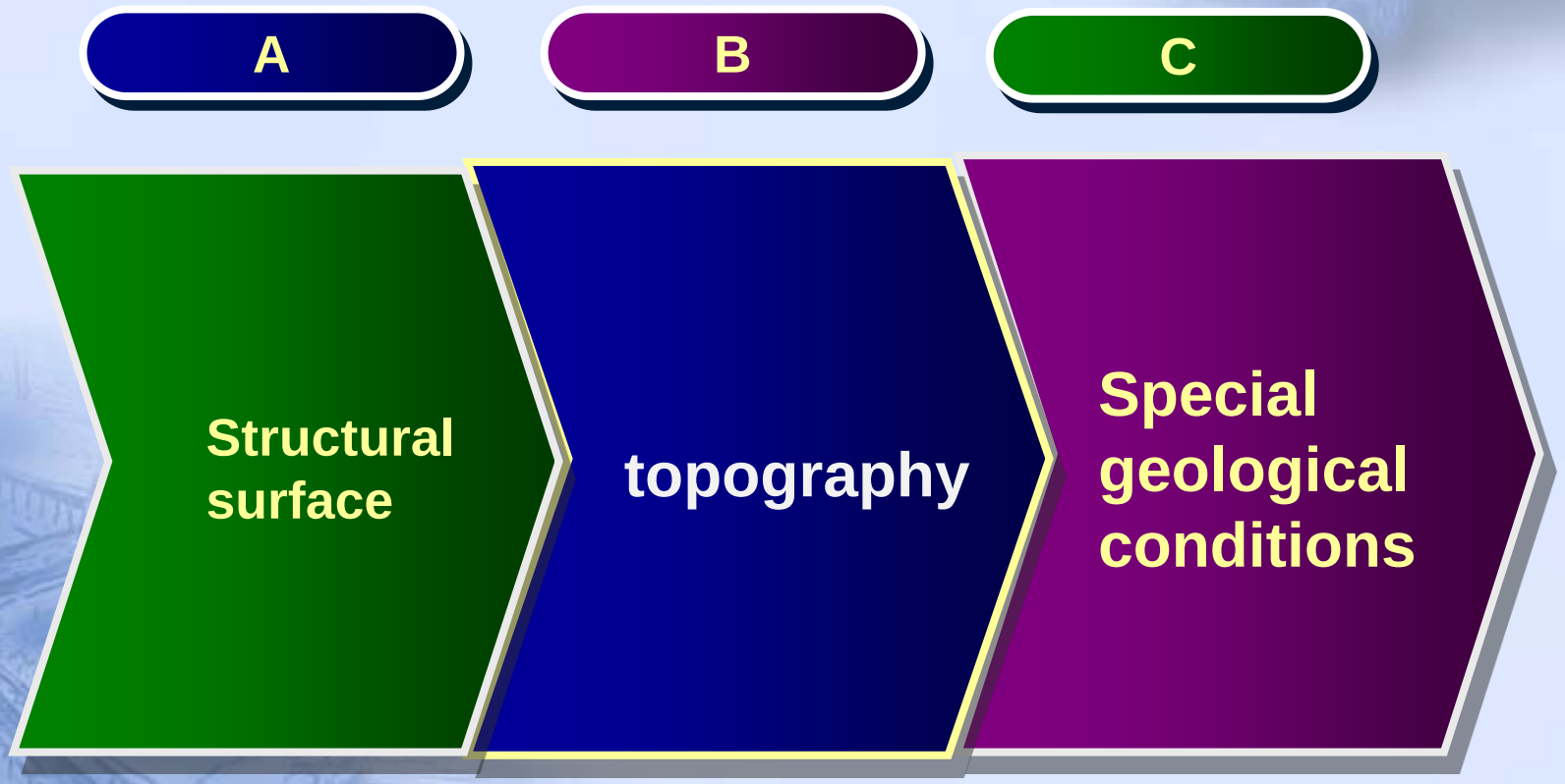
Blastability said the rock broken under the action of explosive. It is the comprehensive embodiment of rock physical and mechanical properties under the action of dynamic load

Section Four the Geological Condition Effected on Blasting

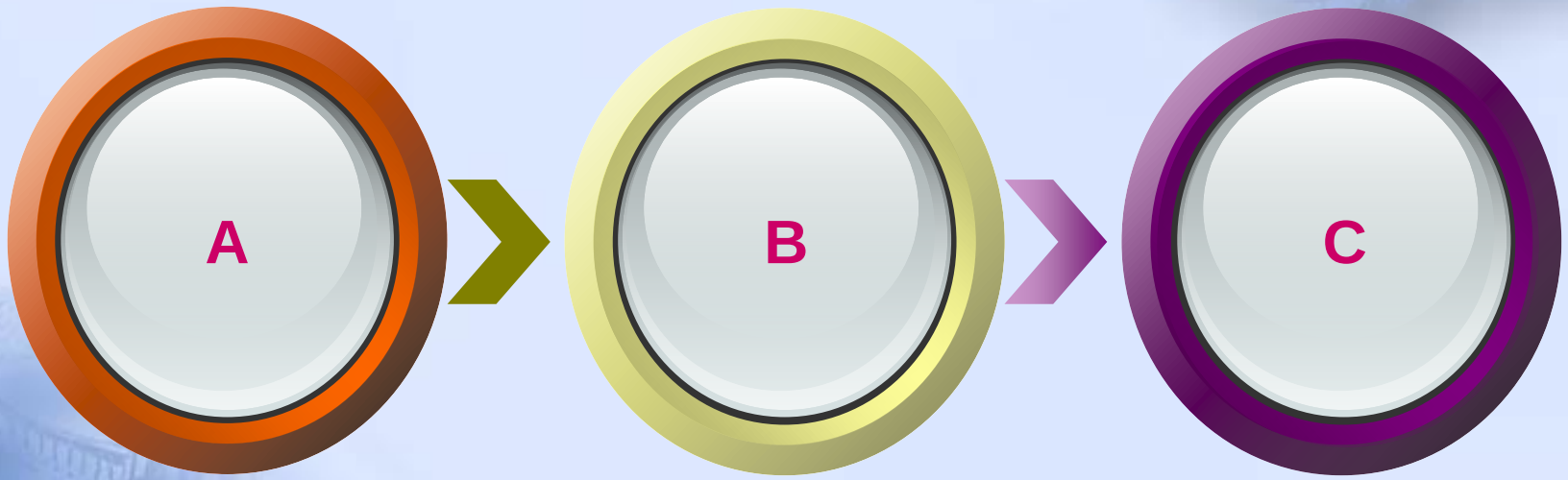
During blasting design，the selection of calculation parameters and lithology have a close relationship：



Geological


A
B
C
Structural surface
topography
Special geological conditions

Section Five Blasting Impact on Engineering Geological Conditions



Thank You !

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