QA 302 – Screening – Making The Right Stuff

Alex Scott

QUARRY ACADEMY

Improving Processes. Instilling Expertise.

DYNO Dyno Nobel

SANDVIK

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“Theory of Screening”

Often described as “not so much a science but a black art”

So let’s see what we can make of it.

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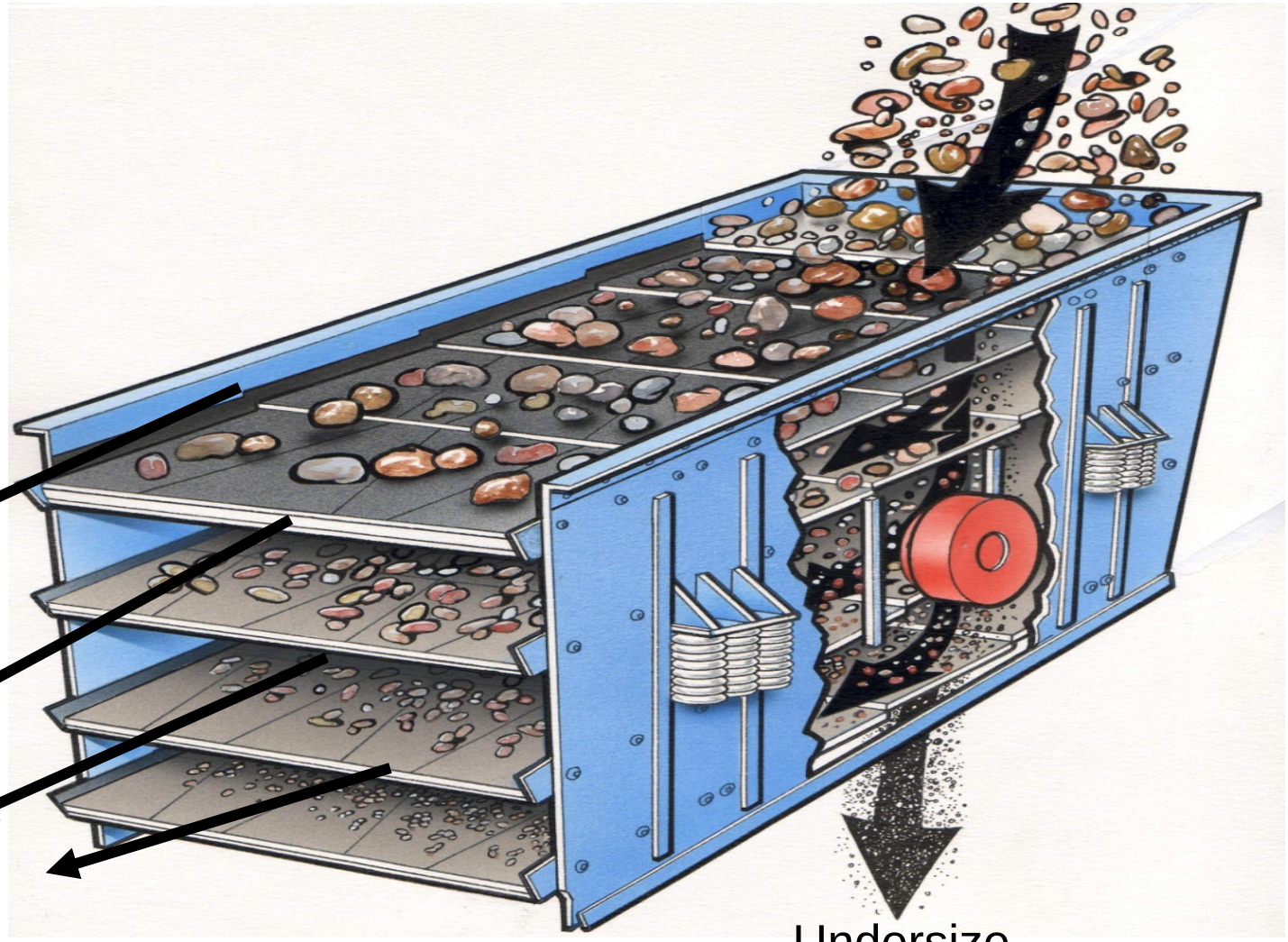
Screens
Basics of Screening

- What is screening?
  - Particles being classified based on their size



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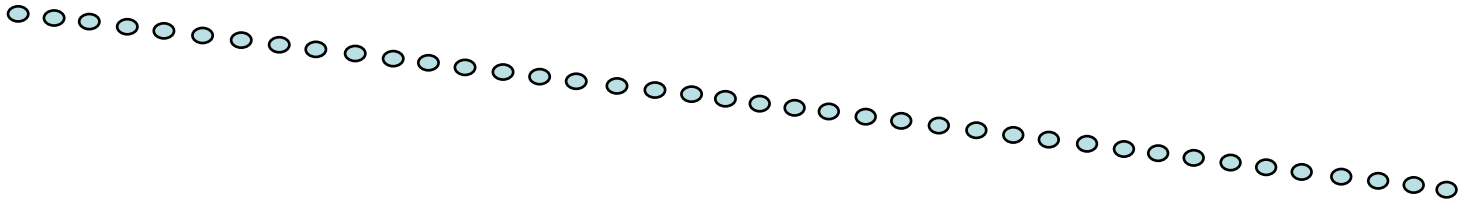
Screens

Basics of Screening

What is conventional-screening?



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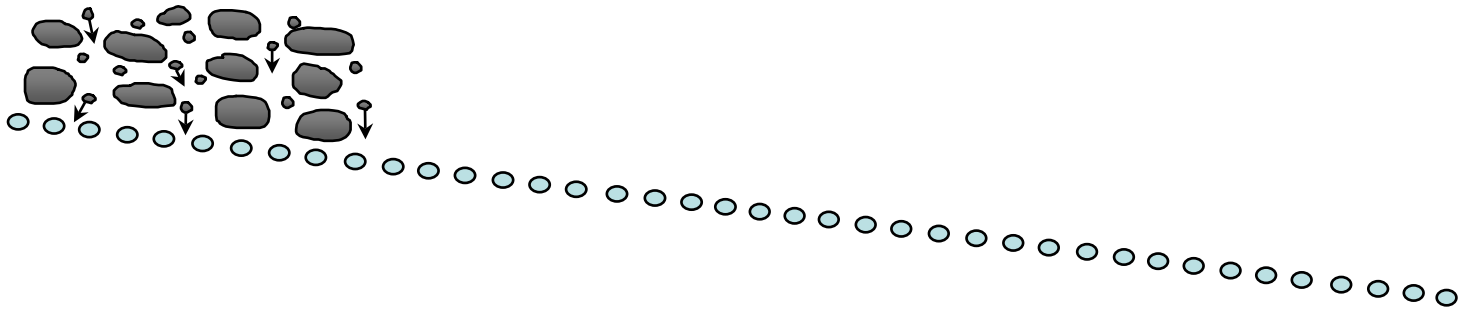
Screens
Basics of Screening

What is conventional-screening?

Material is fed onto the screen.



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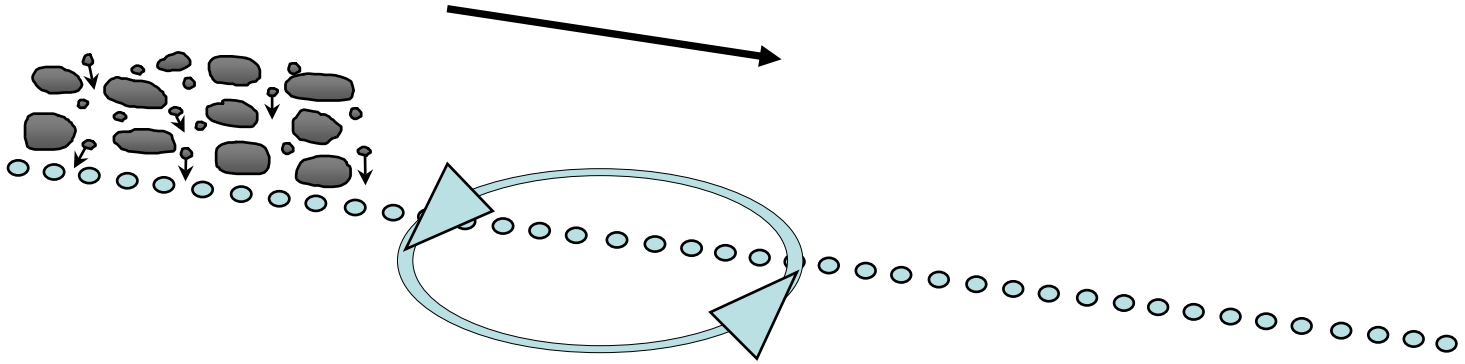
Screens
Basics of Screening

What is conventional-screening?

Material moves along the screen due to gravity and the motion of the screen



Conventional screening is based on stratification

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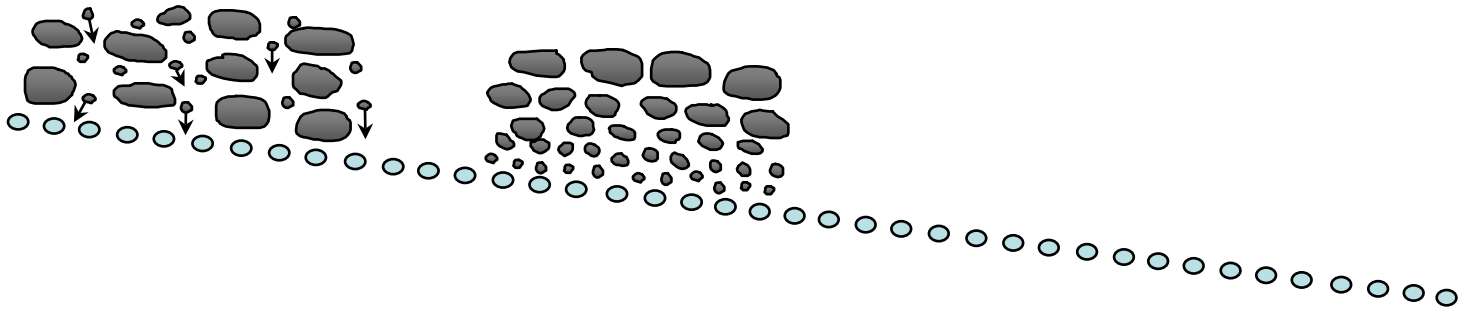
Screens
Basics of Screening

What is conventional-screening?

Particles of the same size end up in the same layer, this is called stratification



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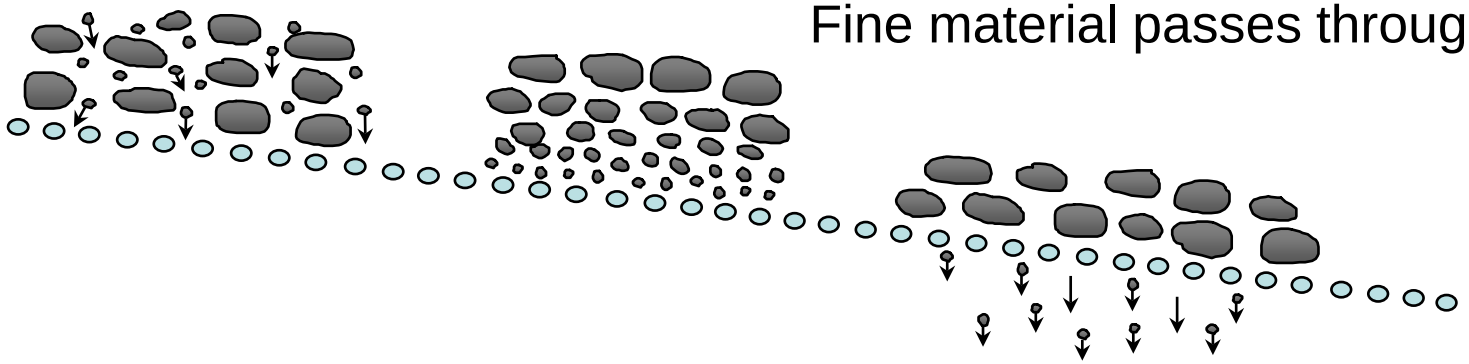
Screens
Basics of Screening

What is conventional-screening?



Fine material passes through the screen

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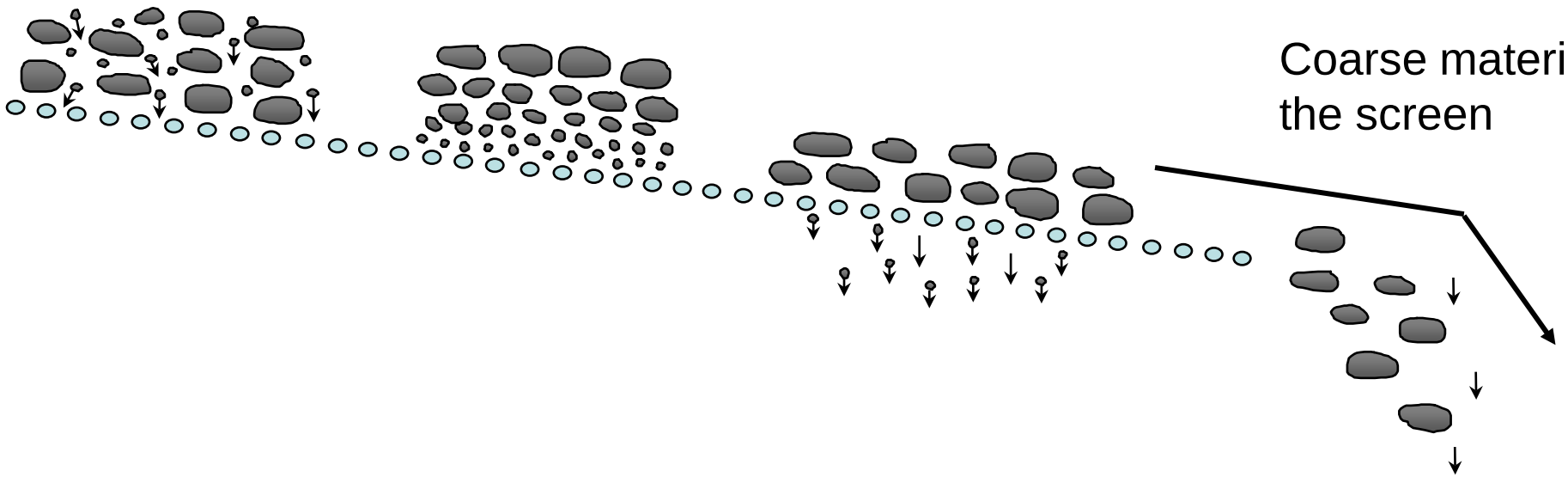
Screens
Basics of Screening

What is conventional-screening?



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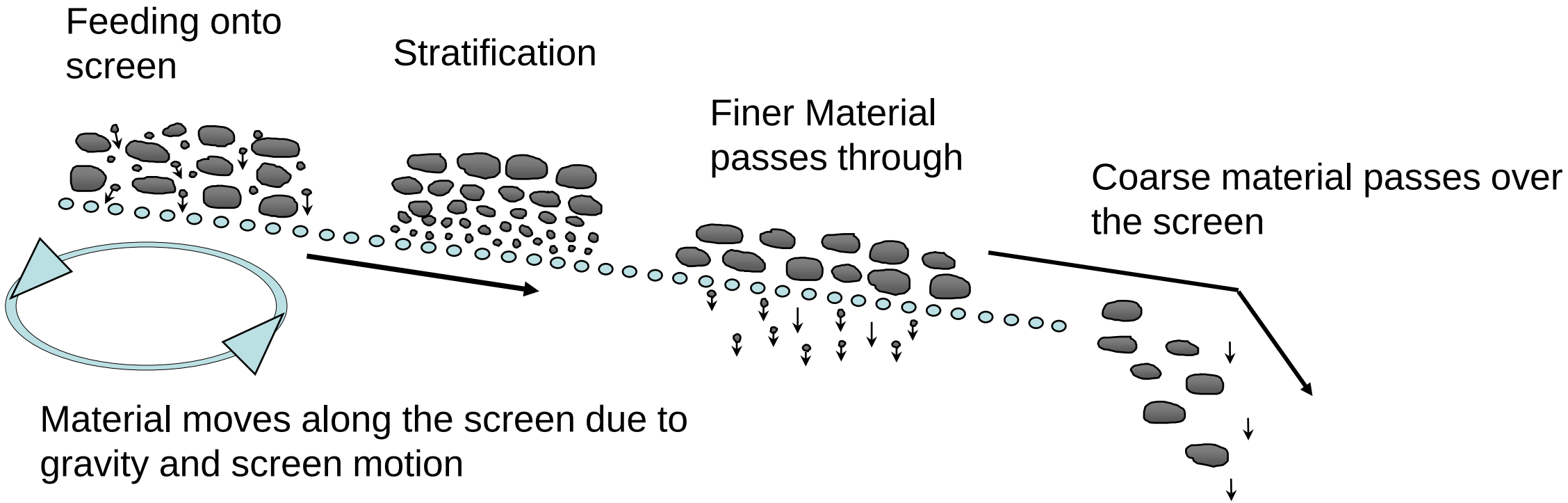
Screens
Basics of Screening

Conventional Screening – based on stratification



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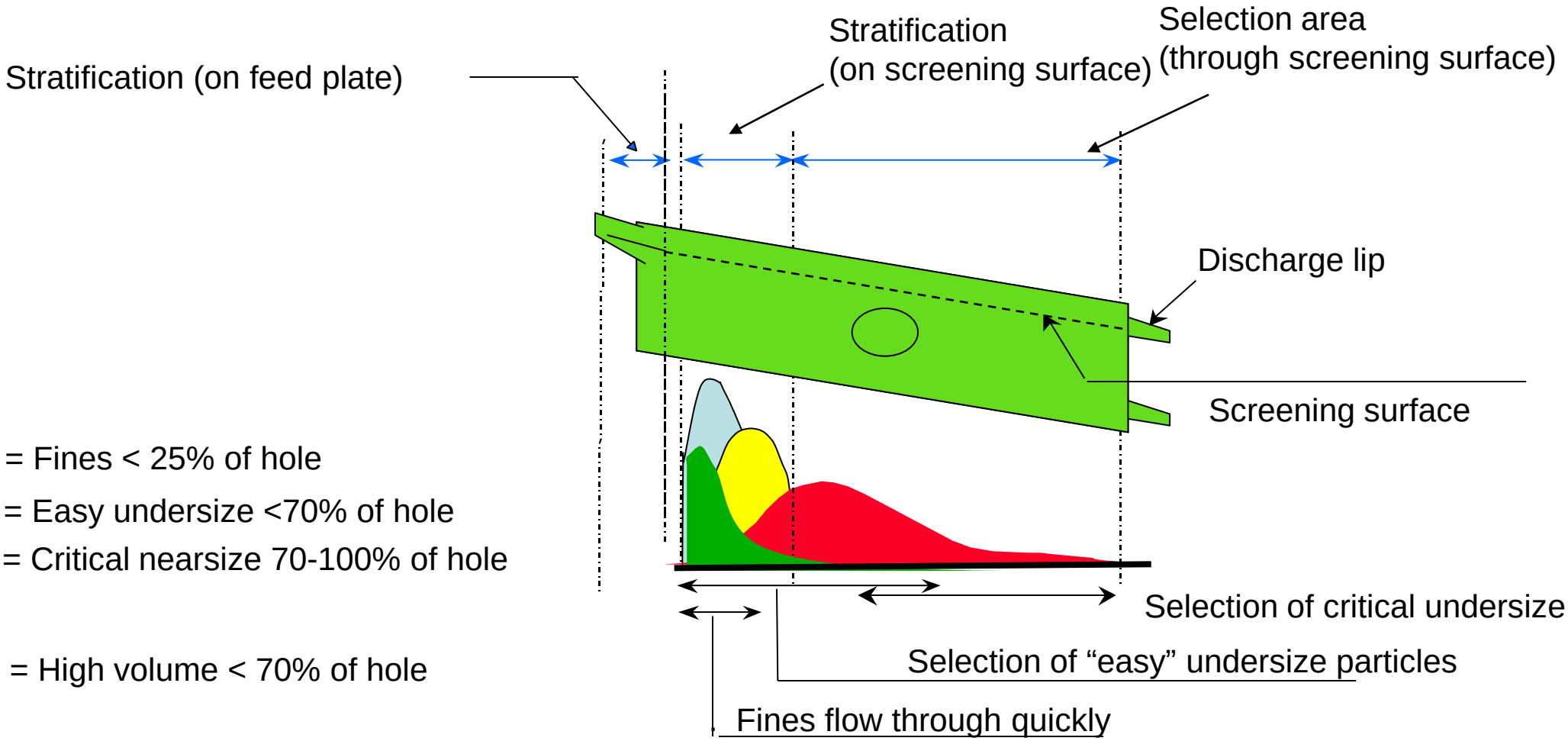
Screens

Basics of Screening

Throughput along the length of a screen



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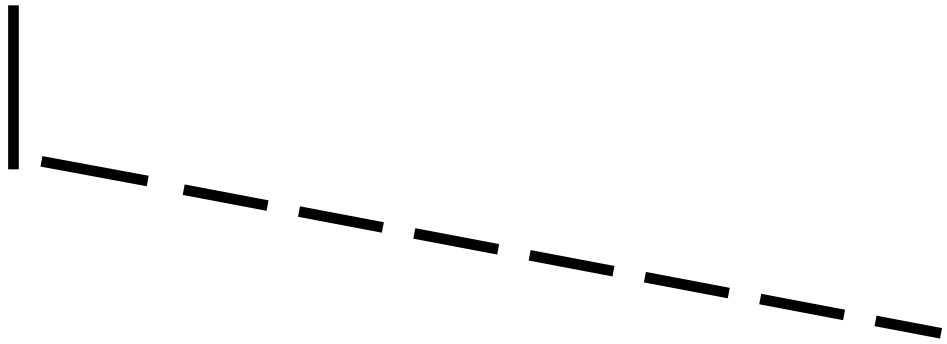
Screens

Basics of Screening

What is free-fall screening?



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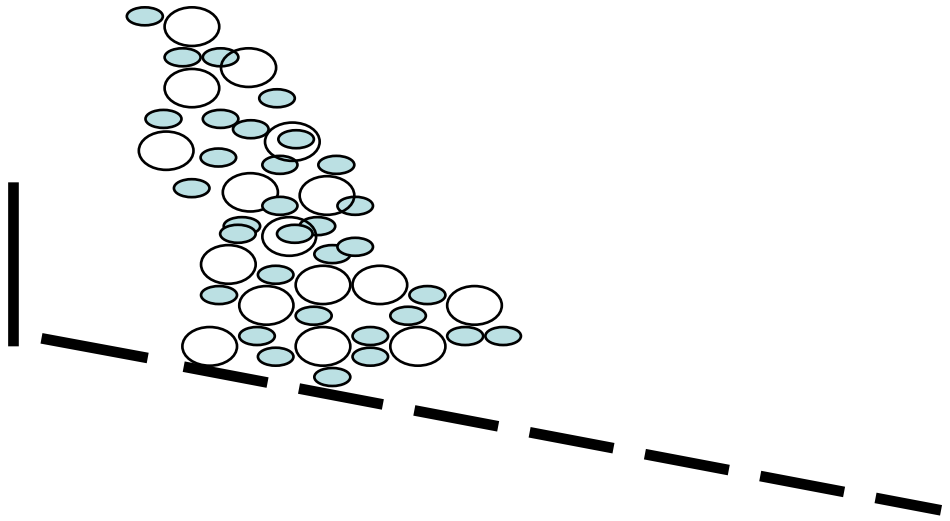
Basics of Screening



What is free-fall screening?

- Coarse material
- Fine material

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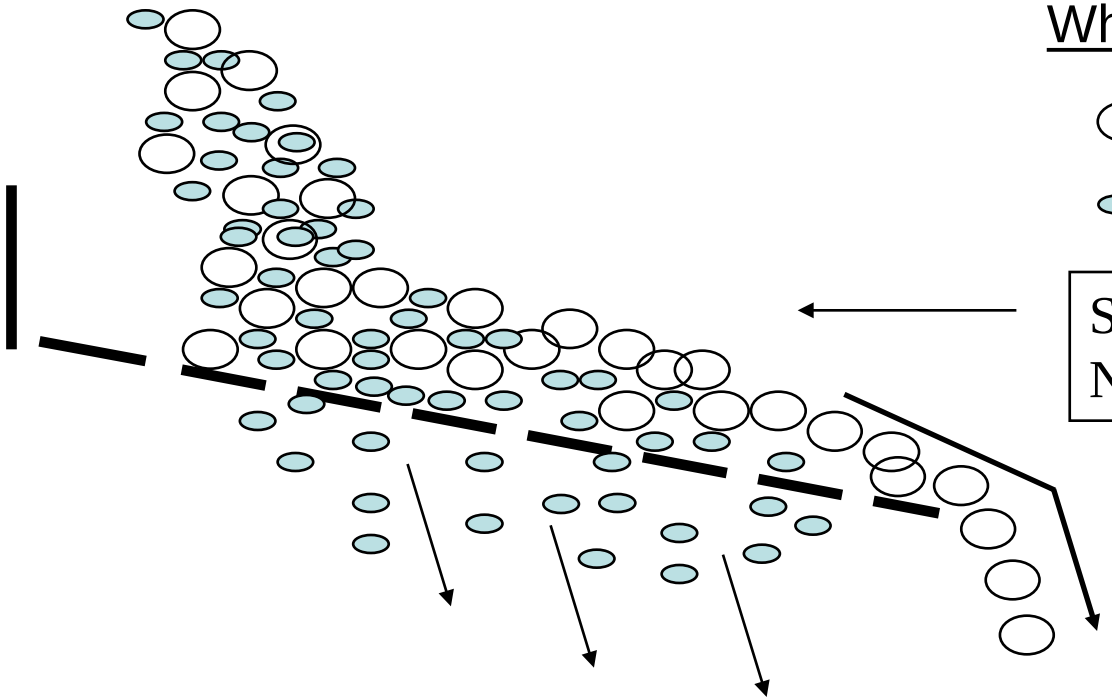
Screens
Basics of Screening



What is free-fall screening?

Coarse material

Fine material

Stratification of material on deck NOT required

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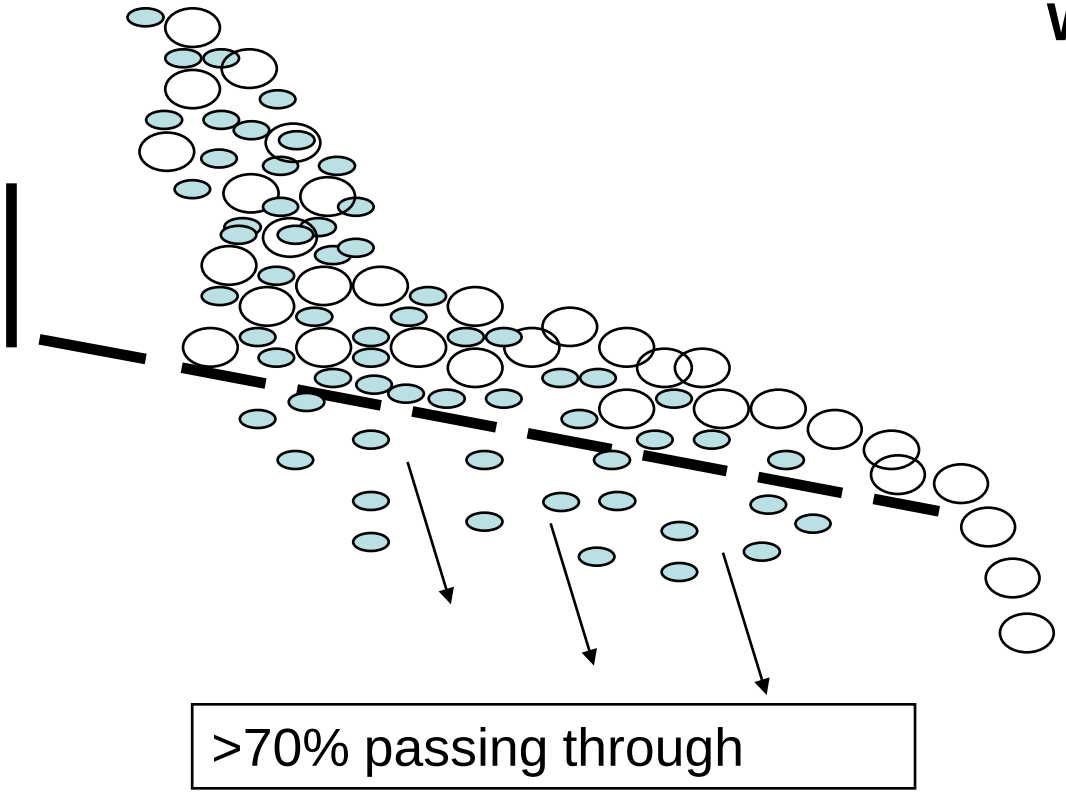
Basics of Screening



What is free-fall screening?

- Coarse material
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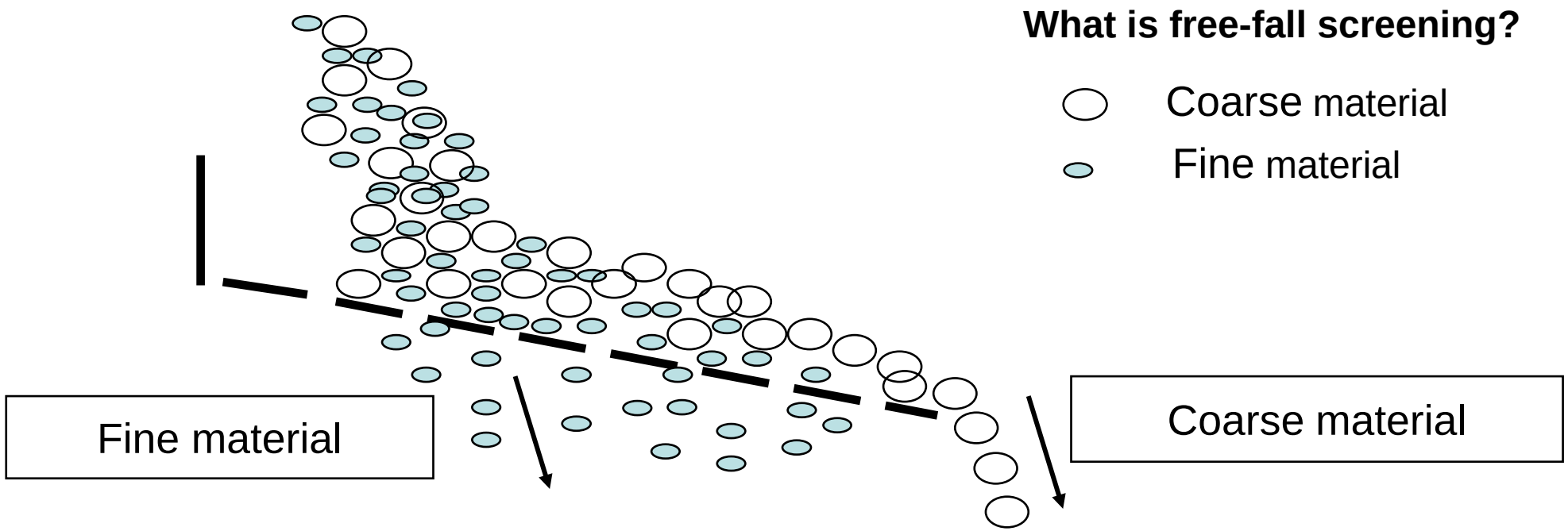
Screens
Basics of Screening



- Free-fall screening is based on principle of free-flow of the material trough and over the deck.
- Optimal free-fall screening demands at least 70 % of the feed through the deck.

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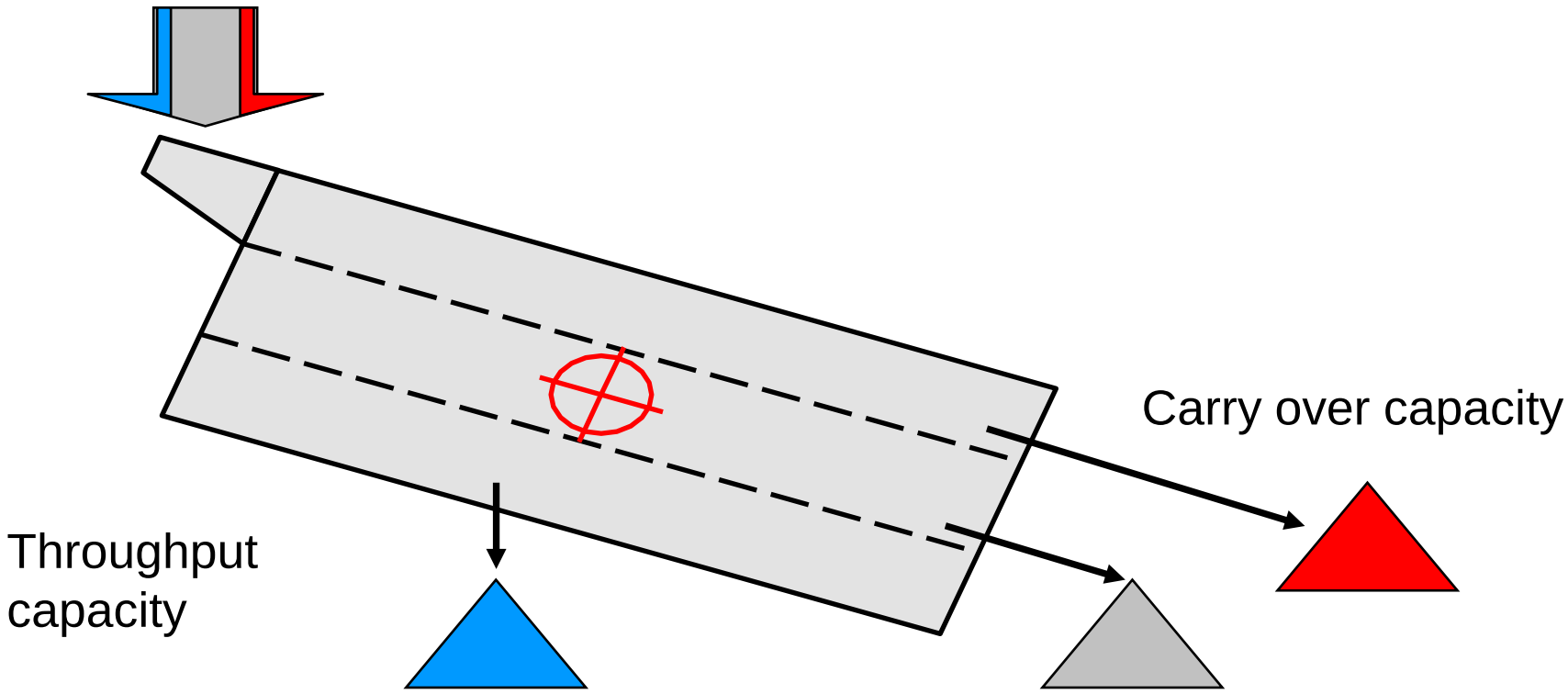
Screening accuracy



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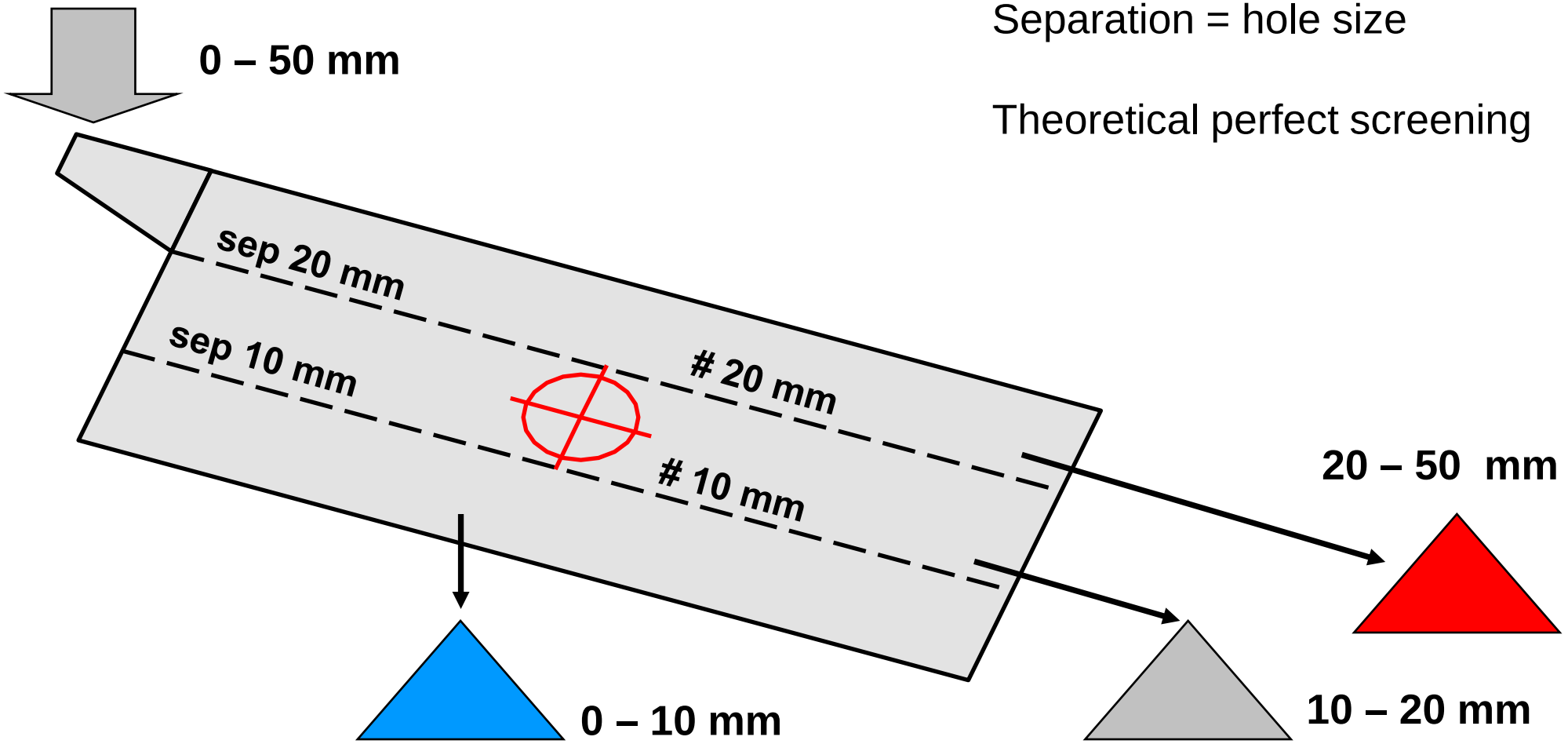
Screens

Screening accuracy

Separation = hole size

Theoretical perfect screening



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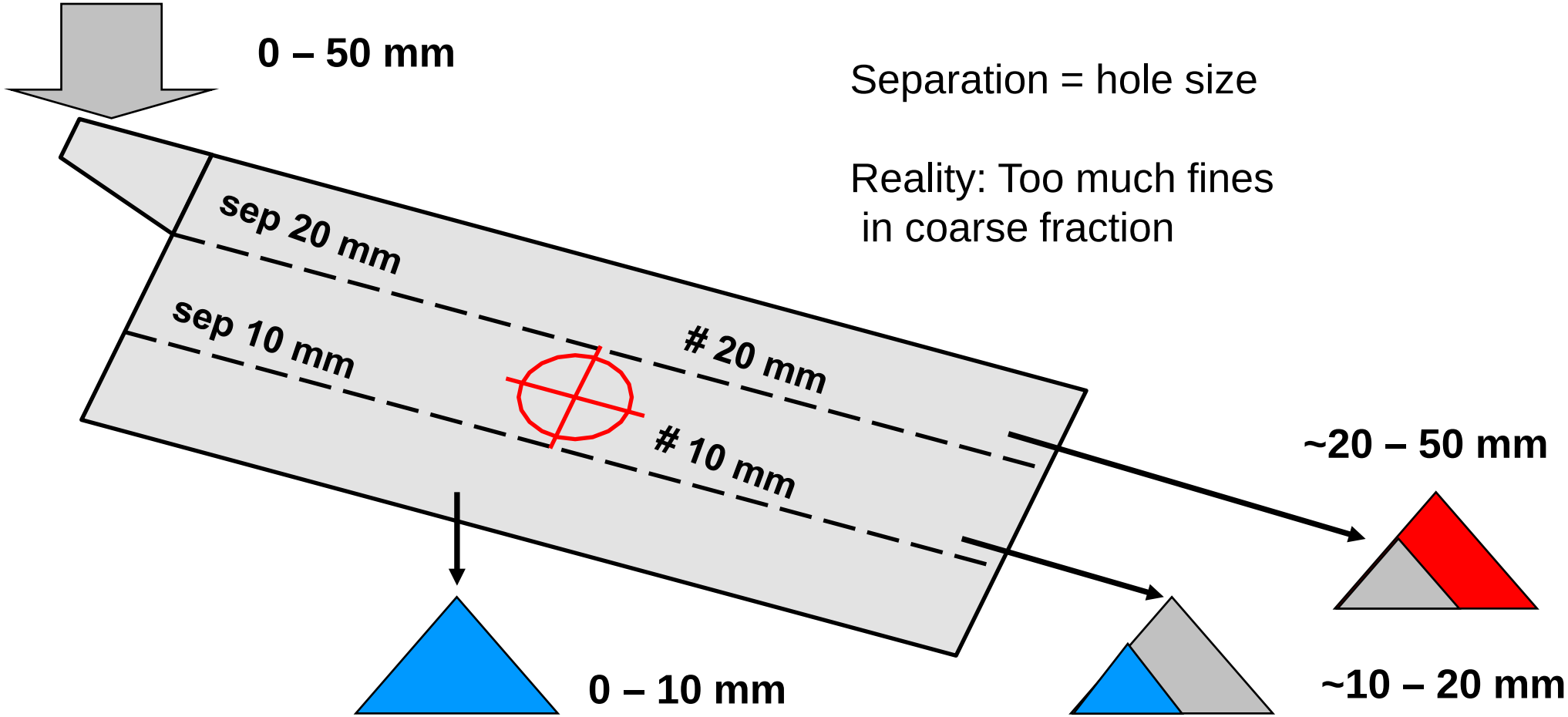
Screens

Screening accuracy



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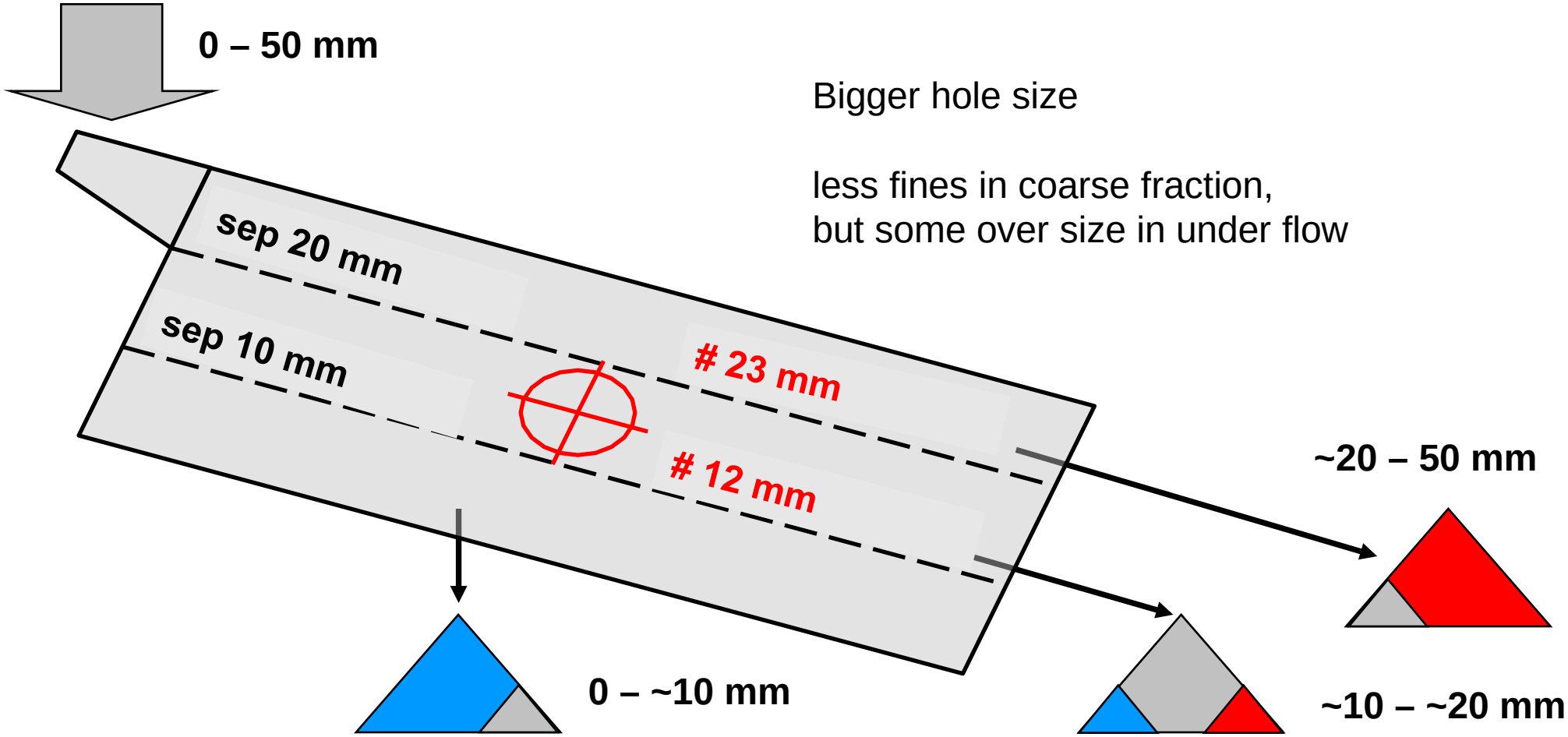

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Screens

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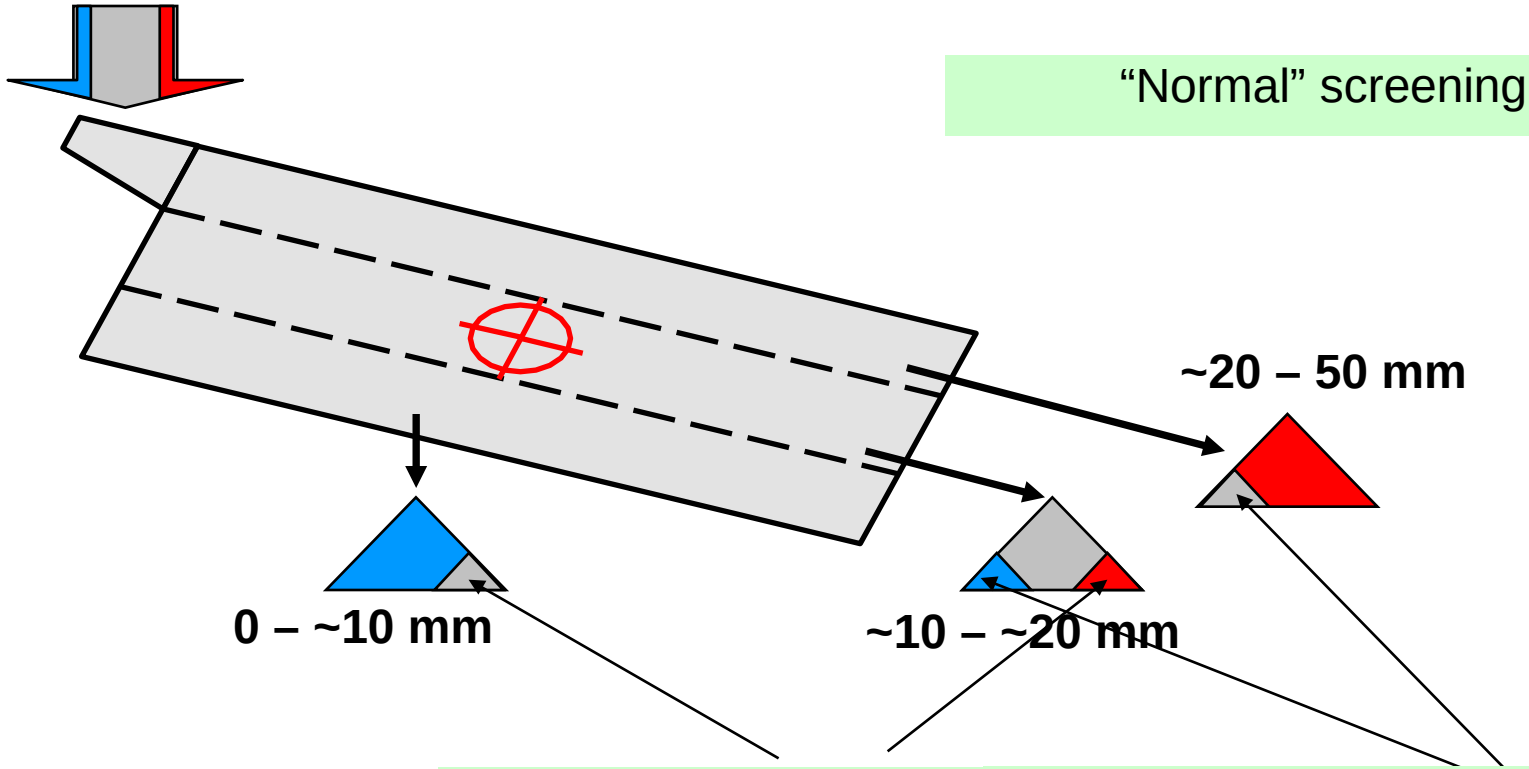

"Normal" screening efficiency: 10/15

Max 10 % oversize and max 15% undersize

Total max 25% "wrong size"

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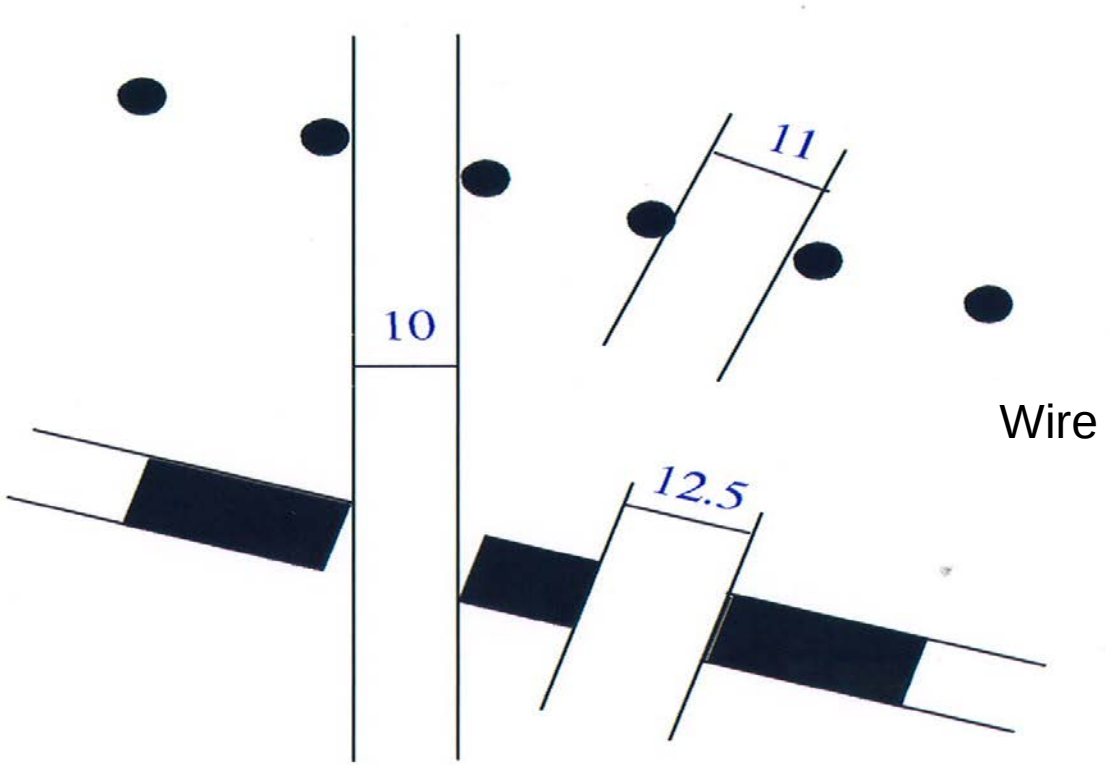
Screens

Screening accuracy

Hole size – Rubber vs Wire



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Screens
Calculation of screen area

- Based on bed depth within the limits and“standard” conditions, the required area and screen selection is “piece of cake”.

- If the conditions are <u>not standard,</u> a more precise area calculation must be done. An initial calculated area 100ft^2 can turn to 0.5 ft^2 or 1000ft^2 on ultimate applications.

  On following pages the more accurate Sandvik sizing method is presented

- Circular stroke screens in 18 degrees inclination, top deck
- Feed is a hard rock crushed in a cone crusher, bulk density 1,6 t/m3
- 75 % of the feed is < separation
- 40 % of the material passing is < 1/2 separation
- Moisture content 1 %, dry screening
- Fraction length of the fraction is over 1,65
- Screening media is wire mesh
- Screening accuracy demand reasonable (10 % o/s in the fine and 15 % u/s in the coarse fraction)

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Screens
Calculation of screen area

Basic formula for through put in conventional screening (t/h per m^2):

$$Q_{through} = A \times B \times C \times D \times E \times F \times G \times H \times I \times J \times K \times L$$

- Q : Throughput capacity (t/h per m^2)

- A: Nominal capacity for separation
- B: Oversize (0.45 … 1.04)
- C: Halfsize (0.5 … 3.5)
- D: Type of material (1.0 … 1.2)
- E: Bulk density (0.5 … 1.2)
- F: Moisture (0.35 … 1.0)
- G: Type of screen (0.95 … 1.2)
- H: Wet screening (1.0 … 1.45)
- I: Deck position (0.7 … 1.0)
- J: Screening element (0.7 … 1.05)
- K: Fraction length (0.5 … 1.25)
- L: Accuracy demands (0.7…1.7)

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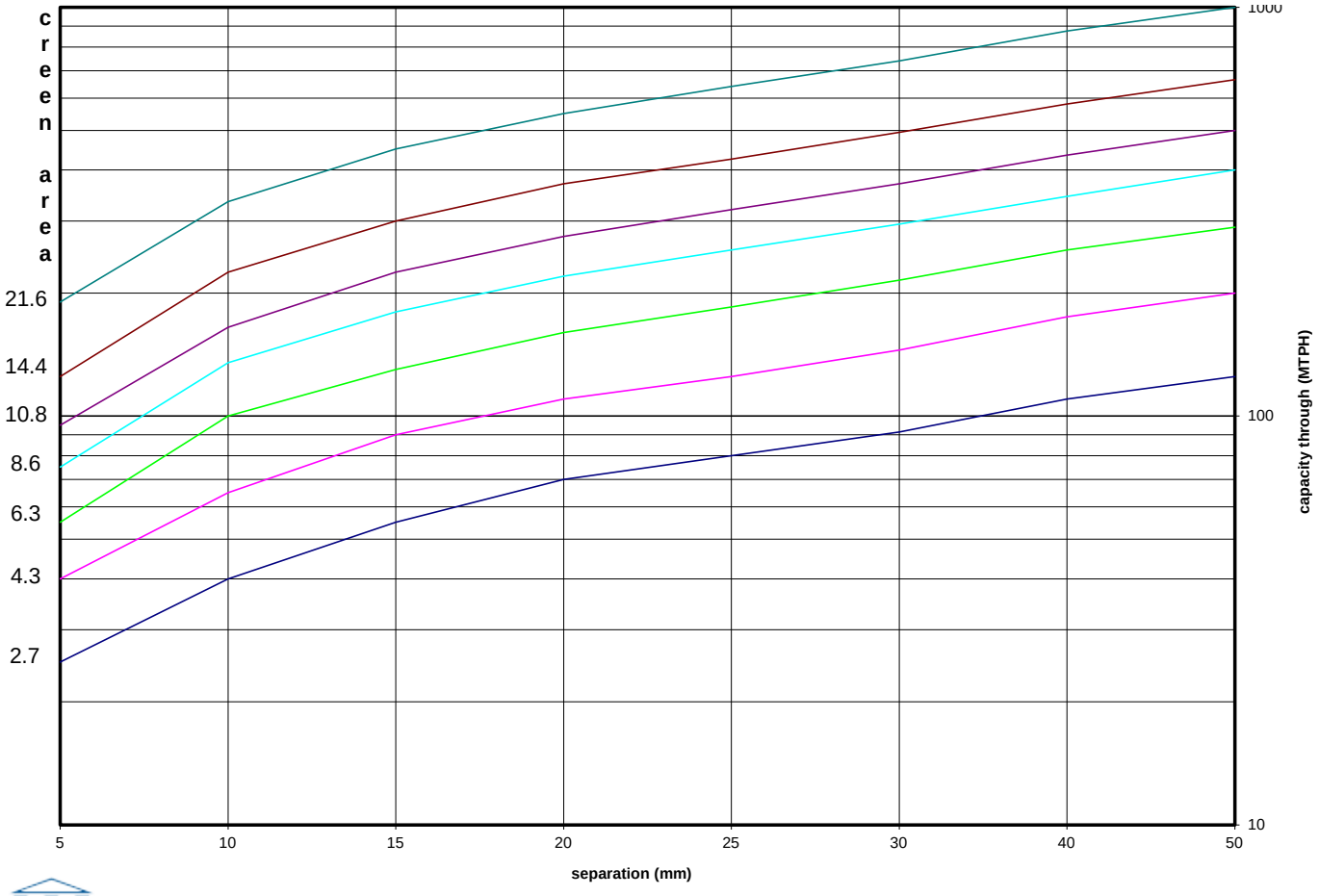
Screens

Calculation of screen area - Quick selection

Nominal throughput capacity in conventional screens



Conditions

- Circular stroke screens in 18 degrees inclination, top deck
- Feed is a hard rock crushed in a cone crusher, bulk density 1,6 t/m3
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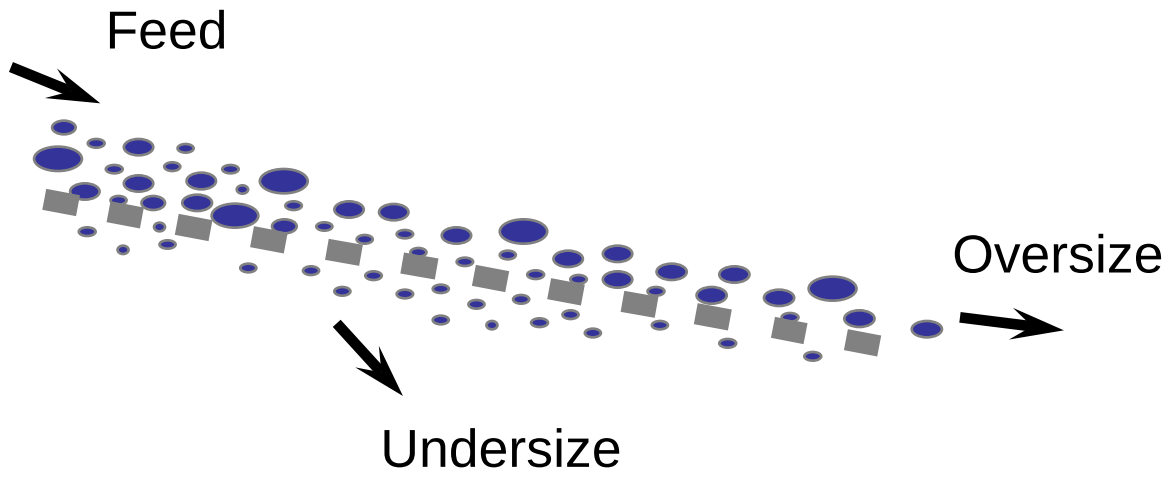
Screens

Performance

- Stratify the material.
- Prevent pegging.
- Prevent blinding.
- Separate the material into two or more fractions.
- Transport the material to provide the screen its carrying capacity!



Carrying Capacity…the amount of material a screening machine can carry over the decks before the momentum of the screen body is overcome by the weight of the material.

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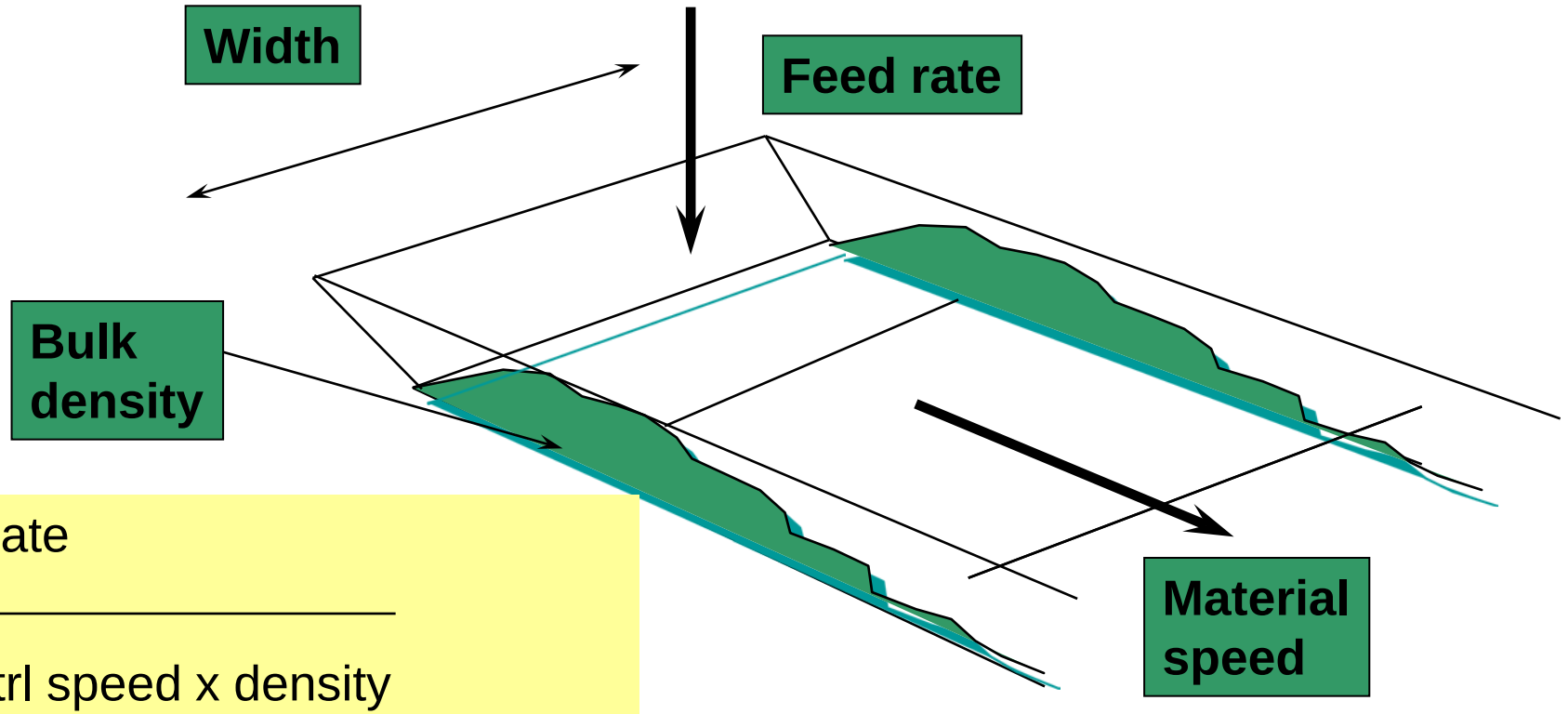
Screens

Calculation of screen width

- Selection of width is based on correct bed depth over the decks
- The factors affecting bed depth are:



$$\text{Width} = \frac{\text{Feed rate}}{3{,}6 \times \text{bed depth} \times \text{mtrl speed} \times \text{density}}$$

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Which bed depth is right for stratification?

A thin bed:

- Becomes easily fluid, helps stratification.
- Shorter distance for fine particles to sift down to the deck.
- Less pegging tendency, stones are not forced down.
- Can promote bouncing and critical size carry-over.

A thick bed:

- Can reduce accuracy.
- Overload the screen – carrying capacity.
- Can prevent segregation and fines carry-over

Bed-depth has to be right—not too thick not too thin!!!!

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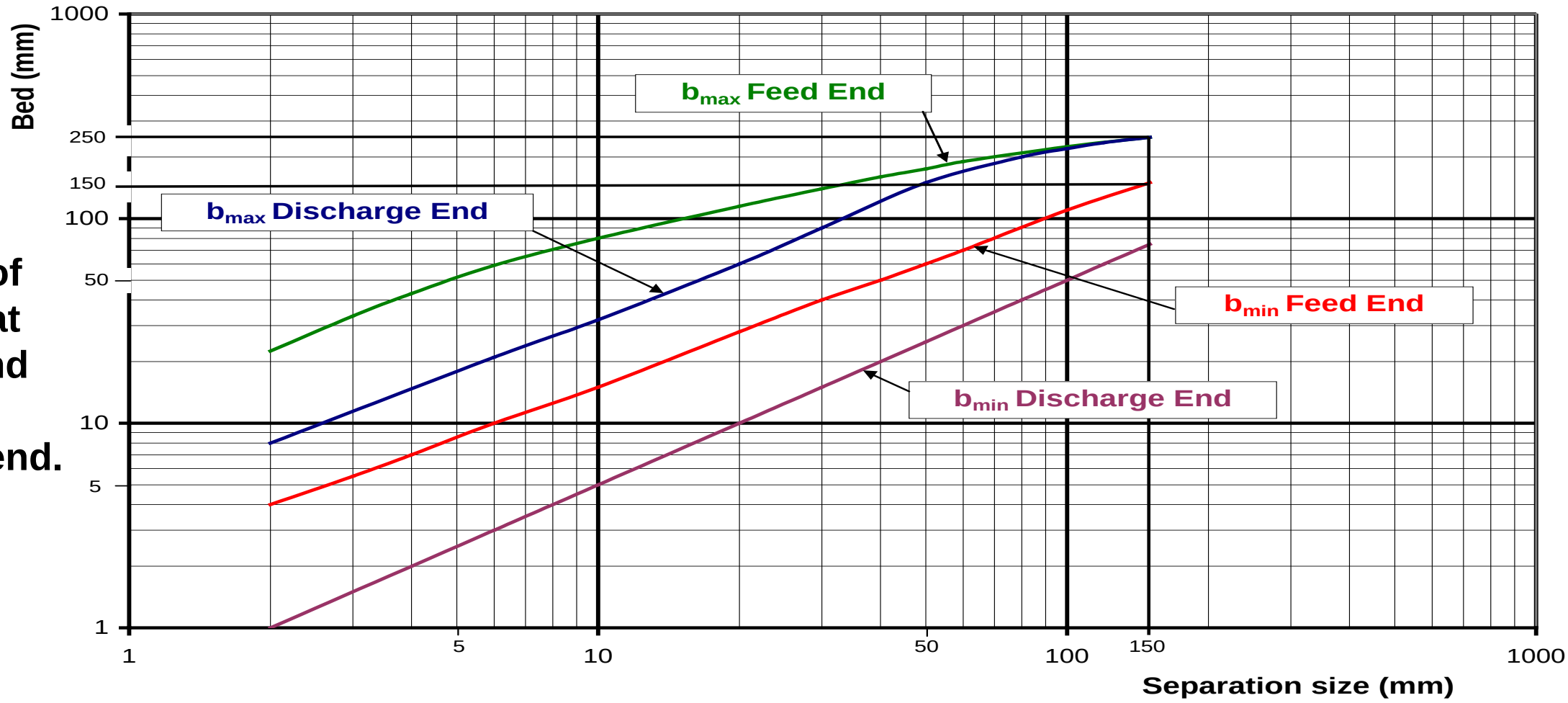
Screens

Calculation of screen width

Limitation of bed depth at feed end and at the discharge end.



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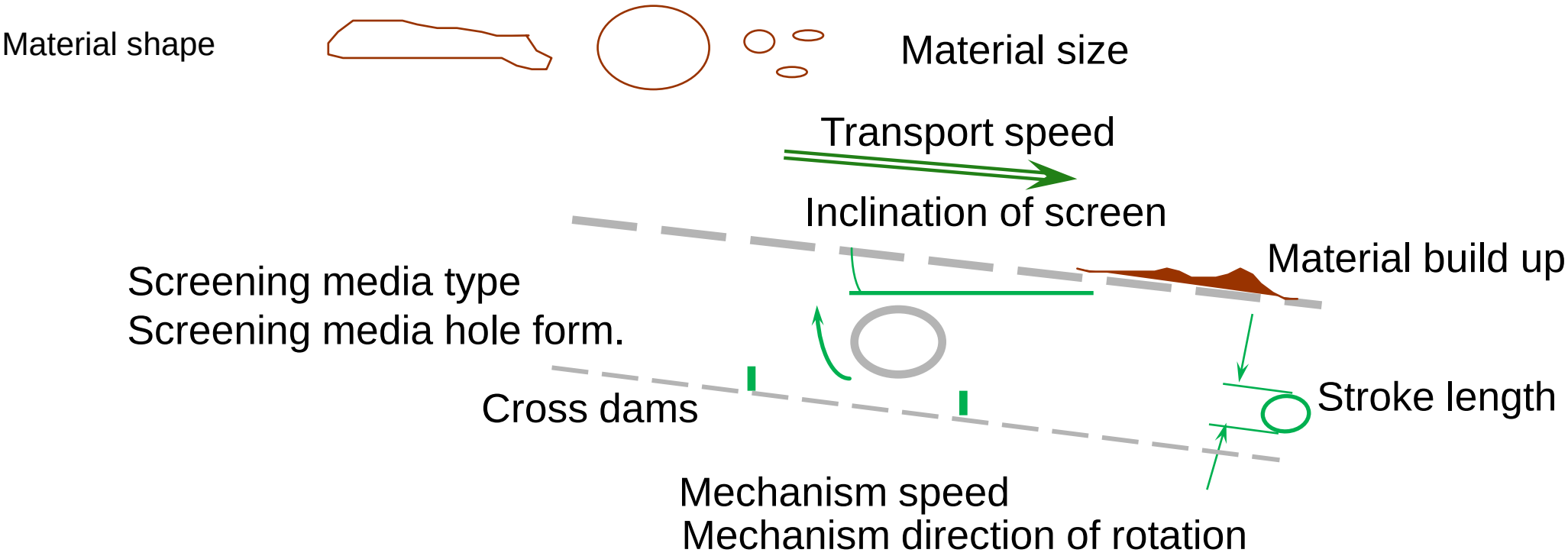
Factors Affecting Material Speed & bed depth.



Gravity Free Fall = 9.81m/s

$$G\ force = \frac{RPM^2 \times Throw\ (mm)}{1788200}$$

$$G\ force = \frac{800^2 \times 11}{1788200} = 3.94$$

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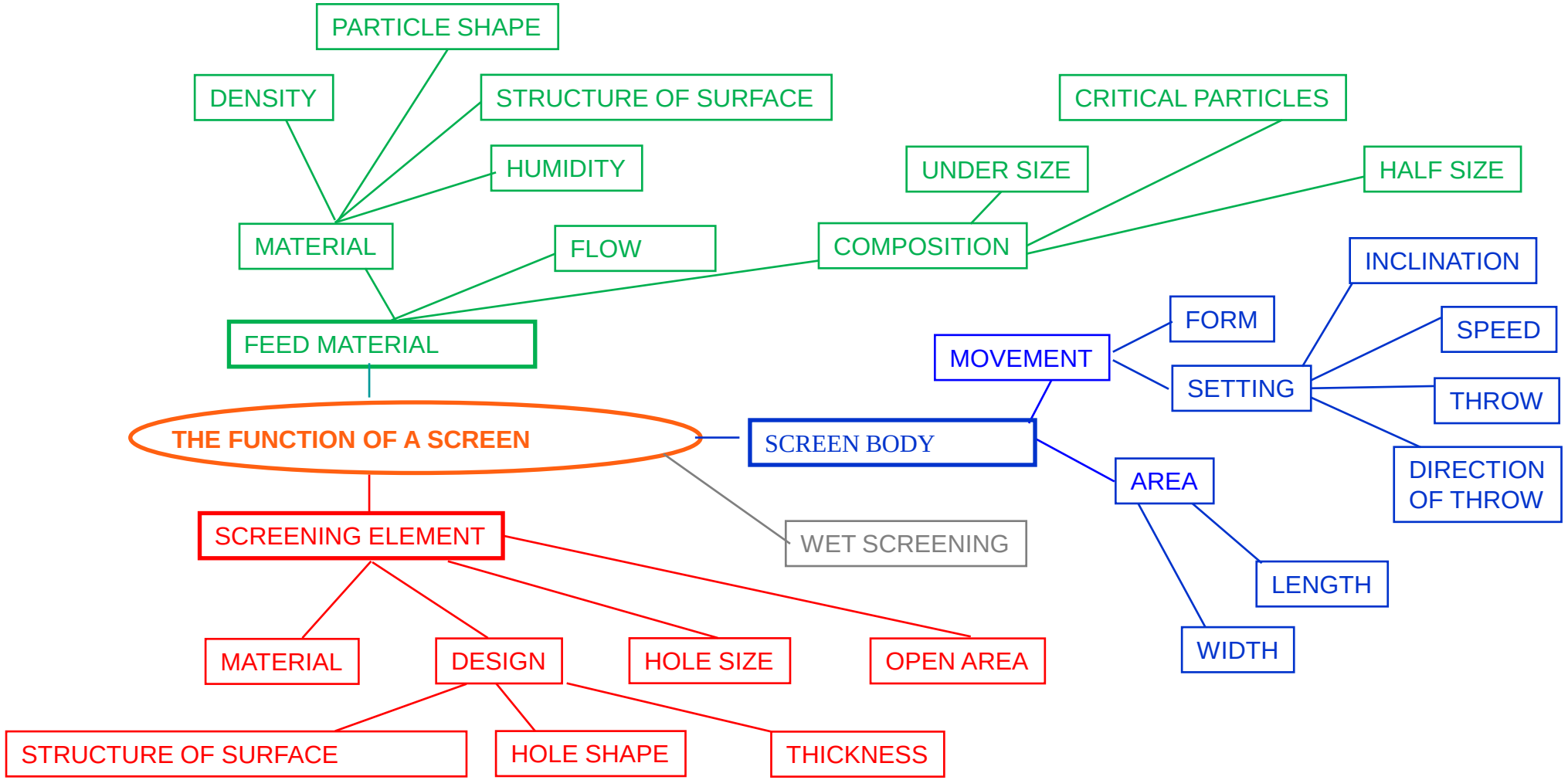
Factors influencing screen performance



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