The Three S's
First in – Last out

Presented By: George Schlemmer

Improving Processes. Instilling Expertise.

DYNO
Dyno Nobel

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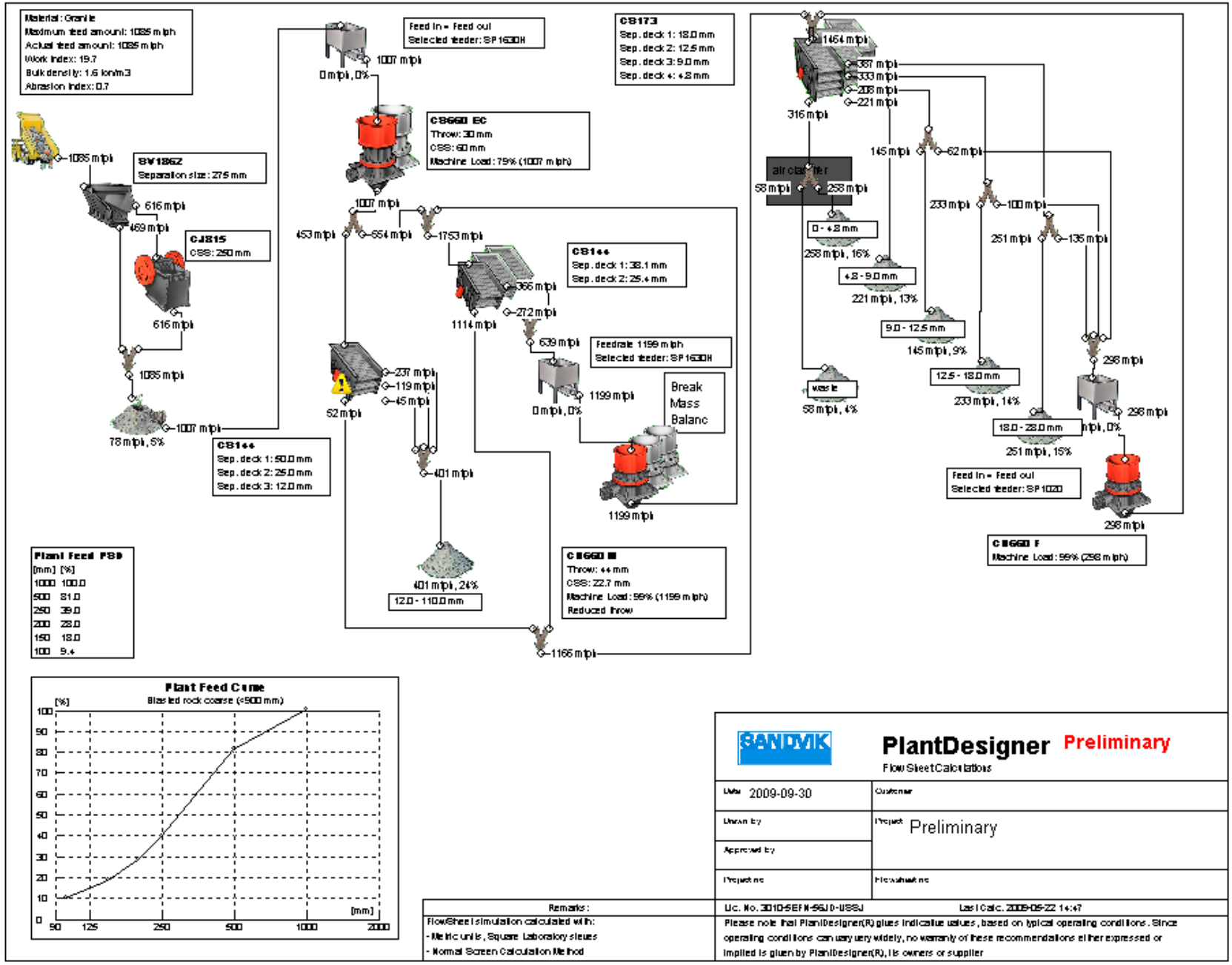
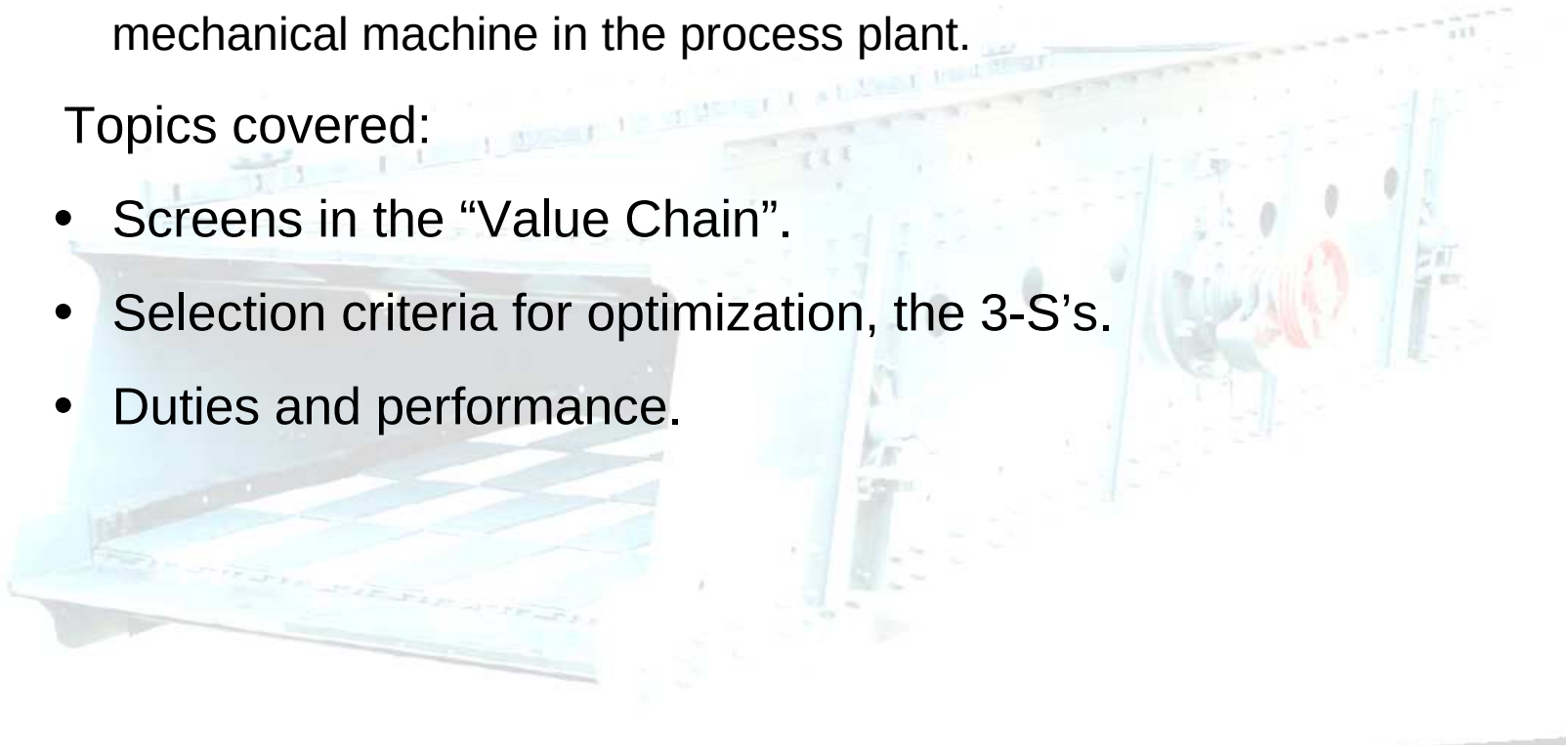


QUARRY ACADEMY

Today's Journey

- Screening to promote a safe, cost efficient operation.
  - Value Chain Synopsis: A critical link…common to be the first and last mechanical machine in the process plant.
- Topics covered:
  - Screens in the "Value Chain".
  - Selection criteria for optimization, the 3-S's.
  - Duties and performance.



QUARRY ACADEMY

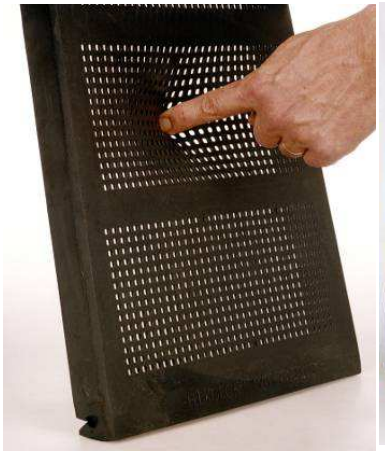
Speed, Stroke and Slope

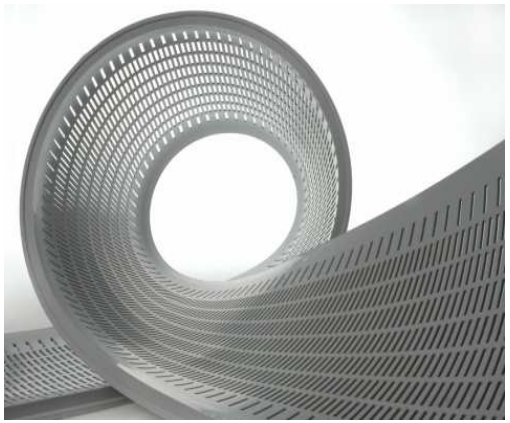
The performance of a screen will revert back to five main parameters:

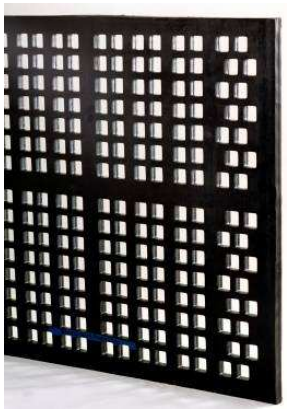
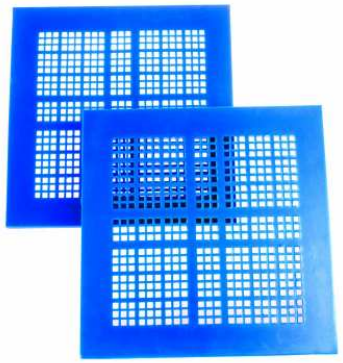
- Motion
  - Incline (Circular): Speed/RPM, stroke/throw and direction of rotation.
  - Horizontal (Elliptical or straight line): Speed/RPM, length of stroke/throw, throw angle (Ex. 45° line of action) and direction of rota tion.
- Slope: Install angle of the unit.
- Screening media and available open area.
- Carrying capacity of the screen.
- Material characteristics (Dry, damp, wet, sticky, etc).
- Take home message: All are related and effect the performance of a screen.

QUARRY ACADEMY

Screening Media

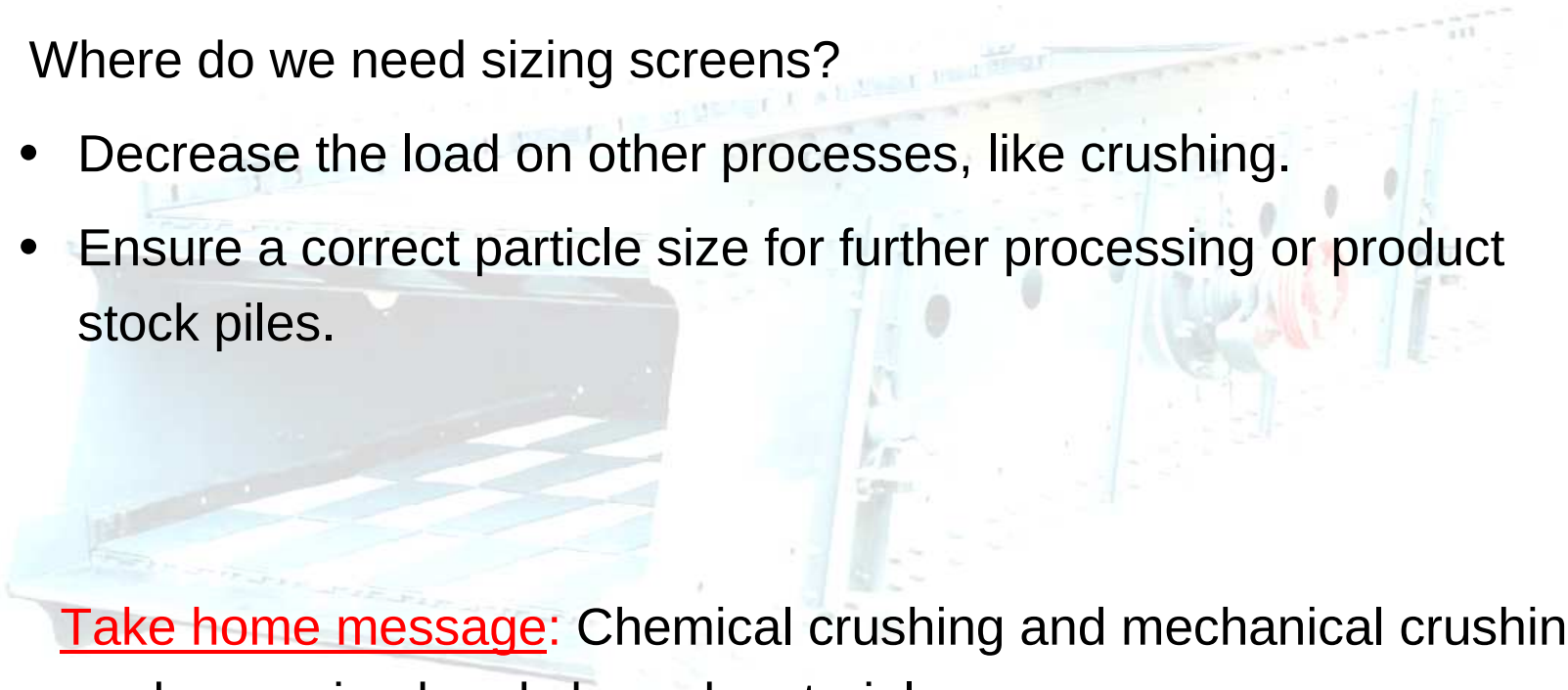



QUARRY ACADEMY

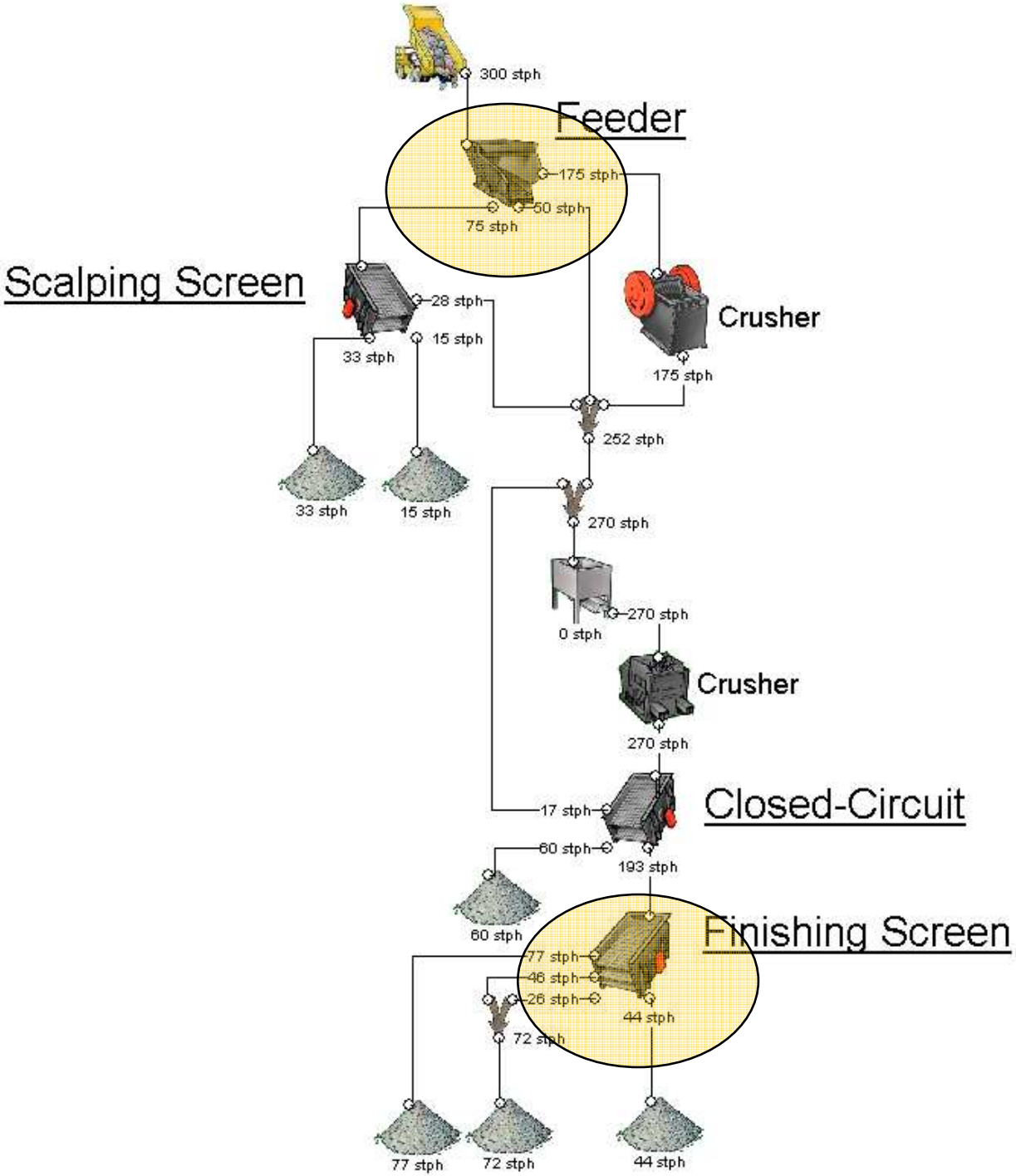
Definition of a Screen

- A screen is a device which separates a mix of particles into two or more groups depending on size.
- Where do we need sizing screens?
  - Decrease the load on other processes, like crushing.
  - Ensure a correct particle size for further processing or product stock piles.



- Take home message: Chemical crushing and mechanical crushing produce a sized and shaped material.

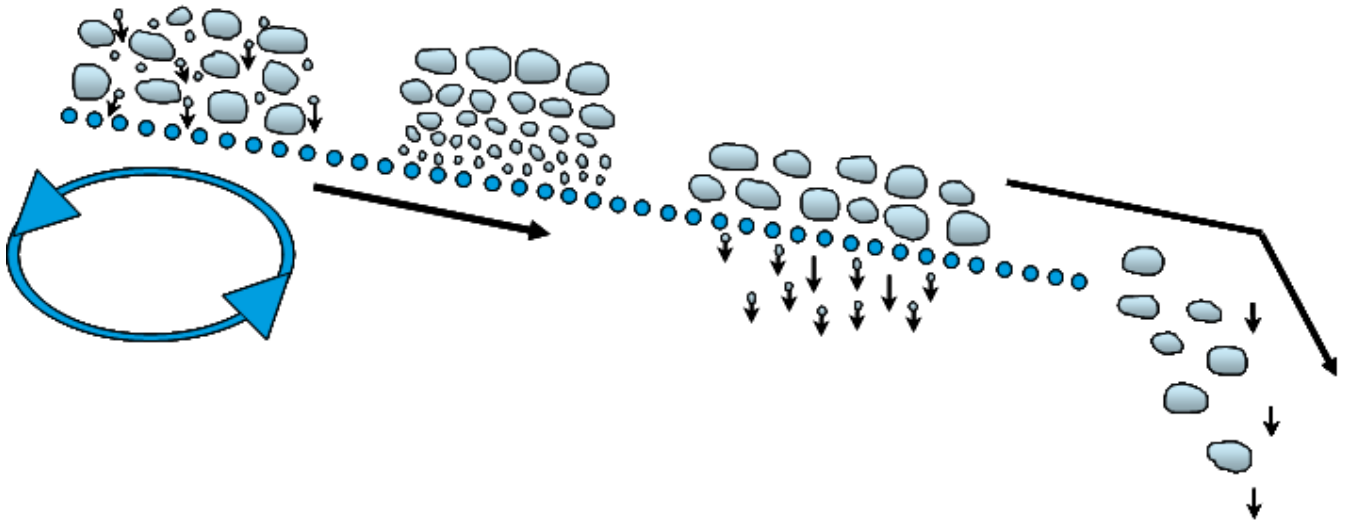
QUARRY ACADEMY



QUARRY ACADEMY

Definition of Screening

- A mechanical process which stratifies (divides) particles according to size. The media (screening surface) opening then accepts or rejects the particles.



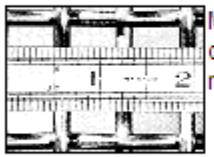
- Take home message: Size control, the process of separating solids into two or more products on the basis of their size.

QUARRY ACADEMY

Definition of Screen Media / Surface

- A screening medium with predetermined openings used to classify (size) two fractions of a feed material. Typically aggregate (sand, gravel, all stone types) whereas a top size product is retained (overs) and a through (fines) product is passed.
  - **Clear opening** is the actual measured opening between two wires, such as in the case of wire cloth media.
  - **Mesh** is defined as the number of openings per linear inch.

The Definition of Mesh



Mesh is defined as the number of openings per linear inch (primarily woven wire cloth or other synthetics). To count mesh, start from the center of one wire and count the number of openings to a point one inch in distance.

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Screening Throughput in Practice

Throughput: The quantity or amount of raw material processed within a given time.

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Selection of your Screen: Application Information Required

- Duty/service
  - Secondary screen
  - Operating schedule
  - Stationary application
- Quality requirements/ separation accuracy
  - Product sizes/specs required
- Feed gradation
  - (Sieve analysis)
- Bulk density of material
- Material characteristics
  - Wet, dry, sticky…
- Desired capacity
  - Feed rate
- Sizing media
  - Material (PU, W/C, Rubber…)
  - Brand (Stringers, side liners)
  - Openings (Per deck)
- Existing footprint
  - Size
  - Inclined (install angle)
  - Horizontal
  - Feed/discharge points
  - Motor horsepower
  - Spray system
  - Spring brackets
  - Weight
  - Hand-of-drive (From the feed end)

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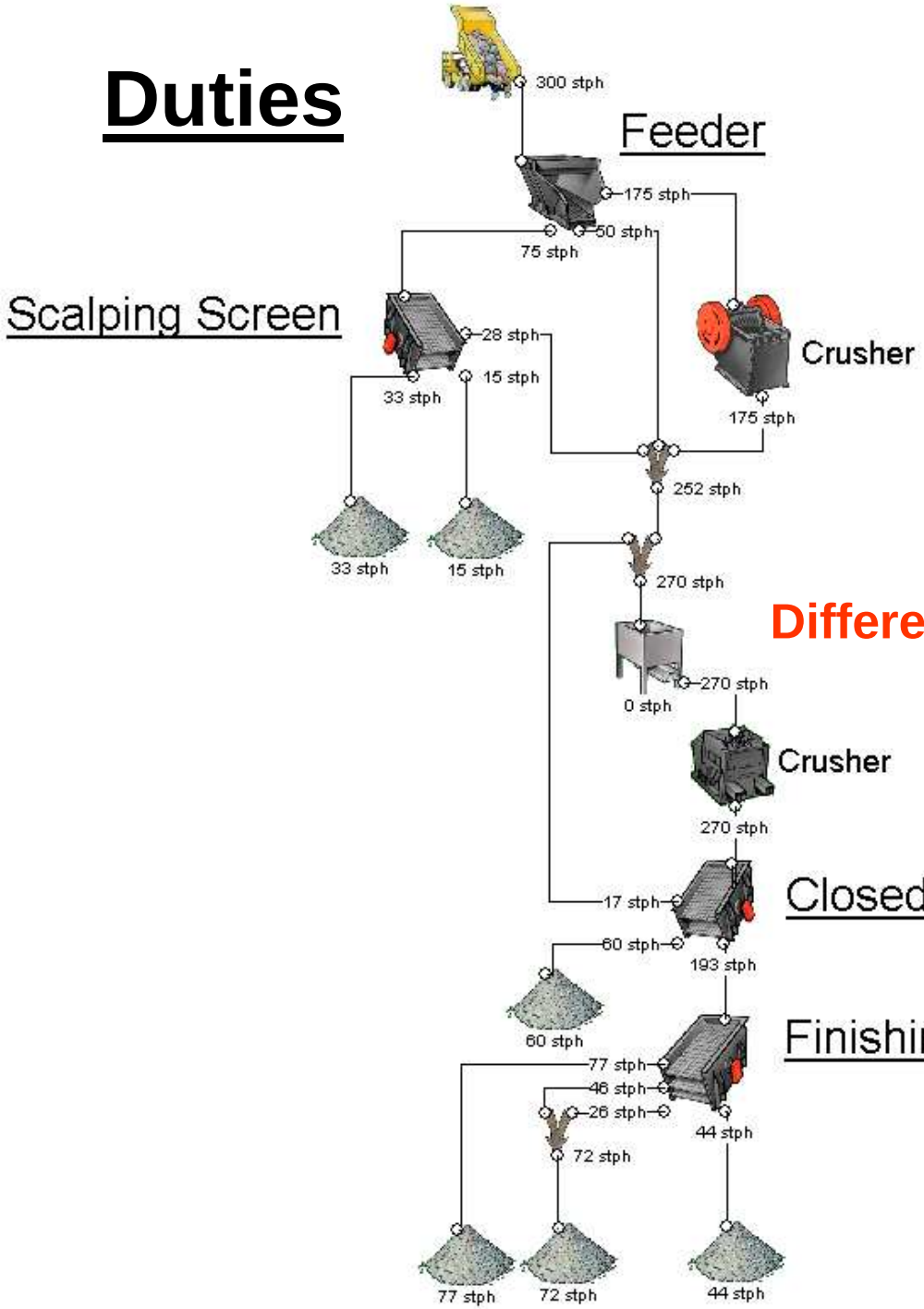
Duties

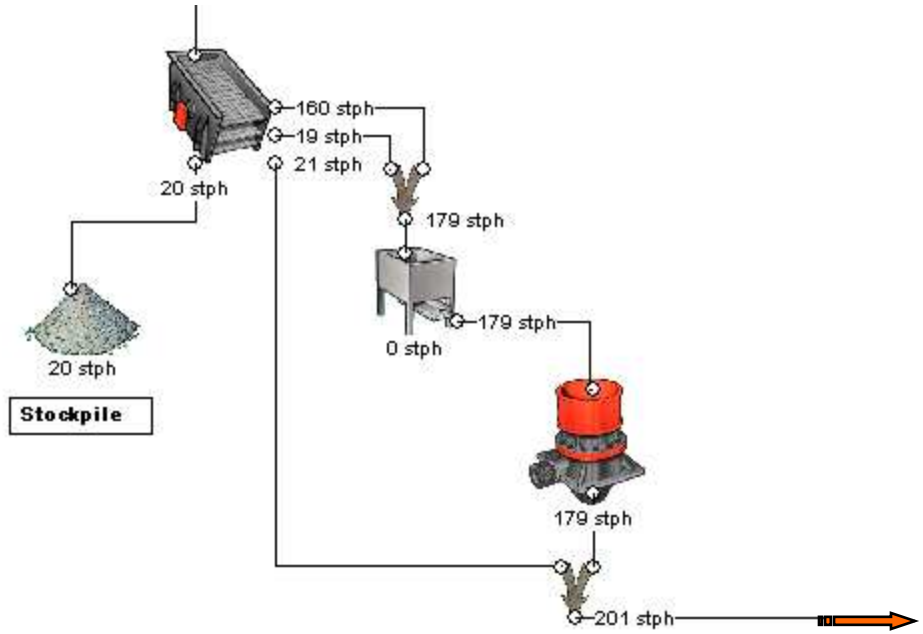


Different duties in a plant

QUARRY ACADEMY

Screen Duties

- To prevent undersize in the feed from obstructing the performance of the next reduction stage.



- Take home message: Keep the fines or sized product out of the next crushing circuit.

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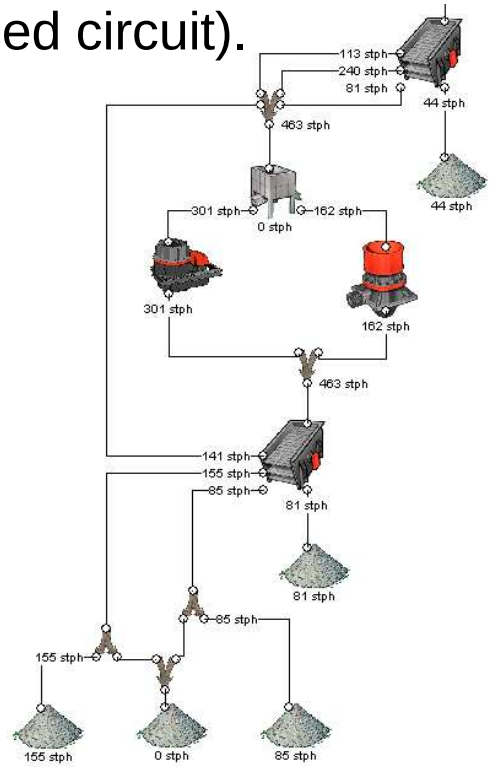
Screen Duties

- To prevent oversize in the feed from moving onto the next process (Closed circuit).



- Take home message: Closed circuit operation.

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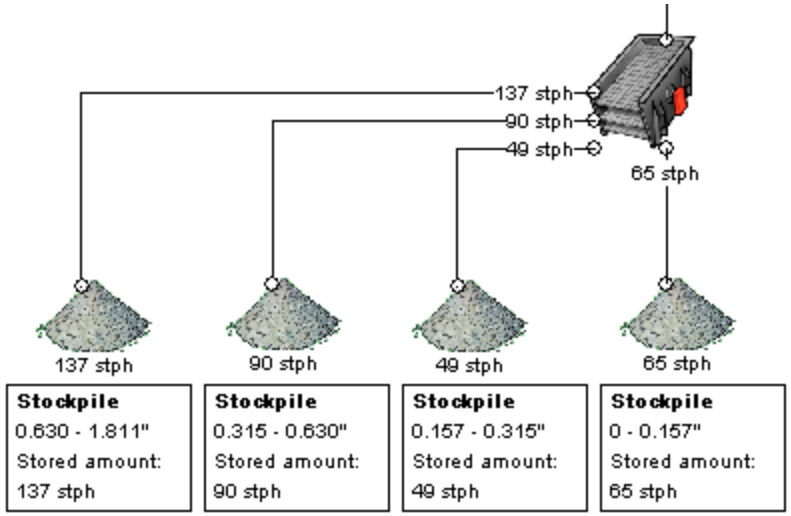
Screen Duties

- To prepare a sized product.



- Take home message: Final product sizing.

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Duties

- **Vibrating Grizzly Feeder (VGF) – Removes fines from the feed material prior to the primary crusher. Another application would be to scalp-off dirty material which may be in the feed.**
- **Primary Scalper - Size primary material for secondary reduction and or to classify products (gabion or rip-rap stone).**
- **Secondary Screen - Size material for tertiary feed.**
- **Tertiary Screen - Final size and or separate material for quaternary circuit.**
- **Final Screens – Open circuit, to product piles.**

QUARRY ACADEMY

Bed Depth
(Discharge end)

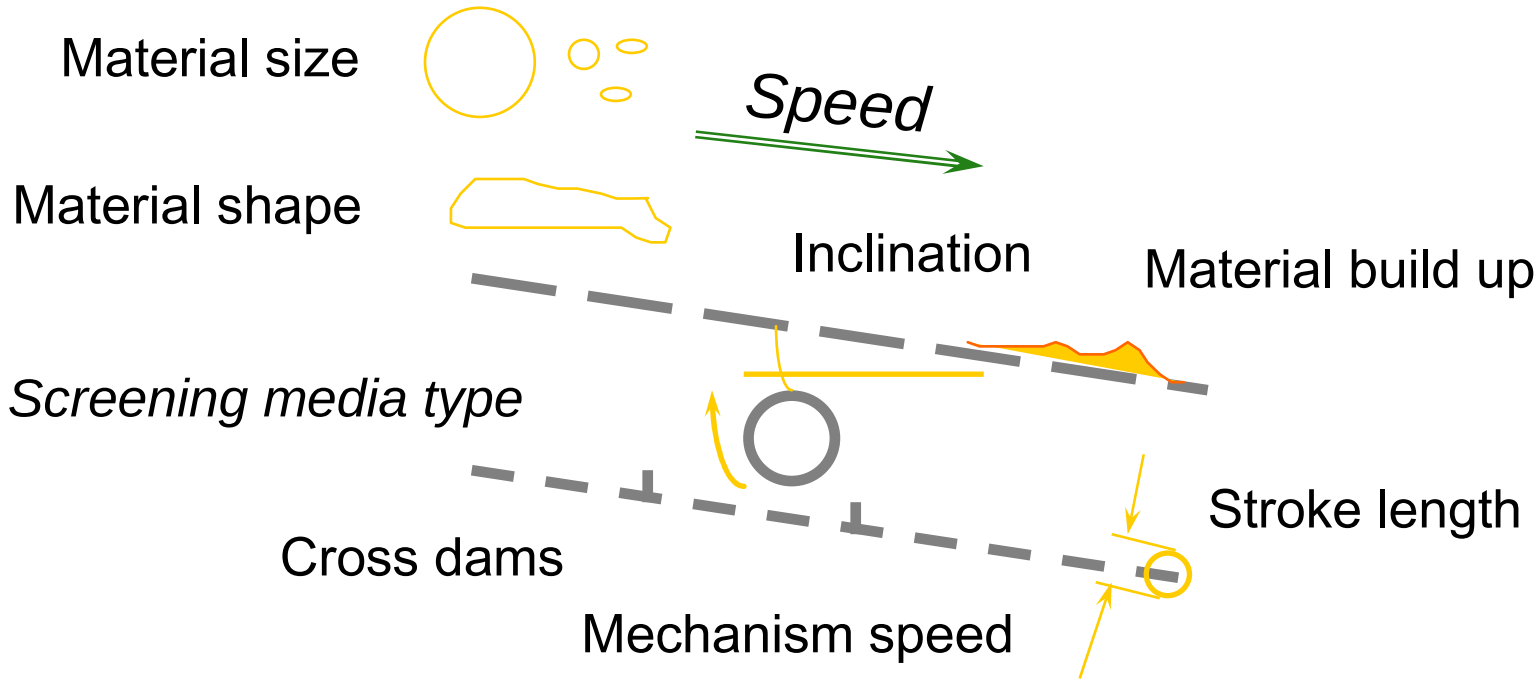
- Maximum bed depth at discharge end is 4x the separation.
  - If too thick, probability is decreased for sized aggregate to properly stratify and pass through an opening.
- Minimum bed depth is 1x the separation.
  - If too thin, material can bounce, stay suspended and not stratify or find an opening, thus reducing accuracy.

- ***Thick bed:***

- ***Thin bed:***

QUARRY ACADEMY

Factors Effecting Material Speed



Gravity Free Fall = 32.2 ft/second^2

$$G_{force} = \frac{RPM^2 \times Throw}{70418} \qquad G_{force} = \frac{800^2 \times 7/16"}{70418} = 3.9$$

QUARRY ACADEMY

Steps to Improving Screen Performance

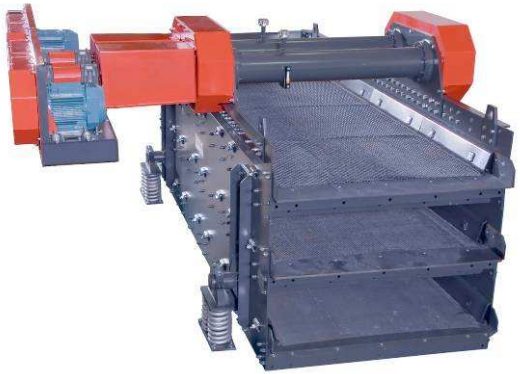
- Identify the improvement you want or determine the problem that you have with your vibrating screen.
  - *Examples: Increase tph, improve accuracy, cleaner product, reduce recirculating load, etc.*
- If you have a new problem, determine if something has changed in the circuit, material characteristics, crusher setting, screen opening, screen speed and stroke.
- Gather specific application data as it applies to that unit and seek assistance from the local dealer or manufacturer.

- Take home message: Every question is a good question!

QUARRY ACADEMY

Types of Vibrating Screens

Incline



High Frequency

Horizontal

Scalper

Differential Deck

Roller Screen = non-vibrating

QUARRY ACADEMY

Trommel Screens = non-vibrating
** Not pictured above

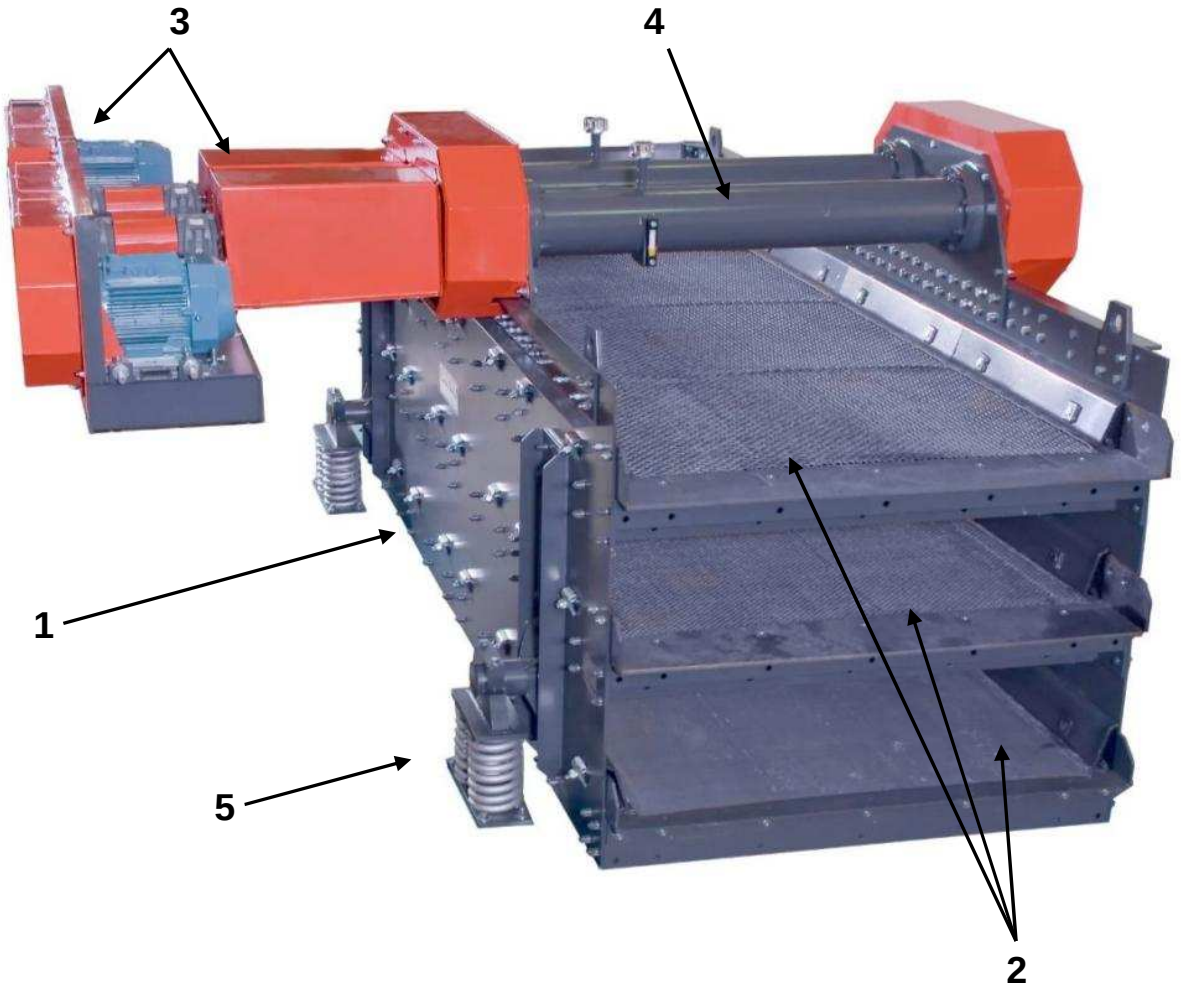
Vibrating Screen Components

Terms

1. Screen body
2. Media
3. Drive: Motor(s) with v-belts or cardan shaft kit
4. Mechanism/Exciter
5. Spring support assemblies

Options not shown:

- Dust encapsulation
- Spray bar system
- Galvanized
- Support structure…



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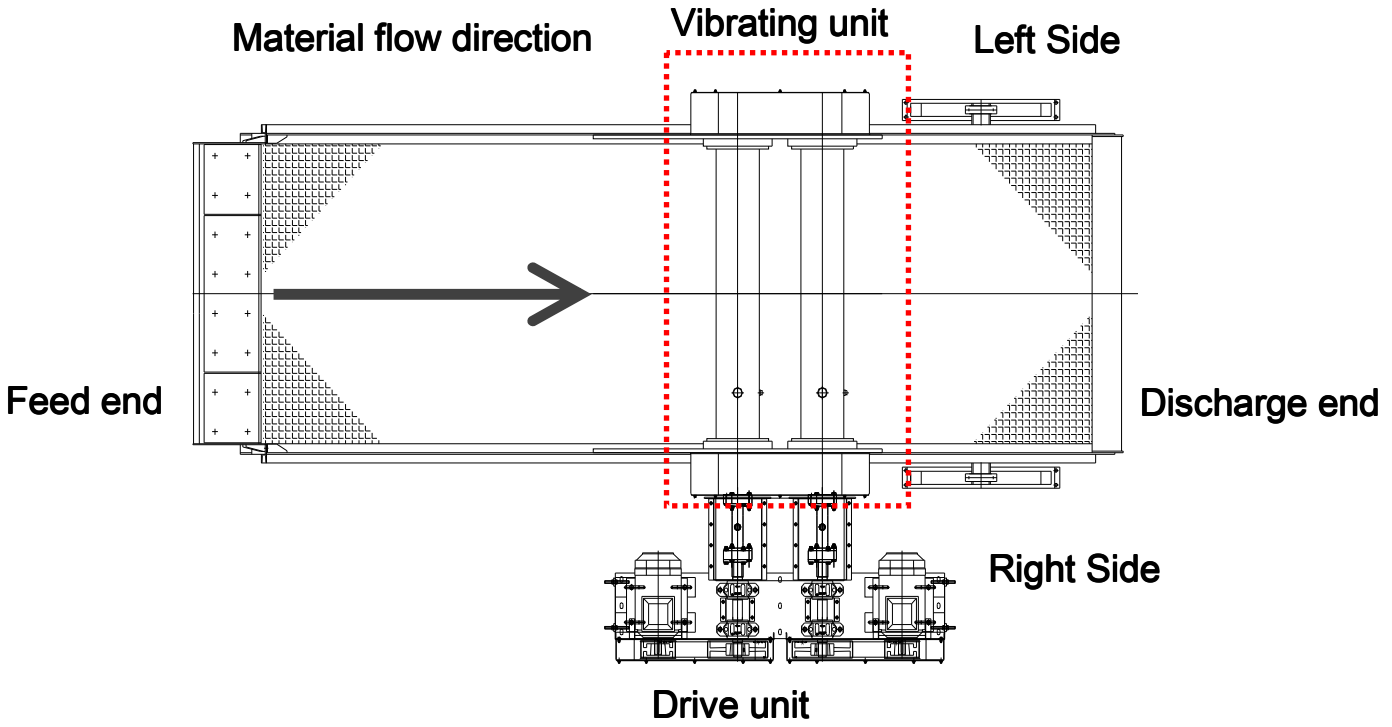
Vibrating Screen

TERMS

- **Feed end**
- **Discharge end**
- **Hand of drive**
  - ✓ Determined by looking from feed end to discharge end. I.e. Material flow direction.
  - ✓ In this case screen is right handed.
- **Stroke angle**
- **Stroke length**
- **Equipment/serial number**



QUARRY ACADEMY

Types of Feeders

Reciprocating Plate

VGF with Screen Deck

Vibrating Grizzly

Pan Feeders

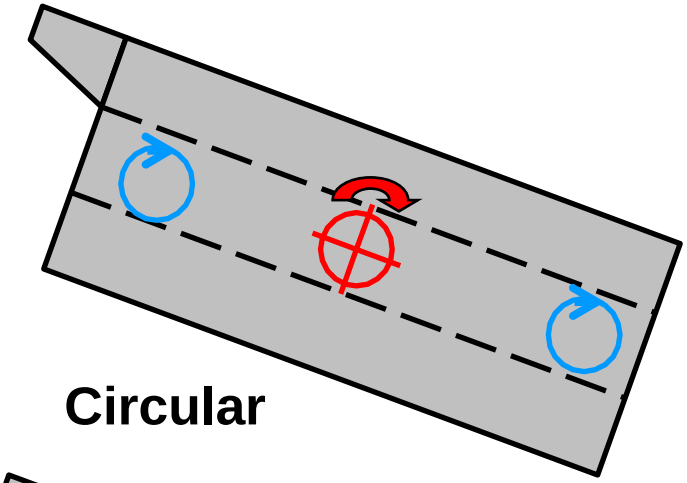
XHD Scalper

Grizzly Screen

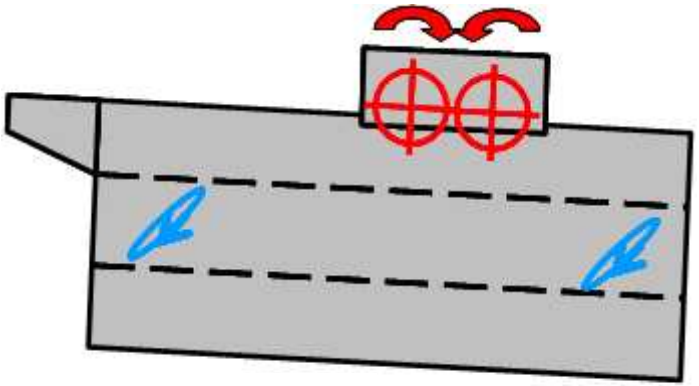
Including Belt Feeders
** Not pictured above

QUARRY ACADEMY

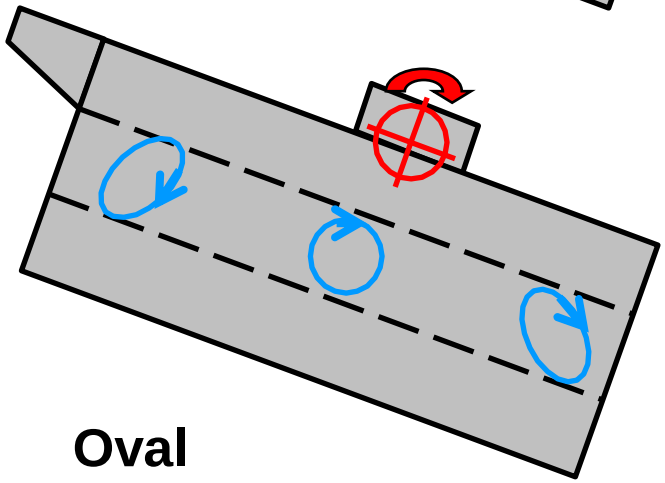
Types of Motion



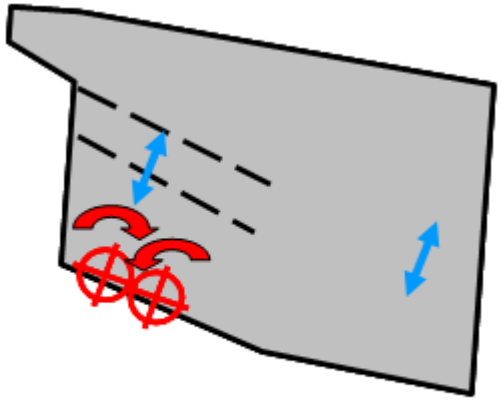
Circular



Elliptical

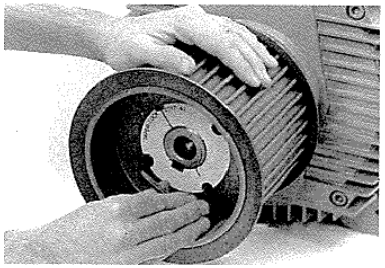


Oval

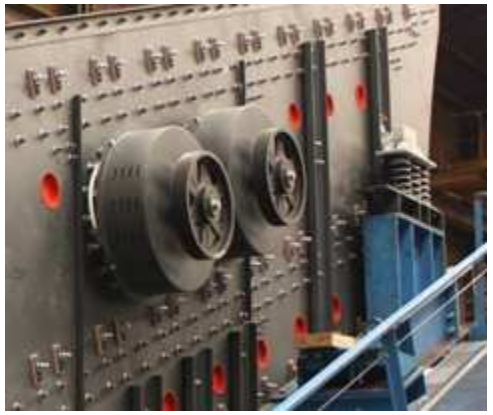


Straight Line

QUARRY ACADEMY

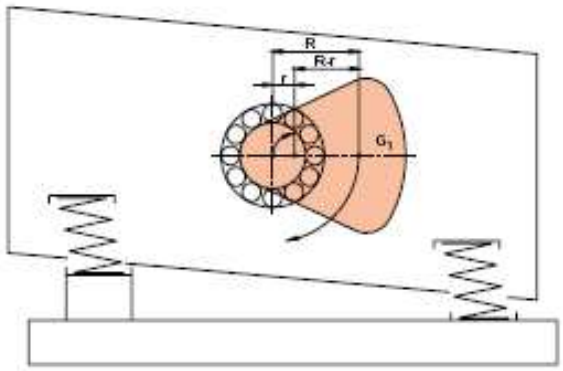


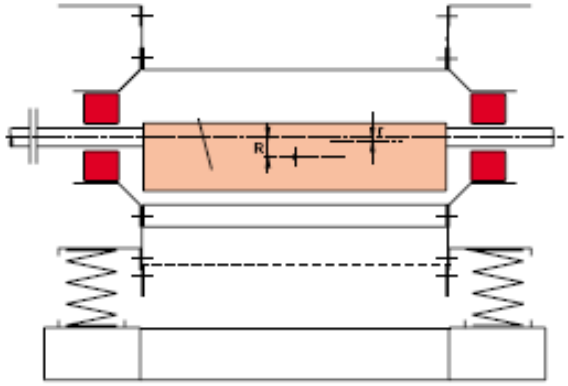
Machine Drive (Exciter)



Two bearing (per shaft line)

- Eccentric shaft design
- Concentric shaft design
- Counterweight





Notes:

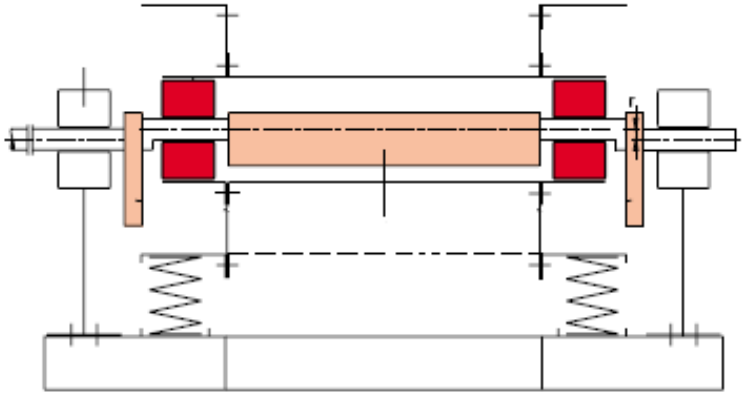
- Resultant circular throw if the exciter is located on the “center of gravity” of the screen box as illustrated above.
- If the exciter is located above the “center of gravity” or on top of the screen box, it will produce a forward ellipse at the feed end, circle throw below the exciter shaft line and reverse ellipse at the discharge end.
- If two shaft lines are required for increased bearing life or carrying capacity, the shafts are normally timed via a timing belt. In this scenario the shafts rotate in the “same” direction.

QUARRY ACADEMY

Machine Drive (Exciter)

Four bearing positive stroke

- Single eccentric crankshaft design
- Counterweight
- Circle throw - only



Notes:

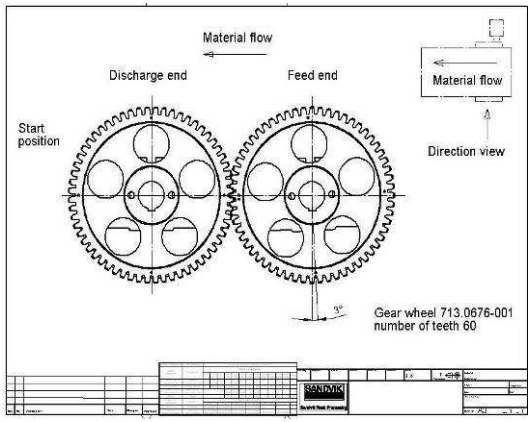
- Referred to as a “positive stroke” machine. Crankshaft design always produces a positive stroke similar to the crankshaft in a car. Used in the mining industry or in applications where high surge loads are common.

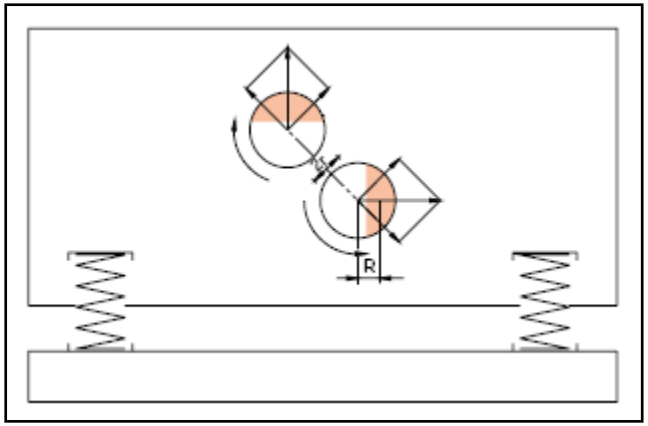
QUARRY ACADEMY

Machine Drive (Exciter)

Two shafts - four bearings – Timed with gears

- Applied for use on a vibrating grizzly feeder or on a horizontal dewatering screen. Drive mechanism could be mounted below the frame as in the case of a feeder or above the body in the case of a horizontal type dewatering screen.
- Typically a 35°- 45° straight line of action.
- Shafts rotate in opposite directions via the gears controlling the throw angle, height and how far the material travels with each complete turn of the shafts.



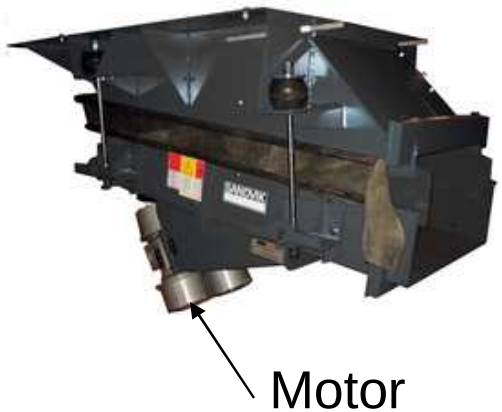


QUARRY ACADEMY

Machine Drive (Exciter)

Offset motors (Electric)

- Stub-shaft with counterweights
- Typically produce a straight line motion

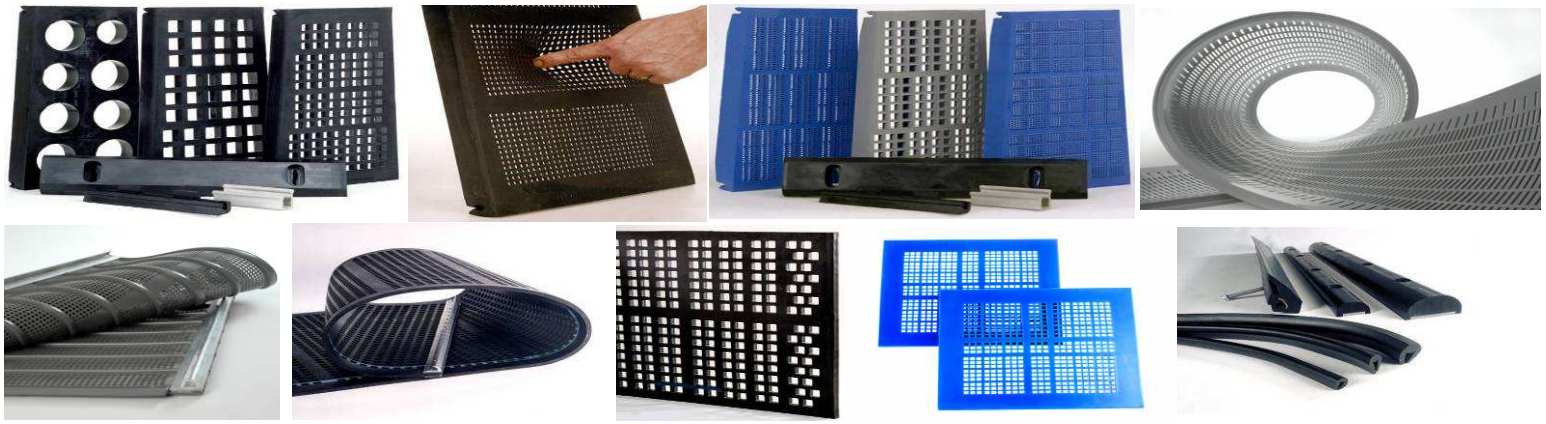


QUARRY ACADEMY

Options: Screening Media

- Woven wire cloth
- Plastic (Monofilament)
- Piano wire
- Rod deck
- Grizzly bar
- Louvered deck

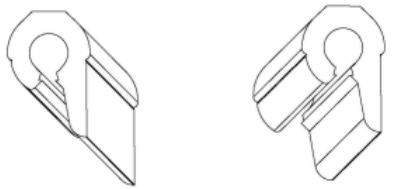
- Profile deck
- Polyurethane (PU)
- Rubber
- Perforated plate
- Cast plate deck
- Rubber clad perforated plate

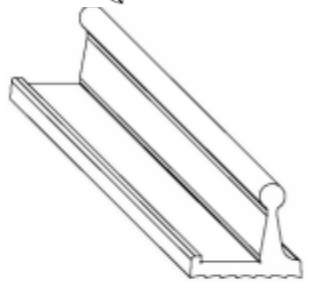


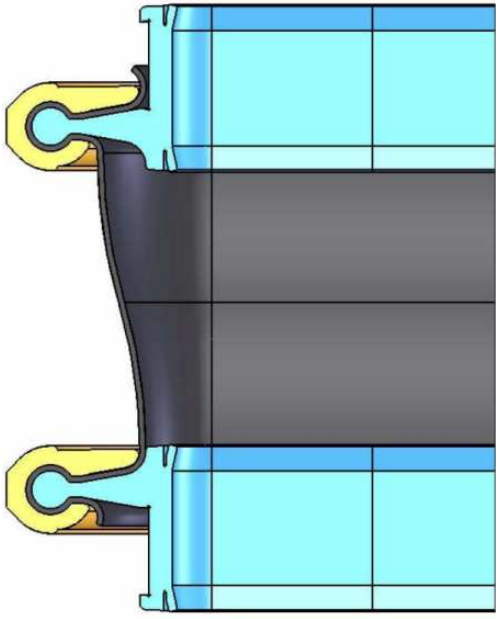
QUARRY ACADEMY

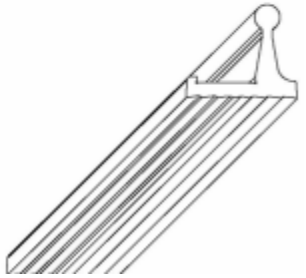
Options: Dust Encapsulation

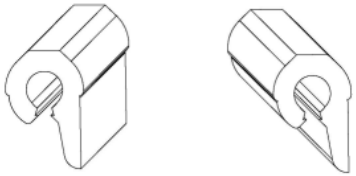
- Safety
- Good neighbor
- Sound
- Dust







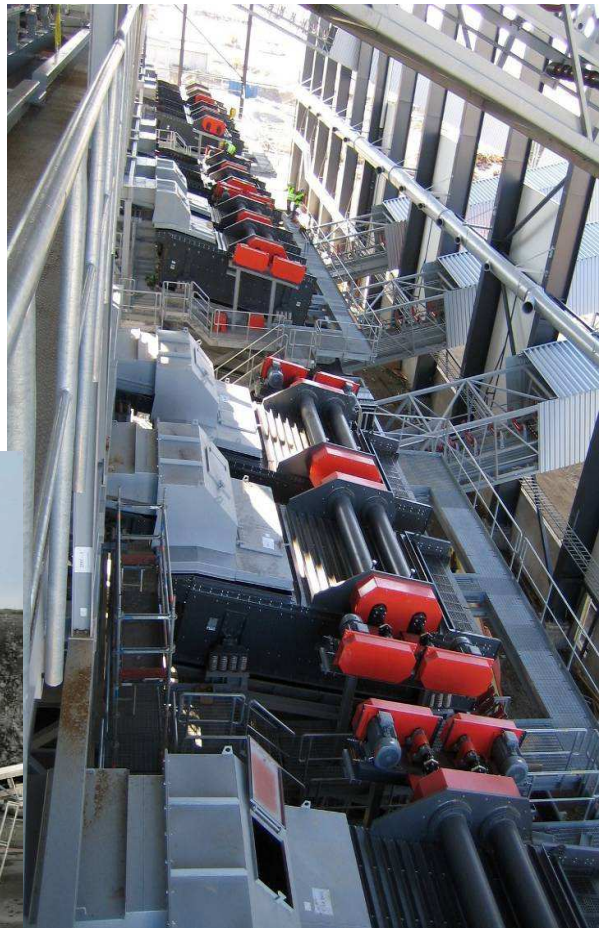




QUARRY ACADEMY

Options

- Base frame
- Cardan shaft drive
- Liners
- Special paint or coating
- Spray bar system....



QUARRY ACADEMY

Conclusion

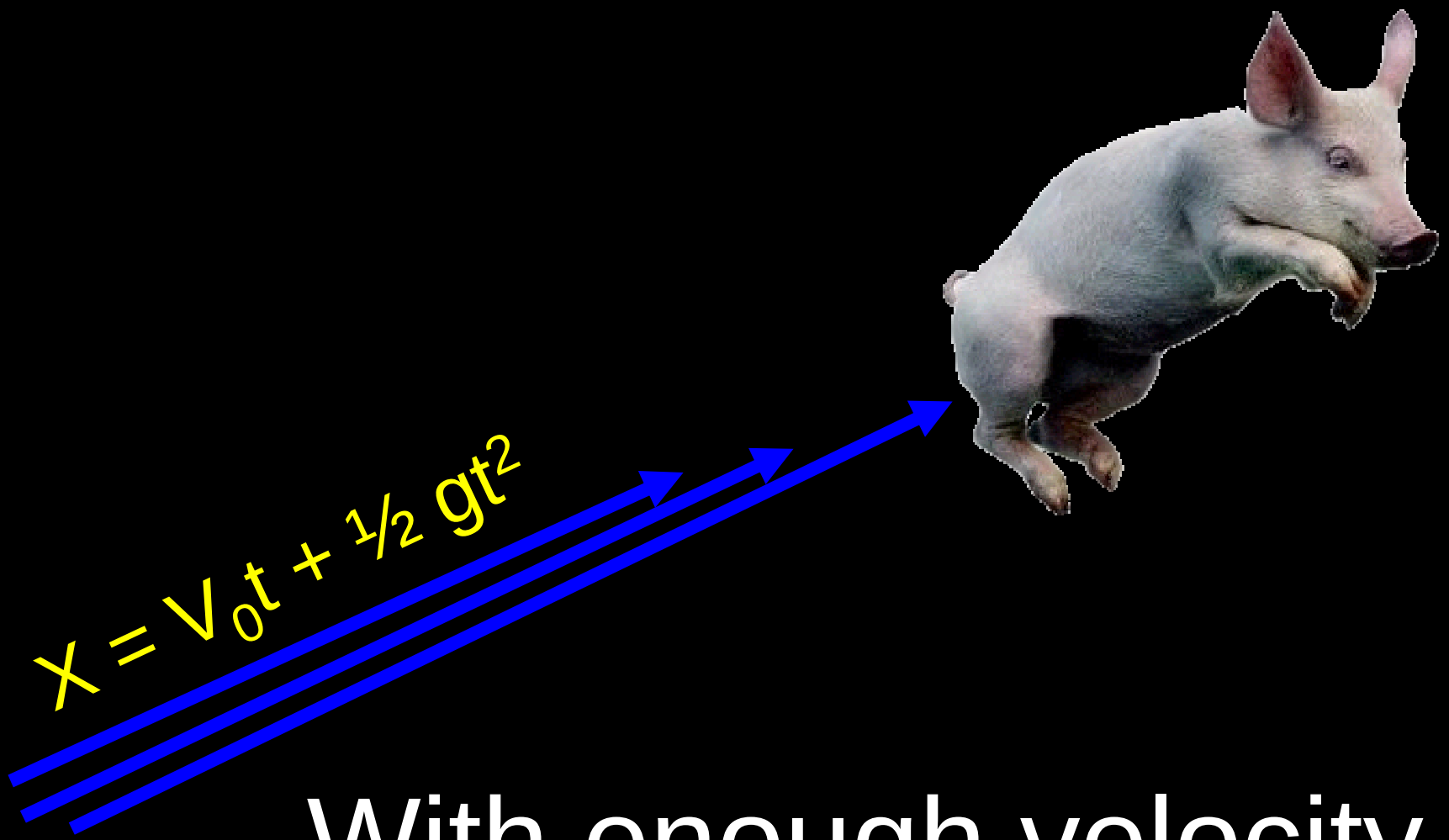
- Safety first. When a screening issue arises, always look for the obvious (broken spring, belt too tight or too loose, broken cross member, loose bolting hardware).
- Remember the three 3-S's…speed, stroke and slope.

Take home message:

Lockout – Tagout always.

Screens are often the critical link in the value chain.

QUARRY ACADEMY



With enough velocity,

pigs fly just fine!

So to can vibrating screens!

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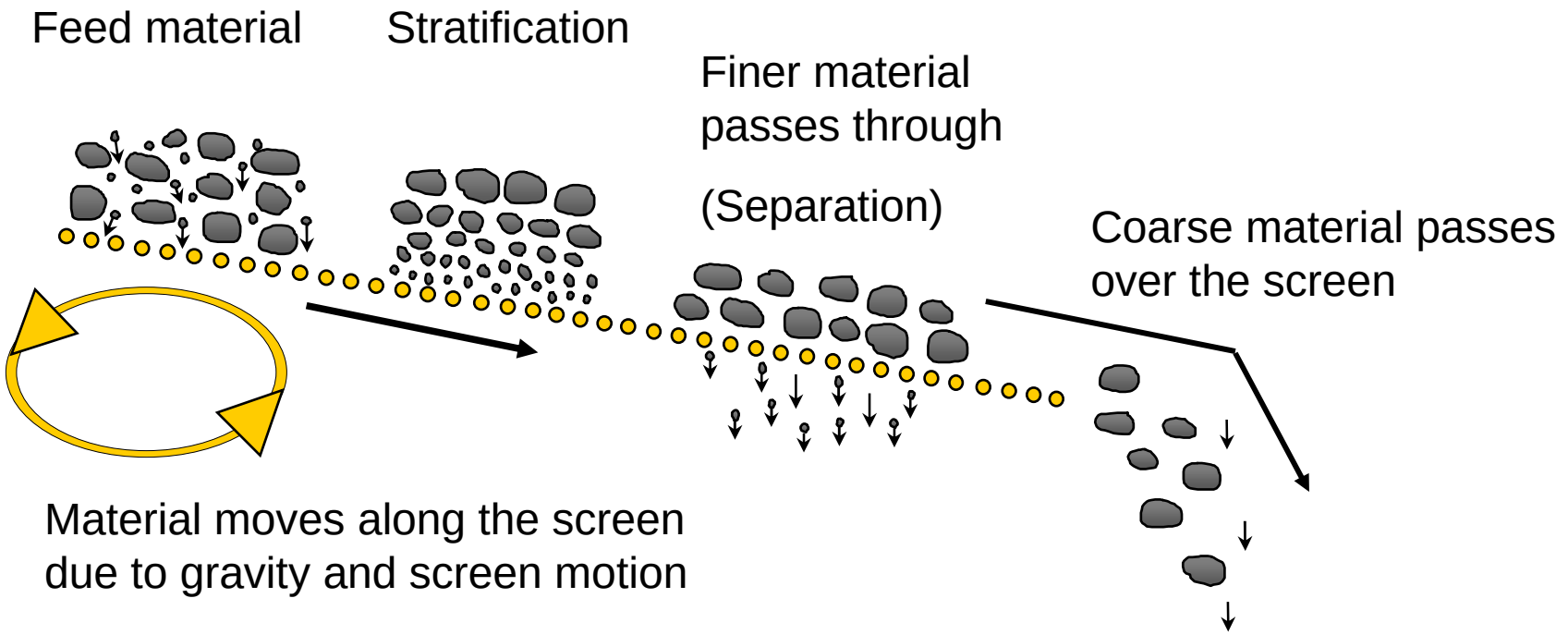
Conventional Screening - Stratification

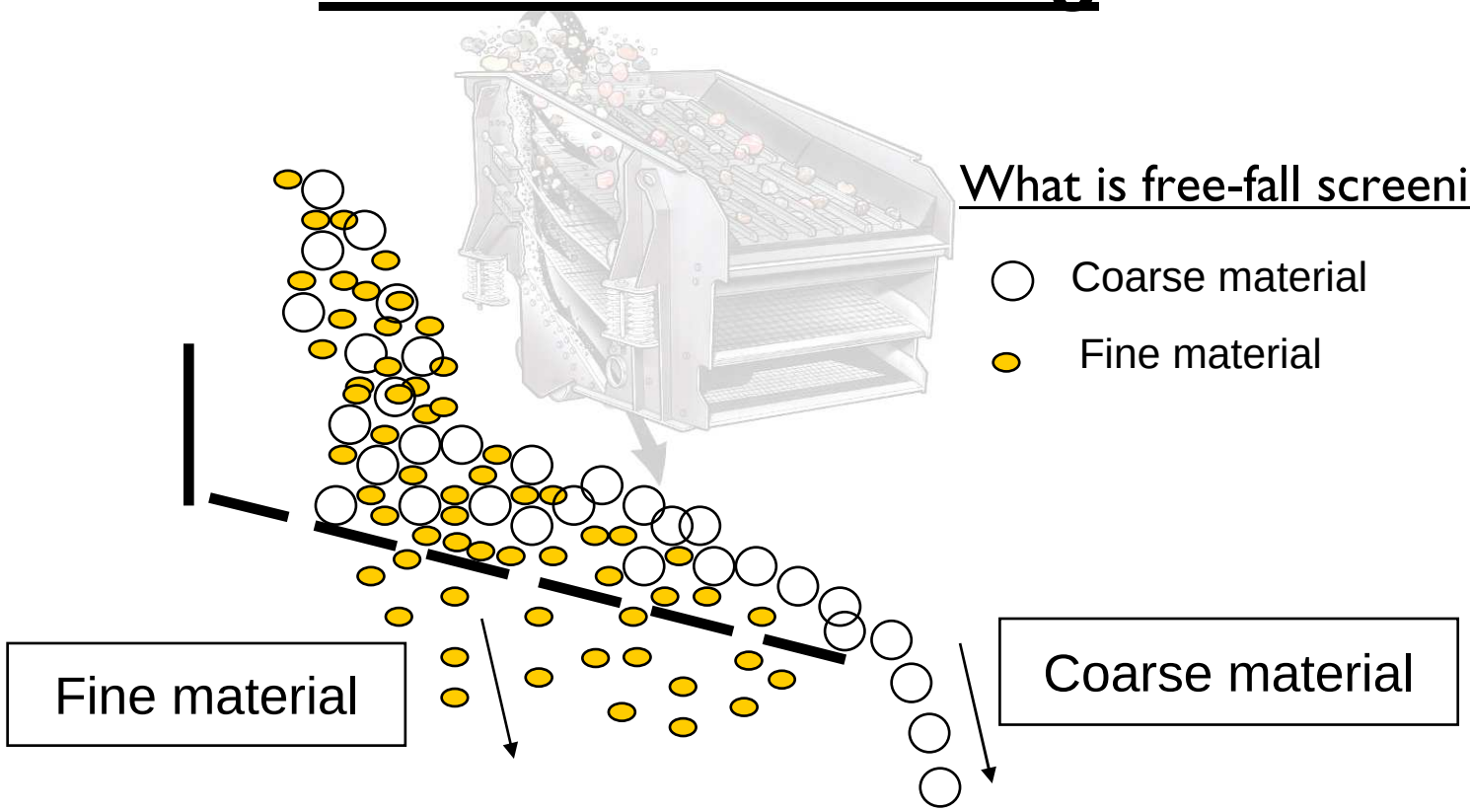
This is Conventional Screening –

it is based on stratification



QUARRY ACADEMY

Free-Fall Screening



- Free-fall screening is based on the principle of free-fall of the material through and over the deck. I.e. No particle layer will build up on the screen deck.
- Optimal free-fall screening demands at least 70 % of the feed through the deck. I.e. High % of fines in the feed, high capacity.

QUARRY ACADEMY