



QUARRY ACADEMY

Improving Processes. Instilling Expertise.

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Do's & Don'ts In Plant Design

Charles H Hillmann



Improving Processes. Instilling Expertise.

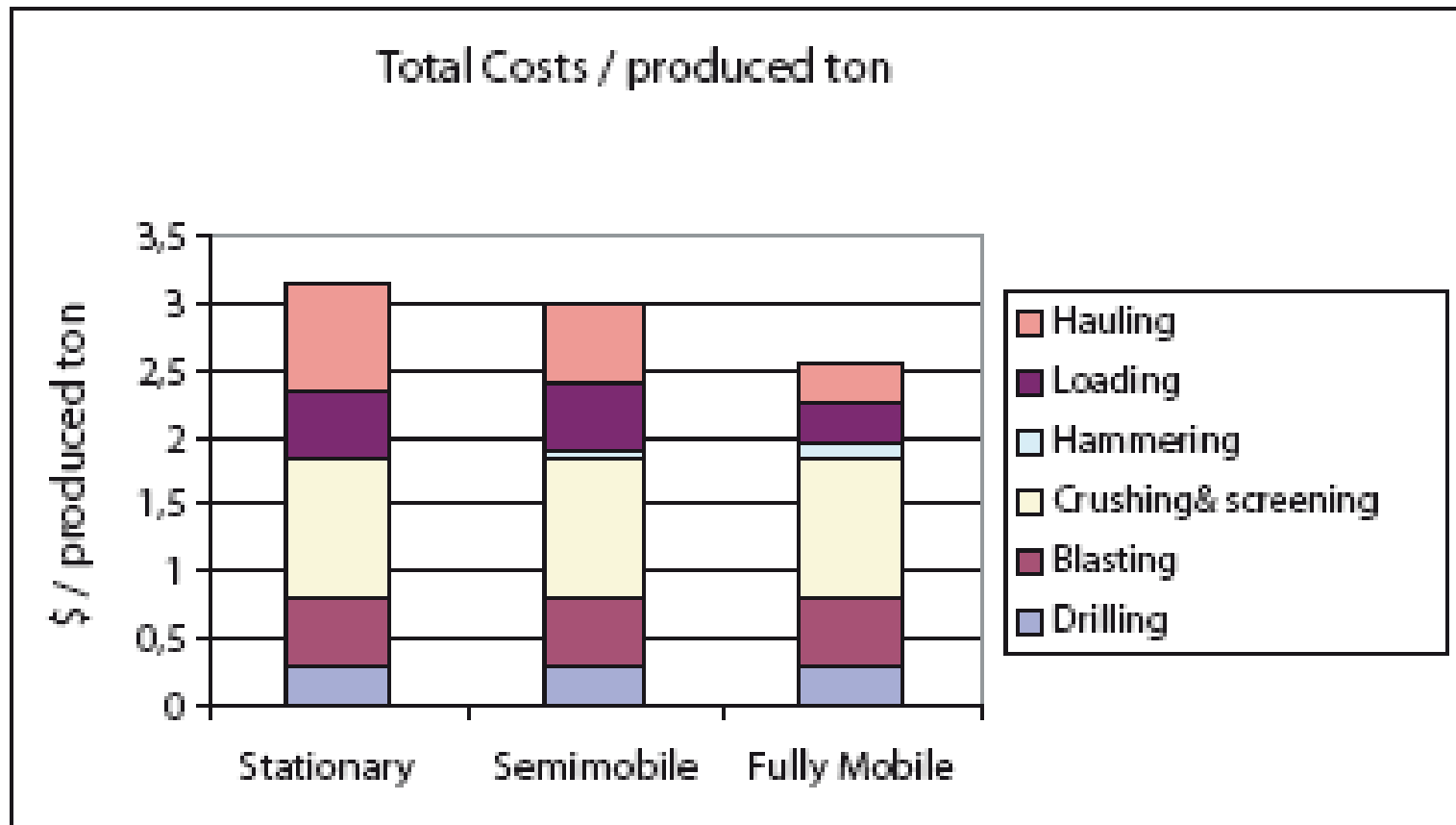
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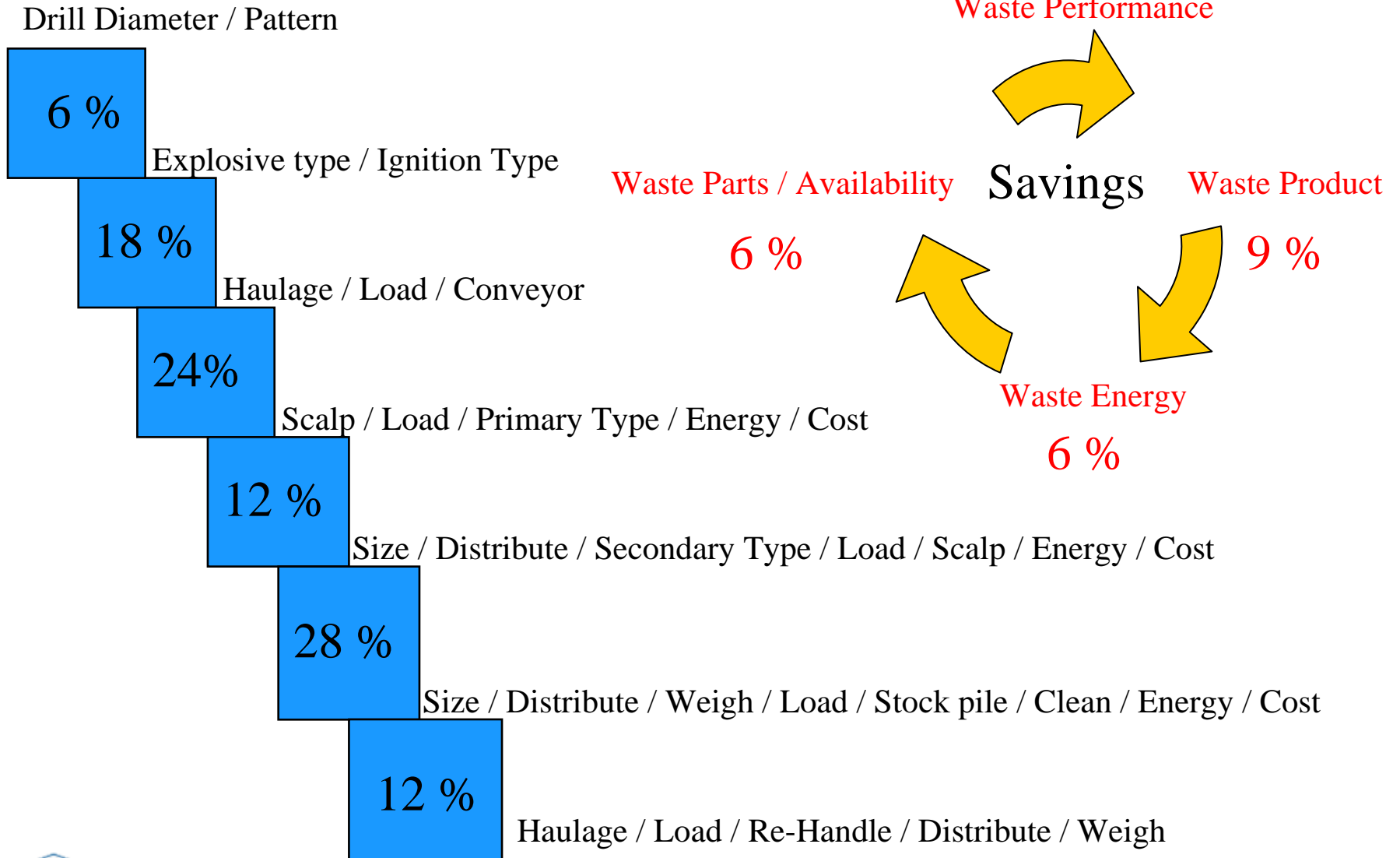
10 Top Things to Avoid In Plant Design

- **Process Plants make up 25-35% of operation total costs.**
- **Process Plants are Labor intensive**
- **Most of the time Design error can add safety issues.**
- **Plant design errors are typically in place for years & often only reviewed through organizational or economical change.**
- **Most errors create a downstream impact and a chain reaction on plants ,which in turn multiply the production & maintenance, financial losses.**

Total Process Costs



Costs Optimization



Profitability Impacts

Profit Impact Is considerably Higher

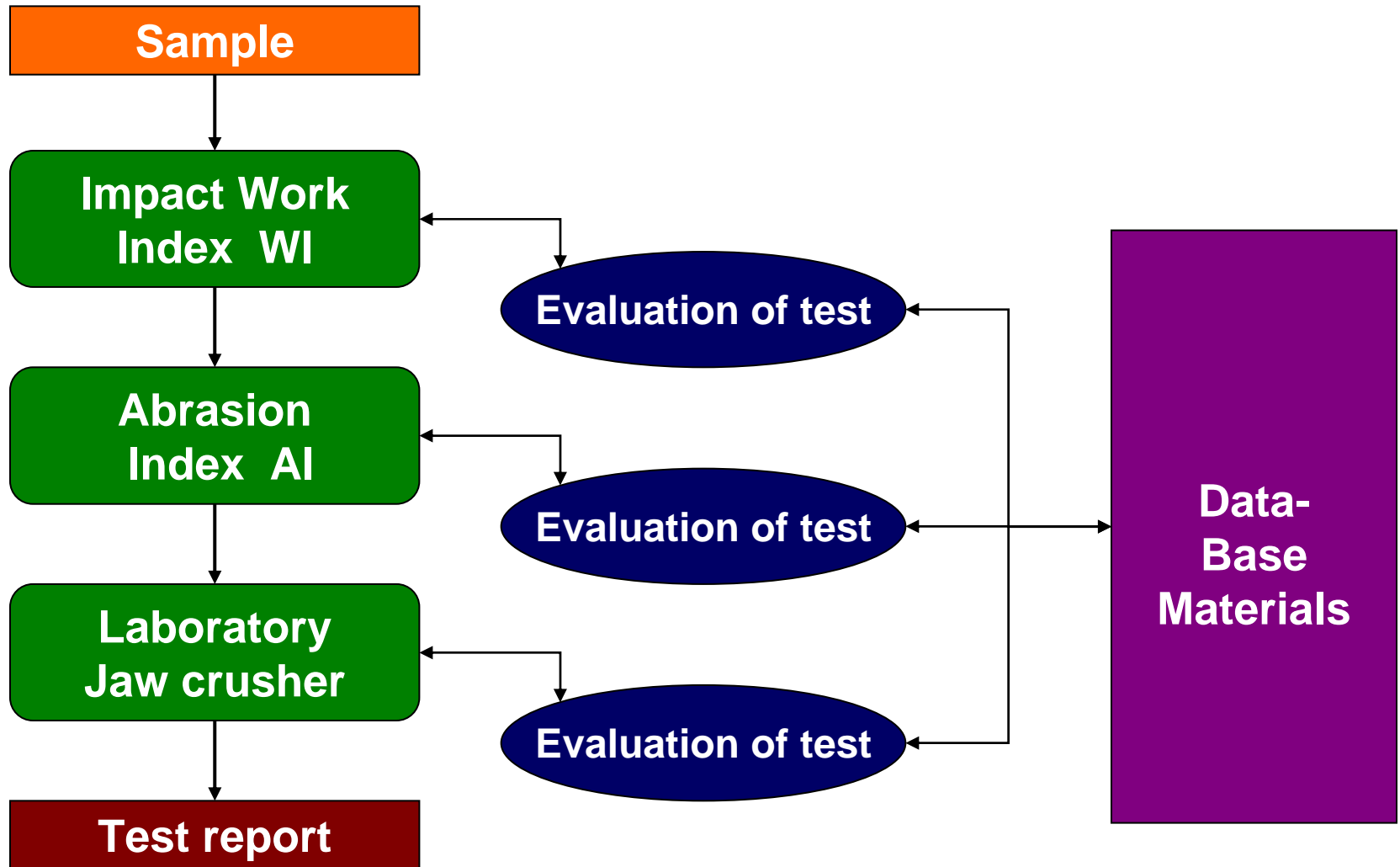
EXTRA DAY PRODUCTION = 1.5% EXTRA PROFIT

1 % EXTRA PROCESS AVAILABILITY = 4.0% EXTRA PROFIT

1 % EXTRA PROCESS CAPACITY = 4.5% EXTRA PROFIT

1 % EXTRA END PRODUCT YIELD = 5.2% EXTRA PROFIT

Testing of Raw Materials



Plants & Processes

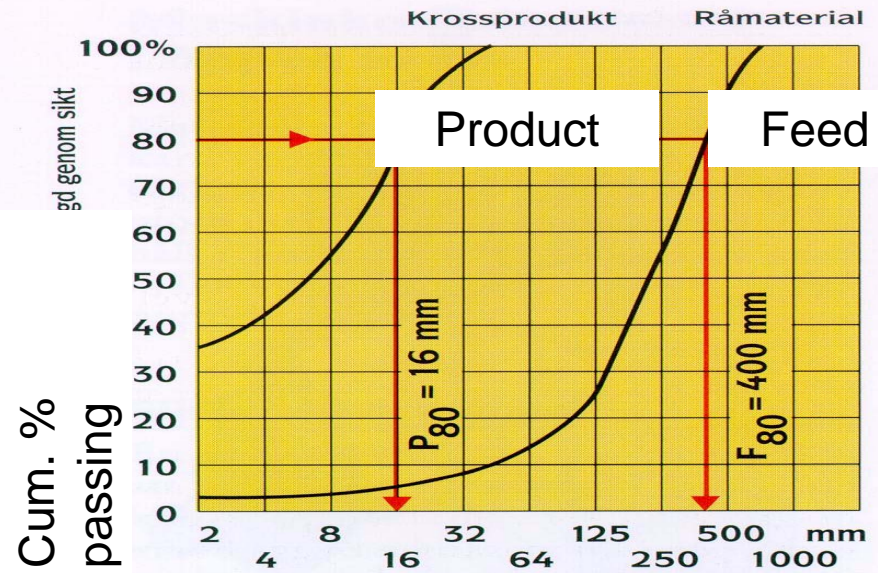
Reduction Ratio

$$= \frac{F_{80}}{P_{80}}$$

Where,

F_{80} = (80 % of feed material)

P_{80} = (80 % of the product)

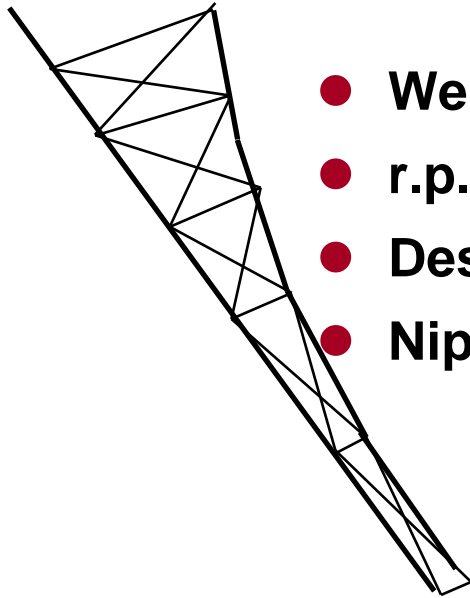
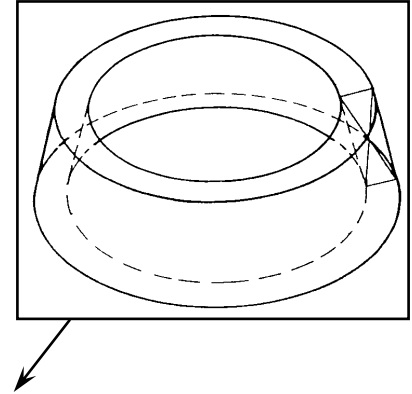
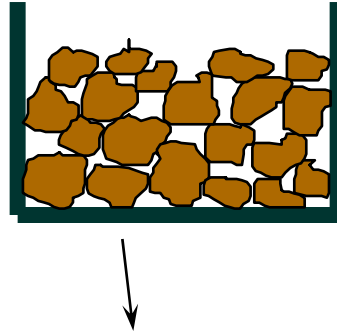


Normal reduction ratio:

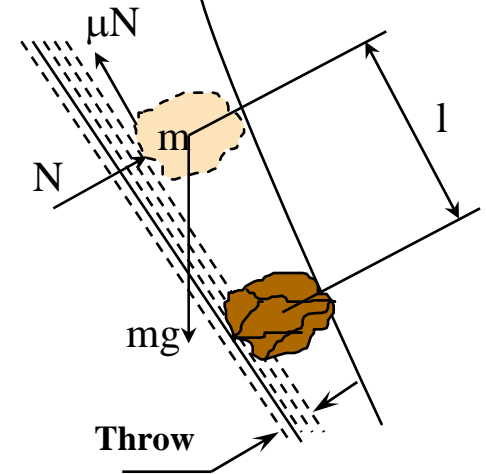
Jaw crushers	2 – 4
Gyratory crushers	3 – 5
Cone crushers	4 – 6
VSI crushers	4 – 6
HSI crushers	10 – 15
Hammer mills	15 – 20
Roll crushers	3 – 5

$$\text{Reduction Ratio} = 400/16 = 25$$

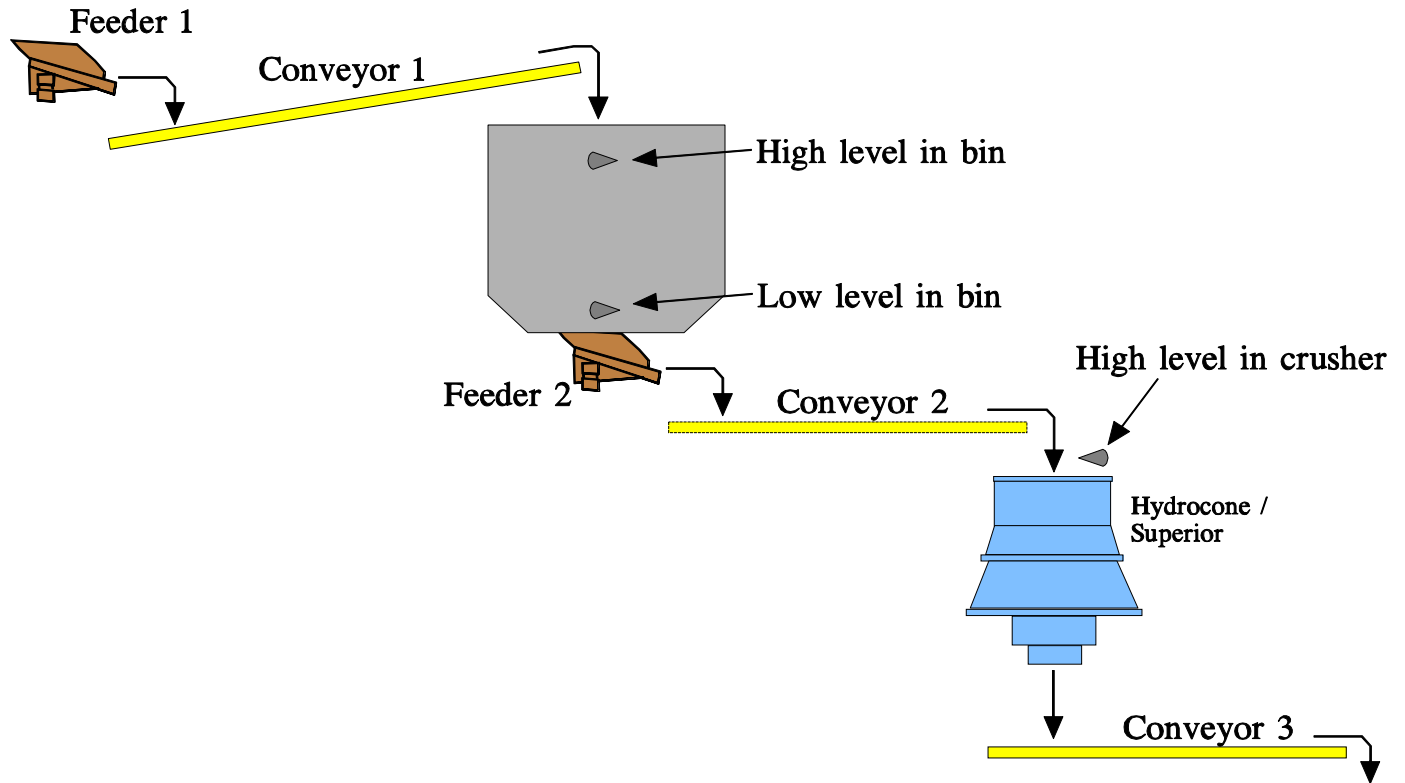
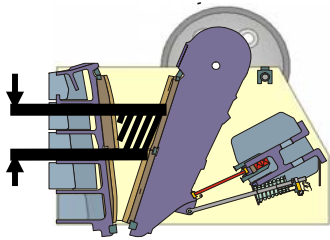
What sets the capacity?



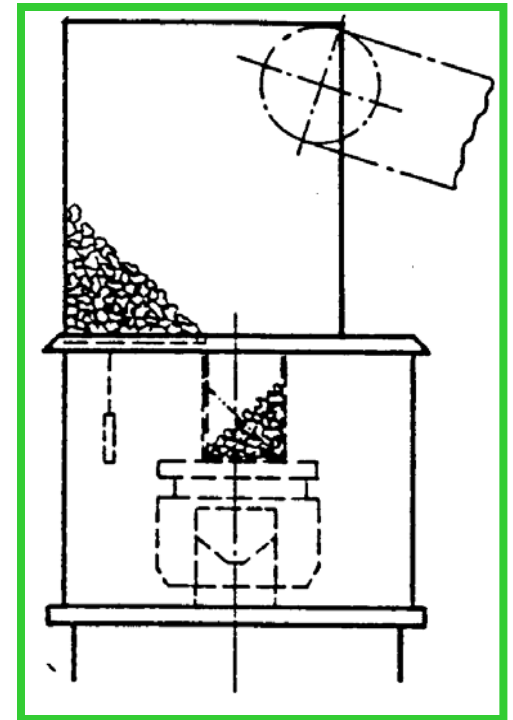
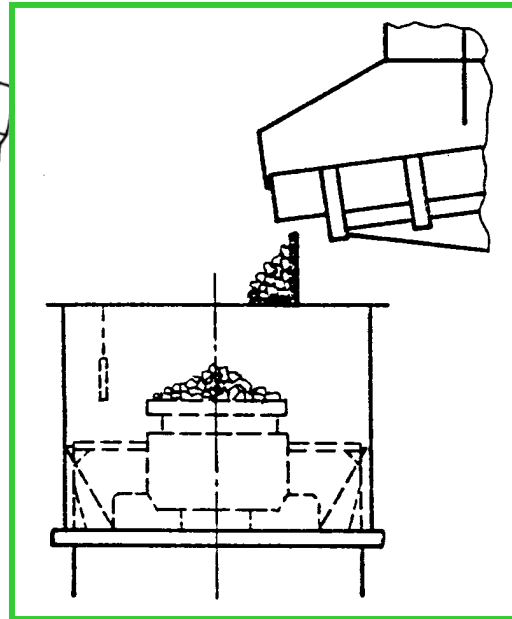
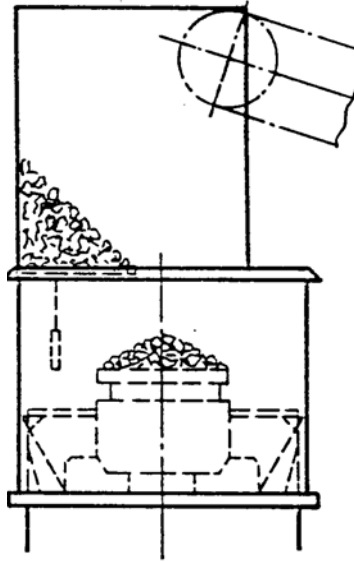
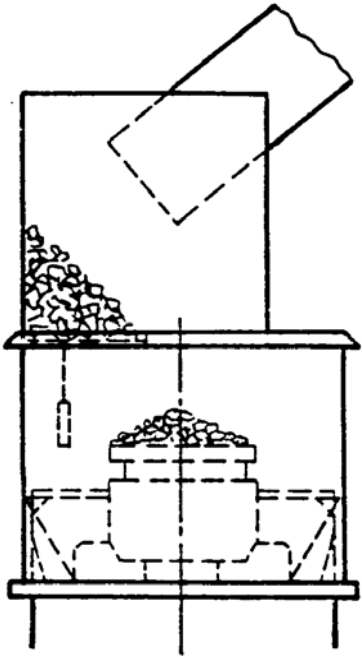
- **Weight (t)=Density(t/m³) x Volume (m³)**
- **r.p.m.**
- **Design of chamber**
- **Nip angle**



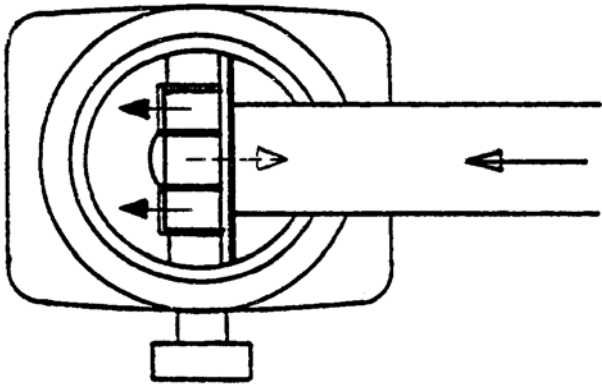
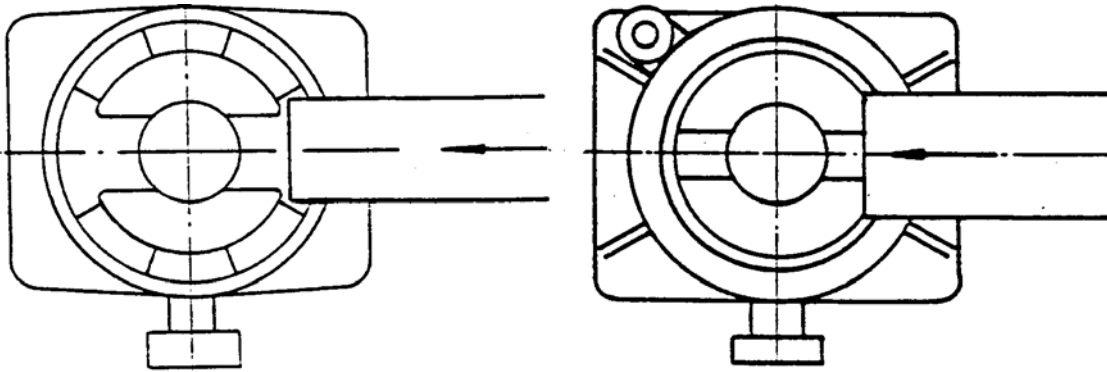
Ideal Setup / Feed Levels



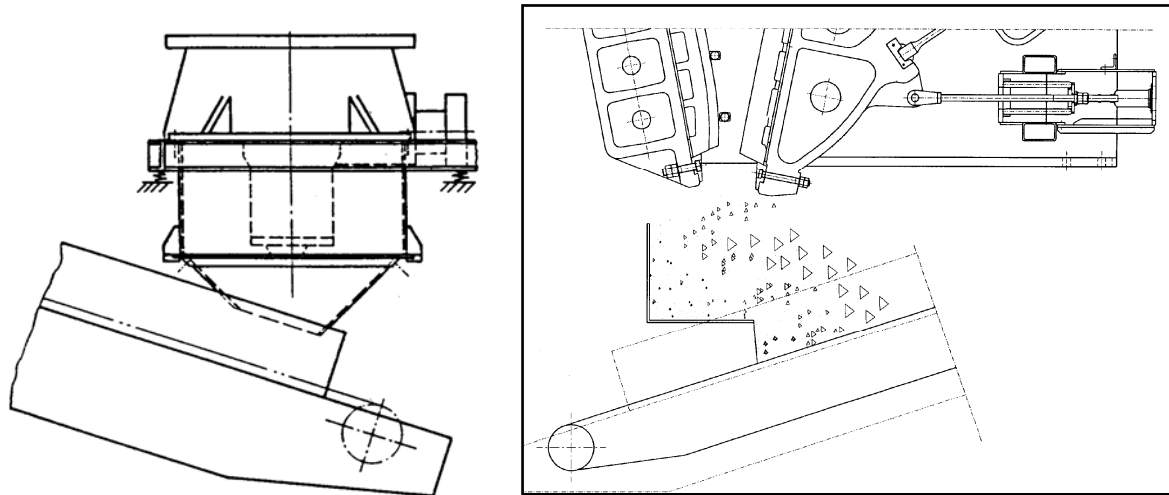
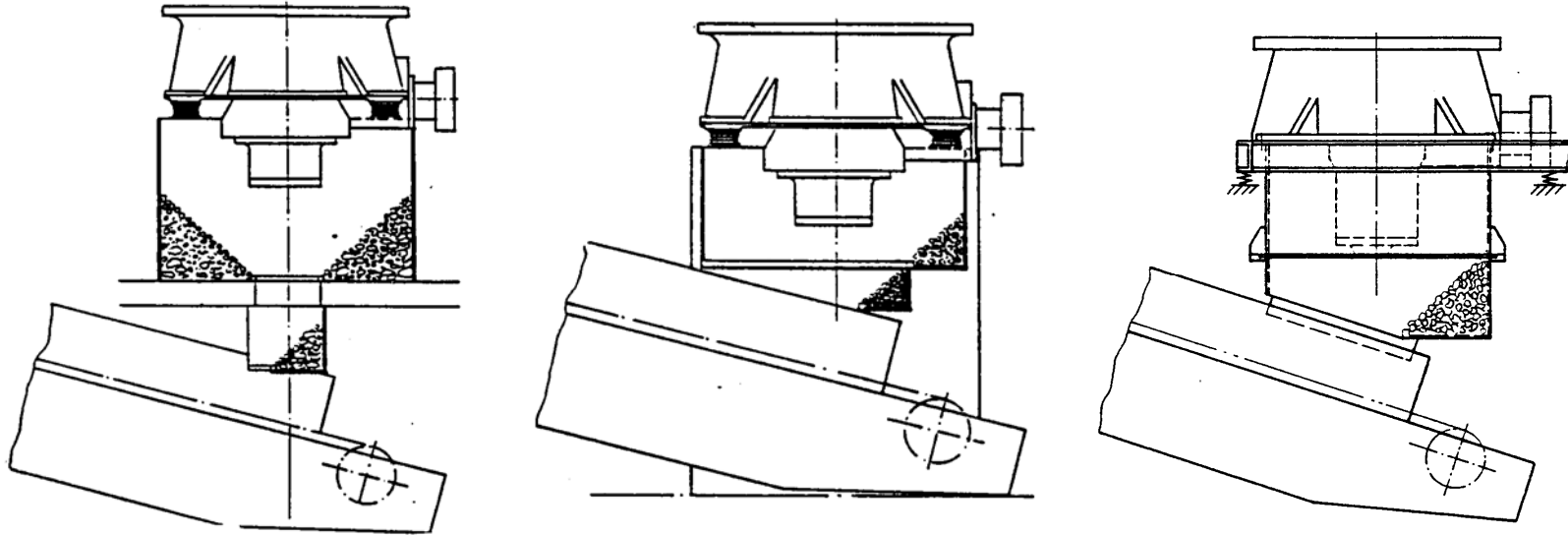
Feed Variations



Splitter Arrangements



Crusher Discharge Variations



10 Top Things to Avoid In Plant Design

- 10) Improper Conveyor Sizing
- 9) Improper Material Handling/ Control devices (Feeders etc)
- 8) Poor Chamber Design
- 7) Screen Media Choice
- 6) Lack of proper storage & feed regulation throughout plant
- 5) Segregation in feed to Crushers & screens
- 4) Poor maintenance Practice / Maintenance Setup/ Access
- 3) Poor Reduction ratio's between crushing stages
- 2) Un- Tuned Plants
- 1) Improper equipment choice for function

Life Span “REAL COSTS”

1,000,000 Tons Annum	Additional Capacity Potential	Profitability Impact x 1000	Annual Savings x 1000	Lifespan Savings x 1000	Profit Impact %	Labor Savings %	Energy KW/Ton %	Lifespan Savings %
MEDIA	250,000	750	\$ 30	\$ -	25%	30%	15%	0%
CONE	176,000	528	\$ 70	\$ 40	18%	40%	15%	15%
JAW	111,000	333	\$ 40	\$ 40	11%	20%	5%	10%
IMPACT	111,000	333	\$ 5	\$ 20	11%	30%	15%	3%
SCREEN	111,000	333	\$ 40	\$ 40	11%	20%	5%	22%
PRI. FEEDR.	111,000	333	\$ 30	\$ 2	11%	20%	5%	18%
CONVEYOR	52,000	156	\$ 20	\$ 40	5%	20%	5%	8%
VSI	52,000	156	\$ 20	\$ 10	5%	20%	15%	5%
TRANSFER	52,000	156	\$ 100	\$ 1	5%	30%	5%	6%
FEED BIN	52,000	156	\$ 100	\$ 1	5%	20%	5%	40%

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