



General Engineering

for Post Graduate Diploma Course in Industrial Instrumentation & Process Automation (DIIPA)
(CANE HANDLING/CANE PREPARATION/MILLING)

by

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Cane Unloading



Trolley

Grab

For a 2500/5000 TCD plant -

Crane gantry : span - 30 metres , length - 40 metres (as per requirement)

| Particular | Type of motor | H.P. |
|---------------------|---|-------|
| Hoisting Drum Drive | Squirrel cage/slip ring induction motor | 25-35 |
| Holding Drum Drive | Squirrel cage induction motor | 25-35 |
| Long Travel Drive | Slip Ring induction motor | 10 |
| Cross Travel Drive | Slip Ring induction motor | 7.5 |



| Name of the factory | TCD | Crane parameters |
|---|------|--|
| Balrampur Chini Mills Ltd, Balrampur | 7000 | Span 22 meters x 57 meters Gantry Length |
| DSM Sugar Mills Ltd. ,Meerganj, Bareilly | 5000 | Span 24 meters x 80 meters Gantry Length |



In a sugar factory cane comes from two modes :

- 1. Gate cane** -
- (i) Cane comes in the factory by this mode with the help of bullock- Cart and Tractor-Trolley.
 - (ii) Unloaded with the help of Mechanical grab, Sling Bar (hooks & chains) or Hydraulic grab unloading.
 - (iii) Generally covers the cane in the radius of Km ?

- 2. Centre Cane-**
- (i) Cane comes in the factory by this mode with the help of Trucks.
 - (ii) Unloaded with the help of tipplers.



Mode of supply.....examples

| Name of the Factory | Capacity (TCD) | Details of mode of supply |
|--|----------------|---|
| DSM Sugar Mills Ltd. ,Meerganj, Bareilly | 5000 | •Truck - 40 •Carts - 10 •Trolleys - 60 |
| Haryana Cooperative Sugar Ltd. Rohtak | 3500 | •Truck - 30 •Carts - 18 •Trolleys - 52 |



Sling Bar (hooks & chains)

- Used for unloading bundled cane from trolleys and truck with the help of rope.





Grab



Mechanical



Hydraulic



Cane Unloading.....

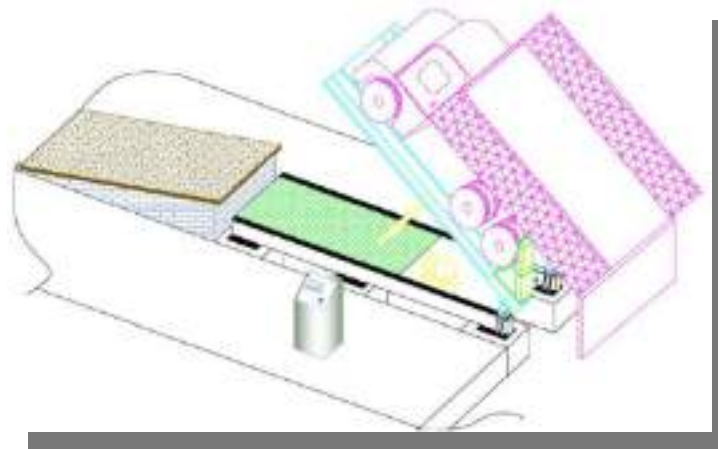
Truck Tippler

➤ These are actuated by hydraulic drives which tilt the wagon/truck body resulting cane to slide into the carrier when inclination reaches about 45° to 50°





| Factory | Capacity (TCD) | Specifications |
|--|----------------|--|
| AVADH SUGAR & ENERGY LIMITED P.O. Hargaon, Distt. Sitapur | 10000 | Capacity : 50 M.T. Length & Width of platform : 9.5 mtr X 3.3 mtr Tilt angle : 55° |
| DSM Sugar Mills Ltd. ,Meerganj, Bareilly | 5000 | Capacity – 40 MT Angle – 45° Rating – 10-12 Lift/hr |
| | | |





| | |
|-----------------------------|---------------------|
| Qty. | 3 + 1 = 4 |
| Type | Grab Hydraulic |
| Capacity | 5Ton Swl |
| Max. lift | 8000 |
| Crane span | 23050 |
| Crane overall length | 23460 |
| H.P.of hoisting motor | 22 KW |
| Hoisting speed M/Min. | 12M/min. |
| HP.of drum holding motor | 22 KW |
| Holding speed M/Min. | 12.0Mtr./Min. |
| Cross travel speed M/Min | 23.0M/Min |
| HP.of cross travel motor | 5HP. |
| Crane travel speed M/min | 23.0M/min. |
| Cane handled(Tons./hour) | 145--180T./hr. |
| Bridge Motor | 7.5KW , 1 No,955rpm |
| | 5.5 KW , 2 No |



Cane Carrier





Cane Carrier

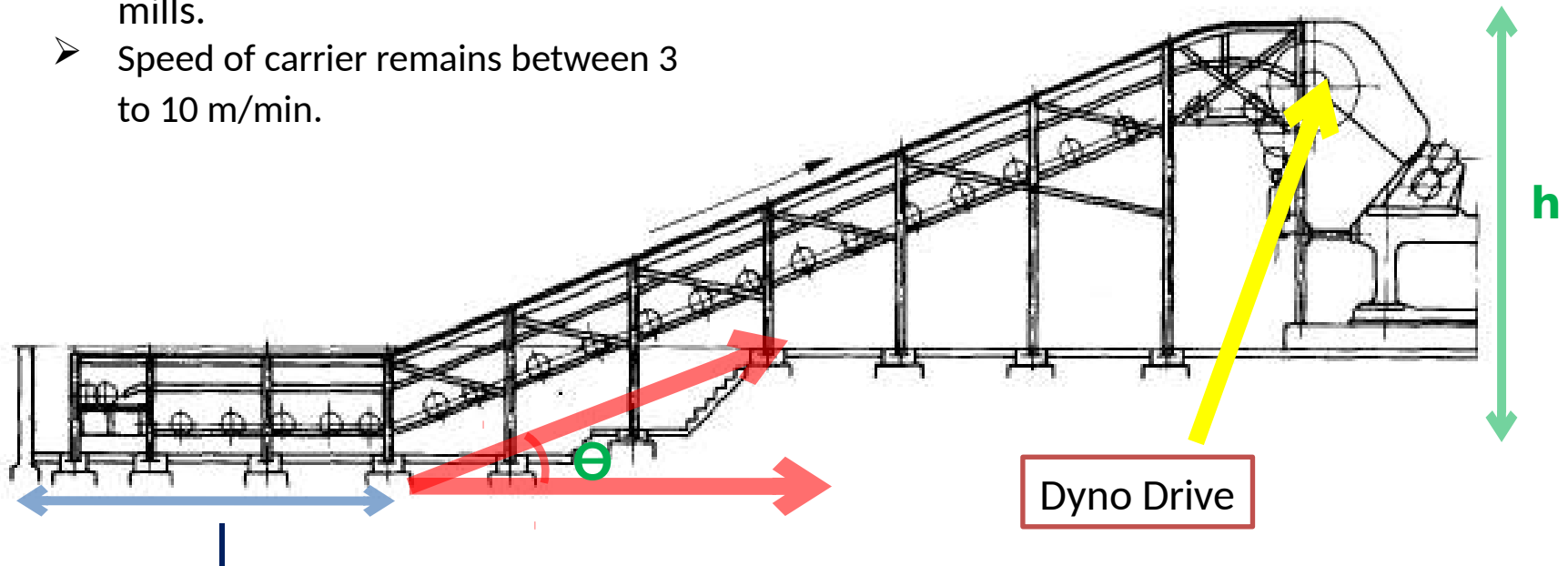
Cane carrier is a moving apron which conveys the cane from cane yard to feed into the mill. It has –

1. Horizontal Portion.

- Length of the horizontal portion depends upon width of feeder tables and the space required for other unloading devices.
- Width of carrier = the length of mill rollers for uniform and effective cane feeding into the mills.
- Speed of carrier remains between 3 to 10 m/min.

2. Inclined Portion.

- Length : 14 to 17 m (3- roller mill)
- **Slope varies from 15 to 22 degree.**
- If less than 15° then cost of installation and space occupied will increase.
- If greater than 22° then cane will liable to slip and carrier would move without picking the cane up.





E.g... M/S Avadh Sugar and Energy Limited Seohara, Bijnor U.P.

Cane Carrier

| | | |
|--|-----------|--|
| Size, Width and Length between centre | a) | Feeder Cane Carrier (78") Width 1.981 Mtrs x 51.1 Mtrs length driven by 100 H.P. Dynodrive system variable speed 3- 10 meter per minute |
| | b) | Main Cane Carrier (90") Width 2.286 Mtrs x length 42.5 Meters driven by Dynodrive system of 150 H.P. variable speed 3-10 meters per minute |
| | c) | Rake Elevator Width 1.981Mtrs x length 18.70 Mtrs with Dynodrive system of 100 H.p. Dynodrive |
| | d) | Auxiliary cane carrier 3.963 Mtrs wide x 30 Mtrs long with 75 H.P. Dynodrive |



E.g...

M/S. Triveni Engineering and Industries Limited, Raninangal

CANE CARRIER

| | 1 st carrier | 2 nd carrier | 3 rd carrier |
|---|-------------------------|-------------------------|-------------------------|
| | (slat conveyor) | (Belt conveyor) | (Rake Elevt.) |
| 1. Width(mm) | 2300 | 2300 | 2300 |
| 2. Length between the sprocket centres(m) | 64m | 45m | 13m |
| 3. Horizontal loading length (m) | | | |
| 4. Angle of inclination(with horizontal) | 17 ⁰ | 14 ⁰ | 45 ⁰ |
| 5. Drive | | | |
| (i)Electric motor | | | |
| (a) Horse power | 75KW | 30KW | 40KW |
| (b) Speed(rpm) | 1480 | 1470 | 1475 |
| (c) Make | | | |
| (d) Type | V.F.D. | V.F.D. | |



Cane Carrier.....

Bulk density

| Type of Sugarcane | Density in Kg/m ³ |
|-------------------------|------------------------------|
| Entangled | 150 |
| Loose pile | 200 |
| Bundle in pile | 250 |
| Mechanically harvested | 300 |
| Prepared by 2-knife set | 480 |



Speed of Cane - Carrier (u)

$$u = 1/2 \text{ (peripheral speed of mill roller)}$$

$$= 1/2 \pi D n \text{ ,where 'n' is rpm of the mill roller}$$

Power requirement of Cane - Carrier (u)

The mean power absorbed by the cane carrier is having two components

-

- (i) The Power necessary to overcome friction
- (ii) The Power required to elevate the cane

$$P = P_f + P_e$$



Cane Carrier.....

The Power necessary to overcome friction

$$P_f = \frac{(Q + K)f + Kf'}{60 \times 75} u \lambda$$

where,

P_f = power necessary to overcome friction, in h.p.

Q = weight of cane on the carrier, in kg

K = half the total weight of the moving part of the carrier
(= weight of the upper or lower run of the conveyor)

f = coefficient of friction of the upper run (~ 0.30)

f' = coefficient of rolling friction of the lower run (~0.15)

u = speed of the conveyor, in m/min

λ = coefficient (~1.4 to 1.5), depending on the efficiency of gearing transmitting the drive.



Cane Carrier.....

The Power necessary to elevate the cane

$$P_e = \frac{1000 \times AH}{3600 \times 75} \lambda$$

where,

P_e = power necessary to elevate cane, in h.p.

A = crushing rate of the mills, in t.c.h.

H = difference in height between the highest part of the carrier and the horizontal part of the carrier in the yard, in m

λ = coefficient (~1.4 to 1.5), depending on the efficiency of gearing transmitting the drive.

$$P = P_f + P_e$$



Cane preparation

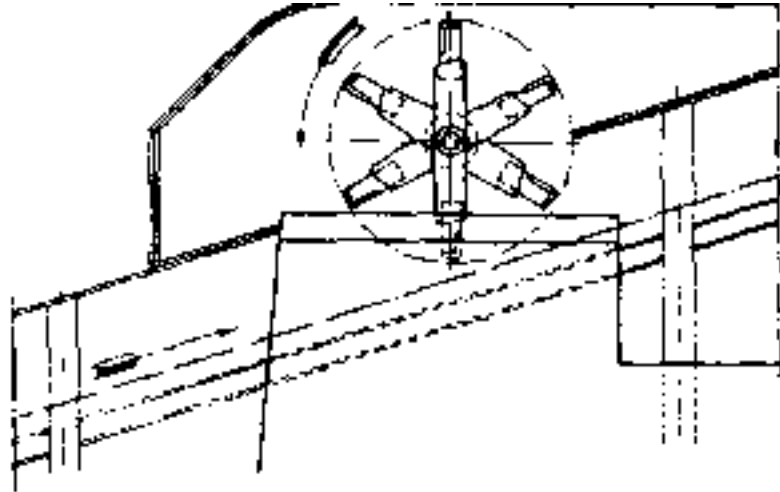
➤ The purpose of cane preparation is to cut cane into short pieces for feeding the mills and to rupture the cells, without extracting juice. This is achieved by set of rotating knives.

➤ 1st Set of Knives (Leveller/Kicker)

2nd Set of Knives

Fibrisor/Shredder

➤ Clearance - The clearance of a knife set is the distance between the circle desired by the extremity of the knives and the plane passing through the highest portions of carrier.



➤ Required Preparatory Index - 85-90%

➤ Methods of drive - (i) Steam turbine (ii) Electric Motor (SRIM) - LT or HT motors



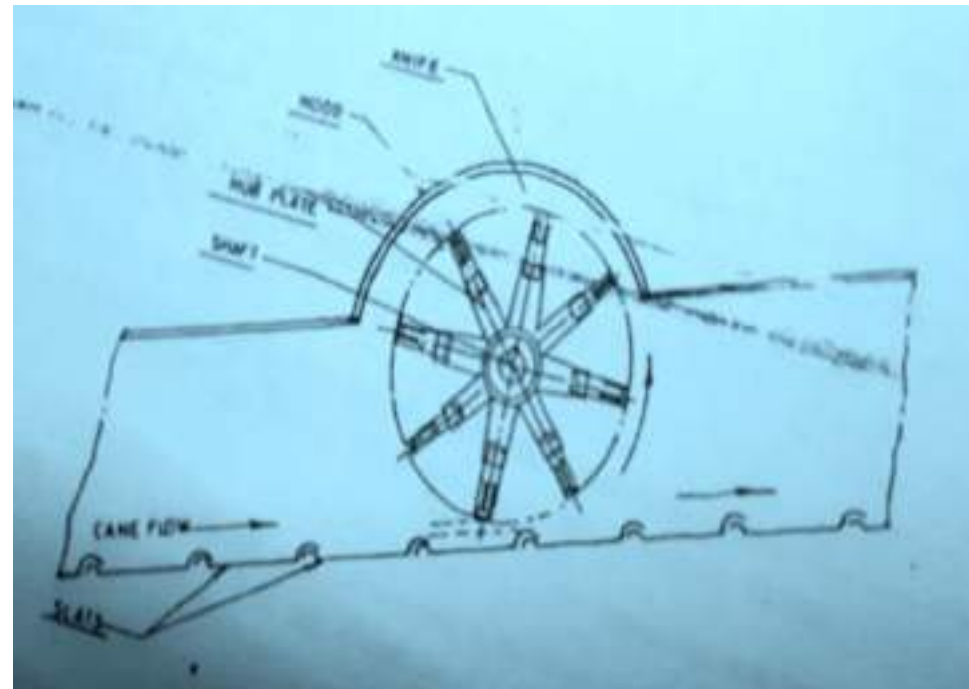
Cane preparation.....

1st set of Knives (Leveller/Kicker)

- It is required mainly to even out layer of cane. They are arranged to work with high clearance and hence leave large portion of uncut cane.

✓ Power requirement : 10-15 HP/tfh

✓ Pitch : 50mm



➤ 2nd set of Knives :

It is required to further prepare and disintegrate the cane and having clearance lower than 1st set of knives.

✓ Power requirement : 20-25 HP/tfh

✓ Pitch : 20-22mm

"pitch" of knives is the mean distance, measured parallel to the axis, separating two successive circles of rotation.



Direction of rotation :

- Knives at the lowest part of their rotation will move in the direction corresponding to the movement of the carrier.
- The opposite direction will have better preparation but require more power.

Balancing :

- The knives set should be perfectly balanced to avoid undesirable vibrations.

Factors for Power requirement :

- Tonnage of cane
- Fiber in the cane and its nature (more/less resistant)
- Proportion of cane actually cut
- Number of blades
- Speed of rotation
- Radius of cutting circle
- friction, lubrication, wearing f knives





Knives of preparatory Devices:

1. General Features

- The knife blades are removable, so that they can be easily taken off for resharpening or for replacement by another set of blades.
- It is preferable to fix a knife to the arm in such a way that the edge affected by shocks is supported by a flange or a wide stirrup rather than fixing it so that shocks are absorbed by the bolts or pins securing the knife.
- No. of blades/Knives :

$$N = W/P - 1$$

Where, W is the width of carrier in cm

P is the pitch of Knives in cm

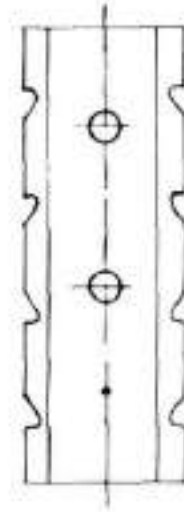
When above eqn. gives an odd number for N, the even number immediately lower is generally adopted;



2. Design/types of knives/blades

(i) Reversible Knives

- The working life of the blades is prolonged by diminishing wear of the cutting edge.
- Producing a self-sharpening effect of the knives on the trailing edge, and so rendering them reversible



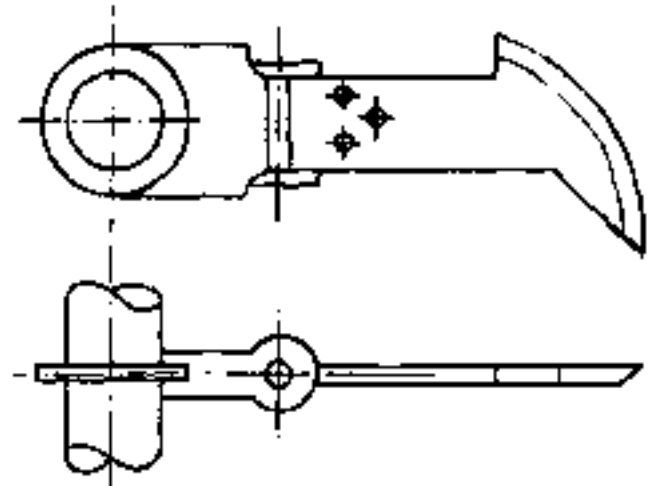
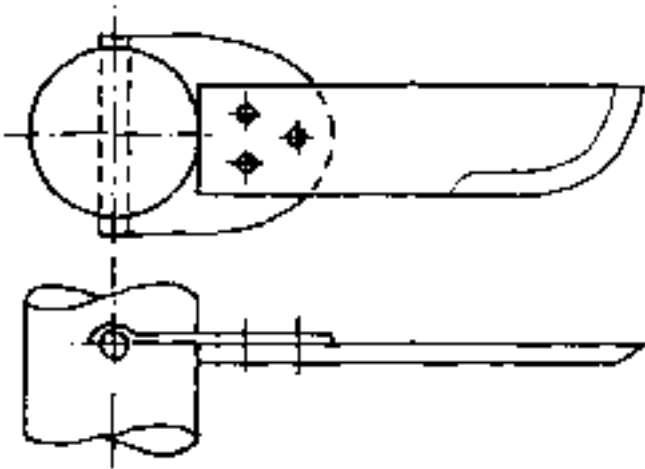
(ii) Hoe Knives

- The radius of action remain constant with wear
- They have the effect of a transverse cut due to the bent end of the knife and this transverse cut is superimposed on the longitudinal cut made



(iii) Swinging Knives

- These have ability to diminish or reduce the consequences of shocks, by mounting the knives so as to swing on a pin, obtaining at the same time a slight displacement of the cutting points



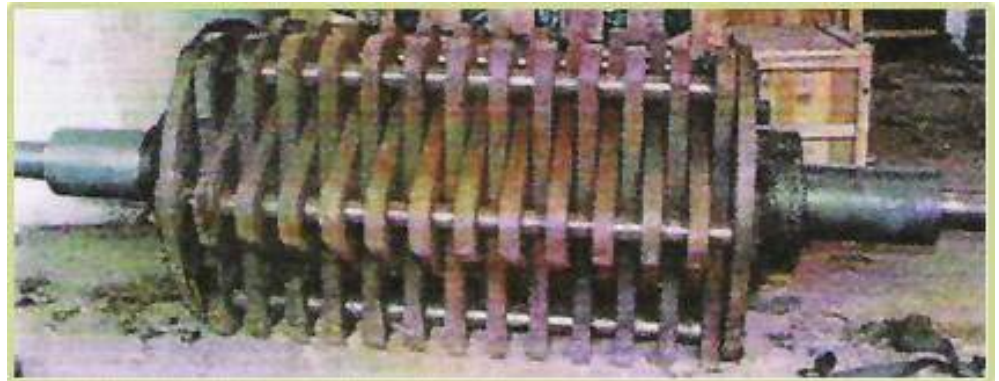


Shredder

- The object of the shredder is to complete the preparation and disintegration of the cane, so as to facilitate the extraction of juice by the mills.
- The shredder is placed at the head of the tandem, after the knives and before the first mill.

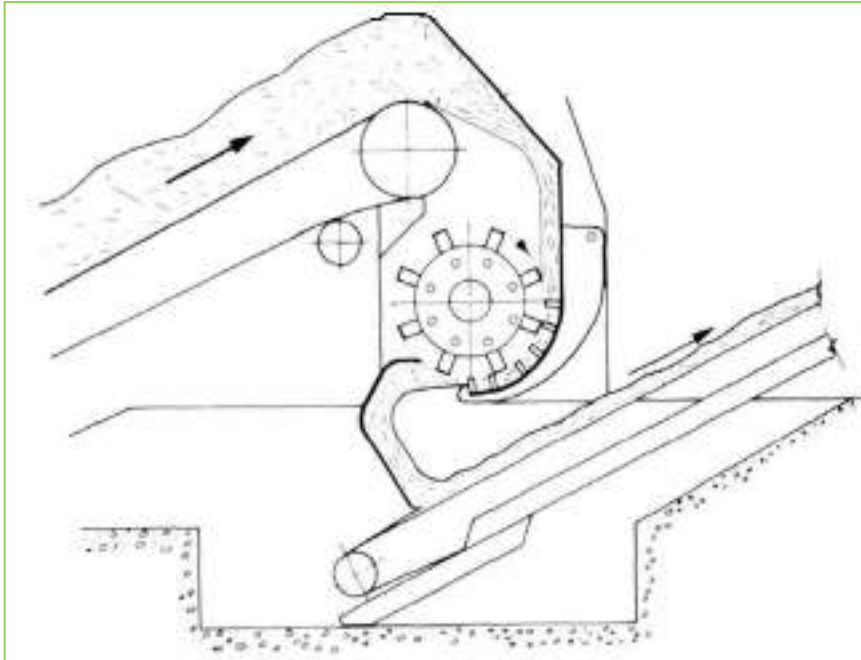
Function : The shredder owes its existence and its value to the fact that the tissue of cane cells is very resistant; simple crushing between rollers, even under very high pressure, is not sufficient to break all the cells and extract the juice. On the other hand, if these cells can be torn open and disintegrated, the juice is liberated, becoming more accessible and more easily extracted. To obtain such an effect it is necessary to rupture the tissues: this is achieved by forcing the pieces of cane to pass through a very narrow space, thus blocking them on one side and striking them on the other side with a powerful blow; the hammer mill has been chosen with this object.

The shredder thus consists of a rotor carrying hammers which are pivoted on discs or plates; the end of the hammer passes very close to an anvil plate which is formed either with a saw-toothed profile

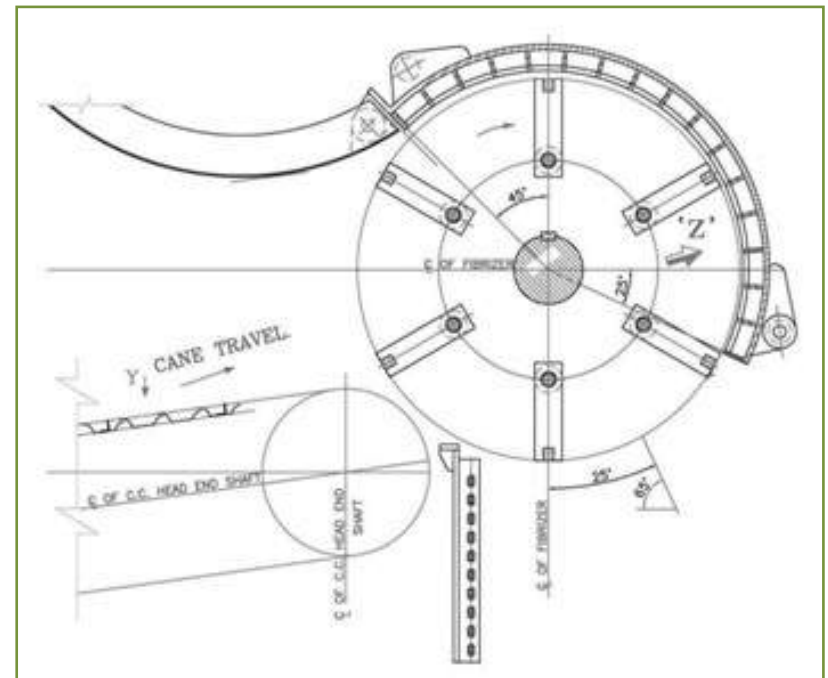




Position w.r.t carrier head.....



Shredder



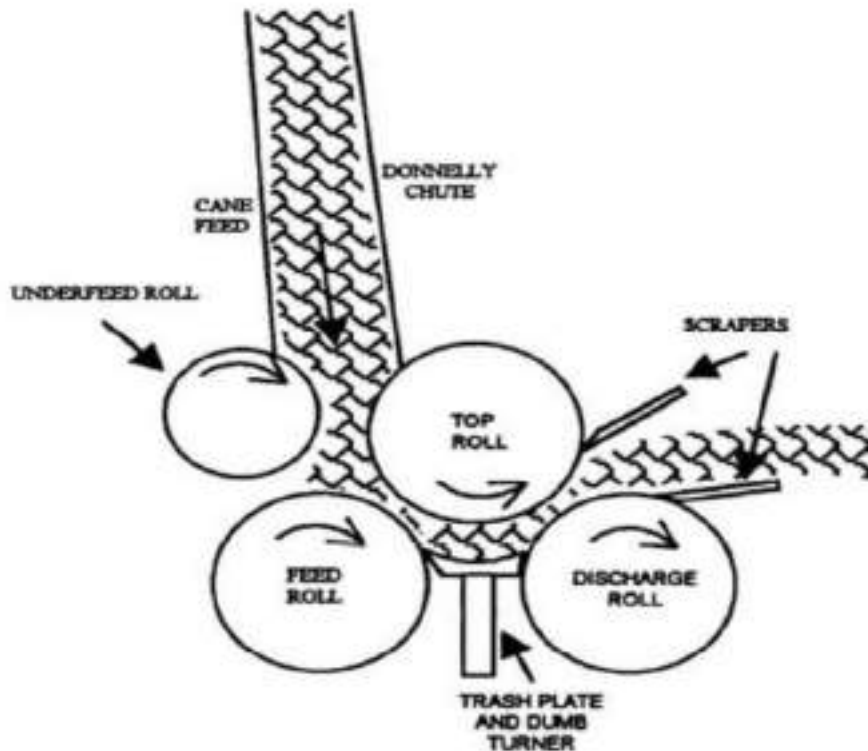
Fibrizer



Milling



The function of Mill is extraction of juice from cane by the effect of pressure.

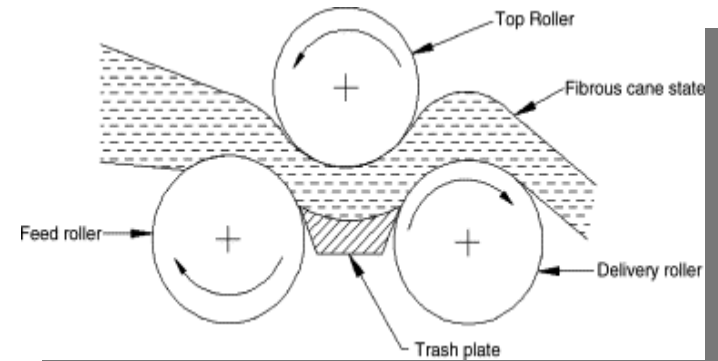
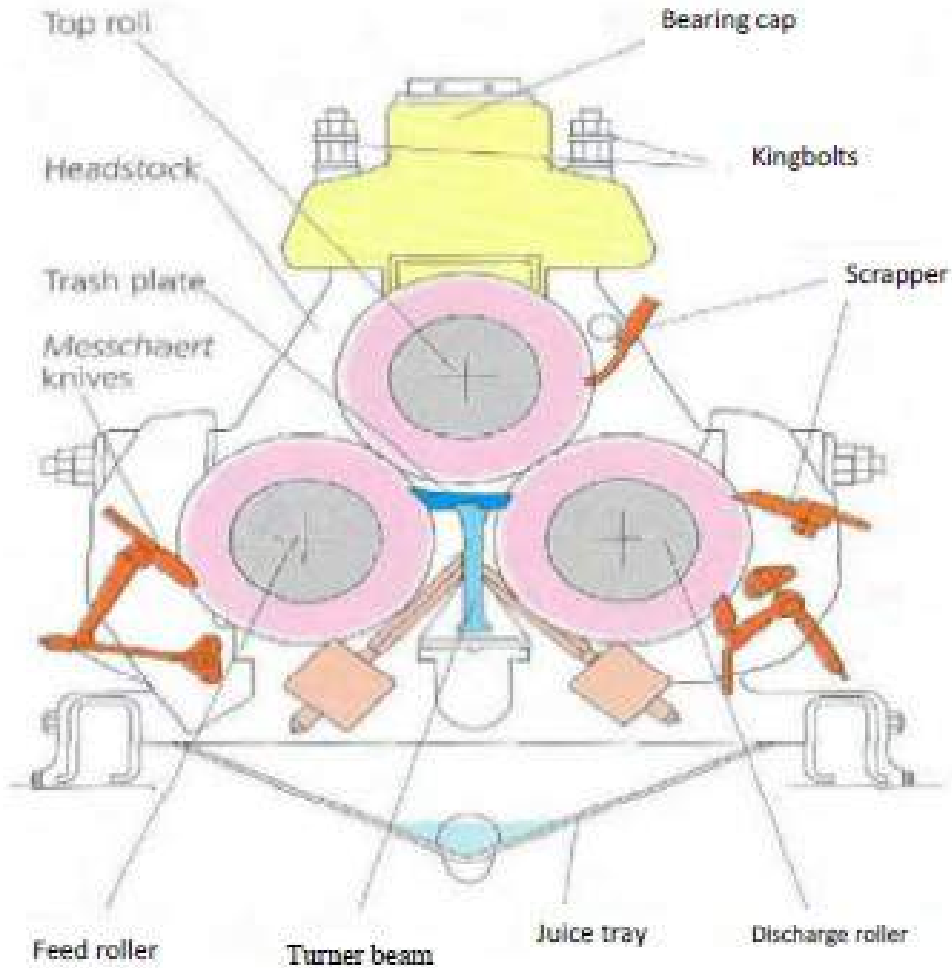


Important terms:

- Housing
- Feed arrangement (Donnelly chute)
- Roller
- Trash plate
- Grooving
- Pressure in mills
- Scrapper
- Mill setting
- Imbibition



Three Roller Mill



The feed and discharge rolls are fixed, while the top roll is free to move up and down by means of a hydraulic pressure system.

| Sl.No | Size(D" X L") | TCD (max.) |
|-------|---------------|------------|
| 1 | 24 x 48 | 1600 |
| 2 | 30 x 60 | 2880 |
| 3 | 33 x 66 | 3890 |
| 4 | 36 x 72 | 4580 |
| 5 | 40 x 80 | 5850 |



Grooving of Rollers

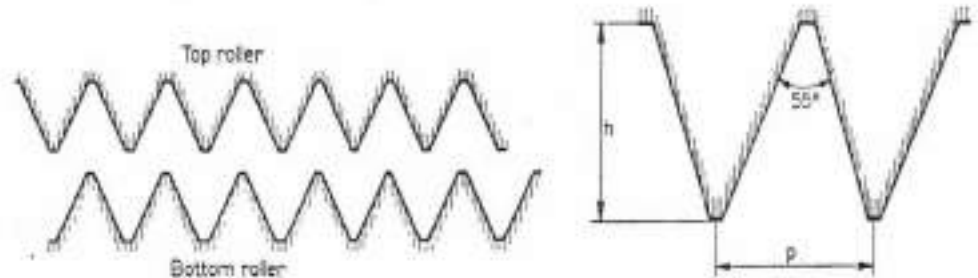
- increases the capacity of the mill
- breaks up the bagasse more completely and thus facilitates the extraction of the juice by the following mill

Circumferential Grooves

➤ It is formed by grooving the roller with notches describing complete circles, in planes perpendicular to its axis

➤ Types

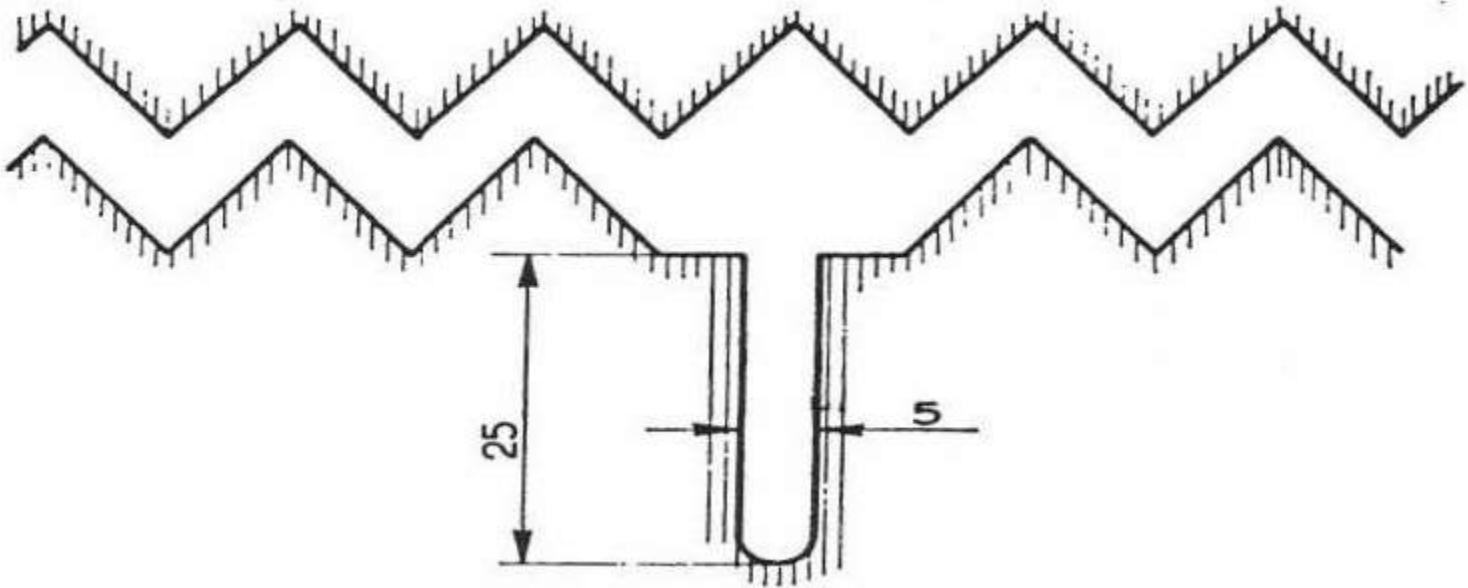
- Fine : 5-20 mm pitch
- Medium : 20-25 mm
- Coarse : > 50mm





Messcharet Grooves

The grooving mainly adopted on feed rollers is also known by Messchaerts or Juice grooves. The only objective of such grooving is improvement of extraction. Special scrappers or combs are fitted so that the grooves are kept free of the bagasse.





Chevron Grooves

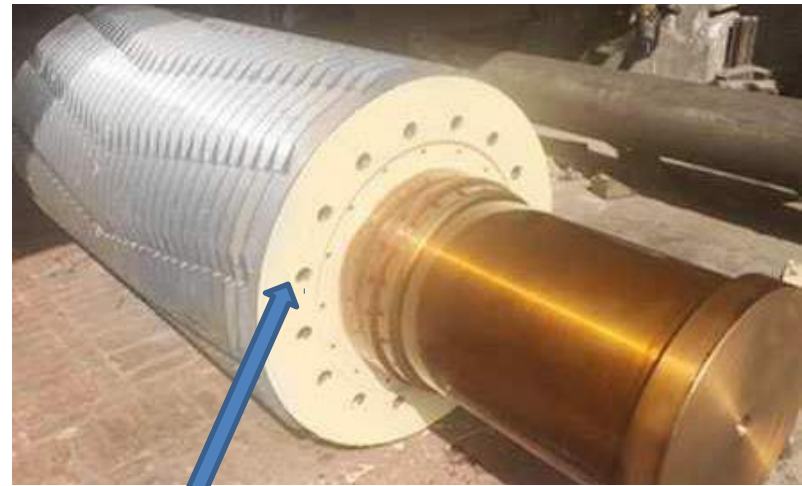
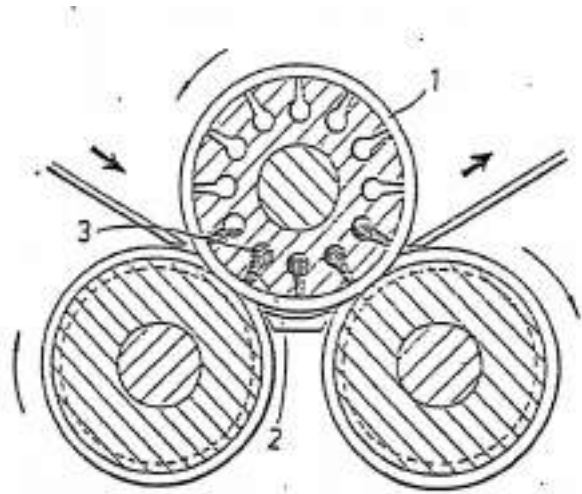
Such kind of grooving is adopted for basically gripping on bagasse so that we can achieve improvement in feeding of bagasse. Chevron is placed only on two feeding rollers i.e. on top roller and on feed roller.





Lotus Rollers

Messchaert grooves cannot be used in top rolls because there would be no easy outlet for the juice except into the bagasse exiting the mill. They would also seriously weaken the roll that is most highly stressed and most frequently broken. Drainage from the upper surface of the bagasse passing through the mill is indeed a major problem, since the juice must flow in the roots of the grooves all the way back to before the first squeeze. This problem prompted the "Lotus roll" concept of providing an alternative drainage passage from the top roll.





Mill feeding

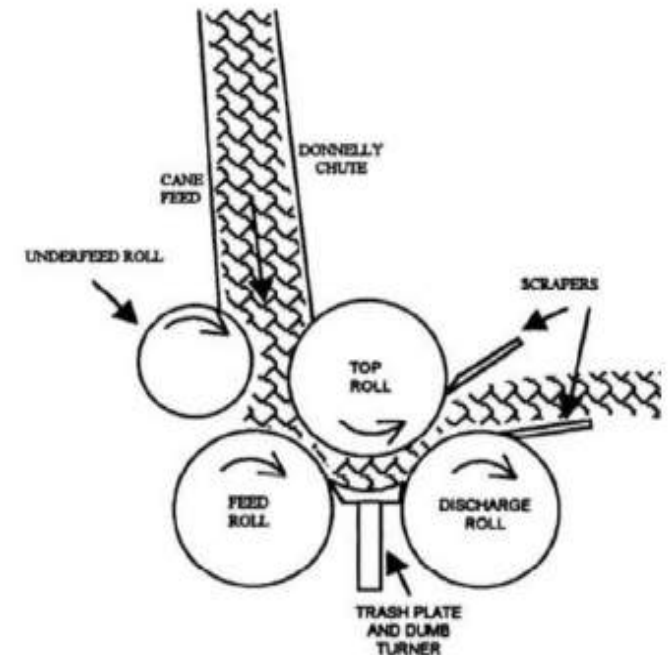
Cane preparation coupled with high levels of imbibition render gripping of bagasse extremely difficult resulting development of new feeding methods had to overcome the mill feeding problem like Donnelly chute, GRPF, TRPF, etc.

Donnelly chute

In the gravity feed system closed feed chute is provided at an angle of 75° to 90° to the horizontal. The inner parts of this chute viz. the side plates have to be very smooth and are preferably of stainless steel to avoid frictional resistance and for easy flow of bagasse or prepared cane. It is usually provided at the first mill, where cane preparation is fine.

Underfeed rollers

The underfeed rollers usually are of cast iron and grooved, with diameters half to two thirds of the mill roller diameter. The drive for these rollers is provided from the mill rollers by pinion or chain. The peripheral speed is about 10% higher than that of the mill to which it is attached. These feed rollers require low power (5-10 hp.) and helps improve capacity and extraction of mills.





S

Continuous pressure

- (i) **GRPF** : This feeder consists of a pair of rollers mounted ahead of the mill and connected to the mill by closed chute of stainless steel, which has some what more opening towards the mill. These rolls extract good amount of juice reducing the load on the mill and rendering gripping action easy. The speed of these rollers is about 30-70% higher than that of the mill. They give positive improvement in capacity and extraction as they permit of addition of high imbibition and fine
- (ii) **TRPF** : Toothed rings are fitted to rollers and are welded with hard faced electrodes for maintaining their condition as their wear affects the performance. The toothed rollers push the bagasse blanket towards the mill and provide more positive feed. The power requirement of toothed rollers is about half that for GRPF.

