



ISGEC HEAVY
ENGINEERING LTD.

FE17 Presentation @ ISSCT Congress

Sao Paulo, Brazil

***Innovative Energy Efficient
Milling Train***

Speaker

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27 June 2013



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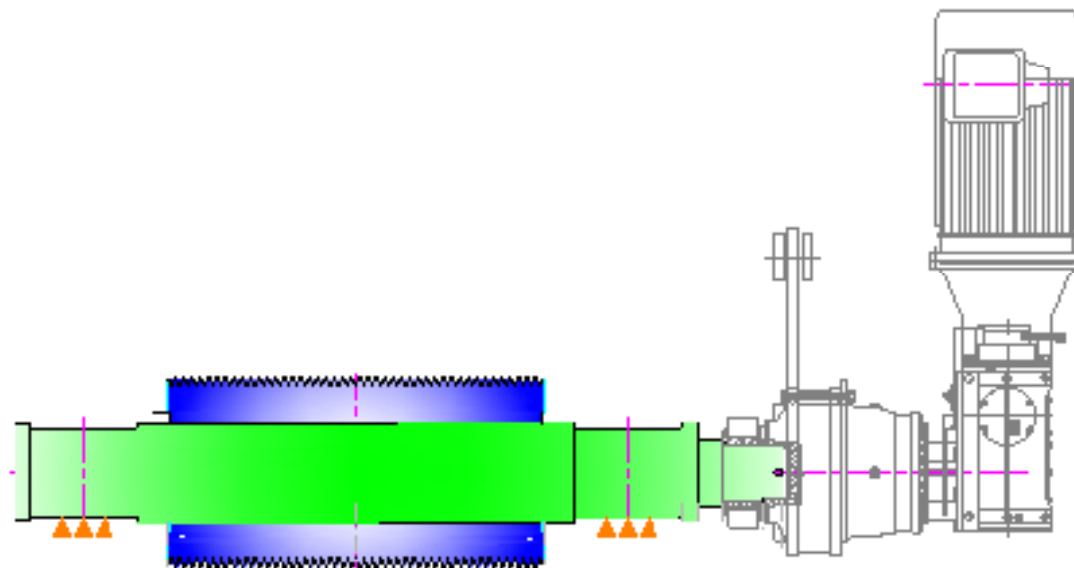
Background

- **Milling accounts for 50% of the total power consumption in a Sugar Plant.**
- **Co-generation demands energy efficient milling**
- **We have innovated design of mills with a view to**
 - ✓ **Improve extraction efficiency**
 - ✓ **Reduce**
 - Investment**
 - Energy consumption**
 - Maintenance cost**

Isgec Innovation: Pinionless Mill

➤ Feature:

- ❑ Individual drive for each bottom and top roll, without using crown pinions



Isgec Innovation: Pinionless Mill.....

➤ Advantages

- ✓ **Higher extraction efficiency, due to:**
 - ❑ **Free float of top roll**
 - ❑ **Operation of top and bottom rolls at differential speed**
- ✓ **Smaller foot prints**
 - ❑ **50% saving in cost of civil works**

Isgec Innovation: Pinionless Mill.....

➤ Advantages...

✓ Lower friction losses:

- ❑ 15% Reduction in energy consumption
- ❑ Substantial reduction in wear and tear of mill components
- ❑ 15% reduction in consumption of lubricant

✓ Lesser risk of mill chokes

Pinionless Mill: Drive Options

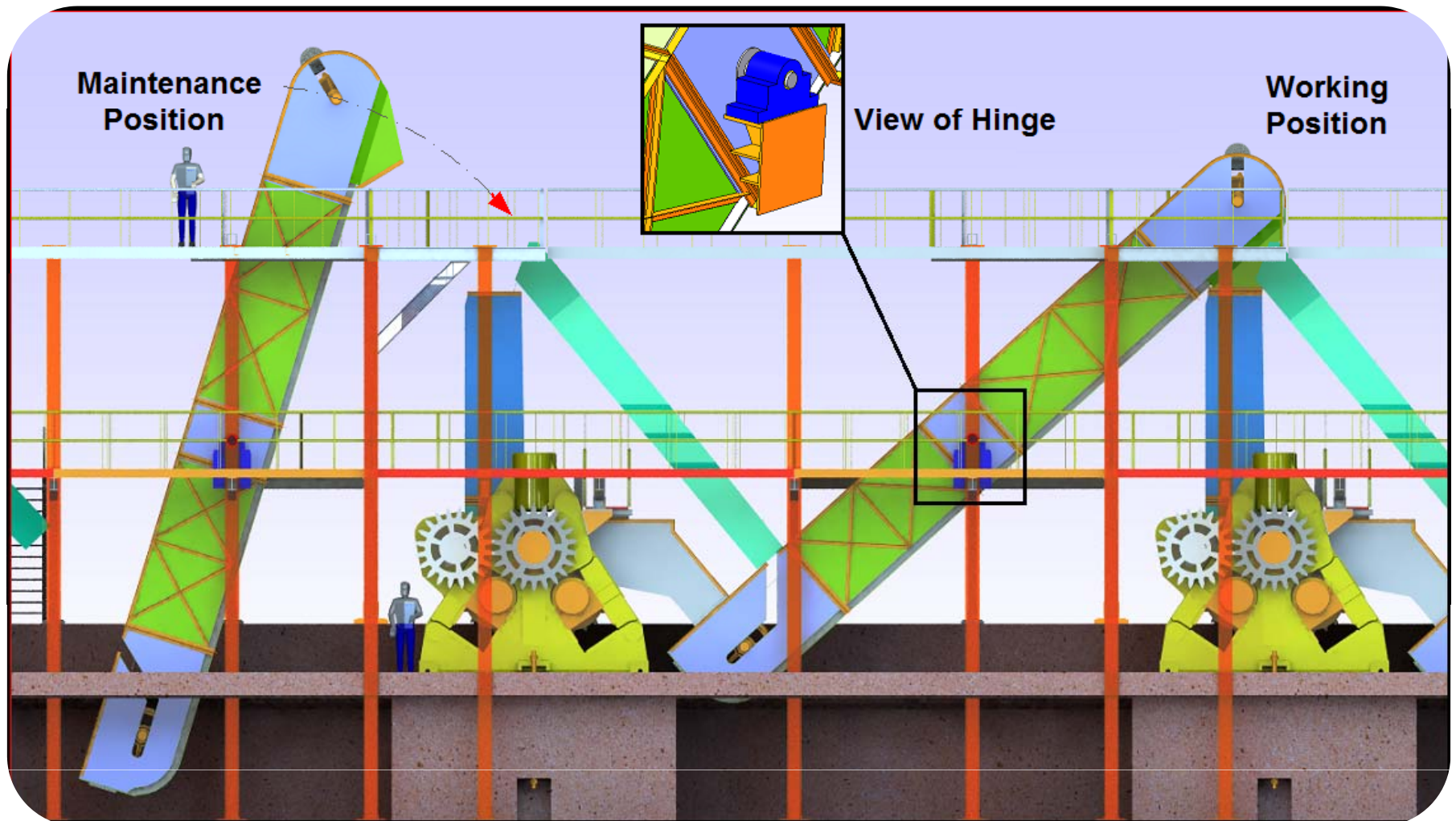
➤ Types of Drive:

- ❖ Variable speed AC electric motor
- ❖ Variable flow hydraulic motor

➤ Drive mounting configurations:

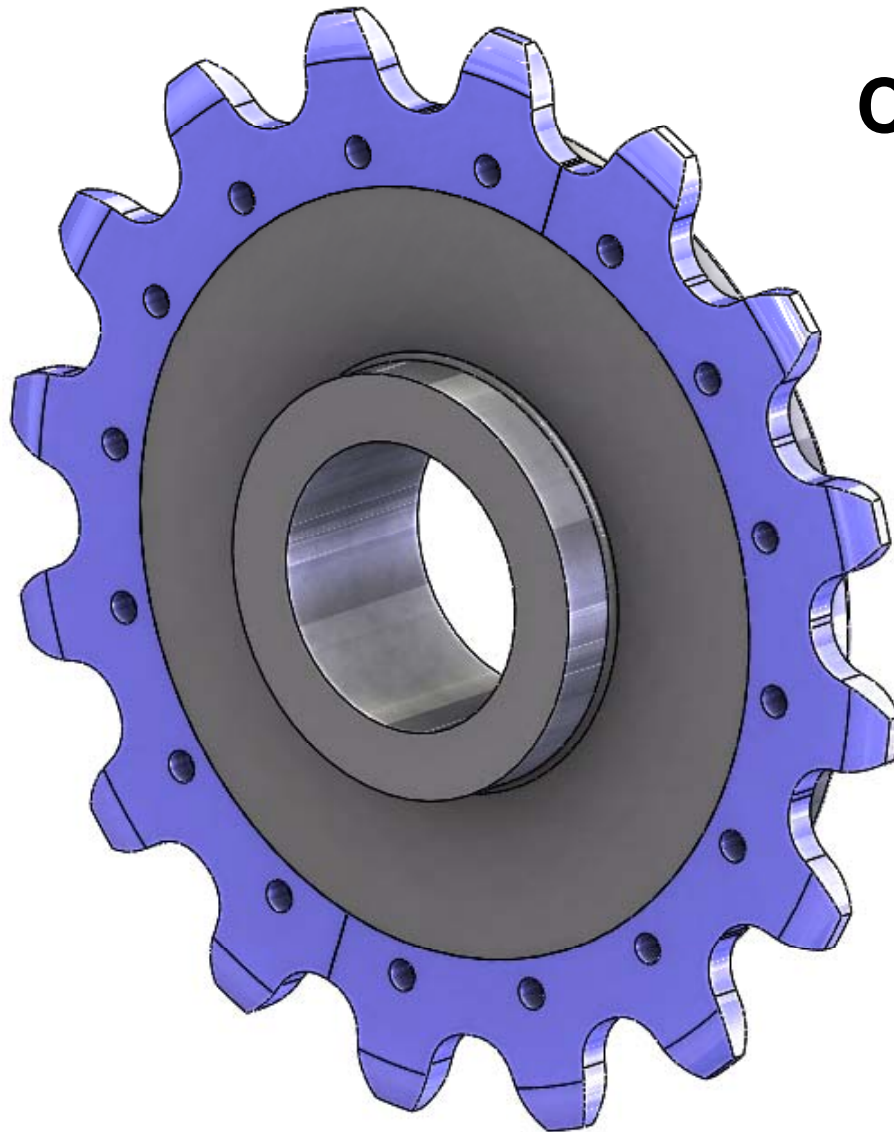
- ❖ Individual shaft mounted drives,
 - 2 on top roll, 1 each on bottom roll
- ❖ Assist drives
 - Foot mounted for top roll,
 - Shaft mounted, 1 each on bottom roll

Ease of Maintenance: Inter Carrier



Swiveling Rake Inter Carrier: Addax, Sierra Leone

Ease of Maintenance: Drive sprocket



Cane Carrier head shaft:
Sprocket with girth
type bolted teeth

Ease of Maintenance: Inclined Set Mill



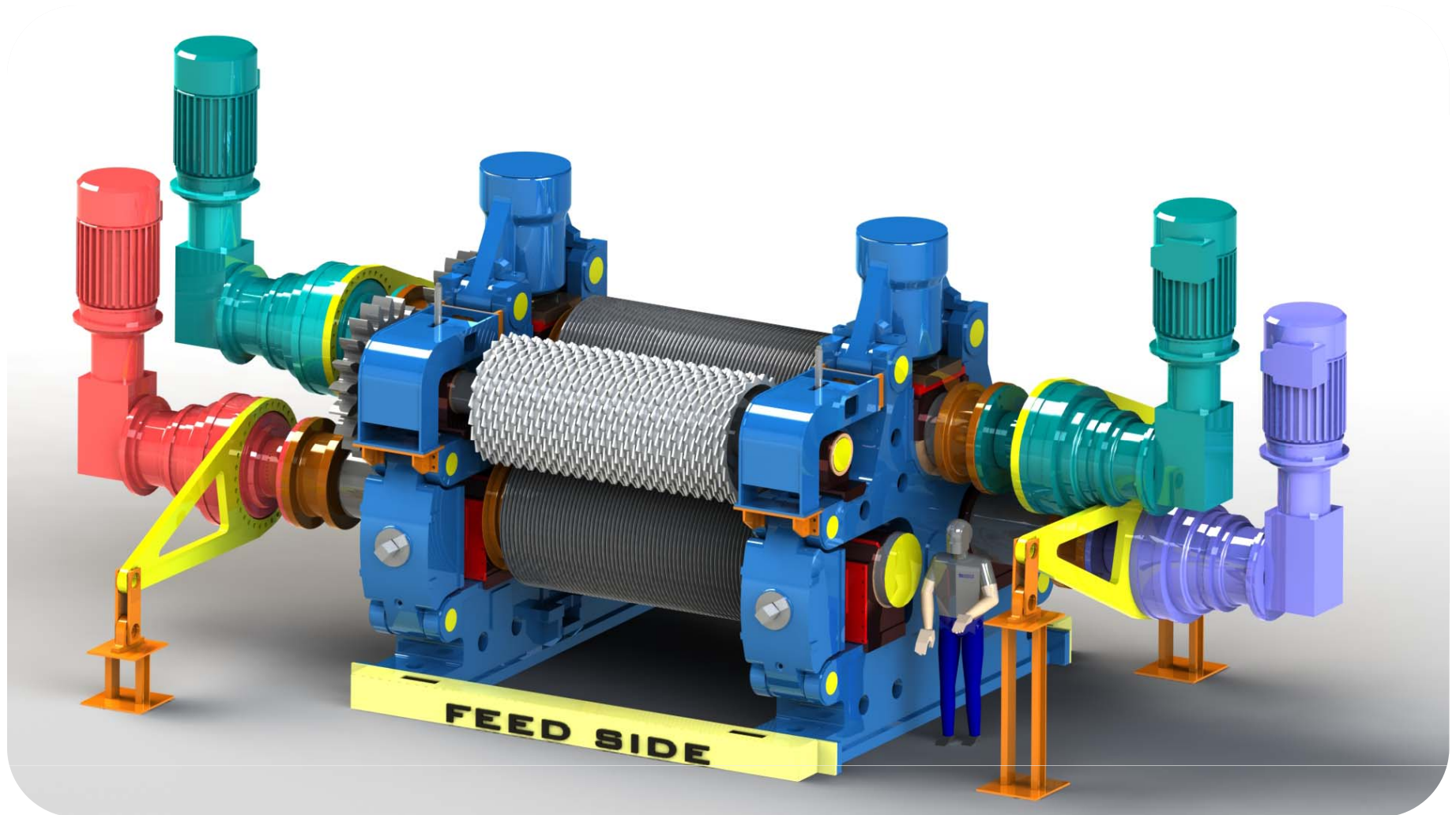
45" x 90" Mill: Xinavane, Mozambique

Pinionless Mill: Design Methodology

- Preparation of 3-D model of mill with drive
- Computation of forces on 42" x 84" head stock and top bearing for 340 tons cane / hr at 3.5 rpm
- Finite Element Analysis of head stock assembly
- Evaluation of stresses on top roll assembly

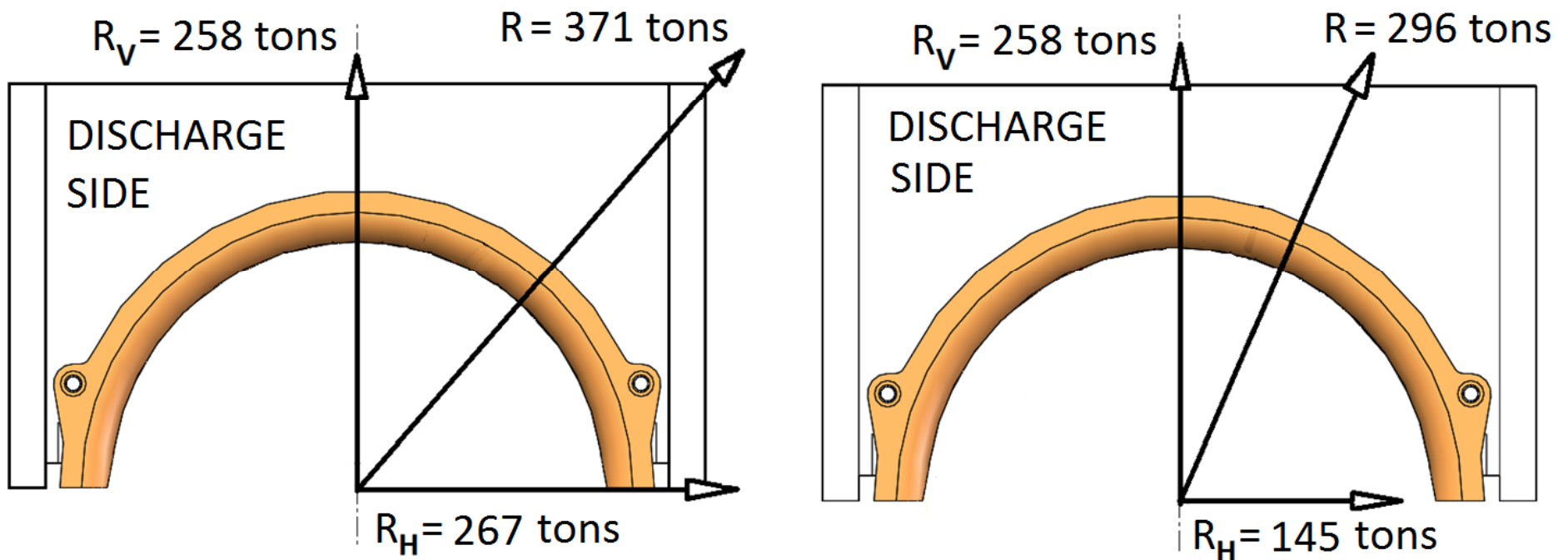
Strengthened the head stock and roll shaft in high stress areas, while optimizing overall weight

Pinionless Mill: 3D Model



42" x 84", 4 Roll Mill: Jay Mahesh Sugar, India

Radial Force Comparison: Top Bearing



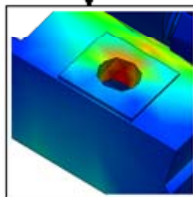
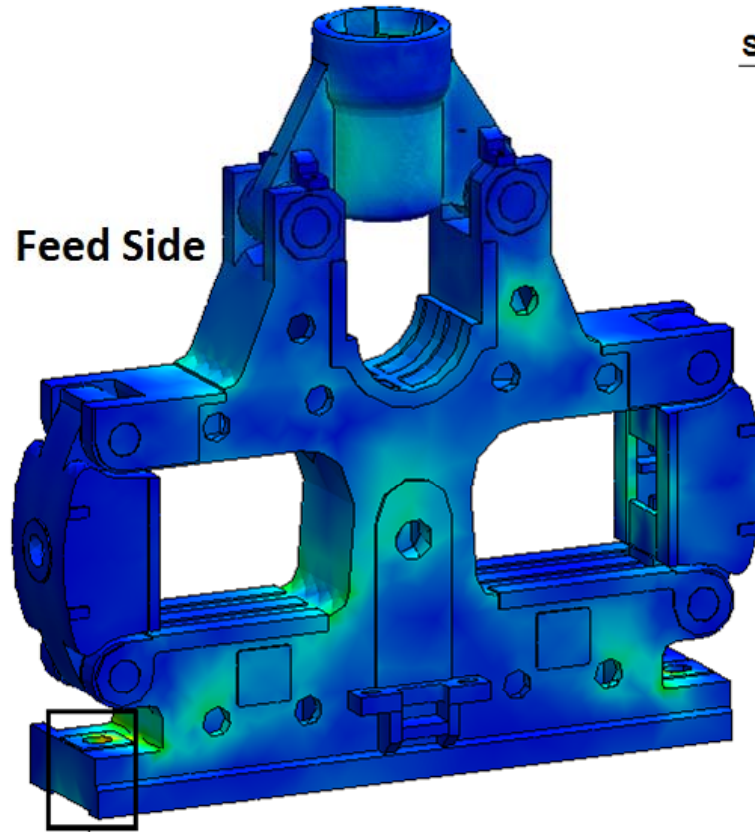
Conventional Mill

Pinionless Mill

***Horizontal force on top bearing
of Pinionless mill is 40% lower***

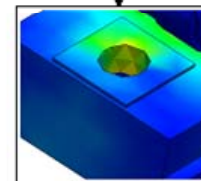
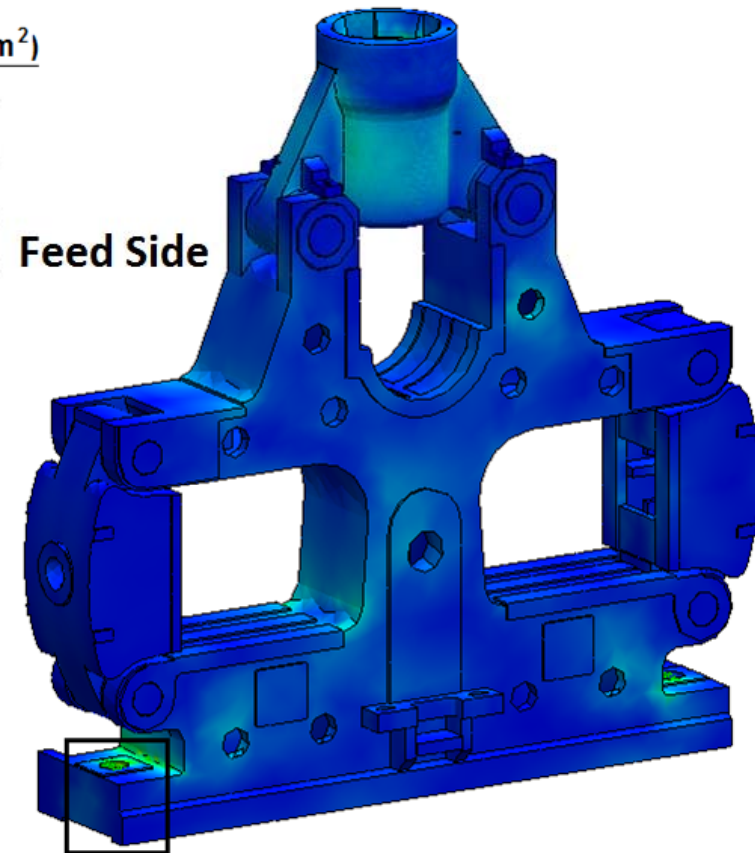
Stress Comparison: Head Stock

Conventional Mill



Max : 2634 kgf/cm²

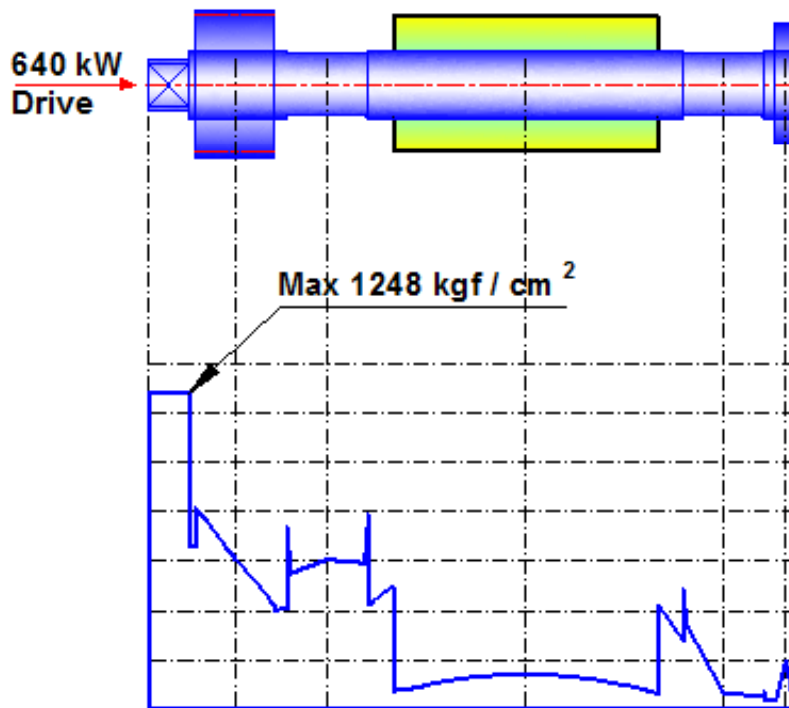
Pinionless Mill



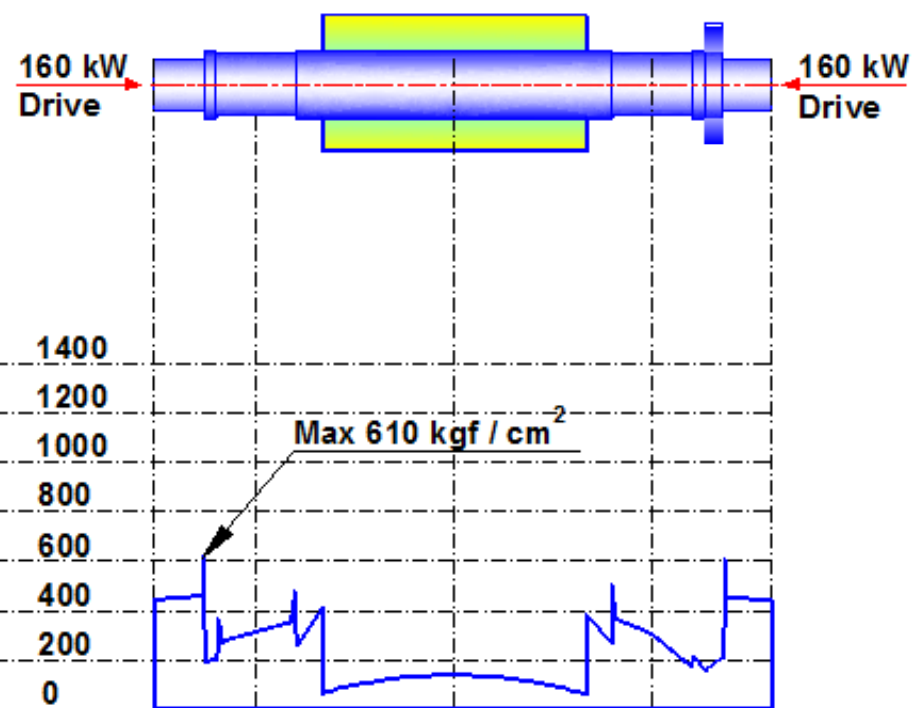
Max : 1728 kgf/cm²

Stress Comparison: Top Roll

CONVENTIONAL MILL



PINIONLESS MILL



Stress Diagram: Top Roll Assembly



Stress Comparison: Summary

Mill Component	Max Stress (kgf/cm²)		Stress Reduction
	Conventional Mill	Pinionless Mill	
Headstock	2634	1728	35 %
Top Bearing Housing	1213	863	29 %
Top Roll Shaft	1248	610	51 %



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Drive Efficiency Comparison: Summary

Drive Equipment	Conventional Mill	Pinionless Mill	
		Hydraulic Drive	Planetary Gear Box
Hydraulic Motor with Power Pack	Not Applicable	78	Not Applicable
AC Motor with VFD	94	Not Applicable	94
Planetary Gear Box	95	Not Required	90
Tail Bar	98	Not Required	Not Required
Mill Crown Pinions	92	Not Required	Not Required
Total Efficiency	80.5 %	78 %	84.6 %

Pinionless Mill: Commercial Installations

- **42”x84”**, 4 roll Pinionless mill, with individual shaft mounted planetary drive, Jay Mahesh, India
 - ❑ **1st Mill commissioned in Feb, 2008**
 - ❑ **Two repeat orders**
 - ❑ **Full fledged milling train since Oct, 2010**

- **45”x90”**, 4 roll Pinionless mill, with assist drives at Santa Ana, Guatemala.
 - ❑ **Commissioning: May, 2014**

Pinionless Mills: Jay Mahesh, India

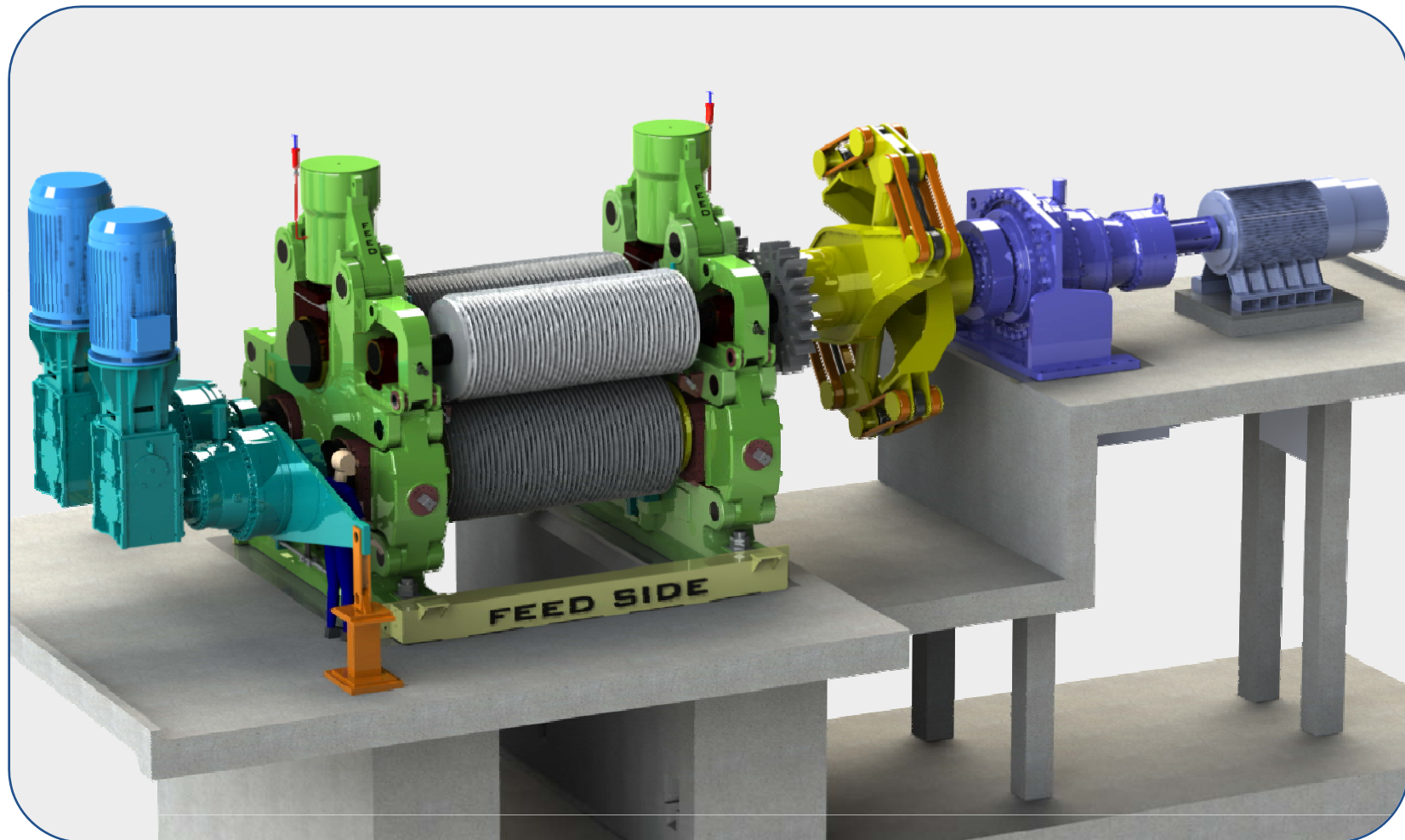


Success Story at Jay Mahesh, India

Operating results:

- ❑ **Crush Rate: 250 tons / hr**
- ❑ **Energy Consumption: Only 1.1 kWh/ton cane/mill**
- ❑ **Reduced Extraction: 96+ with 3 mills in operation**
- ❑ **Bagasse moisture: 49% with 3 mills in operation**
- ❑ **Negligible wear on mill roll journals and bearing liners even after completion of 4 crops**

Pinionless Mill: Assist Drive System



45" x 90", 4 Roll Mill: Santa Ana, Guatemala

Innovative Efficient Milling Train

➤ Configuration:

- ❖ **Single preparatory device, whole stick shredder**
 - ✓ **92 PI, operating at 94 m/sec tip speed**
 - ✓ **Smaller foot print of cane preparation system**
- ❖ **4 nos Pinionless mills with individual AC VFD**
 - ✓ **15% reduction in energy consumption**
 - ✓ **Smaller foot prints of milling tandem**
- ❖ **Swiveling type rake inter carrier**

Innovative Efficient Milling Train....

➤ Advantages

- ❖ **50% lower cost of foundations and building**
- ❖ **Higher extraction efficiency**
- ❖ **Higher energy efficiency**
- ❖ **Ease of maintenance**

This milling train consumes only 12 kWh/ton cane

Tandem Size: Crushing Vs Efficiency

Sr. no.	Mill Size	Tandem Size			
		3 Mill	4 Mill	5 Mill	6 Mill
1	42"x84", 4 Roll				
1.1	Crush rate (tons / hr)	250	350	500	600
1.2	Roll Speed (RPM)	2.5	3.5	5.0	6.0
3	Reduced Extraction	96.0	96.5	96.5	97.0
2	45"x90", 4 Roll				
2.1	Crush rate (tons / hr)	400	500	650	750
2.2	Roll Speed (RPM)	3.0	4.0	5.0	6.0
2.3	Reduced Extraction	96.0	96.5	96.5	97.0

Conclusions

- **Pinionless mill consistently delivers:**
 - ✓ **Higher extraction efficiency**
 - ✓ **Higher energy efficiency**
 - ✓ **Flexibility in through put**
 - ✓ **Longer life of components**

Conclusions.....

- **Pinionless mill with shaft mounted planetary gear boxes has higher transmission efficiency and lower capital cost **Vs** Hydraulic drive**
- **Pinionless Mills with shaft mounted planetary gearboxes working satisfactorily for 4 years**
- **Innovative Milling Train is 10% cheaper and consumes only 12 kWh per ton of cane**



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**Thank You
Gracias
Obrigado**



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