

# THE DESIGN AND INSTALLATION OF BFP CHAIN

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### Abstract

Because of continual chain breakages on two cane carriers at Sezela it was decided to fit stronger chains to all the front end carriers. Existing standard bushed chains were not available in a stronger design. A chain was locally designed using imported pins and bushes but locally made side bars of heavy construction. This chain has proved reliable and lower in maintenance costs.

### Introduction

Sezela Mill has two lines; East (E) and West (W) line, each of which has four carriers. Although similar problems were experienced on both the No. 3 and No. 5 carriers only the E3 carriers will be considered in this paper.

This carrier transports up to 250 t of shredded cane per hour over a distance of 20 m and up an incline of 45°.

### Method

#### Sequence of events

1. The carriers were fitted with BOP cranked link type chain (see Figure 1) in 1983.
2. Soon after start up numerous slat attachment plates broke off from the gusset plate along line A as shown in Figure 1.
3. The weld between the slat attachment plate and the gusset plate was then improved because, on examination, it was clear that there was a lack of weld penetration between this plate and the gusset plate.
4. Numerous gusset plates then broke off from the chain link along line B as shown in Figure 1.
5. The links were then examined carefully and the heat treatment checked. As the heat treatment was found to be in order and no corrosion fatigue could be found, it was decided that the links had broken because they were under designed. The links were then reinforced with a strengthening plate as shown in Figure 1.
6. The slats then broke at point D as shown in Figure 2 on the Mark I slat.
7. A modified slat was then installed, which consisted mainly of two 100 x 60 unequal angle irons welded toe to toe (Mark II in Figure 2 refers).

8. The chain then broke at the interface of the bush and side bar (point C in Figure 1) causing a 36 hour stoppage. Again the links were examined carefully and the heat treatment checked, and again it was felt that the breakage was due to under design.

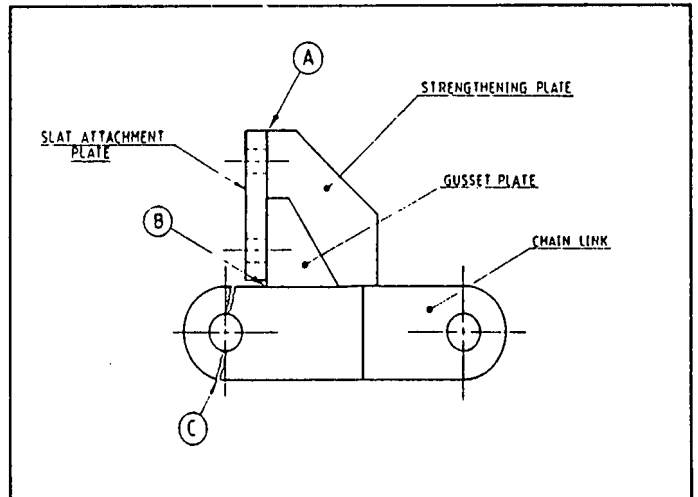


FIGURE 1

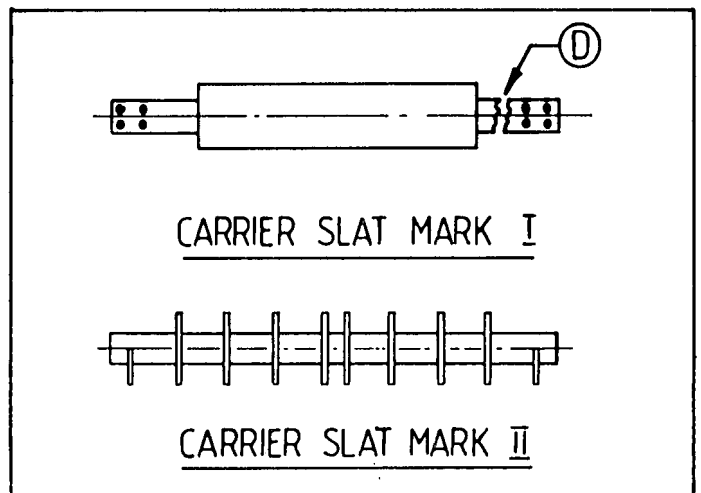


FIGURE 2

Table 1

03-10-83	Replaced 1 link	05-03-86	85/86 o/c replaced chain
03-10-83	Replaced 12 slats	17-04-86	Replaced 6 links & 3 slats
03-10-83	Replaced 5 attachment links	21-04-86	Replaced 6 links & 3 slats
14-11-83	Replaced 2 attachment links	28-04-86	Replaced slat
24-09-84	Replaced 1 slat	18-05-86	Replaced 1 slat & 1 attachment link
22-11-84	Replaced 1 slat	09-06-86	Replaced 1 slat & 2 attachment links
03-02-85	Replaced 3 slats	07-07-86	Replaced 3 slats & attachment links
09-04-85	84/85 o/c replaced chain	31-08-86	Replaced 3 slats
29-04-85	Replaced 1 slat	08-09-86	Replaced 1 slat
06-05-85	Replaced 4 attachment links & 4 slats	11-11-86	Replaced 1 attachment link
22-07-85	Replaced 2 slats	10-11-86	Replaced 200 links & 7 slats
18-11-85	Replaced 4 slats	17-11-86	Replaced 30 links
18-11-85	Replaced 4 slats		
02-12-85	Replaced 3 slats		

**Design criteria**

As no problems were experienced with the existing pins and bushes it was decided that only the side bars need to be strengthened. The BOP side bars were 57,2 x 9,5 mm and had an ultimate tensile strength of 34,5 tons. The side bars were made twice the strength so that locally made side bars could be used even if the heat treatment was not completely correct. The closest locally made steel available for the side bars which met these criteria was 70 x 16 mm, which gave the chain a tensile strength of 76,0 tons.

Imported pins were used because locally made stainless steel pins would not be heat treated correctly and therefore would not stand up to this arduous duty.

To accommodate the thicker side bars the pins and bushes were lengthened slightly. Parallel side bars were chosen because it was felt that to crank a link of this thickness and pitch would be difficult in engineering terms. Note that the BOP chain is cranked.

Two types of chain were considered, one with the existing Sezela attachment and the other with a side lug attachment. The No. 3 carriers were fitted with the Sezela attachment and the other carriers were fitted with the side lug type chain. Refer to Figures 3 and 4 for illustration of the attachment styles.

The reason for going over to the side lug type chain was to eliminate the bending moment, which was a contributing factor in the gusset breakage on the BOP type chain. Because none of the gussets broke on the BFP chain it was decided to run with the two types of chain, and when time and money became available to change over to the side lug type chain.

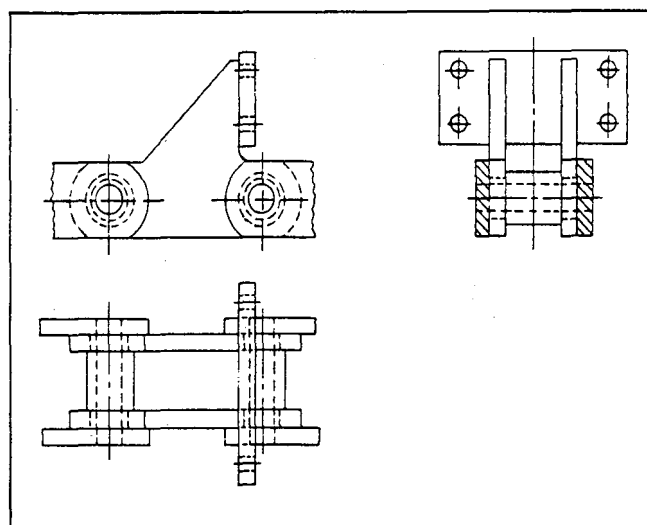


FIGURE 4

**Results**

*Operating experience*

The first chain was then purchased with imported pins and bushes but locally made side bars. After running for some time cracks were found on the inner side bars at the bush/side bar interface. These were changed out as and when the cracks were found (about 20 were changed out). It was decided after this that only imported side bars would be used.

No problems have yet been experienced with the chain with the Sezela attachment, but the holes in the lugs of the side lug type chain were badly worn and the lug plates had to be changed after one season. The slats were then Huck bolted to the lugs and wear was greatly reduced.

Experimental locally made links from 3CR12 have been run for 1,5 seasons in the W5 carrier. To date these links have stood up as well as the AS side bars in this carrier. 3CR12 links will be tried at a later date in the No. 3 carrier.

The chain that was removed from the No. 3 carriers in the 1990 off-crop had three broken link plates at the interface between the link plate and the bush. These chains had each run for 2,5 seasons. It is therefore concluded that the expected life of this chain is 2 years.

Table 2

	BFP 160 HH	BOP 160
Average tensile strength	76,0t	34,6t
Material : Pins	SS 403 T	SS 403T
: Bushes	SS 403 T	SS 403T
: Side Bars	AS SCM3	AS SCM3
Hardness : Pins	38-44 RC	38-44RC
: Bushes	38-44 RC	38-44RC
: Side Bars	290-321 HB	290-321HB
Pin Diameter	25,4 mm	25,4 mm
Bush Outside Diameter	48 mm	48 mm
Side Bar : Width	70 mm	57,2 mm
: Thickness	16 mm	9,5 mm

Table 3

1. BFP TYPE CHAIN

CARRIER	YEAR			
	1	2	3	4
E3/W3	NEW	-	NEW	-
E4/W4	OLD E5/W5	OLD E5/W5	OLD E5/W5	OLD E5/W5
E5/W5	NEW	-	NEW	-
E6/W6	OLD E4/W5	OLD E4/W4	OLD E4/W4	OLD E4/W4

2. BOP TYPE CHAIN

CARRIER	YEAR			
	1	2	3	4
E3/W3	NEW	NEW	NEW	NEW
E4/W4	OLD E3/W3	OLD E3/W3	OLD E3/W3	OLD E3/W3
E5/W5	NEW	NEW	NEW	NEW
E6/W6	OLD E5/W5	OLD E5/W5	OLD E5/W5	OLD E5/W5

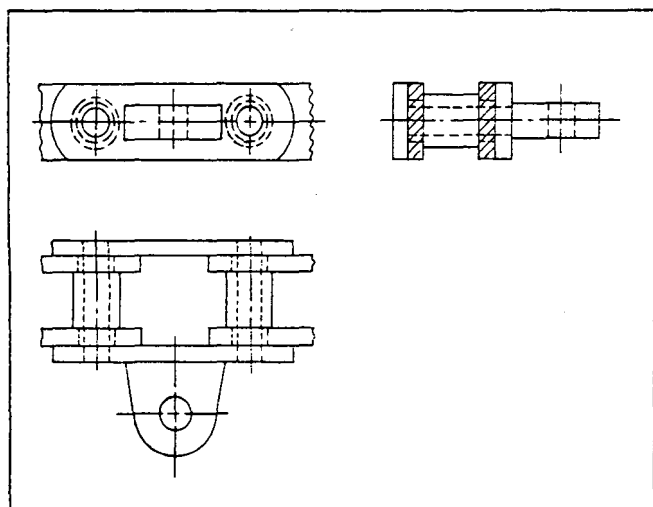


FIGURE 3

Table 4

*EAST LINE*

CARRIER	BOP	BFP
E3	R371 000	R212 000
E4	-	-
E5	R371 000	R212 000
E6	-	-

*WEST LINE*

CARRIER	BOP	BFP
W3	R371 000	R212 000
W4	-	-
W5	R371 000	R212 000
W6	-	-

COST OF BOP CHAIN	R1 484 000
COST OF BFP CHAIN	<u>R 848 000</u>
TOTAL SAVINGS	<u>R 636 000</u>
SAVINGS PER ANNUM	<u>R 159 000</u>

A schedule of the chain replacement programme and a schedule of costs are shown in Tables 3 and 4, respectively.

It can be seen that for all eight carriers a saving of R159 000 per annum was made by changing over to the BFP type chain. This saving does not take into account the cost of making good the damage during the season, nor the cost of downtime.

**Conclusion**

Changing over to a chain designed by the Mill Staff and Tsubaki representatives has been a success for Sezela on three counts:

- saving in maintenance costs
- less disruption to Mill operations
- better usage of labour.

Sezela will therefore continue to use this type of chain for the foreseeable future.