CAD TRASHPLATE DESIGN

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Abstract

The CAD trashplate design has been produced on Caddie, a computer aided design and draughting package. The design requires information regarding the roll diameters, wear rates and mill settings, which are used to calculate and display the roll centre distances, underfeed arm lengths, wedge angles at the beginning and end of the season and the trashplate profile. The advantages over the old drawing board method of designing trashplates include time saving, increased accuracy and an improved trashplate design.

Introduction

CAD is a computer aided design and draughting package with its own programming language which allows programs to be written whereby draughting and design unique to various different environments can be performed efficiently and accurately. Although used effectively as a drawing tool, CAD is often neglected as a programming or design instrument due to the perception that writing CAD programs is extremely complex and should be left to the "computer boffins".

An ideal opportunity for reaping the benefits of programming in CAD is presented by mill trashplate design. In the past, the process has been both time consuming and laborious, consisting of drawing out the mill rolls and performing the design on a drawing board measuring about 4 m × 2 m. The CAD trashplate design completes the trashplate design and displays the mill rolls, trashplate profile and all desired mill information quickly and accurately.

The aim of this paper is to illustrate that the CAD trashplate design leads to benefits in time saving, accuracy and improved trashplate design. In doing so, the author hopes to demonstrate that programming in CAD may be of benefit in other areas of repetitive design in the sugar industry.

About the Noodsberg mills

To appreciate fully the CAD trashplate program, one requires an understanding of the mill layout and some of the terms used. A general arrangement of the Noodsberg Mills and trashplate is shown in Figures 1 and 2.

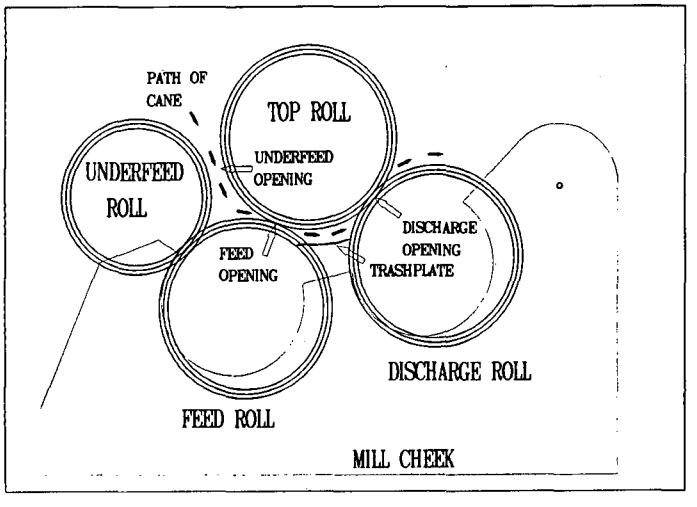

FIGURE 1 General arrangement of a Noodsberg mill.

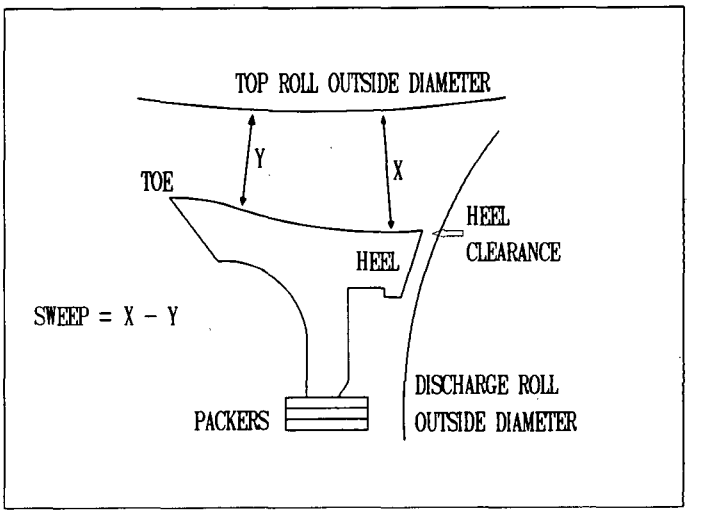

FIGURE 2 A mill trashplate.

The Noodsberg mills have a unique arrangement whereby the feed and discharge roll positions are adjusted by wedges which move in the mill cheeks as shown in Figure 3. The wedges are important in that they provide support for the roll bearings and should rotate within certain limits so that the bearings are properly supported throughout the season.

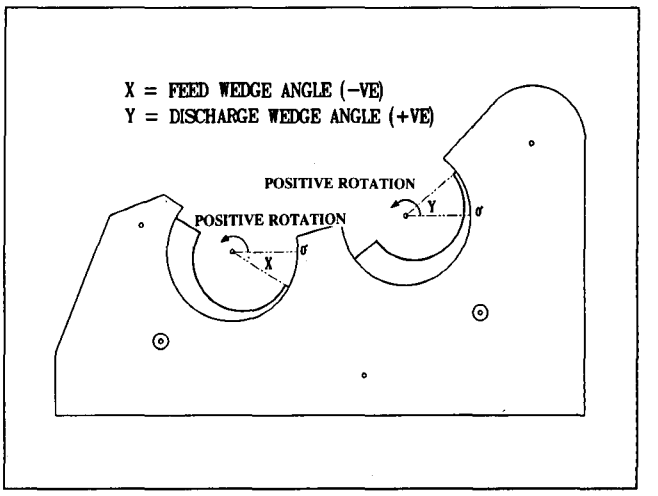

FIGURE 3 Mill wedge arrangement.

The Noodsberg trashplate design

To put the trashplate design in perspective it is important to have a basic knowledge of the entire process of setting up the mill for any particular set of conditions. Shown in Figure 4 is a flow diagram indicating where the trashplate design fits into the overall mill design together with all the information required to complete the design.

A basic description of how the trashplate profile is designed is listed in the following procedure. The method is shown graphically in Figure 5.

- Locate the top roll centre position (T).

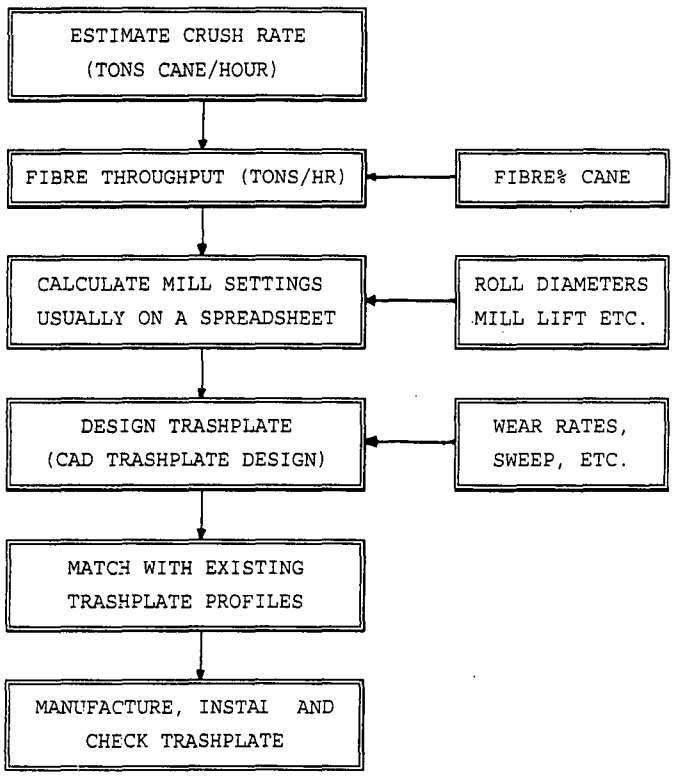

FIGURE 4 Mill and trashplate design flow diagram.

- Using the calculated roll centre distances, locate the positions of the feed and discharge rolls at the beginning (Fb and Db) and end (Fe and De) of the season.
- Draw the roll outside, mean and root diameters using T, Fb and Db as centres.
- Check the bearing positions at the beginning and end of the season.
- Decide on the correct trashplate height below the top roll, the sweep and the heel clearance.
- Construct the trashplate profile using the construction lines shown in Figure 5.

Caddie and Caddie command language

Caddie is a computer aided design and draughting package which, as well as being an effective draughting tool, has the facility to enable the user to write programs in Caddie Command Language. "The command language is based on a C-like format with variables, functions, sub-routines, flow control and loops" (Anon., 1992). These programs use the operator's input or response to perform calculations and constructions which result in desired designs and drawings. Stated very simply, Caddie programs can execute any design/drawing which could be performed using conventional drawing instruments.

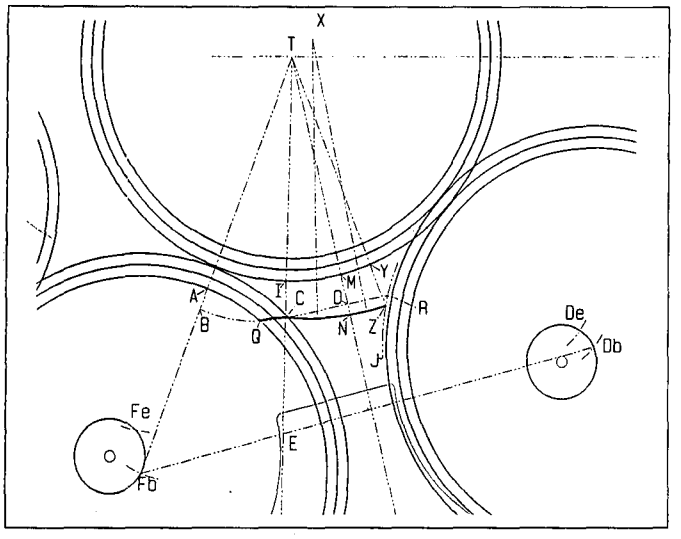

FIGURE 5 The Noodsberg trashplate design method.

The programming language has been specifically developed for the Caddie user in order to develop commands and implement new features to suite each unique environment. Although programming in Caddie Command Language is relatively simple, one does require a basic knowledge of computers and programming to produce effective programs.

The trashplate design program

The CAD trashplate design program consists of three main parts:

(a) The program prompts the user for the information required to complete the first phase of the design. The information required is shown in Figure 6 and is used to calculate the mill roll positions, roll centre distances, underfeed arm length, maximum gearwheel diameter and, wedge positions at the beginning and end of the season. The program uses roll wear rates to predict the end of season wedge positions.

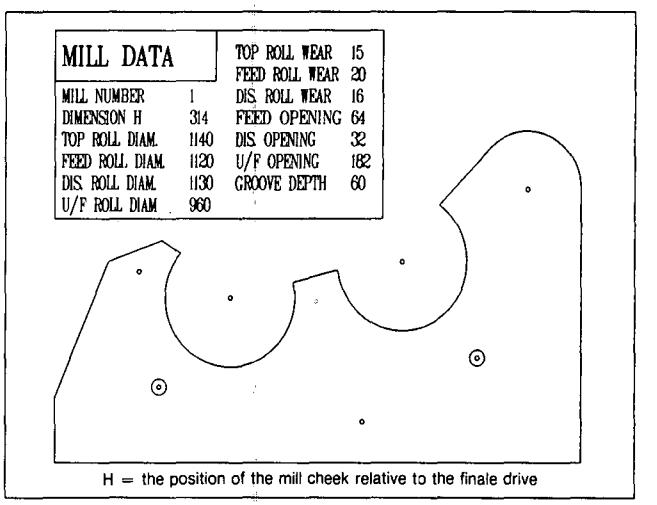

FIGURE 6 Information required for the CAD trashplate design.

(b) For the second phase of the design, the user is prompted for the trashplate height below the top roll, the heel clearance and the trashplate sweep. This information is used to produce the trashplate profile, the heel and toe angles, the trashplate packers required and the trashplate length. The final layout of calculated data and the trashplate profile is shown in Figure 7.

(c) The final aspect of the trashplate design is a feature of CAD rather than part of this program whereby profiles of existing trashplates or trashplate patterns can be compared to the newly designed profile. This is achieved by having the profiles of all trashplates, with available patterns, stored as symbols. The trashplate length will be the main criteria in assessing whether or not an existing pattern is worth comparing to the newly designed trashplate or not. This process will determine if any existing patterns may be used to cast the new trashplate.

Expanding or modifying the CAD trashplate design

Modifying the CAD trashplate design to suit a conventional mill would entail re-writing almost all of the calcu-

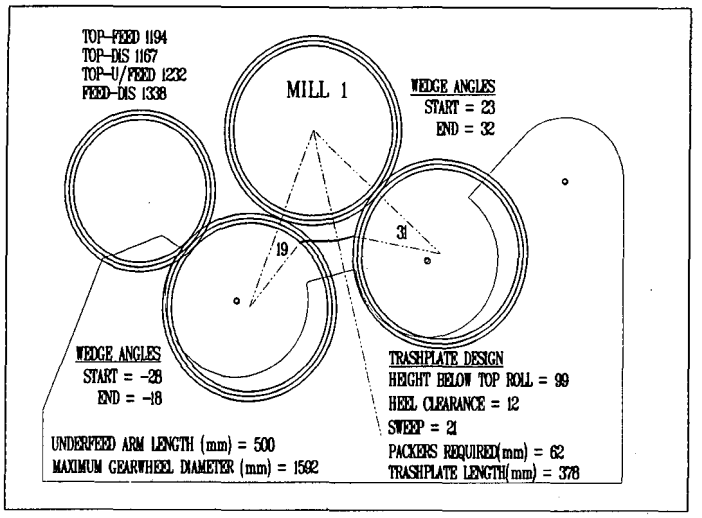

FIGURE 7 Design and information produced by the CAD trashplate design.

lations in the program to suit the different mill layout and design method. The basic structure of the program, i.e. prompting the user for mill information and drawing the rolls and trashplate would essentially remain unchanged. The conversion would require a basic knowledge of programming and the CAD commands.

The program could also be expanded to include other aspects of mill design such as:

- Roll selection and positioning
- Pinion sizing
- Mill settings – although mill settings could be included in the program, it would require a fair amount of programming and can be done far more efficiently on a spreadsheet.

Advantages of the CAD trashplate design

The advantages of using CAD as opposed to the old drawing board system for designing trashplates are:

- A large reduction in design and drawing time. Where the old system took in excess of a week to complete all six trashplate designs, the CAD Trashplate Design completes the designs in a few hours.
- An improvement in accuracy and a reduced probability of making mistakes.
- The CAD trashplate design allows Engineers to see immediately the effects of varying trashplate height, roll wear, sweep, or any other trashplate parameter and therefore become more efficient and effective in obtaining ideal trashplate profiles.
- The CAD trashplate design allows an easier and more accurate comparison between existing trashplate profiles and the newly designed profile. This will lead to a more effective use of existing patterns to cast new trashplates and ultimately a saving of time and money.
- The design can easily be adapted to suit various different mill types or trashplate design procedures and the program may be expanded to include other aspects of the mill design, e.g. mill settings, roll positions or pinion sizes.

Conclusions

The CAD trashplate design has been successfully introduced to Noodsberg Sugar Mill and has had the desired effects of reducing design time and improving the accuracy and efficiency of trashplate designs.

Although the particular application of trashplate design has been presented, it is the intention of the author to demonstrate that CAD programming language may be used as an effective design tool to save time and money where any design or drawing is being repeated on a weekly, monthly or yearly basis.

Acknowledgements

The author would like to thank Mr M Hardwick for his support and assistance, and Miss H Atkins for her help with the project presentation.

REFERENCES

Anon. (1992) *Caddie Professional Version 4.0. Reference Guide* – Volume 2. January.