

## End-to-end supply chain optimisation - NatSteel

### Background

Opturion solved the problem of cutting rebars in a shearline in the optimal way, considering setup times, yield, and re-use of offcut for NatSteel in Malaysia.

A rebar shearline cuts (shears) rebars into bars of different length in order to fulfil orders. Order consist of one or more batches with the following characteristics:

- Diameter
- Quantity (number of bars)
- Length
- Bar mark
- Further processing requirements (e.g. requires bending)

The operation of the shearline then consists of a sequence of the following steps:

- Load 1 or more bars; if multiple bars are loaded at the same time, they would have to have the same diameter and same length, and there can be a diameter-dependent limit on the number of bars that can be loaded (and cut) at the same time.
- Cut the loaded bars at a given length; the cut bars would be dropped into a designated bin and the remainder length may be cut into further pieces.
- Drop the remainder bar length (called offcut) into a designated bin; or scrap the remainder length if below a certain threshold.
- Empty one or more bins.

On either side of the shearline, there are a number of bins which span the length of the shearline. Cut orders and dropped offcut need to be allocated to a bin and offset within the bin. Multiple orders could go into the same bin, at different offset, with a minimum separation between them.



E.g. if the shearline length is 12m, it should have stops every 0.5m and orders need to be 0.5m apart, then an order for 2.73m and an order for 5.53m could both go into the same bin, with e.g. the former at the end of the bin (offset 0m) and the latter at an offset of 3.5m from the end. Bins have a capacity, i.e. a maximum weight in any bin/section.

There are some further constraints on which bars can go into the same bin, which relate to further processing requirements, length differences, and number of open (not yet completed) batches.

Below is a picture of a rebar shearline (from RMS, for illustration purposes).



The optimisation needs to consider the following factors:

- Material yield: length or weight of bars going in vs length or weight of bars produced
- Time cost for the different steps (loading, cutting, bin emptying)
- Offcut generation and re-use: this is about ensuring the inventory of different lengths of offcut remains within limits, the lengths produced are of potential use for future.



## The Solution

Opturion has developed an optimiser for this problem. It produces a schedule of steps that together fulfil the orders. Each step can be one of the following:

- Load bars:
  - What diameter?
  - What length (e.g. from offcut stock or full length bars)?
  - How many?
  - Drop remainder bar length or scrap:
  - Into which bin (for offcut)?
- Cut bars:
  - What length?
  - Into which bin?
- Empty bin:
  - Which bin?

Each schedule has a total duration to execute, which relates to the number of operations, as well as changeover times when going from one diameter/bar length to another. Each schedule also results in a certain yield and offcut generation.

The latter in particular can be an important consideration: for instance, it may not be a good outcome to produce large quantities of offcut of a small length that is unlikely to be re-usable. The optimisation can be tuned with that in mind, e.g. it can look at the current stock levels of different bar lengths and order forecasts to determine whether it is useful to produce more offcut of a particular length and diameter.

## Benefits

The optimiser can produce plans in almost no time compared to a human planner, and produce plans of a consistently high quality.

Furthermore, it allows running what-if scenarios and quick replanning when circumstances change.

## Further Information

Please contact Opturion for a demonstration, or give us some data that we can use to identify potential benefits.