Bachelor's Thesis Engineering Technology

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Automated piston rod cutting machine

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Specialization Electromechanical Engineering Technology

Background

Tenneco Sint-Truiden gave the assignment to design a machine that automatically cuts steel beams to a desired length. These beams will be further manufactured into the central rods for their automobile shock absorbers. Their current setup is not fully automated and too inefficient.

Specifications

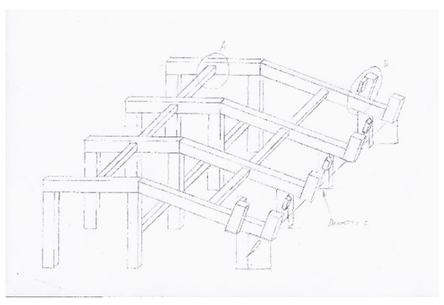
The design must meet several key requirements:

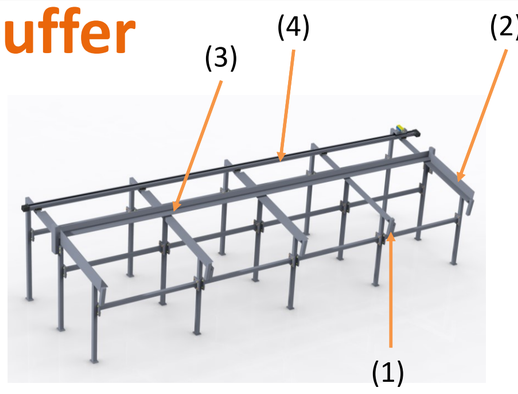
- Entrance length = 5.6 m
- Variable diameters from 10.6 mm to 18.2 mm
- Input buffer for > 400 pcs
- Variable cutting lengths from 80 mm to 600 mm
- Output buffers sorted by length for 500 pcs
- Production rate > 1 pc/4 s

Methods

After the primary problem study the thesis followed the van den Kroonenberg design methodology to obtain design concepts. These were further developed into three-dimensional models and were tested for their structural strength by mechanical calculations. This method was applied iteratively.

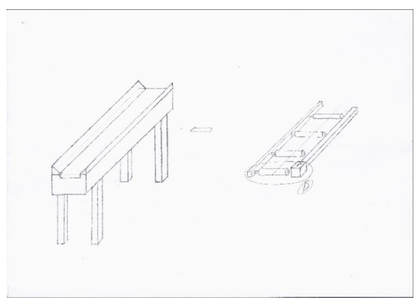
Input buffer

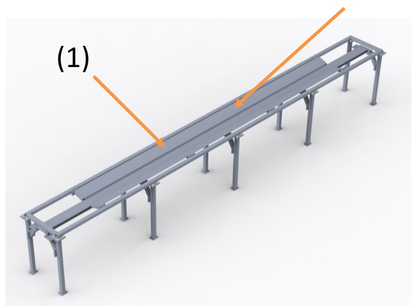




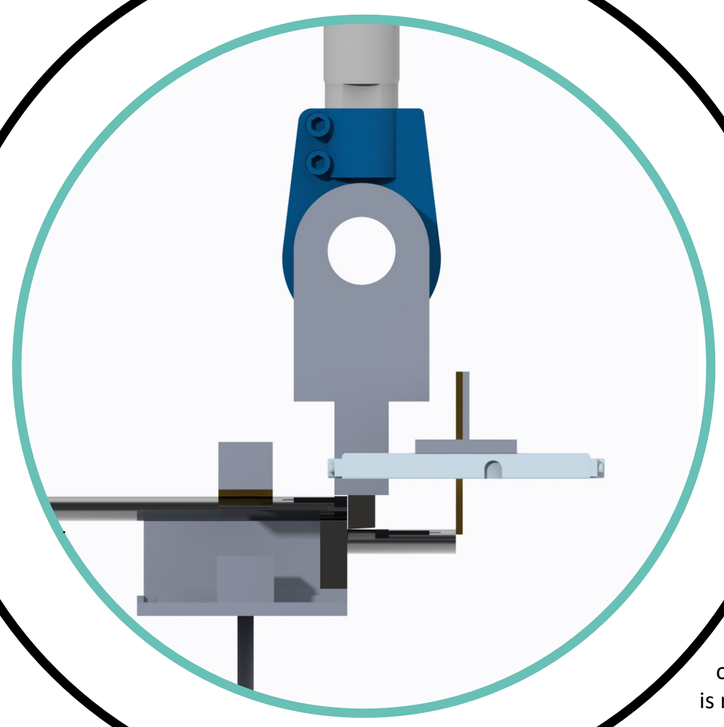
For the entrance buffer of the machine, the eventual design stayed true to the original concept. It is made up of steel profiles slanting downwards so the steel beams can roll down. At the end, there is a stopper (1) with a piston which will push one rod over at a time. This way the machine will always be fed one rod at a time. We expanded the original concept with some sheet metal guiding (2) so the beams can't fall off. A guide rail (3) was added in the middle so beams that would be laying on top of each other are separated. An automated cutting device (4) was added on request. The uncut steel beams are delivered to the machine in bulk, held together with cable ties. This added cutting device can cut these cable ties automatically without the need of an additional worker.

Entry/exit transport

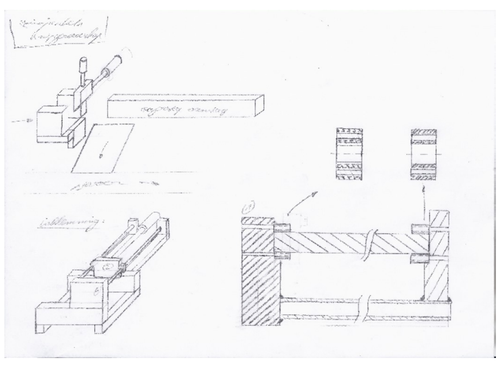


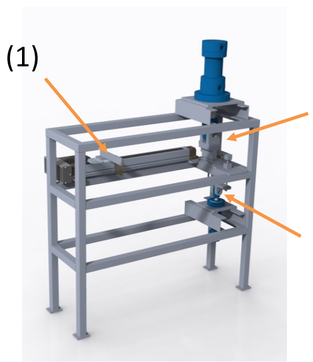


The transport for both entering and exiting the cutting module are based on the same parts and ideas. It utilises a conveyor belt (1) where one of the transport rollers is driven by an electric motor. The other rollers can roll freely on ball bearings. Similar to the input buffer, sheet metal guiding (2) was added to make sure the steel beams will fall on the conveyor belt and can't roll off anymore. The only difference between the entry and exit transport will be two added pistons to push off the cut pieces of steel rod to guide them into the correct export buffer.



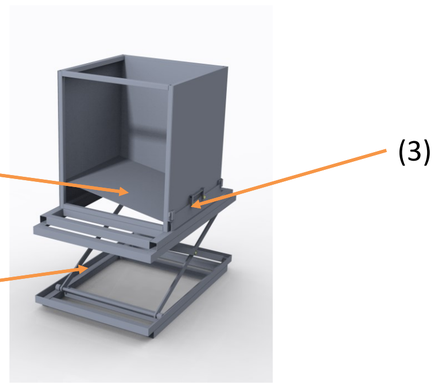
The cutting module is the section of the machine where the steel rods will be cut to the desired length. First, the rod is transported into the cutting module by the entry transport. Next, they will be stopped at the desired length by a variable stop (1). The module will clamp the rod with one of its hydraulic cylinders (2). Finally, the blade mounted on the second cylinder is pushed down onto the rod cutting it to length (3). The cut piece now lands on the exit transport and gets moved towards the output buffer.





Cutting module

The final part of the machine is the output buffer. Tenneco asked for a a mobile design that's height adjustable. This way, the output buffer of our machine also serves as the input buffer of the next one. The height adjustability is realised by a scissor lift (1) construction underneath the buffer On the inside of the buffer, a slanted plate (2) makes sure the rods will all be oriented the same way and makes them roll out as soon as the stopping handle (3) is removed.



Output buffer

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