Heat equation in rolling mill

The project goal is computing the heat transfer for a solid metal bar in a hot rolling mill. The domain exists between two stands where conduction exists between the roller and the metal bar aswell as convection to surrounding air between the stands. Energy is also released during the deformation process which causes an increase in temperature. The shape of the bar is non-uniform and moving.

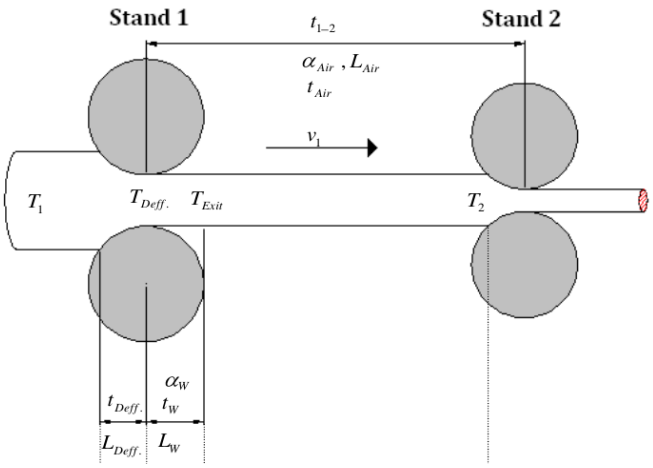

Figure 1: Illustration of model setup

The solution can be compared to an already existing simplified model and also comparison with data from a real mill may be possible. Implementation can be made in a programming language of choice (Matlab, Python, C etc.). The numerical method can be either Finite Elements or Finite Differences as preffered. Suggested work flow:

1. Derive a PDE containing terms handling convection, conduction, energy generation and other necessary terms to obtain a reasonably correct description of the system.
2. Show that the PDE in (1.) is well-posed under some conditions.
3. Derive the chosen numerical method.
4. Implement working 1D stationary heat equation for the full problem.
5. Derive time-dependant 1D equation.
6. Implement time-dependant equations.
7. Expand to a 2D and possibly 3D model depending on time.
8. Compare with the simplified model and real data to measure performance and convergence of the model.

Company name: Morgårdshammar AB
POC: Carl Sahlin (carl.sahlin@morgardshammar.se)