Simulating Approaches for Heating Process in Continuous Furnaces

G. Petrone, R. Sinatra, C. Barbagallo
BE CAE & Test S.r.l., Viale Africa 170 Sc. A, I-95129, Catania, Italy
Mail to: info@be-caetest.it - Web: http://www.be-caetest.it

INTRODUCTION: Heating of **pieces** linearly **translating** in tunnel furnaces is an argument of high interest in several industrial processes such as thermal **treatment of metals**, **glass production** and **food industry**.

Because of pieces move into the furnace, **heat flux** they receive from fixed (and not symmetrically arranged) heat sources **is variable in time and space**.

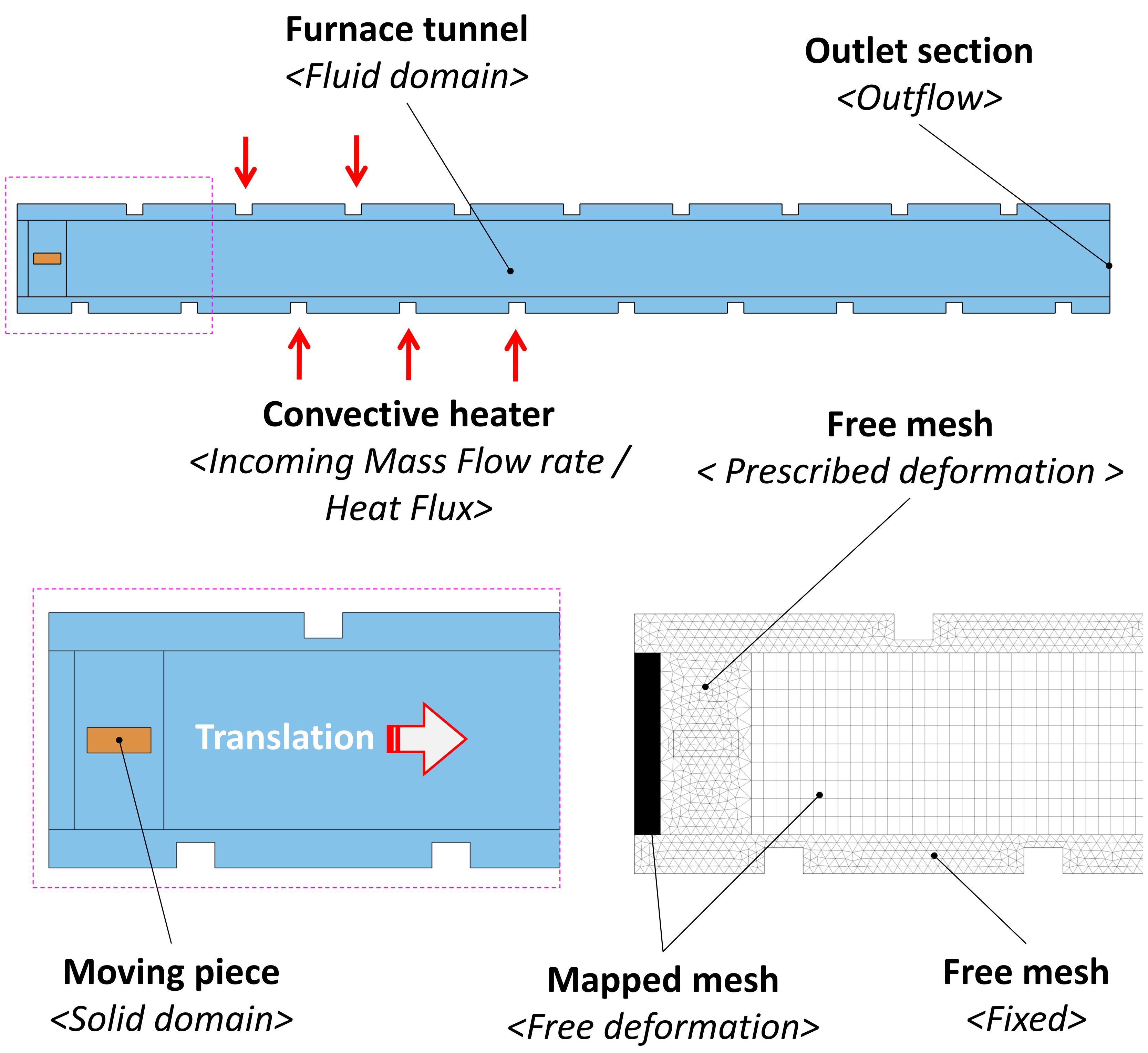

Figure 1. System lay-out and computational mesh.

A **moving mesh approach** is applied in order to solve the transient thermal state of a **solid piece** entering a **ventilated heating furnace** at a set temperature and linearly **moving** inside it at constant velocity.

MODELLING: The **conjugate heat transfer** problem is solved exploiting the following COMSOL Multiphysics® features:

- PDE (coefficient form) on boundary identity pairs;
- Moving mesh (ALE);
- Single phase turbulent flow (k-ε);
- Conductive/convective heat transfer.

Models are built both in **2D** and **3D**. An initialization step is needed to compute fluid motion field and thermal distribution at initial time for transient analysis.

RESULTS: Results are mainly presented in the form of **temperature maps** at different time (Figure 2 and 3).

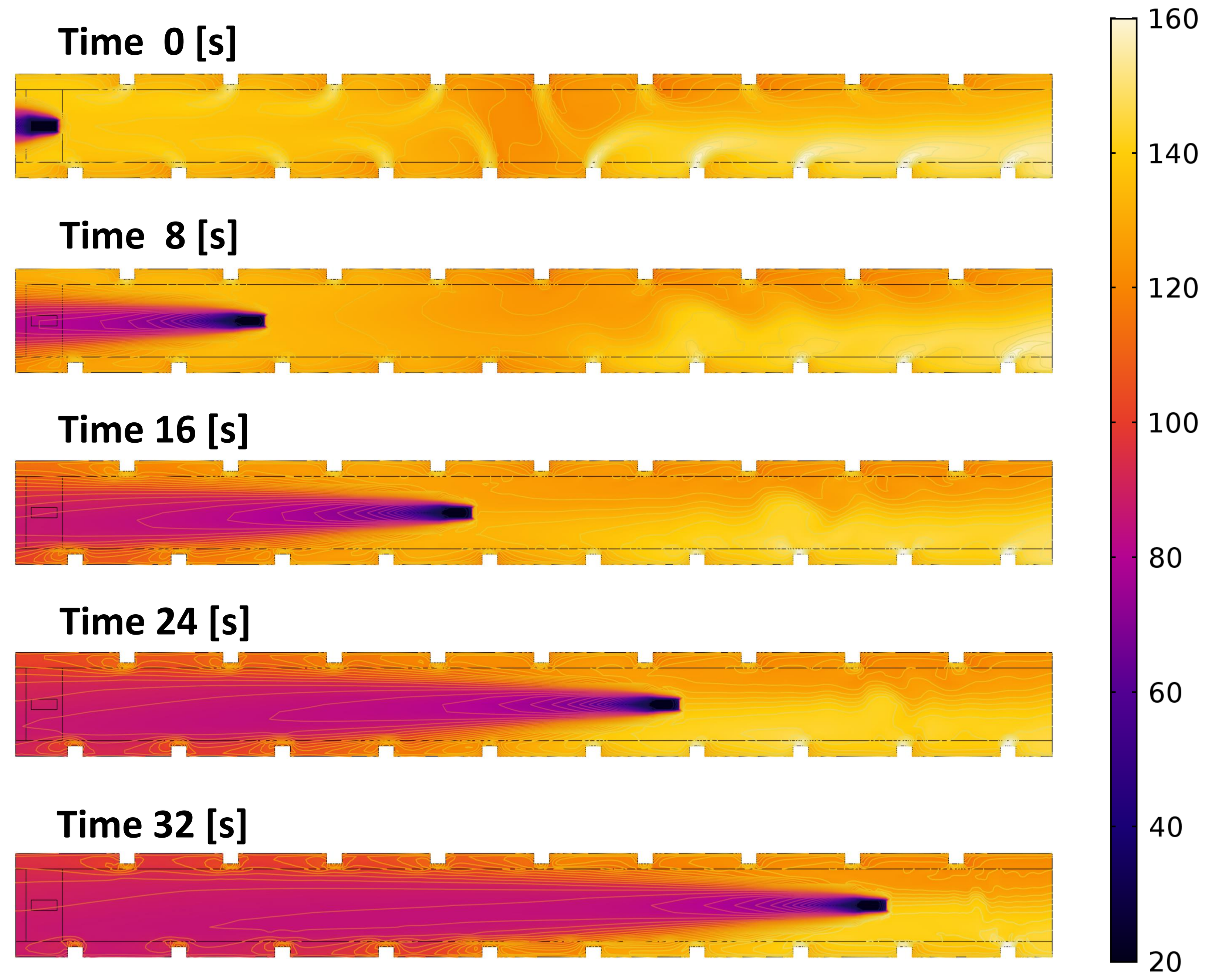

Figure 2. Temperature [°C] at different time (*U_piece =0.5 m/s*).

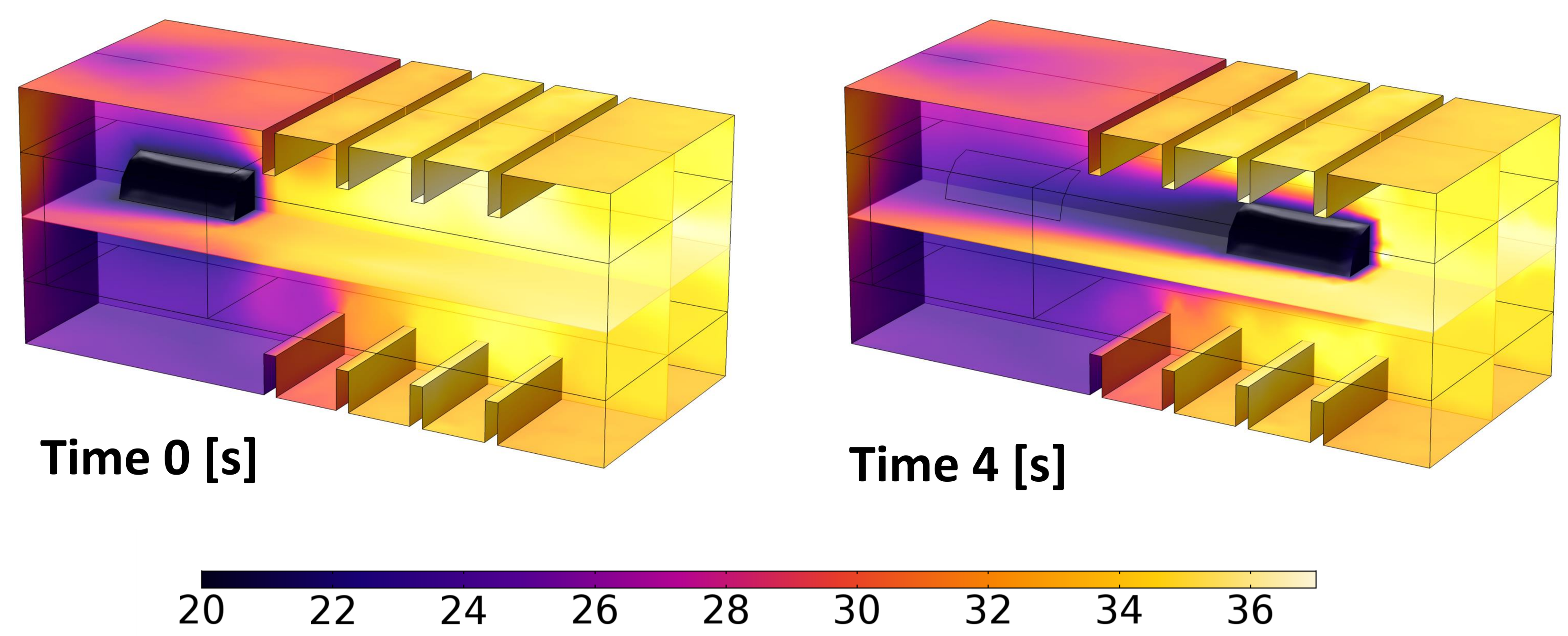

Figure 3. Temperature [°C] at different time (*U_piece =0.3 m/s*).

CONCLUSIONS: Numerical model allows to **predict piece temperature** as a function of **time** / **furnace length** and **translating velocity** (Figure 4).

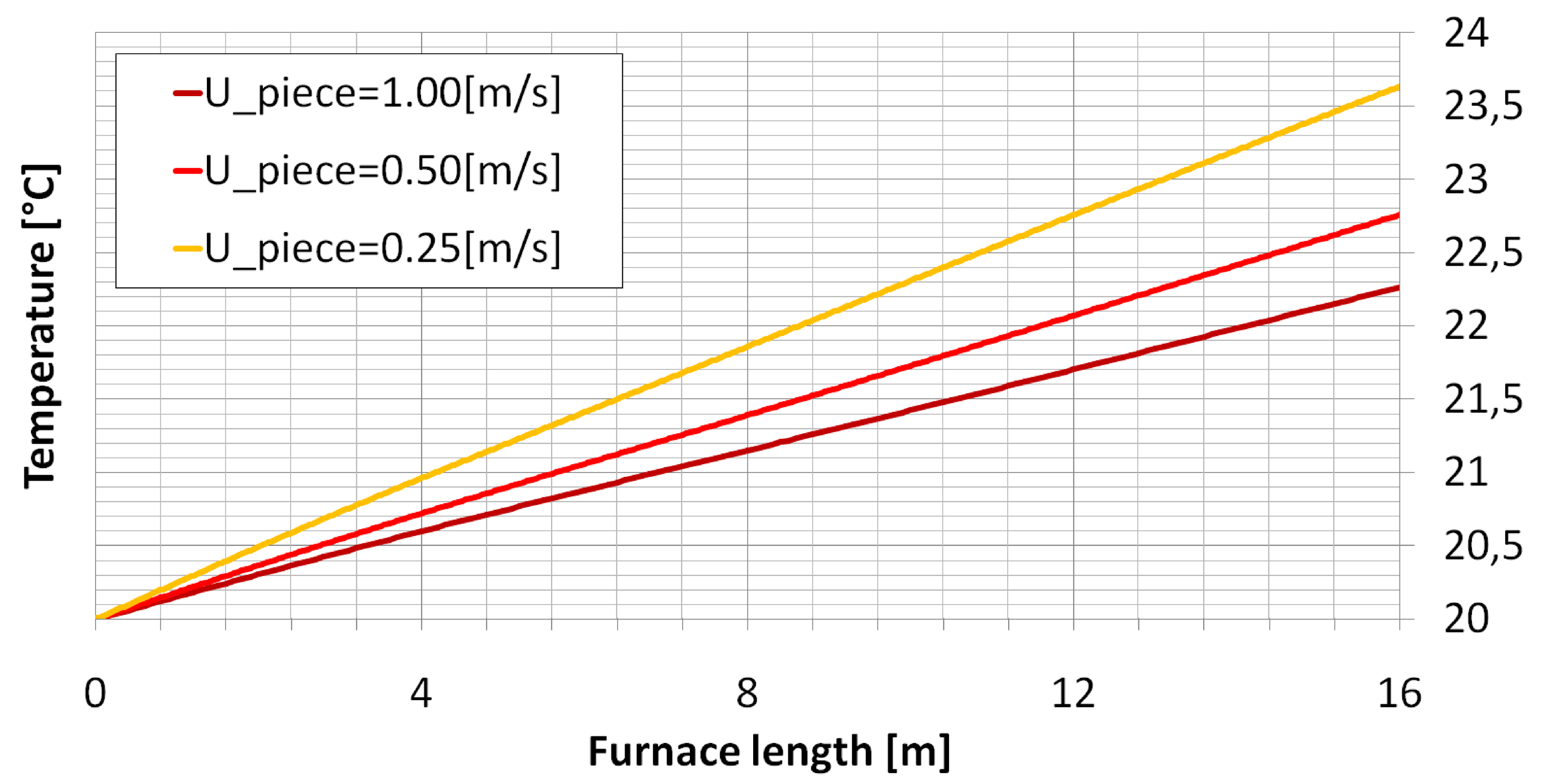

Figure 4. Average piece temperature [°C] as a function of the furnace length for different translating velocity (2D application).

REFERENCES:

1. Walter Frei, Deformed Mesh Interfaces: Rotations and Linear Translations, COMSOL BLOG, September 7, 2015, https://www.comsol.com/blogs/