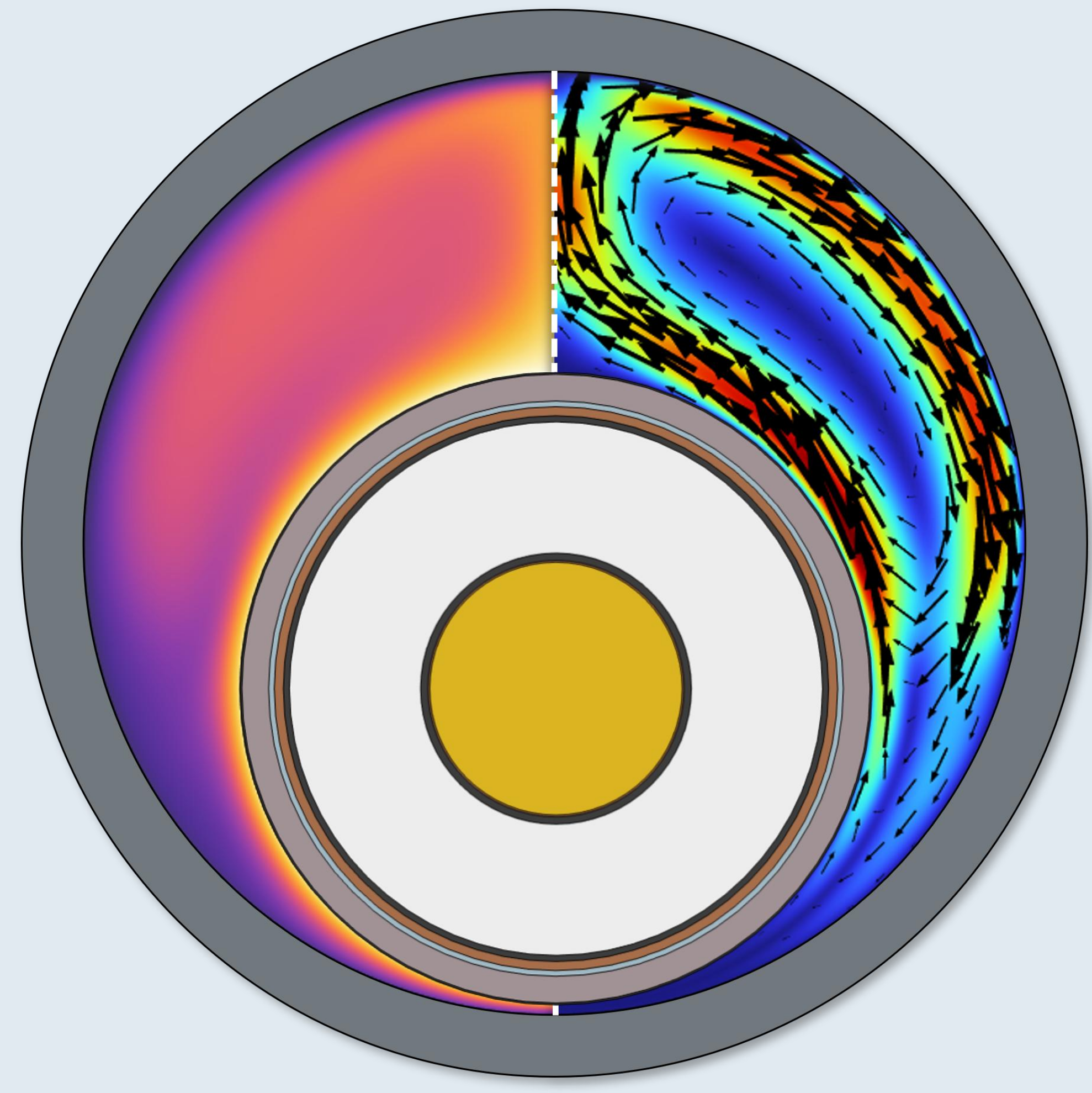




# Current Rating of Cables Placed at Metallic Ducts Using COMSOL Multiphysics®

Cable placement in metallic duct installations plays a crucial role in the electromagnetic losses generated within the duct. This work proposes a new modelling approach for their realistic evaluation.

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## Abstract

Power cables are often installed inside ducts for mechanical protection, limiting current-carrying capacity due to increased thermal resistance. Accurate cable rating therefore depends on reliable prediction of both heat transfer and electromagnetic losses.

Conventional analytical rating methods assume concentric cable placement within the duct. In practice, however, cables typically rest at the bottom, altering current distribution and loss

generation, particularly in metallic ducts. Consequently, duct losses and conductor temperatures may be underestimated.

This work presents a COMSOL Multiphysics® modelling approach that combines analytical heat-transfer methods with realistic electromagnetic modelling, enabling more accurate prediction of the metallic duct losses and the cable thermal behaviour while avoiding the high computational cost of CFD simulations.

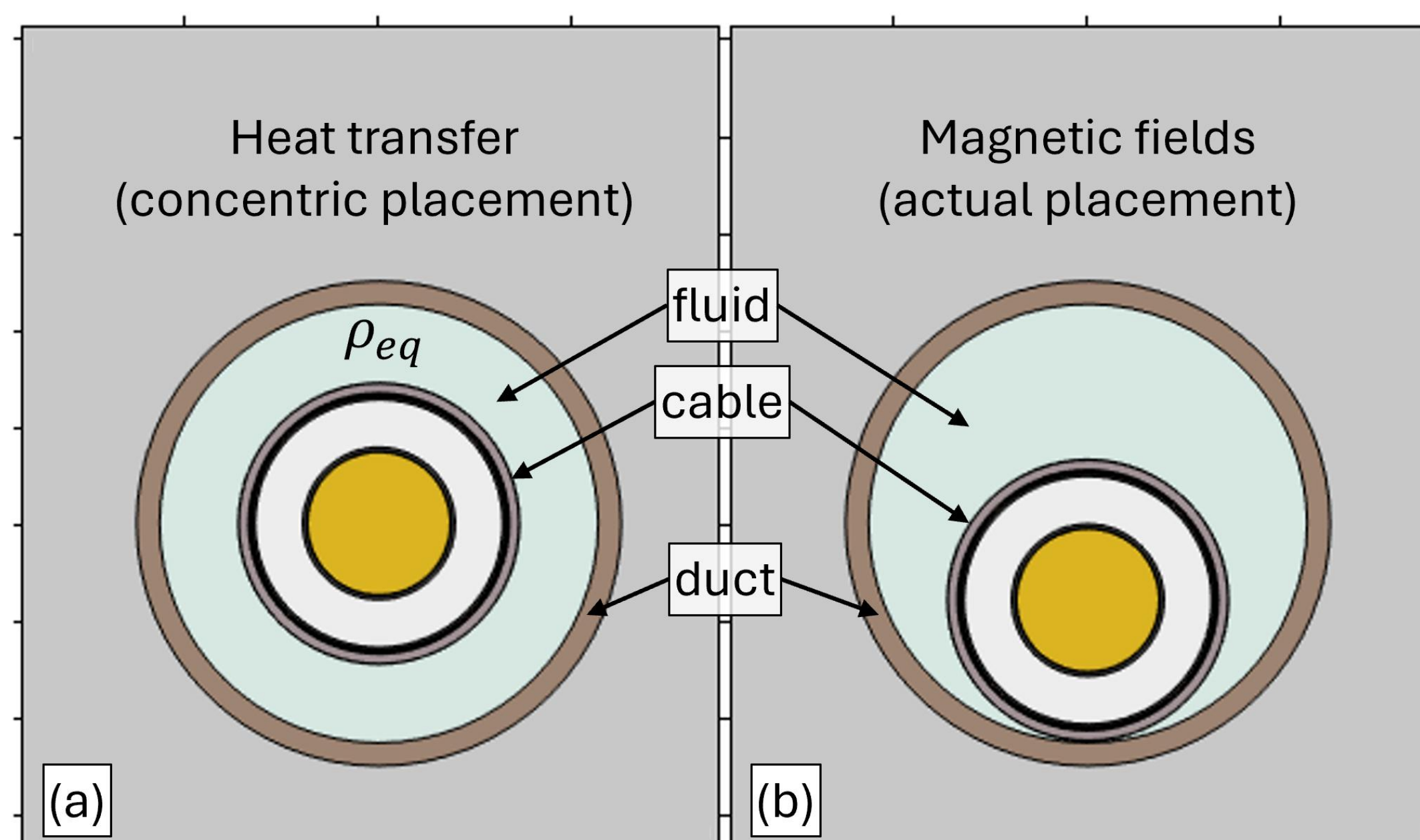


Figure 1. Proposed modelling approach for metallic duct installations (a) heat transfer component; (b) magnetic field component.

## Proposed approach

### Heat Transfer (HT) component

- Concentric cable placement (Figure 1a) in accordance with [1] and [2].
- Average temperature of metallic parts is imported in the Magnetic Fields component.

### Magnetic Fields (MF) component

- Cable is positioned at the bottom of the duct (Figure 1b).
- Electromagnetic losses of metallic parts are imported to the Heat Transfer component.

Proposed approach allows for separate component geometry for HT and MF physics, allowing for realistic calculation of metallic duct losses.

## Results

Metallic duct loss factor increases by up to 18.3 times with diameter ratio leading to 8.7 K cable temperature rise in the **proposed approach**.

In contrast, **concentric approach** predicts only a 6-times increase in duct loss factor, leading to a 17.2 W/m duct loss deviation from the **proposed approach**.

This eventually leads concentric approach to underestimate maximum cable temperature by up to 13.7 K, compared to our proposal.

**Proposed approach:** an efficient tool for current rating studies, combining the concentric configuration required by analytical heat transfer methods with accurate modelling of electromagnetic losses in metallic ducts and realistic cable placement.

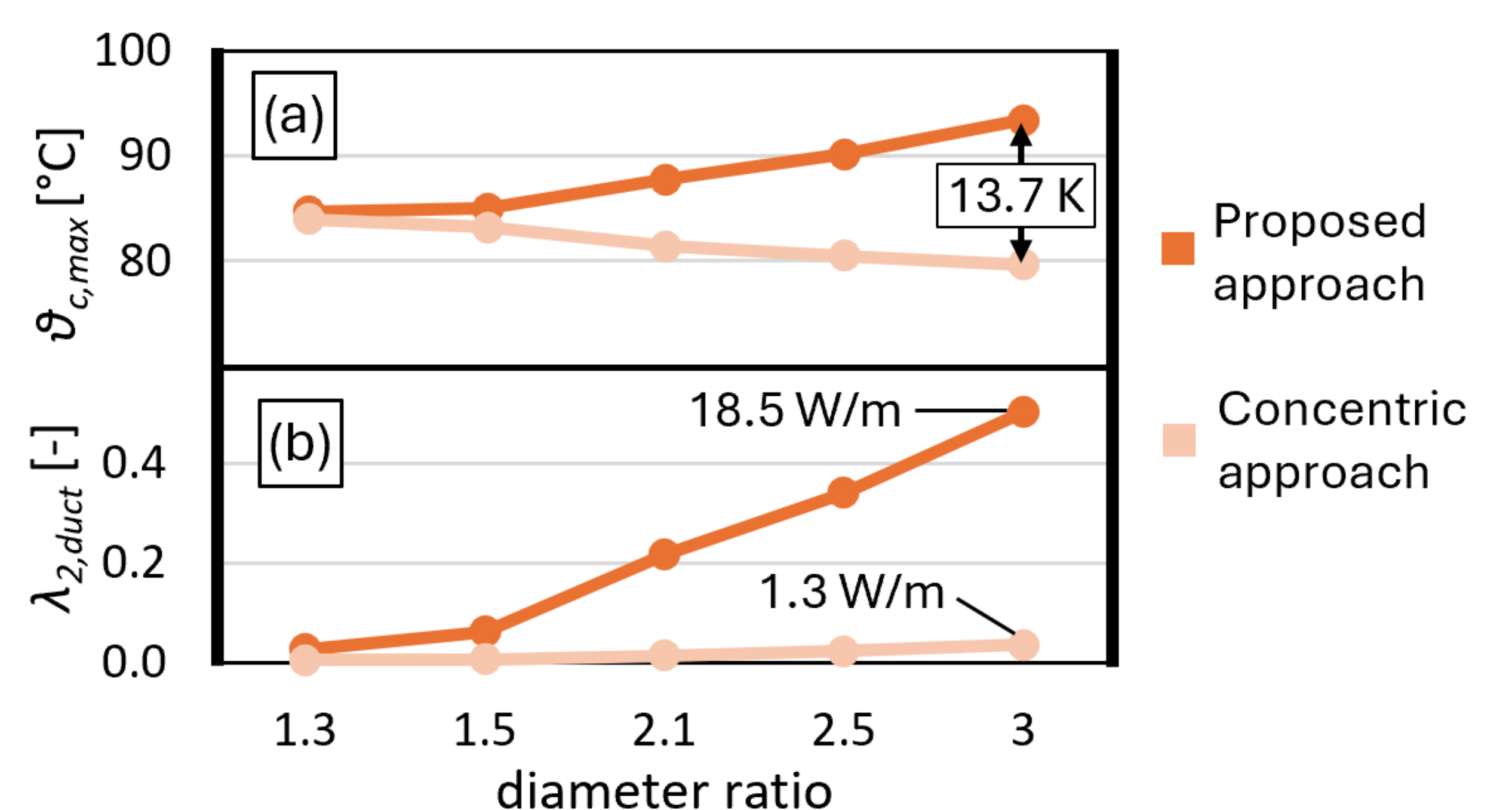


Figure 2. (a) Maximum cable temperature; (b) metallic duct loss factor for different diameter ratios for proposed and concentric-cable approaches.

## REFERENCES

1. Standard 60287-2-1 IEC, "Electric cables - Calculation of current rating - Part 2-1: Thermal resistance – Calculation of thermal resistance, Edition 3.0," IEC, 2023.
2. CIGRE Working Group B1.87, "Finite Element Analysis for Cable Rating Calculations, Technical Brochure 963," CIGRÉ, 2025.