CYMCAP power cable ampacity software
Brightlayer Utilities suite

Enhance your modeling and analysis of non-standard cable installations with add-on installation modules

CYMCAP software offers a complete set of powerful tools based on years of research to assist cable engineers in cable thermal rating and modeling of installations common in today's electrical grid.

Multiple duct banks and backfills

The multiple duct banks and backfills add-on module (CYMCAP/MDB) is designed to determine the ampacity of cables installed in several neighboring duct banks and/or backfills with different thermal resistivity. The module computes the values of T4 (the external thermal resistance to the cable) using the finite element method and then the ampacity (or operating temperature) of the cable installation is obtained using the IEC standardized solution method.

Capabilities include:

- Modeling of multiple rectangular or circular soil areas (ductbanks and backfills) with different thermal resistivity
- Modeling of heat sources or heat sinks in the installation
- Computation of the steady state ampacity or temperature
- Support for transient analysis, cyclic loading and emergency ratings
- Computation of the thermal rating of cables installed in filled troughs

Advanced tunnel modeling module

The optional advanced tunnel modeling module (CYMCAP/ATM) allows you to determine steady-state temperature and ampacity, cyclic loading, emergency rating and transient analysis for cables installed in unventilated tunnels, as well as steady-state temperature and ampacity analysis for cables installed in ventilated tunnels.

Major features for unventilated tunnels include:

- Modeling of a large variety of installation methods: laying on the floor; hanging from a wall; in ladder-type racks or in cable trays
- Cables and groups of cables can be single-core or three-core; single-core cables can be arranged in flat formations (vertically or horizontally) or in trefoil
- Cyclic loading using daily, weekly and yearly load factors and computation of emergency ratings in unventilated tunnel configurations

Major features for ventilated tunnels:

- Model an unlimited number of non-identical (unequally loaded) circuits for single-core cables in either flat (horizontal or vertical) and trefoil configurations.
- Consider the heat transfer produced by radiation and convection between the cables and the tunnel wall, as well as the conduction between the tunnel wall and soil
- Graphically represent the temperature profiles for each cable, the air and the tunnel wall as a function of their positions along the ventilated tunnel
- Consider the effects of the tunnel wall and wind velocity in calculations
- Obtain a graphical representation of the heat removed by the tunnel
- Circular and rectangular tunnel shapes

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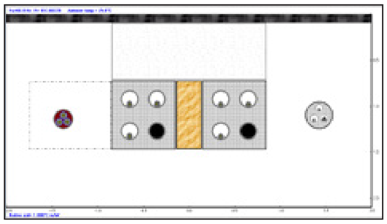
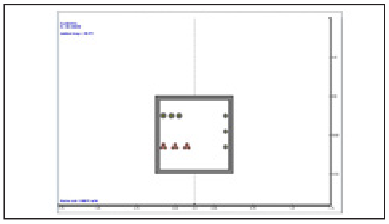


Multiple ductbanks and backfills



Multiple circuits in various configurations installed in a rectangular ventilated tunnel

CYMCAP software — additional installation modules

A comprehensive set of tools designed to assist cable engineers in thermal modeling of non-standard cable installations.

Cables in troughs

The thermal rating of cables installed in unfilled or in filled troughs is determined using the CYMCAP unfilled troughs – CYMCAP/UNF and the CYMCAP/MDB modules respectively.

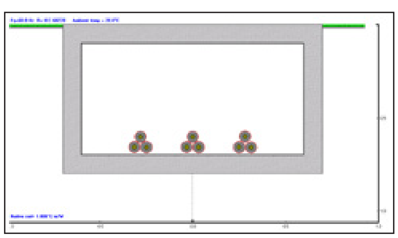
In these modules, a trough (or a trench) is defined to be a long, shallow rectangular-shaped excavation, where the walls, bottom and cover are made of concrete or a similar material. The cables can be installed on the floor, hanging from supports on the walls or racks. The trough can be filled with a material with good thermal properties, or it can be left unfilled (air-filled). The heat transfer mechanism is different for filled and unfilled troughs and therefore they are treated independently.

Unfilled troughs

The CYMCAP/UNF add-on module offers four approaches to find ampacity in unfilled troughs: IEC standard, Slaninka Method 1, Slaninka Method 2 and Anders Coates Method. The IEC standard approach is based on the methodology applied for cable ratings in free air, but the temperature inside the trough is computed according to the IEC Standard 60287-2-1. Thermal resistivities of the soil and the trough's cover are ignored in this method.

With the Slaninka Method 1, the thermal resistivity of the soil surrounding the trough is considered. The Slaninka Method 2 considers both the thermal resistivities of the cover and the soil surrounding the trough.

With the Anders-Coates method, in addition to the thermal resistivities of the soil and the cover, the wind velocity above the trough is taken into account. In all options the user can choose whether the trough is exposed to sun radiation or shaded. The approaches are all based on field research by independent parties and published in scientific journals.



Cables in unfilled troughs

Filled troughs

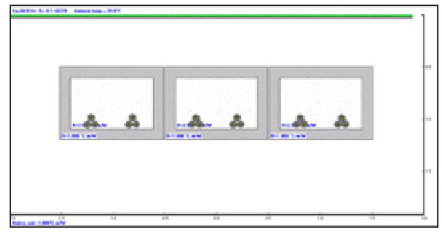
Filled troughs are treated in the CYMCAP/MDB module as multiple backfills.

Cables in filled troughs are rated in the CYMCAP software using:

- Finite elements method to compute the external-to-the-cable thermal resistance T4
- IEC standards procedures to efficiently perform ampacity calculations

The module also offers:

- Computation of the temperature and steady-state unequally loaded ampacity
- Extended capabilities to move the troughs and model asymmetrical troughs
- Ability to perform cyclic loading rating through the use of load factors



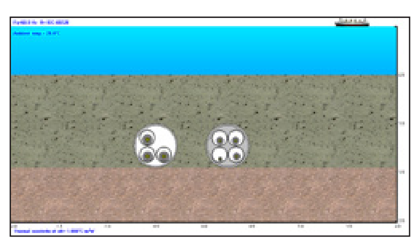
Cables in filled troughs

Multiple casings

The multiple casings add-on module (MCAS) allows the user to determine the steady-state unequally loaded ampacity and/or temperature rating of cables installed in one or more casings. In the CYMCAP software, a casing is defined to be a large conduit filled with air or a solid material, inside which cables in ducts and cables not in ducts can be installed. Casings can be immersed in water, placed on the seabed, or buried underground.

Major features for multiple casings include:

- Different burial environments are allowed: casing in water, on the seabed or in the silt (submarine soil)
- Modeling of any number of casings in parallel in the same installation
- Modeling of any number of ducts inside one or more casings at the same time
- Capable of modeling any number of circuits inside a casing and a duct
- Circuits in ducts and in casings can be multiple cables per phase
- Several materials are available to model ducts and casings: PVC, polyethylene, earthenware, magnetic and non-magnetic metal, etc.
- Sizes of ducts and casings are not limited

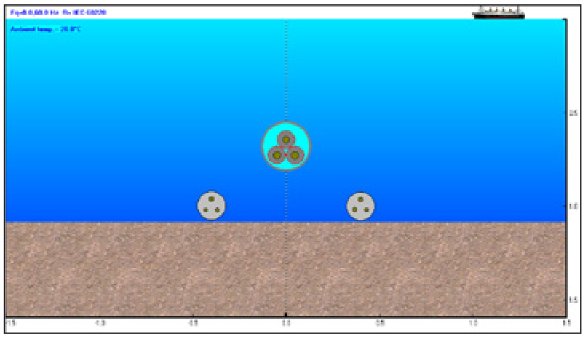


Multiple casing in silt

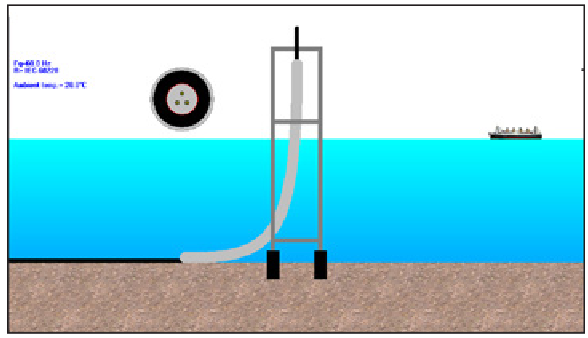
Submarine cable installations

The submarine cable installations add-on module (CYMCAP/SUBMA) allows the user to determine steady-state temperature and ampacity for cables installed in water, cables on the seabed and cables in the silt (submarine soil).

CYMCAP/SUBMA also allows engineers to determine steady-state temperature and ampacity for cables installed in J-tubes. More precisely, this add-on module supports modeling of the J-tube section (filled with air portion) above the sea level. This section represents the thermal bottleneck inside of the J-tube, and it is very often considered as the most common limiting section in submarine cable installations.



Cables on the seabed



Cables in J-tubes

Major features for cables immersed in water, on the seabed and in the silt:

- Supports most of the cable configurations including multiple conductors per phase
- Multiple dissimilar cables are supported in the same environment
- Supports DC cables
- Submarine soil thermal resistivity is required for cables in the silt
- Smooth transition from multiple casing installation MCAS to submarine installation
- Seabed is assumed to behave as an isotherm for cables in the silt, no matter the depth
- Cables on the seabed and cables immersed in water produce the same results since heat is assumed to be mostly dissipated in water when installed on the seabed
- Cyclic and transient calculations are not supported for cables immersed in water or on the seabed

Major features for cables in J-tubes:

- Radiation and convection inside and outside of the tube is considered in the calculation
- Single-core or three-core cables as well as selected single-phase multiple conductors per phase configurations are supported
- Supports DC and AC cables
- J-tube is assumed to be sealed in both ends
- Cyclic and transient calculations are not supported

For more information on CYMCAP software, visit **Eaton.com/cymcap** or contact us at **cymeinfo@eaton.com**

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Printed in USA
Publication No. BR917030 / GG
March 2024

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