CYMCAP 3D modeling module
Brightlayer Utilities suite

Discover the ultimate solution for complex cable arrangements and crossings

Eaton's CYMCAP 3D modeling module is a cutting-edge tool that enables three-dimensional thermal analysis for complex cable installations. It handles non-parallel complex cable geometries often seen in congested areas with multiple circuits crossing. It also provides valuable insights into effects produced by bending, sudden changes in cable depth and inclination, making it an indispensable asset in power cable analysis.

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The new CYMCAP 3D modeling module provides a proven solution for complex cable arrangements that meets current standards in ampacity calculations. The method used in this software extends the actual methodology described in the IEC 60287 and has been extensively tested against full finite elements solutions and validated by international experts. Results are also consistent with IEC 60287 for cables in parallel and crossing.

To perform these calculations, each cable is subdivided into small components (point sources), considering the electrical connection and thermal interaction between components within the same cable and across different cables in the same installation. An iterative methodology computes the temperature rise produced by each component and the heat dissipated in the surrounding medium until convergence is reached in the system.

Key features:

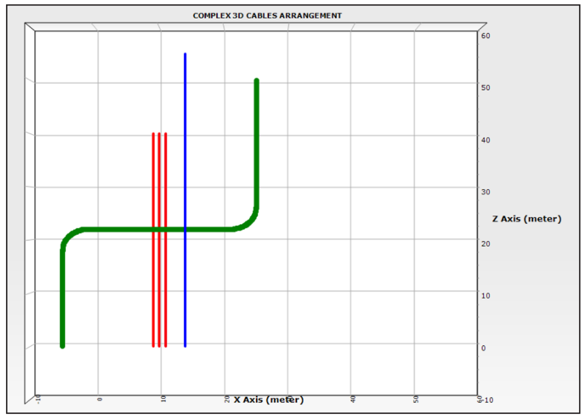
- Perform accurate temperature calculations for complex cable crossings with multiple underground circuits
- Leverage understanding of circuits changing directions with 3D representation of curved geometries such as bending angles and inclinations
- Get an increased understanding and prevent potential problems produced by short sections, such as a sudden change in the cable depth, to avoid obstacles in the route
- Handle various types of cables, including single core, three core, AC and DC, multiple cables per phase, etc.
- Support cables in ducts and solid duct filling materials such as bentonite
- Precisely identify the thermal bottlenecks and obtain temperature profiles for each cable
- Soil dry-out effect can be included
- Rigorously validated against full finite elements software and consistent results with the IEC methodology for parallel cables and single crossing

One of the main assumptions supporting the current methodology for standard ampacity calculations is that cable laying conditions are unchanged for a large extension. This assumption helps to simplify the analysis into a two-dimensional problem where the heat is mainly transferred radially from the conductors to the environment. However, cables installed in congested areas near the substations can involve multiple circuits crossing or changing direction (or depth) to avoid obstacles. These complex cable installations often fall out of the scope of the methodology described in the standards for cable ampacity calculations.

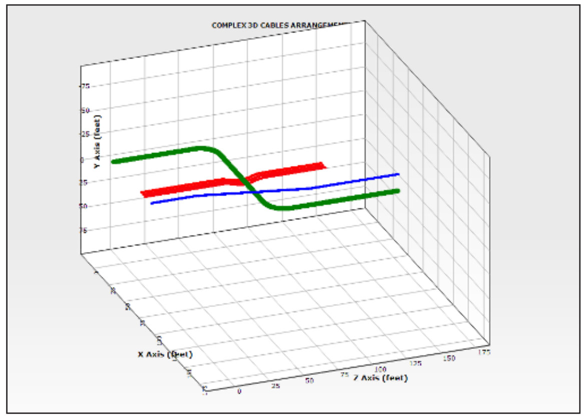
In the absence of a clear methodology for complex cable installations, some companies use conservative approaches that can involve assuming cables running in parallel or introducing derating factors to keep the results on the safe side. Another common practice is ignoring problematic sections, falsely assuming that short sections are not relevant when compared to the full circuit length. Modeling the installation with full finite element software is also a possible option. However, this approach requires deep knowledge of cable thermal behavior and strong modeling skills and sometimes, the complexity of the installation can make this process extremely difficult or inefficient.

Notes and limitations

- Soil surface is assumed as an isotherm. Thermal sections near the surface are not allowed
- Uniform soil is assumed. Multiple soil layers are not supported
- Transient and cyclic loading simulations are not allowed
- Maximum size of the thermal section is 200 meters
- Same electrical connection is assumed in the thermal section

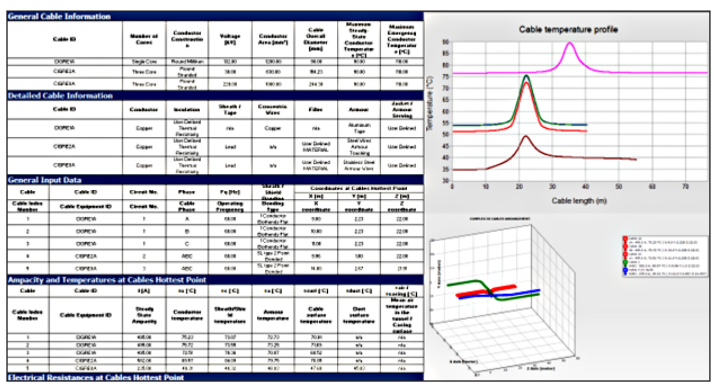


Complex crossing installation — top view



Complex crossing installation — 3D view

Multiple circuits in a complex cable crossing
The images showcase the top and 3D graphical views of three different circuits in a complex crossing situation. The green circuit changes direction, crossing the paths of the other two. The red circuit increases its depth, avoiding intersecting the green circuit at the top. The blue circuit maintains a consistent, inclined trajectory, crossing underneath the green circuit.



3D modeling report and temperature profile
A comprehensive report is provided, including information about the highest temperature and its location and detailed intermediate calculated parameters. Cable temperature profiles as a function of the length are available for each of the cable's main components: conductor, sheath, armour, cable surface and duct surface.

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

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