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Cable rating using a computer analogue

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Abstract: This paper gives an outline of a modelling technique that has capabilities similar to those of the finite element method but is much simpler to understand and implement. It uses only simple physical concepts and has a rigid logical development that requires no reference to partial differential equations and their associated theory. Thus two and three-dimensional modelling techniques are more accessible to a much wider audience who do not have the advance mathematical knowledge normally required for these methods. Hopefully such techniques will thus become more accessible to designers of cable installations and encourage more innovative solutions to cable rating problems

Keywords: cable rating, thermal modelling, two-dimensional, three dimensional, finite element method.

Résumé : Cet article donne une description générale d'une technique de modélisation dont les possibilités sont semblables à celles de la méthode par éléments finis, mais qui est plus simple à appréhender et à implémenter. Elle a recours uniquement à des concepts physiques simples et suit un développement logique strict qui ne nécessite aucune référence aux équations aux dérivées partielles, ni à leur théorie associée. De ce fait, des techniques de modélisation à deux ou trois dimensions sont plus accessibles à un auditoire bien plus large qui n'a pas de les connaissances mathématiques avancées normalement requises pour ces méthodes. Heureusement, de telles techniques deviennent alors plus accessibles à des concepteurs d'installations de câbles, et encouragent des solutions plus innovantes aux problèmes de capacité de transport des câbles

1. Introduction

Modern computers have provided a powerful capability for the analysis of cable rating. However this capability is not in generally available to designers who must rely on procedures described in IEC publications based on techniques developed before the advent of computers.

Procedures described in IEC documents [1][3][4] for calculating ratings rely on the assumption of radial heat flow. Such procedures are sometimes too limited and designers must rely on their experience for a practical solution. Such problems could include a special trench design, a group of cables or duct bank or even the effect of a long length of duct on the cable rating. A study of such problems requires techniques such as the finite element method (FEM) allows modelling of a two or three dimensional region or field and is not limited to the one dimensional radial heat flow solutions of the IEC documents.

Reasons for the limited use of techniques such as the finite element could include costs to purchase and maintain such software for occasional use, the necessity for training and a good mathematical background to properly use the software. There is also a general lack of familiarity with numerical methods that are considered to be the domain of engineering research establishments and universities. Such an attitude is reinforced when considering the advanced mathematical expertise required to master techniques such as the finite element method.

Lack of access to capabilities provided by the finite element method need not be a limitation. This paper provides a short description of a technique that can provide access to such capabilities. It is easy to understand, relatively simple to implement and also has the flexibility of finite element method. The aim is to show that the more powerful techniques for studying cable rating are accessible and put this capability in the hands of designers and provide the opportunity for more innovative solutions. It could also lead to less expensive software.