FLUX STUDIO: Dimensioning of an electromagnet at Schneider Electric.

Ph.Schuster – J.C.Ramirez – D.Savall - *SCHNEIDER ELECTRIC.*

Circuit breakers of the Schneider range.

Most often forgotten in a cupboard, their existence being generally not remarked (except for the case when the fuses blow…), the miniature circuit breakers are however high technology devices, with a complex design and able to show amazing performances considering their reduced size (switching short-circuit power of about 10000 A in less than a hundred of cm^3 !).

The heart of this equipment is an electromagnet with a plunger core, having a twofold purpose: to allow the unlock of the mechanism in case of short-circuit, and to impose an opening speed of the mobile contacts high enough to limit the instantaneous value of the current to a value that can be supported by the installation.

The optimal dimensioning of this electromagnet is therefore a key element in the design of circuit breakers.
Firstly, this dimensioning is important at the anticipation phase (elaboration of new apparatus), then at the development and adjusting phases. Finally, the existent and already commercialised products can be the object of new studies in order to evaluate the impact on the performances of a partial re-design carried out to increase efficiency and reduce costs.

Thus, the dimensioning of a magnetic actuator is not an infrequent event; however, it is not so frequent as to make it possible, for a designer, to have a day-by-day competence on tools of FLUX2D type (not speaking of FLUX3D). Experience has shown that, in fact, these tools require regular practice, so that all their efficiency and reliability be exploited. In any case, the constraints of in-project work do not allow designers enough time for this practice.

Besides the understanding of the physical principles involved, the difficulties arise mainly in the logic of using the software tools (the new interfaces ease this task) and especially in the mastering of the notions linked either to the theory (for example the boundary conditions), or to the finite element method (for instance, the quality of the mesh).
For someone who is not a specialist, it is not easy to decide which modifications and simplifications can be made, for example, in order to use a 2D axi-symmetrical model for a 3D object.
Thus, the major benefit of Flux Studio consists in the possibility of hiding the specific technical part of the finite element analysis: boundary conditions, mesh, etc.

On the other hand, the parameterisation feature allows the user to make use of the quantities at hand (dimensions, material references). Moreover, one can take into account the possible modifications that are necessary in order to pass from the real 3D geometry to a 2D axi-symmetric representation.

(continued on page 4)

Asynchronous machine end windings characterisation with FLUX3D. (continued from page 2)

Fabrice Foucher, Claire Blache - CEDRAT.

Connections with a FLUX2D study

The computed value can be introduced in the CIRFLU module of FLUX2D in order to realise a complete study on motors. With the knowledge of the end winding inductance, your study will take into account the extremity leakage, which are important in transient.

You can see below the representation of the electrical circuit with the components which represents the end winding leakage.

Studied device.

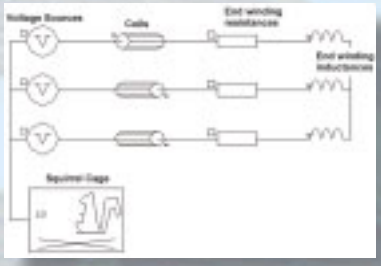


Figure 5: Representation of the asynchronous machine with CIRFLU.

Method	FEM 1		FEM 2	
Simulation	Number of solves	Total solving time (mn)	Number of solves	Total solving time (mn)
Reference case	1	3	2	5
Monophase	1	1	2	2
With saturation	X		X	
Rotor	1	4	2	6
Method	FEM 3		FEM 4	
Simulation	Number of solves	Total solving time (mn)	Number of solves	Total solving time (mn)
Reference case	2	6	2	5
Monophase	1	2	1	2
With saturation	X		4	28
Rotor	2	8	2	6

Table 1: Computing times

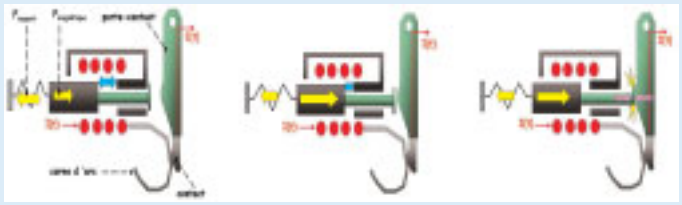
FLUX STUDIO: Dimensioning of an electromagnet at Schneider Electric. (continued from page 3)

Ph.Schuster – J.C.Ramirez – D.Savall - *SCHNEIDER ELECTRIC.*

Finally, the possibility to attach a hypertext help to the application, specific to the studied device, developed by an expert which integrates all the knowledge and the design constraints, allows the designer to propose, in an autonomous way and over a minimum amount of time, a dimensioning approaching the optimal case.
Thus, Flux Studio is involved in a permanent process of improving the design offices.

The analysis of a certain number of actuators designed over the last years has allowed us to create a model entirely defined by about thirty representative geometric parameters of the constitutive parts. When these parameters do not correspond to standard dimensions, the on-line help will assist the designer to set their values.
This parameterisation assigned to convenient surface and line regions at their creation allows the modelling of a variety of shapes of the components, according to most of the requirements formulated. The problems connected to the solving process, which are related to the quality of the mesh, have been anticipated as much as possible and, moreover, the help can be used to interpret the error messages and correction suggestions.

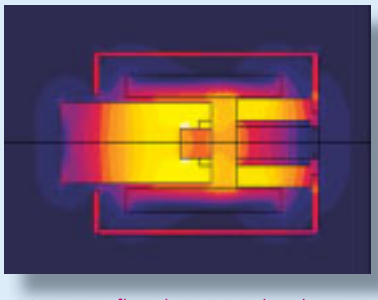
This first application has been developed in the frame of an intership of about 3 months. During this time, the person who worked on it passed through the following steps: understanding the dimensioning issue, learning how to use the software, reflection time on significant parameters and, finally, the creation of the test-problem. The time spent by an engineer with experience in FLUX2D and having already good knowledge of the products should be obviously much shorter.



Operating principle of the circuit breaker..

For the moment, the developed application has been tested on two concrete cases (a new product and an existent product). In both cases, the time to train the designer to use the tool and create the particular geometry was of about half a day.

Studied device.



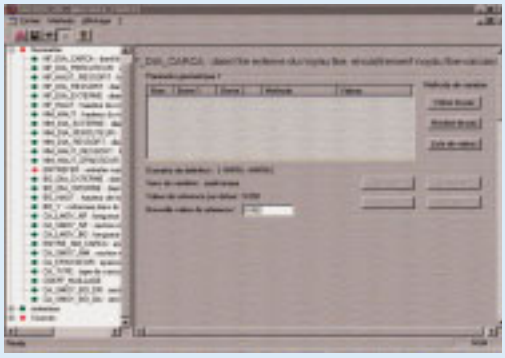
Magnetic flux density in the device.

The quality of the results obtained, validated by a specialist in FLUX2D, allowed their usage without any modifications.

However, in order to impose such a tool on a large scale, we have considered that certain improvements, such as the possibility of defining a link between parameters of different nature, should be added to the present release of the software.

In conclusion, in spite of some reserves, we consider this experience as a very positive one.
The interest shown by the designers in charge of the test has encouraged us, on the one hand to try to improve and then develop this first application on a larger scale, and, on the other hand, to look for other devices that can accept a similar approach.

Schneider Electric



FLUX2D parameterisation window.

2002 European Flux Users Club.

This year Users Meeting took place at Hotel Maritim, in Munich, Germany. Around 100 participants joined us to share their experience in Flux use and showed their interest in the software. We thank all of them. The answers to the final questionnaire showed us you have appreciated this meeting.
Finally some of you guessed where next Users Meeting will take place. Congratulations!
Next years Users Meeting will take place in Paris, France. We are looking forward to seeing you there.