NUMERICAL MODELLING AND DETERMINATION OF FRACTURE MECHANICS PARAMETERS: WORKSHOP SUMMARY REPORT

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1 Introduction

In this paper a short summary of the workshop "Numerical Modelling and Determination of Fracture Mechanics Parameters" is given. The goals of the workshop were:

(1) Develop efficient procedures for estimating model parameters that could lead to a fracture model with predictive capabilities.
(2) Promote a close cooperation between numerical modellers and experimentalists.
(3) Suggest a standard test method that could be used as a benchmark problem for numerical models, and which could serve as a comparative means between experimental studies.

The presentations of the introductory speakers were split into two parts. First the different numercal models, with their own problems, advantages and needed input parameters were explained after which a discussion followed. Next the results of a workshop on 'standard test methods' held in Cardiff a week before the FraMCoS-meeting were presented.

2 Summary of Presentations and Discussion

In the short presentations of the papers, which are published in this volume, an overview was given of different fracture models. Main issue was the different parameters needed in the models. These parameters have to be measured or fitted from experimental data. Depending on the sophistication of the model, one or more of the following parameters are needed:

- maximum load
- initial slope of the descending branch
- fracture energy
- shape of the softening curve
- internal length scale of the material
- probabilistic/variation parameters

It has to be mentioned that in some models not all of the parameters can be extracted from experiments, and thus they can not be regarded as material parameters. These parameters which have to be fitted or guessed are model parameters.

An other point of attention was whether practitioners will use fracture mechanics if the model to simulate fracture and the method to find the input parameters are not simple.

The general conclusion from the presentations was that more parameters are needed when the model is more advanced. Yet from the other side, the more advanced the model is, the more realistic the simulated results look. It is not clear if the sophisticated models have realy better predictive capabilities. Maybe it are better fitting capabilities, because of the larger number of parameters, which govern the more realistic results. In most of the models, especially when they are more advanced, also model parameters are included. It would be best, also to convince practitioners that fracture mechanics can be useful, when the number of these model parameters is kept as small as possible.

Part of the discussion dealt with the fact whether or not it would be better to use the simplest model with the smallest number of parameters. In most cases this would probably give results which are close enough to reality and it would be best for convincing practitioners. Also the test that has to be done to determine the input parameters could be kept simple and could be easily being performed in every laboratory. However, if the choice would be a simple test, from which only a few parameters of the list above could be determined, then the development of more advanced models would become a problem. The parameters needed in these models could then not be obtained from the simple test and no comparison with simple models could take place. Therefore, because of further research demands, a standard test is needed from which as much as possible parameters from the above list

can be determined.

Of course there are different opnions about which test would be best. But it is also agreed on that one test has to be chosen, otherwise a comparison between different models is never possible.

Another question that was addressed was whether the standard test should lead to mode I parameters only, or should also parameters for mode II or mixed mode failure be the result. And what about failure under compression? Yet this topic was already heavily discussed in the Cardiff workshop on standard test methods. For the results of this discussion and also for the standard test that was decided on, the reader is referred to the paper by S. Swartz & B. Barr in these proceedings.

A large part of the discussion was if we can use micro- or meso-level models to fit or determine the input parameters for macro-level models. There is no doubt that results of fracture simulations with such kind of models look very realistic and give insight in the fracture process. However, also in these models at some point input parameters have to be chosen. To do so, material on a certain scale has to be assumed to behave as a homogeneous continuum. For instance in a macro-level model we consider the concrete as homogeneous. In a meso-level model we generaly consider three phases: matrix, aggregates and interface. These three phases are taken homogeneous, which is of course not correct either. This means that at lower scales one has the same problems and errors in determining the input parameters. It can be concluded that the models on a lower level are not the ultimate solution for finding the input parameters for macro-level models, yet they can certainly help.

3 General Conclusions

The final conclusions of the workshop can be summarised as follows:

(1) A Standard test is needed to determine the input parameters for different fracture models.
(2) This standard test should also be used as a benchmark to check and compare the numerical models.
(3) Use the benchmark for a 'blind round robin' to check the models for their predictive capabilities and discuss the results at FraMCoS-III.