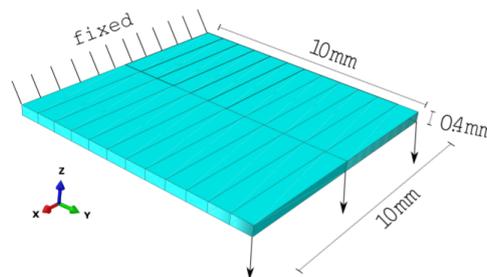


# Computer Modeling of Paperboard for Fast Simulations in the Packaging Industry

*Are you interested in computer simulations of real world applications? In this thesis we investigate an approach for fast simulations of the paperboard material. A potential application is the forming process of paperboard in the packaging industry.*

Paperboard is frequently used in the packaging industry. One example is the global cooperation Tetra Pak. If paperboard can be accurately described in a virtual environment, the cost in product development could be vastly reduced. A virtual environment, describing the fundamental manufacturing process, can also aid and inspire innovation. While we are all very familiar with the paperboard material from daily life, an accurate physical model describing paperboard is actually really hard to achieve. Very sophisticated modeling tools are required to capture the inner complexity of paperboard. In this thesis, a complex model for paperboard is used together with a special numerical technology in order to reduce the computational time. The numerical technology is a “special element”, used in the so called “Finite Element Method”, shorthand notation FEM. The strength of the FEM method is that it can be used to solve complex problems, governed by fundamental equations, without being restricted to very simple geometries. In the FEM method you divide the geometry, for instance a paperboard subject to forming, into many small sub-regions. To calculate the equations for all sub-regions is a much simpler task then to solve the problem for the entire geometry. The solution to the entire problem is then provided by combining the solution for all the sub-regions. A small (another word is Finite) sub-region in this context is called a “finite element” and thus the name “the Finite Element Method”. In this thesis a special type of finite element is studied which is particularly suitable for thin geometries with curved boundaries. If this element is used with such geometries, you can solve problems without having to divide the geometry into as many sub-regions compared with standard FEM elements.



**Figure 1:** Only a few special elements are required to produce an accurate solution.

Many forming applications, using paperboard, are modeled with geometries where the special element is performing well. The element is therefore of interest in the packaging industry. The work in this thesis is showing the potential to use the special element in combination with a very complex model for paperboard. This was done by studying a number of simple problems, where the element was rigorously compared against precise solutions. The special element was also implemented in the commercial software Abaqus and it is ready to be used for more complex simulations related to the forming process.