1. INTRODUCTION

The stress concentrations can be determined in a shaft by diverse methods: mathematical methods, photoelasticity, Finite Element Analysis, etc. By knowing the behavior of these concentrations, the engineer can modify its design in order to increase the service life of the element and also the security of the people who operates it. The success of it depends on the value of the Stress Concentration Factor used, because if it is high, the element is more prone to failure.

The stress distribution can be constant over a certain area or it can be variable. Most of the engineering applications have variable distribution, and that it is why it is important to predict or to have a clear idea of how the element is going to behave under certain load conditions. Three important parameters to consider when figuring out the stress distributions are the material, the shape of the element and the loading conditions.

The determination of the Stress Concentration Factor includes basic concepts in engineering such as maximum stresses, nominal stresses, strains, etc. This factor is a ratio between the maximum average stress generated in the critical zone of discontinuity and the stress produced over the cross section of that zone. It can be defined as:

$$K_t = \frac{\sigma_{\max}}{\sigma_{nom}}$$

In order to find these values, tables have been done, but a big problem is that each element needs its own Stress Concentration Factor Chart. Any particular element needs a particular Chart, and by watching it the engineer is capable of deciding if it is a good option to work with that amount and behavior of stress concentrations.

In this case, the K_t Charts will be generated with analyses done by the Finite Element method. The first thing to do is to define the element shape, and then to add stress concentrators. In this case, the shape taken as a basis is a shaft of diameter = 10 mm, Length = 100 mm, and one notch placed in the middle of it of radius = 1 mm. An analysis is going to be performed for this specimen, and then complementary notches will be added to study the effect of them in the stress concentration of the central notch.

The Stress Concentration Factor Charts include two parameters: in the *x* axis a ratio L/r, which describes the relationship between the distance at which the complementary notches are from the central notch and the radius of the notch; in the *y* axis, the value of K_t. The line generated from this data is a ratio L/r, which describes the relationship between the diameter of the shaft and the diameter of the shaft at the point where the notches are placed (in this case D = 10 mm and d = 8 mm).

The analyses will be divided in three groups: the first group includes specimens with a distance L apart from the highest point of the central notch. Complementary notches in this case will be of radius = 1 mm for the first analyses, and then this radius will be increased in 1 mm. The second group takes the distance L from the same point that the first analyses, but instead of having only one complementary notch on each side of the central notch, it will have two. Finally, the third group will take the distance L from the lowest point of the central notch to the lowest point of the complementary notches. Again, the first of these analyses will have complementary notches of radius = 1 mm and the other two will increase its radius by 1 mm.

Once the groups have been defined, the method of analyses will be explained. First, a specimen will be drawn in the CAD Software of Algor 13. Once this is done, a solid mesh will be generated. When the element is already a solid, it will be exported to the FEMPRO Interface. There, the material will be defined, as well as the boundary conditions and the direction and size of the force. After this, the Global Data will be inserted, and later the analysis will be run. Once the analysis finishes, the Maximum Principal Stresses are going to be looked for. For each notch, the maximum stress has to be at the lowest point of it. When this value is known, it will be divided by the value of the nominal stress, and this ratio will give the value of the Stress Concentration Factor. This analysis has to be performed at least ten times, varying the distance L. Then, the Charts will be generated, and with basis on it, a general equation that describes the behavior of the element will be found.