10. RESULTS

Seven analyses have been performed so far, and they were presented in the past chapter. In the present chapter all those analyses will be compared, and an option of which the best arrangement is will be chosen. This option will be chosen with basis on the effect of the complementary notches on the central notch because there is where the Stress Concentration Factor is wanted to be reduced.

The first arrangement was with notches of the same radius, and separated a variable distance L which goes from 0 to 4 mm. The following chart was obtained:

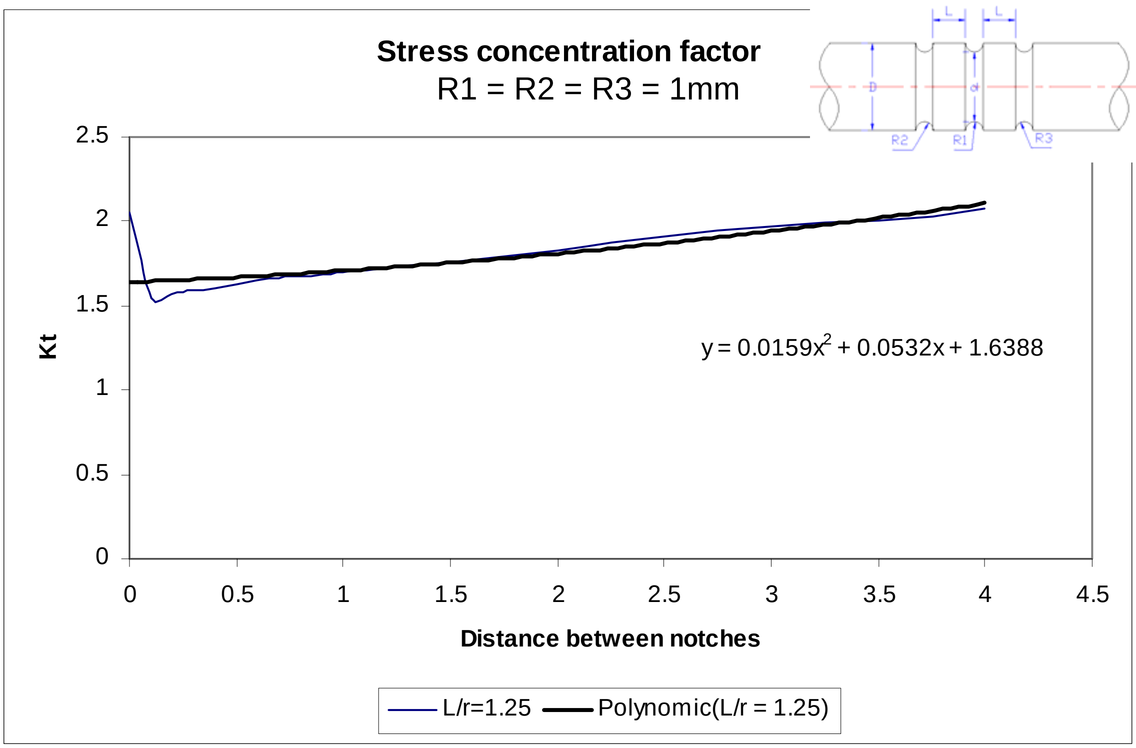

Chart 52. Stress Concentration Factor for First Analysis

The second analysis was with a central notch of radius = 1 mm, and with two complementary notches of radius = 2 mm. The K_t Chart obtained is:

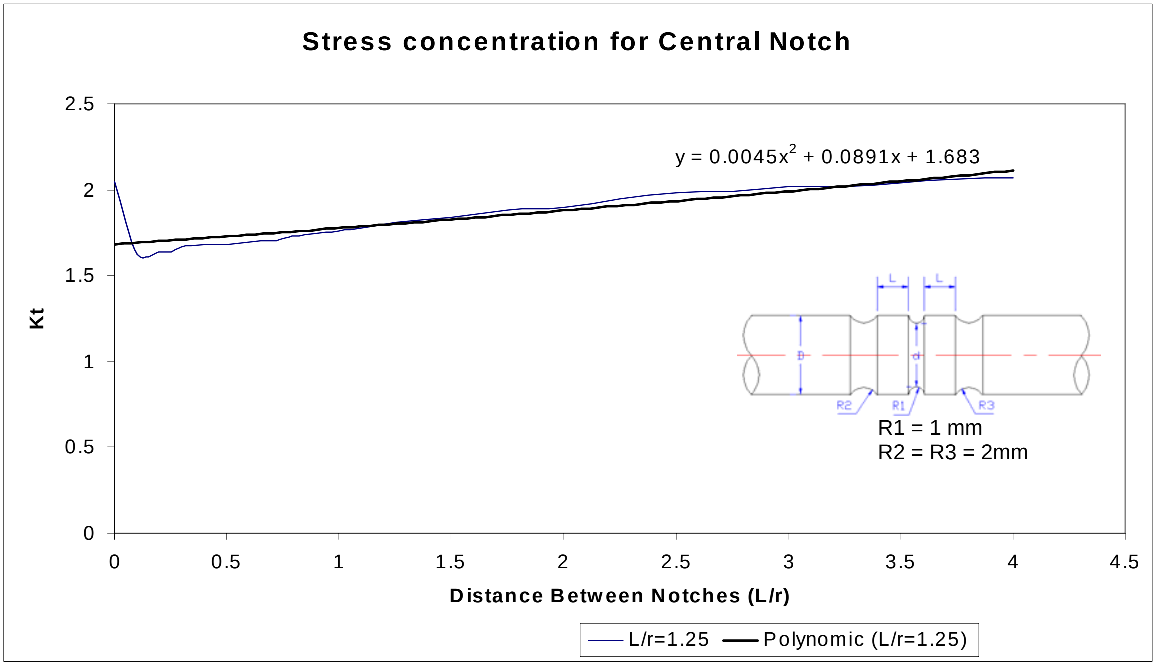

Chart 53. Stress Concentration Factor for Second Analysis

The third analysis was to a specimen with a central notch of radius = 1 mm and with complementary notches of radius = 3 mm. The resulting Chart is:

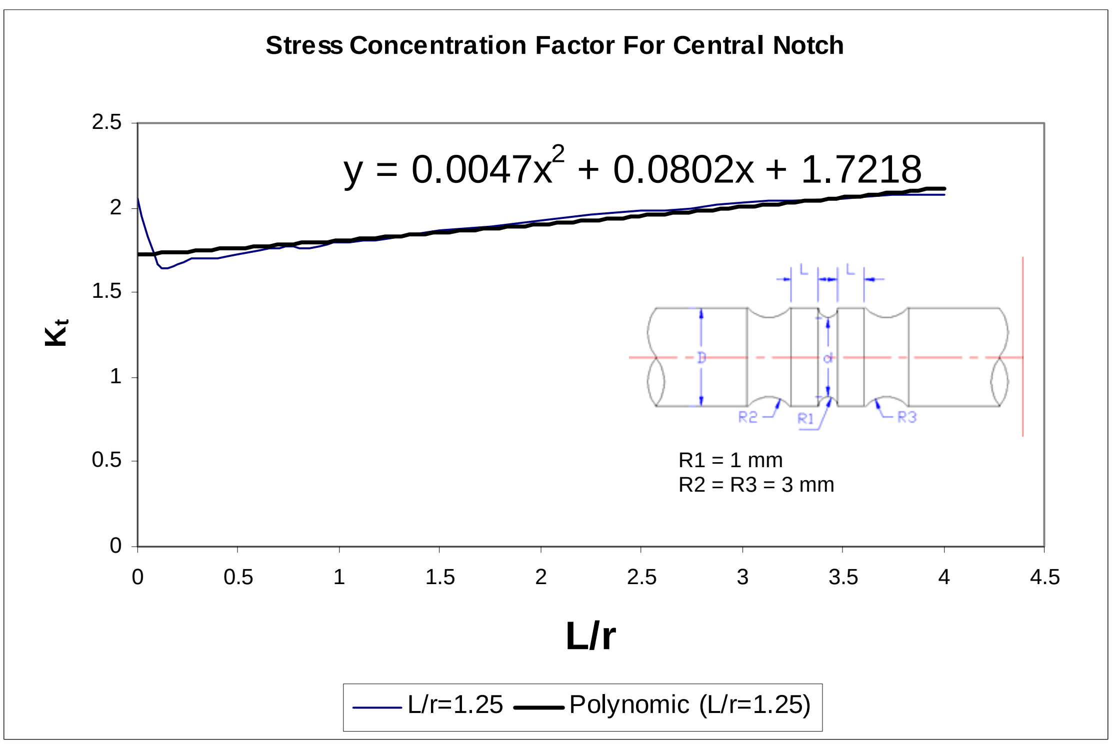

Chart 54. Stress Concentration Factor for Third Analysis

These three analysis were performed with the same distances: 0 mm < L < 4 mm, increasing by 0.1 mm from 0 to 1 mm, and then increasing by 0.25 mm from 1.25 to 4 mm. The fourth analyses performed was to a specimen with a combination of four complementary notches, all of them of radius = 1 mm. The chart for this analysis is:

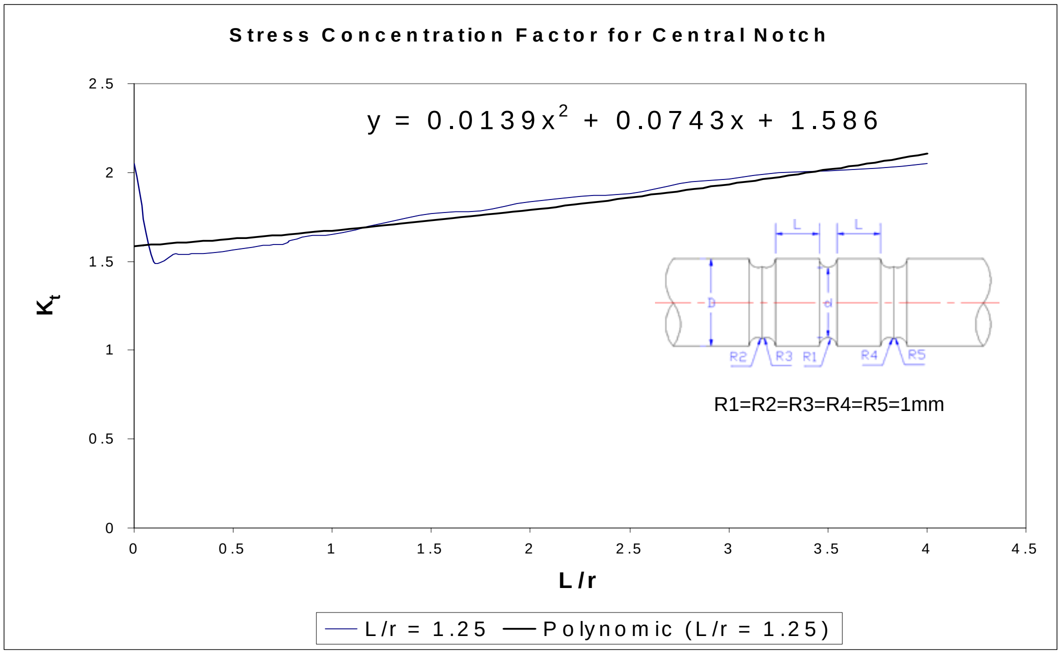

Chart 55. Stress Concentration Factor for Fourth Analysis

For the fifth analysis, the arrangement was changed again. The central notch was still of radius = 1 mm, and so the complementary notches. The difference is that the distance L is taken from a different point (from the lowest point of the central notch). The chart obtained is:

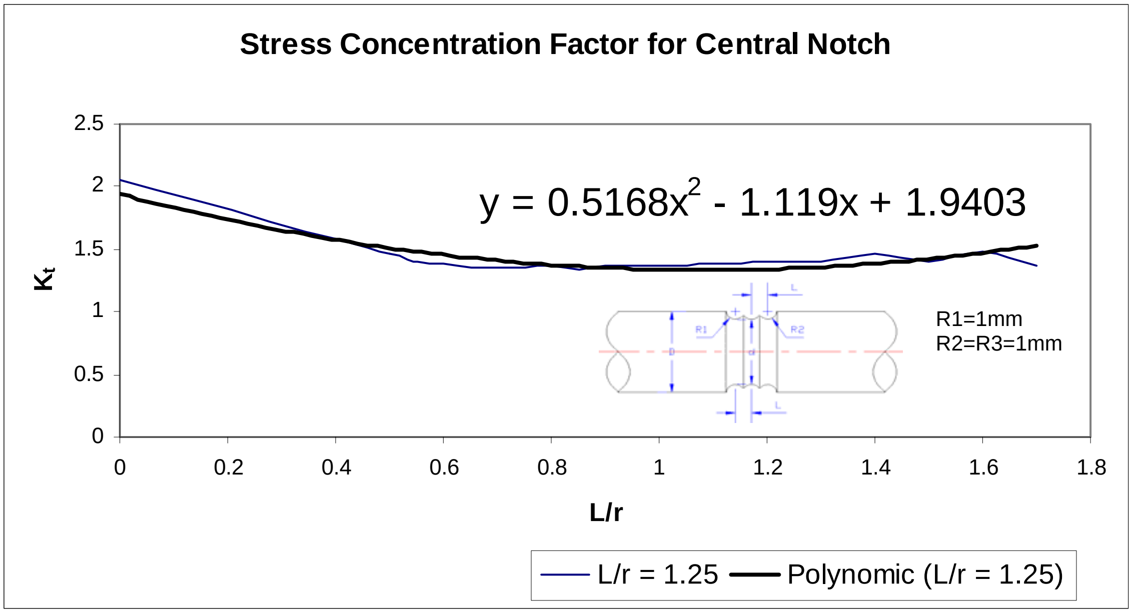

Chart 56. Stress Concentration Factor for Fifth Analysis

The sixth analysis was done with the same arrangement, but instead of having a complementary notch radius of 1 mm, it was increased to 2 mm. The distance at which the analyses were made also changed. The corresponding Chart is:

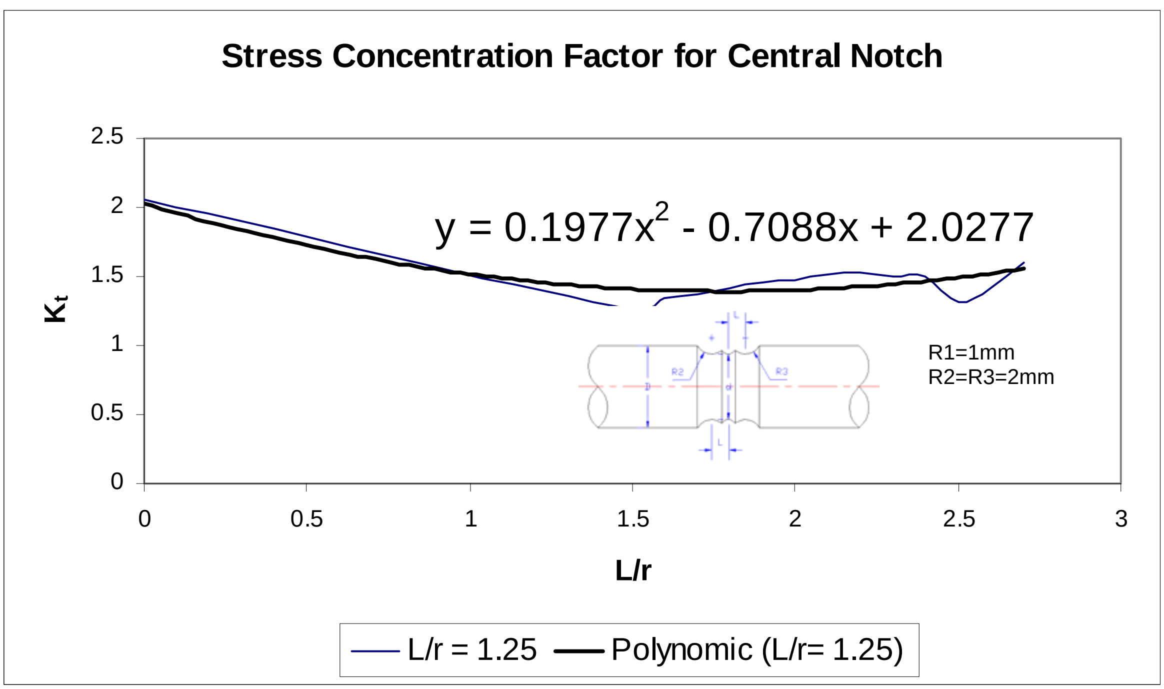

Chart 57. Stress Concentration Factor for Sixth Analysis

Finally, the seventh analysis performed was with the same arrangement than the last two, but instead of having a complementary notch radius of 1 mm, it was increased to 3 mm. The following Chart was obtained:

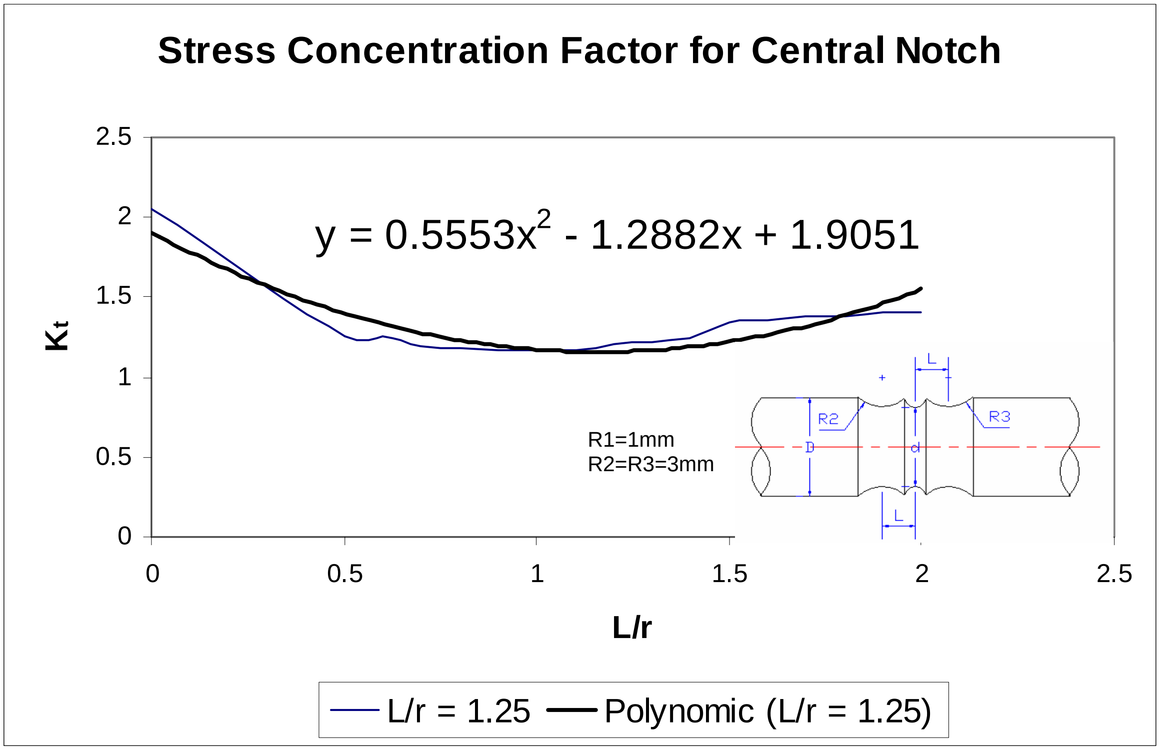

Chart 58. Stress Concentration Factor for Seventh Analysis

Once all these analysis have been performed and their respective Charts have been built, comparisons can be made. In order to make a good comparison of the arrangements, their effect on the Stress Concentration Factor on the central notch has to be analyzed. To do this, a new Chart was built (Chart 59). To have a good pattern of comparison, the parameters used were: Stress Concentration Factor and Distance Between Notches. The ratio L/r was not taken into account because it differed a lot depending on the radius. Because of this a good comparison could not be made, because the lines will differ by one half or by one third, depending on the radius of the notch. That is why this ratio is used only to construct K_t charts. The resulting Chart is shown next:

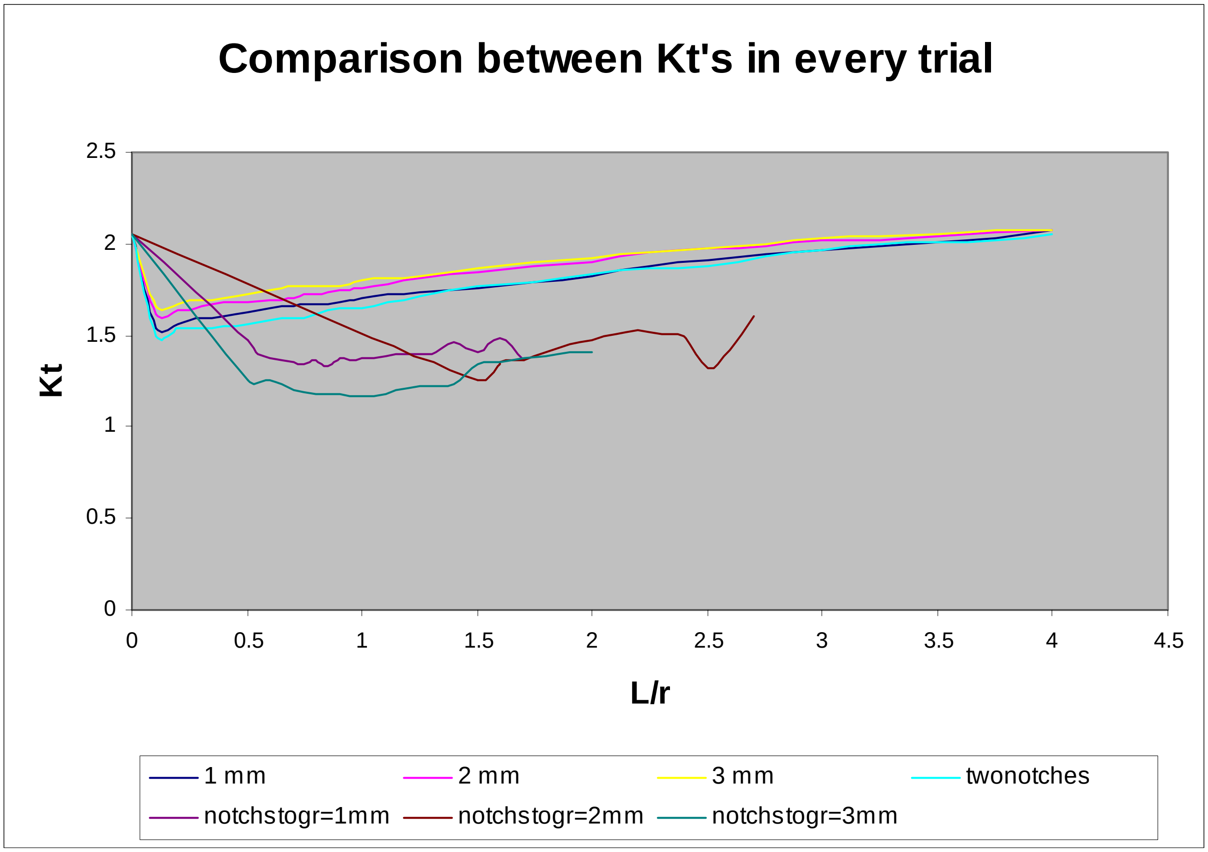

Chart 59. Comparison between Kt's in every analysis

The blue line represents the first analysis performed. That could be one of the most used arrangements, and it represents a good option. It is said to be good because it is in the middle of all the lines of the other analyses. So a "standard" option for all the trials made would be all notches of radius = 1 mm and separated a distance L taken from the highest point of the central notch.

The worst options to take into account are the second and the third one (magenta and yellow line).These options do not diminish the Stress Concentration Factor, but they increase it. That is not a good alternative for the designer, because doing this is going to diminish the service life of the product, and what a designer looks for is to reduce the change of parts of a machine (this reduces costs and increases operation time). So for the first analyses, increasing the radius of the complementary notches has a negative effect on the K_t of the central notch, and that is why these two alternatives should be discarded.

The fourth analysis performed (cyan line) represents the first good option of all the analysis. This arrangement allows diminishing the K_t of the central notch. The disadvantage here is that the reduction of the Stress Concentration Factor is not too big, and it is valid only for a distance L from 0 mm to approximately 1.5 mm, because after this distance the K_t is increased, and it reaches the state of the first analyses performed. In some points it is still lower, but also in some points it is higher, so it can be taken as a parallel line with the one of the first analysis.

For the fifth analysis (purple line), a good improvement is achieved. The Stress Concentration Factor is reduced more than all the analyses done until this point. A great disadvantage here is that analyses could not be done to notches at a distance 0 to 5 mm, but the positive point is that there is no application in this range. The lowest K_t reached in this analysis is about 1.34, which is a reduction of the 34.6% of the original factor. That is the optimum point for this arrangement.

In the sixth analysis (brown line) there is an even more good improvement. The Stress Concentration Factor is reduced more than in the past analysis. Even if the analysis started at the point where L = 1.5 mm, the results are good. So if analyses were performed at a range from L = 0.5 mm to L = 1.5 mm, the data obtained will only complete the data existing now. The reduction of Kt is from 2.05 to approximately 1.25, which represents a reduction of 39.02 %.

The last analysis (green line) is the one with the best results. The distance in this case goes again from 0.5 mm to 2 mm, but the reduction achieved in the first analysis is important, even if after it reduces more. The lowest point achieved here is approximately 1.17, which represents a reduction of 42.93%, nearly half of the original Stress Concentration Factor. This is the best option for the designer to use, because this can increase the service life of the shaft. During all the range of L it represents a good reduction of K_t.