

THE EFFECT OF THE NUMBER OF HARMONICS USED IN THE CALCULATION OF STRESSES IN WHEELS USING A FOURIER SERIES SOLUTION

The stress analysis of railway disc wheels is normally carried out on the finite element program NEWPAC by superimposing a number of Fourier-type solutions. In this procedure the applied loads must be approximated by an appropriate series and the accuracy of the final solution depends on the number of harmonics retained in the series. A greater number of harmonics increases the computation cost.

The report details some investigations made on a lightweight wheel of R&D design both to see the effect of the number of harmonics used and to compare with the results from an analysis using a 3D program.

In conclusion:

- The harmonic type analysis of NEWPAC can give adequate accuracy with a few harmonics for lateral loads on conventionally shaped disc wheels.
- The ratio of stresses obtained from successive harmonics for a radial load is equal to the radius ratio; it is even smaller for lateral loads. Thus the important stresses most likely to be in error because of lack of convergence are those at the web/rim fillet radius caused by radial loads.
- To determine whether the desired accuracy has been achieved, it is recommended that a separate single harmonic analysis is done after a combined analysis and a comparison made of the single harmonic stress with the combined total. A decision can then be made as to whether a) the accuracy is adequate, b) a further analysis with more harmonics is needed, or c) an adjustment can be made based on the single harmonic result and estimates of succeeding results based on the radius ratio.
- A 3D analysis using the program BERSAFE to its current limits showed no significant advantage over the use of NEWPAC harmonic analysis.