8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

SCFJ – A DISCRETE MODEL FOR A PROBABILISTIC ANALYSIS OF CONTINUOUS WELDED RAIL STABILITY AND APPRAISAL OF TEMPORARY TRAIN SPEED LIMITS

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Key Words: *Continuous welded rail, Probabilistic computational model, Non-linear stability analysis, Track buckling model.*

ABSTRACT

In 1992÷1999 period the International Union of Railways (UIC) commissioned a research program from European Rail Research Institute (ERRI) about improving the knowledge of continuous welded rail (CWR) track, including switches [8]. This research was necessary for revision and update of Leaflet UIC 720 which regulate the problems concerning the laying and maintenance of CWR track, which was from January 1986. In the new Leaflet UIC 720 [5], wich was from March 2005, was introduced concepts and criteria for the CWR buckling safety assessment and it were shown cases studies which appeal to the two analysis of CWR stability software, one developed at TU Delft (Holland) for ERRI – software called initialy CWERRI, and nowdays LONGSTAB – and the other developed at Foster&Miller company for Federal Rail Administration of United States of America (FRA) – software called CWR-BUCKLE [4], [5]. In this context, at Civil Engineering Faculty from the University Transilvania of Braşov, România, was developed a software for lost of track stability simulation using a non-linear discret model for CWR buckling analysis, in presence of thermal and vehicle loads, model called SCFJ (**S**tabilitatea **C**ăii **F**ără **J**oante = Stability of CWR). A presentation of SCFJ model can be found in [6].

This paper presents a probabilistic computational model of the buckling of the continuous welded rail (CWR) track. The great variability of the main parameters which characterize the stability of the track is introduced in the computational model by the statistical distribution of the parameters. The model is based on a nonlinear analysis in total lagrangean formulation. The structure consists of beam elements and lateral, longitudinal and torsional spring elements. The source of nonlinearity is due to the geometric nonlinearity of the rail high axial forces and also to the nonlinearity of material type for the lateral and longitudinal resistance of the ballast and the torsional resistance of the fasteners. The use of a

displacement control algorithm leads the analysis beyond the critical point and permits a more realistic computation of the structural safety. The track model is encoded into a special purpose program which allows a parametric study of the influence of vehicle loading, the stiffness properties of the structure and of the geometric imperfections on the track stability. This model is different by the others, because SCFJ also include a correction of torsional resistance of fastenings, which take in account the influence of the vertical loads on the rotation of the rail in the fastenings. The validity of the present model is verified through a series of comparative analyses with other author's results [7], [8].

Also, this paper presents an algorithm for appraisal of temporary train speed limits using the simulation of the continuous welded rail (CWR) track buckling in a probabilistic approach. The algorithm is based on evaluation of convolution integrals [1], [2], [3] in a discret approach [3] using the histograms of the main parameters which characterize the stability of the CWR track [6]. The temporary train speed limits disturb normal passenger and freight traffic set in train schedule and determine losses due to the decrease of circulation capacity on the railway. That has temporary train speed limits one estimation of the allowable temperature limit under which it is possible to circulate in safety conditions with a known speed limit on the railway sector studied is an imperious necessity. In view of the great variability of main parameters which govern the stability of the CWR track it must use the algorithm for probabilistic appraisal of the CWR track buckling developed in [4] and [6] to estimate these temporary train speed limits.

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