NASCon v.1
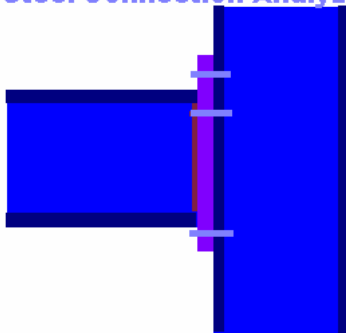**Steel Connection Analyzer**

NASCon

NASCon is a Steel Connection Numerical Analysis Tool.

Developed in the framework of the Master Dissertation

**PROBABILISTIC EVALUATION OF THE
ROTATION CAPACITY OF STEEL JOINTS**

of

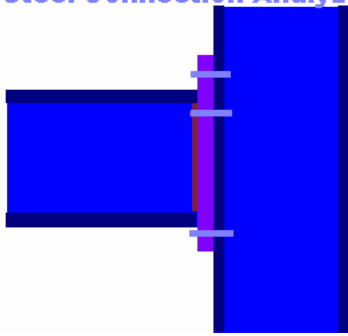*Luis António Costa Borges*

Oriented by

Prof. Luís A. P. Simões da Silva

in the Department of Civil Engineering of the University of Coimbra

Coimbra, 2003 - Freeware for educational purposes.
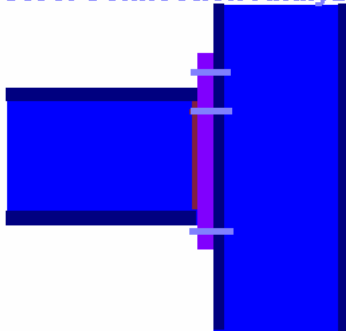
NASCon

HELP file version 1.0

NASCon is a Steel Connection Numerical Analysis Tool.

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Theory
User Guide

NASCon v.1
Steel Connection Analyzer

NASCon

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Theory

The NASCon (Non-linear Analysis of Steel Connections) program was built using Borland Delphi 6 (Object Pascal) development tool. It has been developed in order to provide a computer user-friendly tool that can help researchers and civil engineers implement the components method in an easy way without having to reset time consuming general finite elements packages.

Chapter 1, Introduction to NASCon

It is also intended that NASCon simulates an experimental test so that we can compare results obtained experimentally with those obtained numerically after complete characterization of relevant components behaviour. It allows the user to control both Loadings and Displacements, two different strategies of carrying out a test.

Chapter 2, Brief Description (full description of the calculation procedures is given in the dissertation text)

Kinematic degrees of freedom (dof)

NASCon program considers a unidirectional model is shown in Error! Reference source not found., assuming one degree of freedom between two consecutive springs and two global external degrees of freedom: one for rotation and the other for axial displacement (Rot and De respectively).
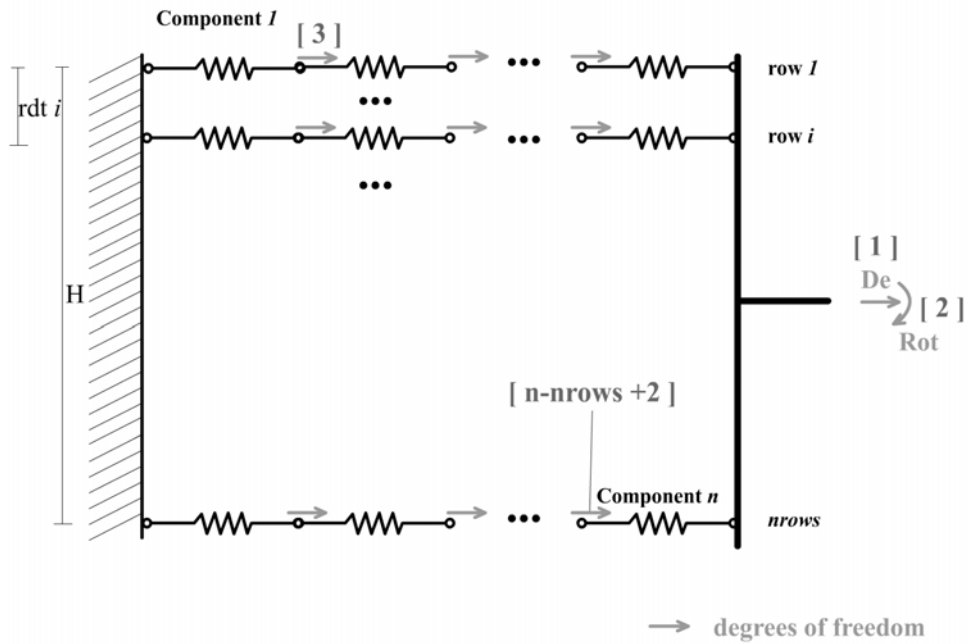
Spring Model and degrees of freedom

Stiffness matrix

The Pascal algorithm that computes the stiffness matrix can be found in Appendix - Error! Reference source not found. - Error! Reference source not found..

Constitutive law of the components

NASCon accepts components which exhibit any multi-linear force-displacement curve provided that abscises are monotonically increasing and the point (0, 0) is explicitly included. The components are restricted to nonlinear elastic behaviour, meaning that unloading follows the loading path.
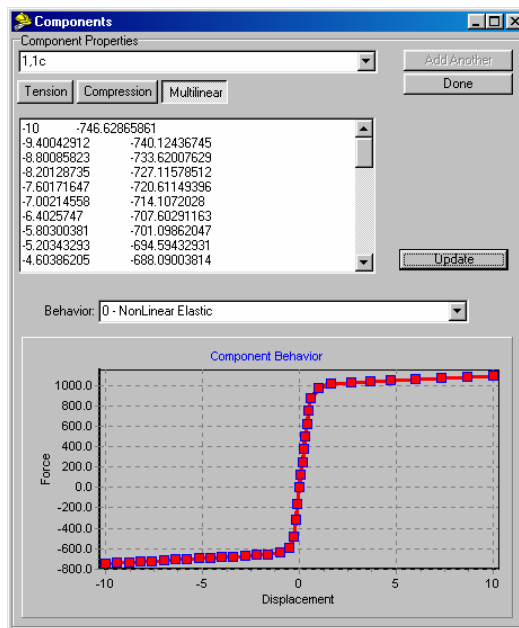
Multilinear nonlinear component behaviour.

The subroutine used to handle the behaviour of the components is given in Appendix Error! Reference source not found. (Error! Reference source not found.)**.**

Strategies

The NASCon program includes different algorithms for solving the nonlinear system originated by the nonlinearity of springs that constitute the model.

If the Simple Incremental Load Control Method is excluded, all other methods, Displacement Control Method, Newton-Raphson Load Control Method, Arc-length Method and Work Control Method have a main structure in common with the Incremental/iterative technique described in Chapter 2 (2.2).

In order to provide more than a "single point solution" and to trace the complete M-rotation curve, these methods combine the incremental and iterative solution procedures. The tangential "incremental solution" can be used as a "predictor" which provides the starting solution for the iterative procedure. A good starting point can significantly improve the convergence of iterative procedures.

NASCon v.1
Steel Connection Analyzer
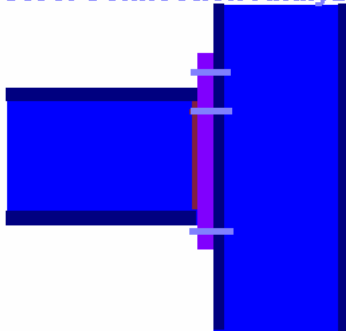
NASCon

HELP file version 1.0

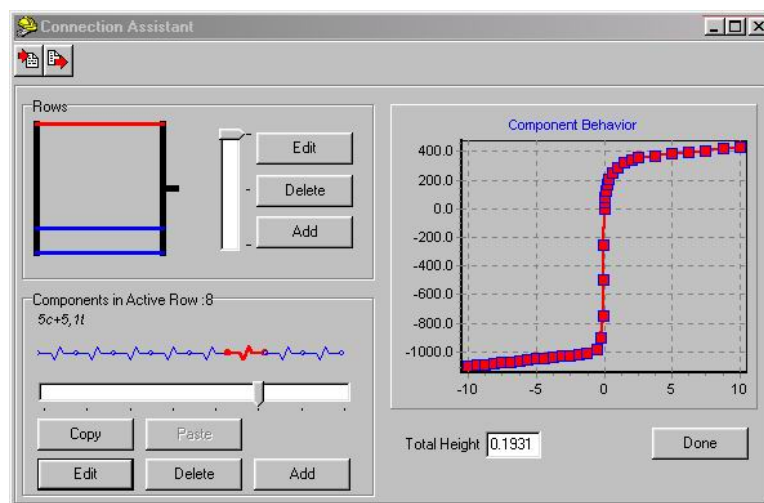*NASCon is a Steel Connection Numerical Analysis Tool.*

Freeware for educational purposes.

User Guide

The use of NASCon requires the following steps:

I. Connection modelling with Connection Assistant program:

The model is created, rows and components are defined and component behaviours are input as shown in Error! Reference source not found.

Modelling connection using SCO.Assistant.

II. Model file loading and data checking;

After modelling the joint according to the behaviour law of components, total height and relative distance between component rows, with the Connection Assistant aid the model file is imported by NASCon.

III. Strategy choosing and load prescription

The appropriate loading strategy is selected and the loads are applied. A relation between axial force and bending moment can be imposed.

IV. Results: Overall Moment-rotation and Axial Force-Displacement curves synchronized with components Force-displacement results;

The calculation process is carried out. It's possible to visualize the overall moment-rotation curves as well as the axial-force-displacement synchronized with the components force-displacement results.
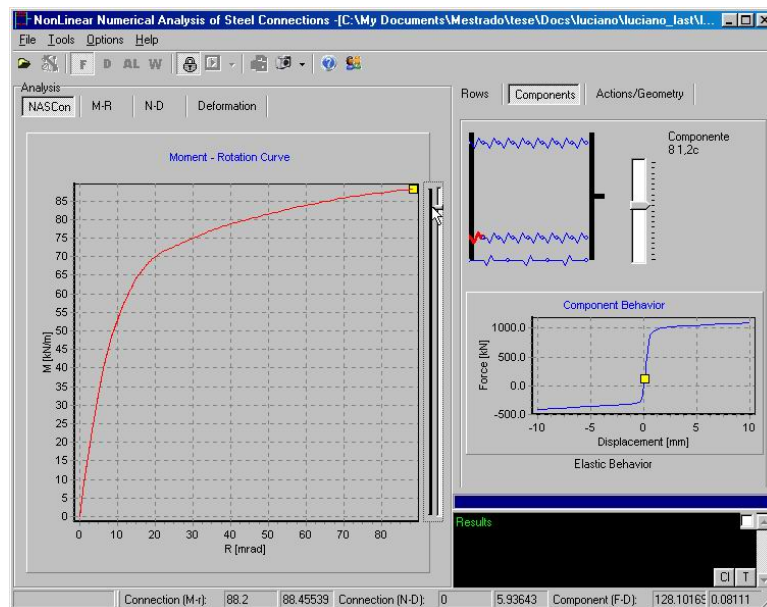
Overall Moment-rotation curve.

The calculated values can be accessed from a text file called "results.txt" located in the model file path.

This file contains the equilibrium solution for the global system and components in the increments carried out. The steps are codified according to the following code:

- **R** - Ordinary point, co-linear with the last equilibrium mode;

- **Y:** *i* - Yield of component *i*;

- **F:** *i* - Failure of component *i*;

- **X** – No convergence problems detected;