Documentation for element ***StringPanelLin***:

The **StringPanelLin** element considers a linear-elastic formulation for the quadrilateral shear panel, the formulation for the stringers may be nonlinear depending on the material properties specified for the stringer sections.

**element StringPanelLin $eleTag $iNode $jNode $knode $lNode $strSecTag1 $strSecTag2 $strSecTag3 $strSecTag4 $E\_p $nu $t <-rho $rho>**

**$eleTag**  unique element object tag

**$eleTag $iNode $jNode $knode $lNode**  corner nodes (counterclockwise)

**$strSecTag1 $strSecTag2 $strSecTag3 $strSecTag4** stringers section tag (counterclockwise)

**$E\_p** modulus of elasticity of panel

**$nu** Poisson’s ratio of panel

**$t** thickness of panel

**$rho (optional)** mass per unit area of panel (default = 0.0)

$jNode

$strSecTag4

$kNode

$strSecTag3

$lNode

$strSecTag2

$strSecTag1

$iNode

Available recorders:

* **forces, force, globalForce, globalForces**
  + Prints the nodal forces counterclockwise in the global coordinate system
* **localForce, localForces, axialForce, axialForces**
  + Prints the forces in the stringers counterclockwise (12 columns, forces shown in sketch in positive sign convention)
* **shearFlow**
  + Prints the shear flow (q, shown positive in sketch)
* **Stiffness**
  + Prints the initial stiffness of the element
* **inertialForce, inertiaForce**
  + Prints the nodal forces counterclockwise in the global coordinate system including the inertial terms

$lNode

$kNode

F11

F10

F9

F8

F7

F6

q

F5

$jNode

F4

$iNode

F12

F3

F2

F1

Notes:

1. This element does not include geometric nonlinearities (i.e. P-Delta or Corotational transformations).
2. The element works in 2-dimensional problems (with either 2 or 3 DOF) and in 3-dimensional problems (with 6-DOF).

Example:

element StringPanelLin 1 1 2 3 4 2 2 2 2 4000. 0.2 0.25; # StringPanelLin element with tag 1, corner nodes are 1 2 3 4 counterclockwise, all 4 stringers are assigned with the section with tag 2, the modulus of elasticity of the material of the panel is 4000, Poisson’s ratio of 0.2 and thickness of 0.25.

References:

* Hoogenboom, P.C., & Blaawendraad, J. (2000). *Quadrilateral shear panel.* Engineering Structures, 22(12), 1690-1698.
* Hoogenboom, P. C. (1998). *Discrete elements and nonlinearity in design of structural concrete walls.* Dissertation, Delft University of Technology. ISBN 90-9011843-8.
* Blaawendraad, J., & Hoogenboom, P. C. (1996). *Stringer panel model for structural concrete design.* ACI Structural Journal, 93(3), 295-305.

**Revision: 1.06** (04/20/2021)

* Fixed outputs when including inertial terms from r1.05

**Revision: 1.07** (04/20/2021)

* Modified computation of generalized strains and resisting force (no change in results for elastic cases).
* Corrected sign output of shear flow.

**Revision: 1.08** (04/27/2021)

* Modified computation of tangent stiffness

**Revision: 1.09** (07/06/2021)

* Added the **inertialForce, inertiaForce** recorder, NEEDS TO VERIFY THE RESULTS.