

**Modified Ibarra-Medina-Krawinkler deterioration model with peak-oriented hysteretic response –  
Suitable for the simulation of RC structural components that exhibit peak-oriented hysteretic response  
(DLL executable for any OpenSees version)**

**Refined C++ code validated with MATLAB-based equivalent**

This command is used to construct an IMKPeakOriented material. This material model simulates the modified Ibarra-Medina-Krawinkler deterioration model with peak-oriented hysteretic response (Ibarra et al. 2005; Lignos and Krawinkler 2011, 2013).

**Command Syntax:**

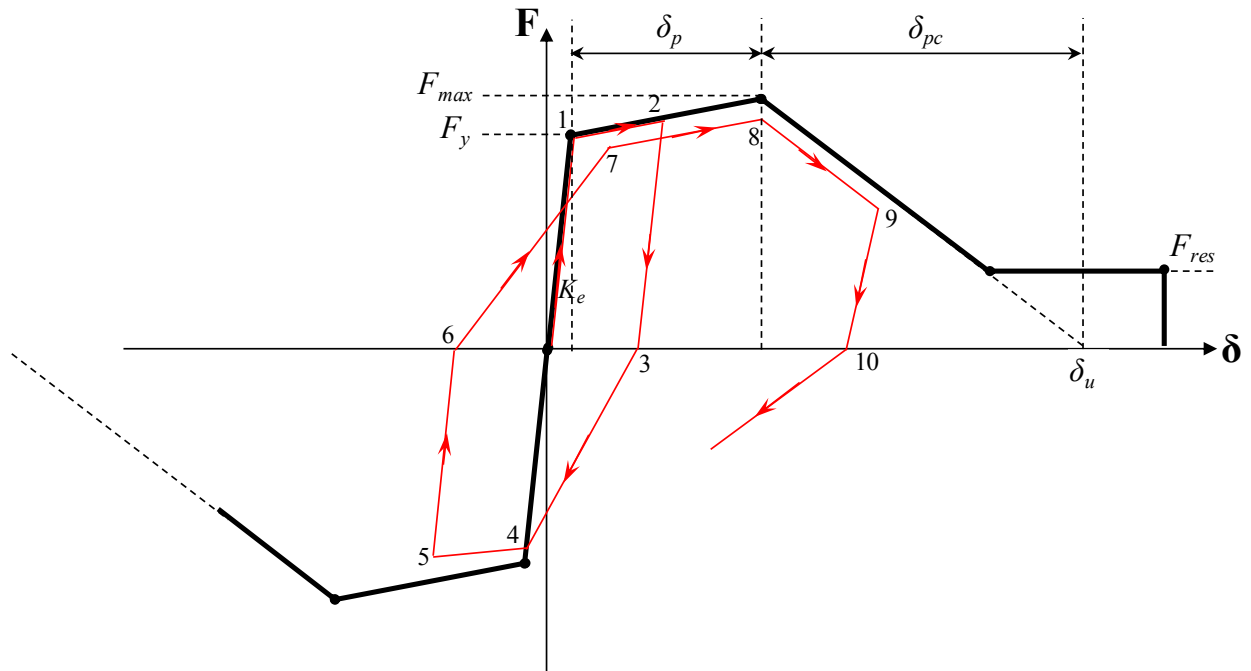
**uniaxialMaterial IMKPeakOriented** \$Mat\_Tag \$Ke \$Up\_pos \$Upc\_pos \$Uu\_pos \$Fy\_pos \$FmaxFy\_pos \$FresFy\_pos \$Up\_neg \$Upc\_neg \$Uu\_neg \$Fy\_neg \$FmaxFy\_neg \$FresFy\_neg \$Lamda\_S \$Lamda\_C \$Lamda\_A \$Lamda\_K \$c\_S \$c\_C \$c\_A \$c\_K \$D\_pos \$D\_neg

**Model Parameters Definitions:**

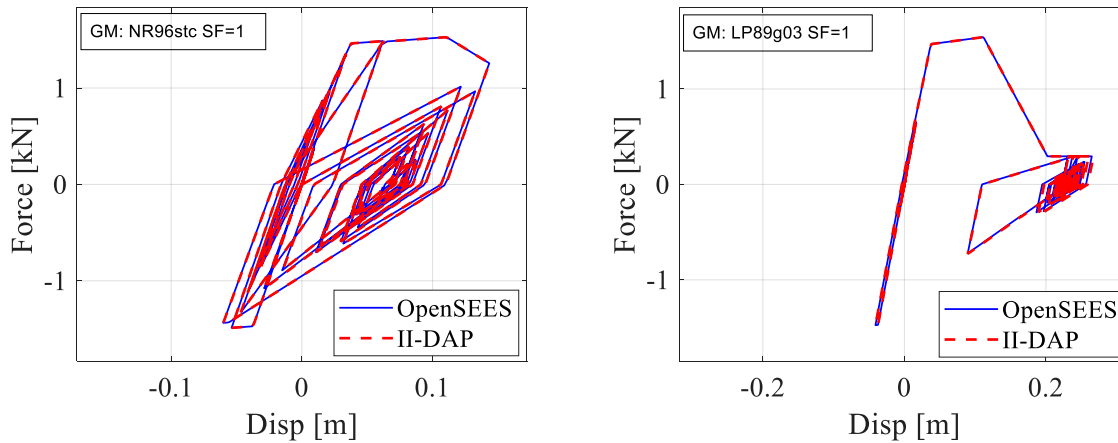
\$Mat_Tag	Integer identifying the material
\$Ke	Elastic stiffness
\$dp_pos	Pre-capping deformation in positive loading direction
\$dpc_pos	Post-capping deformation in positive loading direction
\$du_pos	Ultimate deformation in positive loading direction
\$Fy_pos	Yield strength in positive loading direction
\$FmaxFy_pos	Maximum-to-yield strength ratio in positive loading direction
\$FresFy_pos	Residual-to-yield strength ratio in positive loading direction
\$dp_neg	Pre-capping deformation in negative loading direction
\$dpc_neg	Post-capping deformation in negative loading direction
\$du_neg	Ultimate deformation in negative loading direction
\$Fy_neg	Yield strength in negative loading direction
\$FmaxFy_neg	Maximum-to-yield strength ratio in negative loading direction
\$FresFy_neg	Residual-to-yield strength ratio in negative loading direction
\$Lamda_S	Cyclic deterioration parameter for strength deterioration
\$Lamda_C	Cyclic deterioration parameter for post-capping strength deterioration
\$Lamda_A	Cyclic deterioration parameter for accelerated reloading stiffness deterioration
\$Lamda_K	Cyclic deterioration parameter for unloading stiffness deterioration
\$c_S	Rate of strength deterioration

$\$c_C$	Rate of post-capping strength deterioration
$\$c_A$	Rate of accelerated reloading stiffness deterioration
$\$c_K$	Rate of unloading stiffness deterioration
$\$D_{pos}$	rate of cyclic deterioration in the positive loading direction (this parameter is used to create asymmetric hysteretic behavior for the case of a composite beam). For symmetric hysteretic response use 1.0.
$\$D_{neg}$	rate of cyclic deterioration in the negative loading direction (this parameter is used to create asymmetric hysteretic behavior for the case of a composite beam). For symmetric hysteretic response use 1.0.

**NOTE: All material model parameters in the negative direction shall be specified in positive values.**



**Validation with II-DAP Version 1.1 available from [here](#):**



**References:**

- Ibarra, L. F., Medina, R. A., and Krawinkler, H. (2005). "Hysteretic models that incorporate strength and stiffness deterioration." *Earthquake Engineering & Structural Dynamics*, 34(12), 1489-1511, Doi: 10.1002/eqe.495.
- Lignos, D. G., and Krawinkler, H. (2011). "Deterioration modeling of steel components in support of collapse prediction of steel moment frames under earthquake loading." *Journal of Structural Engineering*, 137(11), 1291-1302, Doi: 10.1061/(ASCE)ST.1943-541X.0000376.
- Lignos, D. G., and Krawinkler, H. (2013). "Development and utilization of structural component databases for performance-based earthquake engineering." *Journal of Structural Engineering*, 139(8), 1382-1394, Doi: 10.1061/(ASCE)ST.1943-541X.0000646.