

This command is used to construct an IMKBilin material. This material simulates the modified Ibarra-Medina-Krawinkler deterioration model with bi-linear hysteretic response (Ibarra et al. 2005; Lignos and Krawinkler 2011).

Command Syntax:

uniaxialMaterial IMKBilin \$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_K \$c_S \$c_C \$c_K \$D_pos \$D_neg

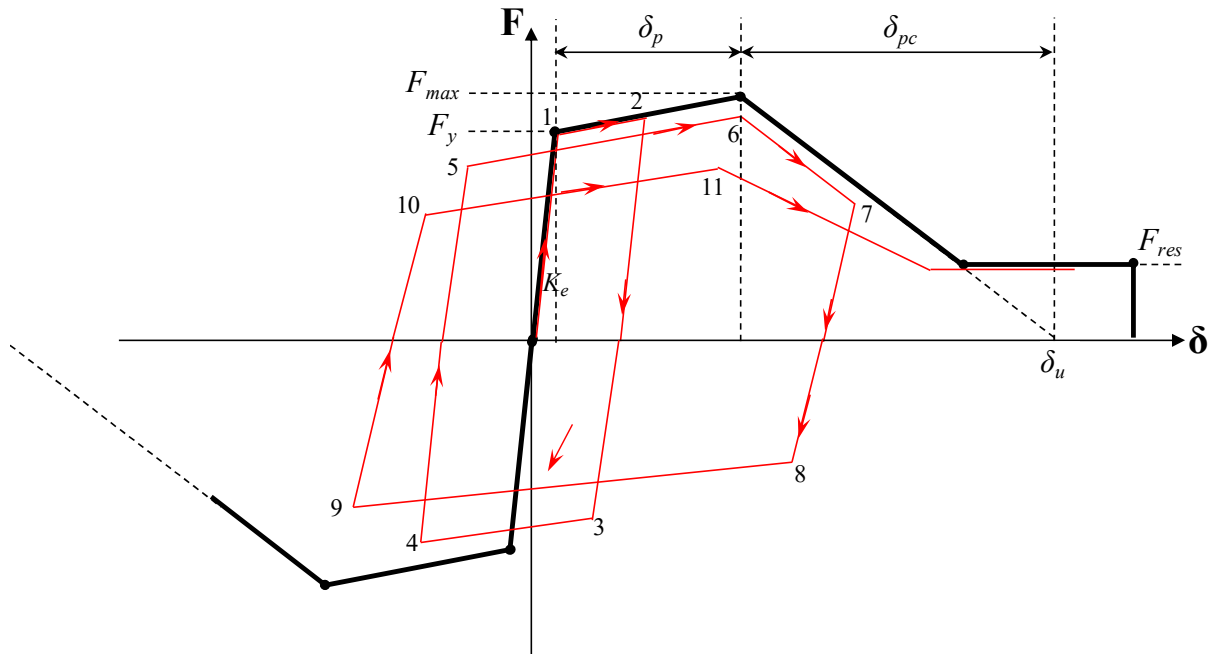
Model Parameters Definitions:

| | |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| \$Mat_Tag | Integer identifying the material |
| \$Ke | Elastic stiffness |
| \$Up_pos | Pre-capping deformation in positive loading direction |
| \$Upc_pos | Post-capping deformation in positive loading direction |
| \$Uu_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 |
| \$Up_neg | Pre-capping deformation in negative loading direction |
| \$Upc_neg | Post-capping deformation in negative loading direction |
| \$Uu_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 yield strength deterioration |
| \$Lamda_C | Cyclic deterioration parameter for post-capping stiffness deterioration |
| \$Lamda_K | Cyclic deterioration parameter for unloading stiffness deterioration |
| \$c_S | Rate of yield strength deterioration |
| \$c_C | Rate of post-capping 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. |

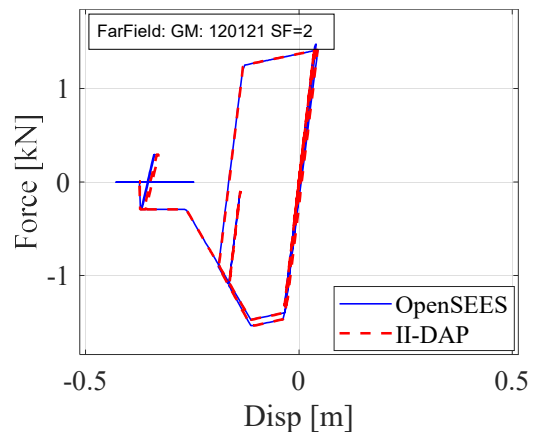
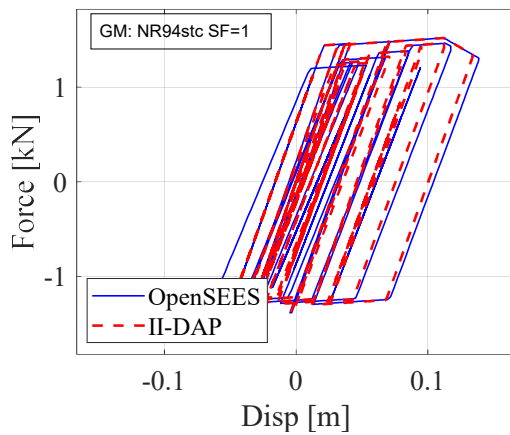
$\$D_neg$

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 should be specified in positive values.



Validation with II-DAP:



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.