

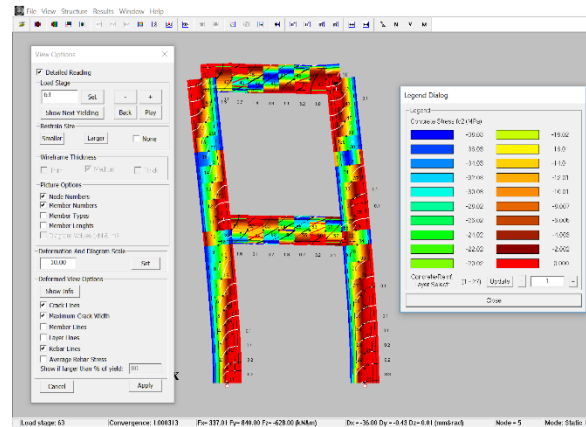
VecTor5 is a nonlinear finite element analysis program for two-dimensional frame structures consisting of beams, columns and shear walls, subjected to thermal, quasi-static (monotonic, cyclic and reversed-cyclic) and dynamic (seismic, impact and blast) loads. Auxiliary program **FormWorks+** allows users to create their analysis models in a graphical environment, while program **Janus** displays the analysis results including deflected shapes, crack patterns, concrete and rebar stress contours, failure modes, and so on.

VecTor5 allows the analysis of frames with unusual or complex cross-sections and considers significant second-order mechanisms to accurately represent the behaviour of cracked reinforced concrete structures. The compression softening due to transverse cracking, tension stiffening, shear slip along crack surfaces and out-of-plane confinement and expansion effects are explicitly considered. Displacement-controlled algorithms enable an analysis to continue after the peak load, capturing the post-peak response and the displacement ductility.

The incorporated deep beam element (Liu et al. 2019) allows combining slender frame and deep beam elements to account for failures and post-peak behaviors associated with complex shear failures. The deep beam element uses a three-parameter kinematic model (Liu and Mihaylov 2018), based on the behavior of two fans (modeled by rotational springs) and a critical shear crack (modelled by a transverse spring).

The included RDM material model (Akkaya et al. 2019) enables capturing the buckling response of compression bars in concrete members while accounting for the interactions between the lateral ties and longitudinal bars. This model is capable of simulating the onset of inelastic buckling and subsequent degradation in the post-buckling region.

VecTor5 employs six-degree-of-freedom fiber-section elements using a distributed-inelasticity algorithm, and an iterative, total-load, secant-stiffness formulation. The nonlinear sectional analyses provide a comprehensive and accurate representation of the concrete response, including the shear effects coupled with axial and flexural responses based on the Modified Compression Field Theory (Vecchio and Collins 1986) and the Disturbed Stress Field Model (Vecchio 2000). Compression-only, tension-only, and truss elements are also available to model various conditions (e.g., special supports, soil, braces, etc.).



Sample Analysis Results Displayed by Janus

Nonlinear dynamic analysis algorithms employ an explicit three-parameter time integration method, allowing the use of Newmark's average or linear acceleration, or Wilson's theta methods. The effects of high strain rates on the material behavior are accounted for. Structural damping is provided by the nonlinear concrete and reinforcement hysteresis models (Guner and Vecchio 2011).

	Premium	Basic
Capacities		
Frame Members	2,000	50
Nodes	2,000	50
Members Types	50	5
Concrete Layers	110	50
Reinforcement Layers	50	5
Material Types		
Concrete layers	✓	✓
Steel bars (discrete and smeared)	✓	✓
Deep beam elements (monotonic load)	✓	✗
Reinforcement Material Types		
Steel, Prestressing Steel	✓	✓
Load Types		
Static Forces	✓	✓
Static Displacements	✓	✓
Prestrains	✓	✓
Impact & Blast Forces	✓	
Ground Accelerations	✓	
Thermal / Heat Flow	✓	
Analysis Modes		
Static Nonlinear – Load Step	✓	✓
Static Nonlinear – Time Step	✓	
Dynamic Nonlinear – General	✓	
Dynamic Nonlinear – EQ Record	✓	
Dynamic Nonlinear – Impulse	✓	
Material Models		
Full Range of Models	✓	
Default Models Only		✓



Journal Papers

- Guner, S., Hrynyk, T. D., and Lulec, A. "Cracked Continuum Modeling of Reinforced Concrete Elements under Impact," High Strain Rate Mechanics and Impact Behavior of Concrete, High Strain Rate Mechanics and Impact Behavior of Concrete, American Concrete Institute, SP-347(5): 85-105. <[download](#)>
- Liu, J., Guner, S., and Mihaylov, B. (2019) "Mixed-Type Modeling of Structures with Slender and Deep Beam Elements" *ACI Structural Journal*, 116(4): 253-264. <[download](#)>
- Akkaya, Y., Guner, S. and Vecchio, F. J. (2019) "A Constitutive Model for the Inelastic Buckling Behavior of Reinforcing Bars," *ACI Structural Journal*, V.116, No.3, pp. 195-204 <[download](#)>
- Salgado, R. and Guner S. (2018) "A Comparative Study on Nonlinear Models for Performance-Based Earthquake Engineering," *Engineering Structures*, V.172, p. 382-391 <[download](#)>
- Peng, C. and Guner, S. (2018) "Direct Displacement-Based Seismic Assessment of Concrete Frames Using Nonlinear Pushover Analysis," *Computers and Concrete*, V.21, No.4, pp.355-365 <[download](#)>
- Pan, Z., Guner, S. and Vecchio, F. J. (2017) "Modeling of interior beam-column joints for nonlinear analysis of reinforced concrete frames," *Engineering Structures*, V.142, pp.182-19 <[download](#)>
- Guner, S. (2016) "Simplified Modeling of Frame Elements subjected to Blast Loads," *ACI Structural Journal*, V.113, No.2, pp. 363-372 <[download](#)>
- Guner, S. and Vecchio, F. J. (2012) "Simplified Method for Nonlinear Dynamic Analysis of Shear-Critical Frames," *ACI Structural Journal*, V.109, No.5, pp.727-737 <[download](#)>
- Guner, S. and Vecchio, F. J. (2011) "Analysis of Shear-Critical Reinforced Concrete Plane Frame Elements under Cyclic Loading," *Journal of Structural Engineering*, ASCE, V.137, No.8, pp. 834-843 <[download](#)>
- Guner, S. and Vecchio, F. J. (2010b) "Pushover Analysis of Shear-Critical Frames: Verification and Application," *ACI Structural Journal*, V.107, No.1, pp. 72-81 <[download](#)>
- Guner, S. and Vecchio, F. J. (2010a) "Pushover Analysis of Shear-Critical Frames: Formulation," *ACI Structural Journal*, V.107, No.1, pp. 63-71 <[download](#)>

User Manuals

- Blosser, K., Guner, S., and F. J. Vecchio (2016) "User's Manual of FormWorks Plus for VecTor5," 29 pp. <[download](#)>
- Loya, A.S., Lourenço, D.D.S, Guner, S., Vecchio, F.J. (2015) "User's Manual of Janus for VecTor5," 28 pp. <[down](#)>
- Guner, S. and Vecchio, F. J. (2008) "User's Manual of VecTor5," 88 pp. <[download](#)>

Reports

- Liu, J., Guner, S., and Mihaylov, B. (2021) "A New Deep-Beam Element for Mixed-Type Modeling of Concrete Structures," Project report, 31 pp. <[download](#)>

User Bulletins

- Liu, J., Guner, S., and Mihaylov, B. (2021) "User Bulletin 8: Deep Beam Modeling with VecTor5," 3 pp. <[download](#)>
- Coffman, A., Guner, S. (2019), "Bulletin 6: Frame Modeling with VecTor5 using Pre-Processing," 15 pp. <[download](#)>
- Chu, P., Guner, S. (2016) "Bulletin 5: Determination of Material Properties," 11 pp. <[download](#)>
- Blosser, K., Guner, S. (2016) "Bulletin 4: Beam Modeling with VecTor5 using Pre-and Post-Processing," 14 pp <[dw](#)>
- Salgado, R. and Guner, S. (2014) "Bulletin 3: Determination of Unsupported Length Ratio L/Db," 11 pp. <[download](#)>
- Viana, H. F. and Guner, S. (2014) "Bulletin 2: Frame Modeling with VecTor5," 16 pp. <[download](#)>
- Viana, H. F. and Guner, S. (2014) "Bulletin 1: Beam Modeling with VecTor5," 20 pp. <[download](#)>

Videos

- Blosser, K. and Guner, S. (2016)
- Video 1: Setup for Nonlinear Analysis (4:25)
 - Video 2: Beam Modeling (18:22)
 - Video 3: Obtaining Analysis Results (7:01)
 - Video 4: Frame Modeling (26:57)

See Dr. Guner's YouTube channel for these and other videos: www.youtube.com/c/SerhanGuner