GmESSI Command Library

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Contents

Chapter 1

Add Node Commands

1. gmESSI :: [Add_Node{PhyEntyTag , Unit , NumDofs}]
   ESSI :: add node # $< . >$ **at** $(< L >,< L >,< L >)$ **with** $< . >$ **dofs;**
2. gmESSI :: [Add_All_Node{Unit , NumDofs}]
   ESSI :: add node # $< . >$ **at** $(< L >,< L >,< L >)$ **with** $< . >$ **dofs;**

Chapter 2

Elemental Commmands

1. gmESSI :: [Add_20NodeBrick{PhyEntyTag , NumGaussPoints , material#1}]
   ESSI :: add element # < . > type [20NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

2. gmESSI :: [Add_20NodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
   ESSI :: add element # < . > type [20NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

3. gmESSI :: [Add_20NodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
   ESSI :: add element # < . > type [20NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

4. gmESSI :: [Add_20NodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
   ESSI :: add element # < . > type [20NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

5. gmESSI :: [Add_20NodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
   ESSI :: add element # < . > type [20NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

6. gmESSI :: [Add_20NodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]

ESSI :: add element # < . > type [20NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

7. gmESSI :: [Add_27NodeBrick{PhyEntyTag , material#1}]
   ESSI :: add element # < . > type [27NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

8. gmESSI :: [Add_VariableNodeBrick{PhyEntyTag , material#1}]
   ESSI :: add element # < . > type [8_27_NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

9. gmESSI :: [Add_27NodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
   ESSI :: add element # < . > type [27NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

10. gmESSI :: [Add_VariableNodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
    ESSI :: add element # < . > type [8_27_NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

11. gmESSI :: [Add_27NodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [27NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

12. gmESSI :: [Add_VariableNodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [8_27_NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

13. gmESSI :: [Add_27NodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [27NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

14. gmESSI :: [Add_VariableNodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [8_27_NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

15. gmESSI :: [Add_27NodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [27NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

16. gmESSI :: [Add_VariableNodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8_27_NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

17. gmESSI :: [Add_27NodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [27NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

18. gmESSI :: [Add_VariableNodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8_27_NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

19. gmESSI :: [Add_ShearBeam{PhyEntyTag , CrossSection , material#1}]
ESSI :: add element # < . > type [ShearBeam] with nodes (< . >, < . >) cross_section = $< l^2 >$ use material # < . >;

20. gmESSI :: [Add_DispBeamColumn3D{PhyEntyTag , NumIntegrPoints , SectionNumber , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [BeamColumnDispFiber3d] with nodes (< . >, < . >) number_of_integration_points = < . > section_number = < . > mass_density = $< M/L^3 >$ xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = ($< L >$, $< L >$, $< L >$) joint_2_offset = ($< L >$, $< L >$, $< L >$);

21. gmESSI :: [Add_Beam_Elastic{PhyEntyTag , CrossSection , ElasticModulus , ShearModulus , Jx , Iy , Iz , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [beam_elastic] with nodes (< . >, < . >) cross_section = $< area >$ elastic_modulus = $< F/L^2 >$ shear_modulus = $< F/L^2 >$ torsion_Jx = $< length^4 >$ bending_Iy = $< length^4 >$ bending_Iz = $< length^4 >$ mass_density = $< M/L^3 >$ xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = ($< L >$, $< L >$, $< L >$) joint_2_offset = ($< L >$, $< L >$, $< L >$);

22. gmESSI :: [Add_Beam_Elastic_LumpedMass{PhyEntyTag , CrossSection , ElasticModulus , ShearModulus , Jx , Iy , Iz , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [beam_elastic_lumped_mass] with nodes (< . >, < . >) cross_section = $< area >$ elastic_modulus = $< F/L^2 >$ shear_modulus = $< F/L^2 >$ torsion_Jx = $< length^4 >$ bending_Iy = $< length^4 >$ bending_Iz = $< length^4 >$ mass_density = $< M/L^3 >$ xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = ($< L >$, $< L >$, $< L >$) joint_2_offset = ($< L >$, $< L >$, $< L >$);

23. gmESSI :: [Add_Beam_DisplacementBased{PhyEntyTag , NumIntegrationPoints , SectionNumber , Density}]
ESSI :: add element # < . > type [beam_displacement_based] with nodes (< . >, < . >) with # < . > integration_points use section # < . > mass_density = < M/L^3 > IntegrationRule = "" xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = (< L >, < L >, < L >) joint_2_offset = (< L >, < L >, < L >);

24. gmESSI :: [Add_Beam_9Dof_Elastic{PhyEntyTag , CrossSection , ElasticModulus , ShearModulus , Jx , Iy , Iz , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [beam_9dof_elastic] with nodes (< . >, < . >) cross_section = < $area$ > elastic_modulus = < F/L^2 > shear_modulus = < F/L^2 > torsion_Jx = < $length^4$ > bending_Iy = < $length^4$ > bending_Iz = < $length^4$ > mass_density = < M/L^3 > xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = (< L >, < L >, < L >) joint_2_offset = (< L >, < L >, < L >);

25. gmESSI :: [Add_HardContact{PhyEntyTag , NormalStiffness , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [HardContact] with nodes (< . >, < . >) normal_stiffness = < F/L > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

26. gmESSI :: [Add_HardWetContact{PhyEntyTag , NormalStiffness , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [HardWetContact] with nodes (< . >, < . >) normal_stiffness = < F/L > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

27. gmESSI :: [Add_SoftContact{PhyEntyTag , InitialNormalStiffness , Stiffningrate , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [SoftContact] with nodes (< . >, < . >) initial_normal_stiffness = < F/L > stiffning_rate = < $1/L$ > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

28. gmESSI :: [Add_SoftWetContact{PhyEntyTag , InitialNormalStiffness , Stiffningrate , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [SoftWetContact] with nodes (< . >, < . >) initial_normal_stiffness = < F/L > stiffning_rate = < m^-1 > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

29. gmESSI :: [Add_Truss{PhyEntyTag , material#1 , CrossSectin , Density}]
ESSI :: add element # < . > type [truss] with nodes (< . >, < . >) use material # < . > cross_section = < $length^2$ > mass_density = < M/L^3 > ;

30. gmESSI :: [Add_4NodeShell_MITC4{PhyEntyTag , material#1 , Thickness}]
ESSI :: add element # < . > type [4NodeShell_MITC4] with nodes (< . >, < . >, < . >, < . >) use material # < . > thickness = < L >;

31. gmESSI :: [Add_4NodeShell_NewMITC4{PhyEntyTag , material#1 , Thickness}]
ESSI :: add element # < . > type [4NodeShell_NewMITC4] with nodes (< . >, < . >, < . >, < . >) use material # < . > thickness = < L >;

32. gmESSI :: [Add_4NodeShell_Andes{PhyEntyTag , material#1 , Thickness}]
ESSI :: add element # < . > type [4NodeShell_ANDES] with nodes (< . >, < . >, < . >, < . >) use material # < . > thickness = < l > ;

33. gmESSI :: [Add_8NodeBrick{PhyEntyTag , material#1}]
ESSI :: add element # < . > type [8NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

34. gmESSI :: [Add_8NodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
ESSI :: add element # < . > type [8NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

35. gmESSI :: [Add_8NodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

36. gmESSI :: [Add_8NodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

37. gmESSI :: [Add_8NodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

38. gmESSI :: [Add_8NodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

Chapter 3

Elemental Compound Commmands

1. gmESSI :: [Add_20NodeBrick_SurfaceLoad{PhyEntyTag , PhyEntyTag , Pressure}]
   ESSI :: add load # < . > to element # < . > type surface at nodes (< . > , < . > , < . > , < . >, < . >, < . >, < . >, < . >) with magnitude $< Pa >$**;**
2. gmESSI :: [Add_20NodeBrick_SurfaceLoad{PhyEntyTag , PhyEntyTag , Press1 , Press2 , Press3 , Press4 , Press5 , Press6 , Press7 , Press8}]
   ESSI :: add load # < . > to element # < . > type surface at nodes (< . > , < . > , < . > , < . >, < . >, < . >, < . >, < . >) with magnitudes ($< Pa >$ **,** $< Pa >$ **,** $< Pa >$ **,** $< Pa >$, $< Pa >$, $< Pa >$, $< Pa >$, $< Pa >$**);**
3. gmESSI :: [Add_27NodeBrick_SurfaceLoad{PhyEntyTag , PhyEntyTag , Pressure}]
   ESSI :: add load # < . > to element # < . > type surface at nodes (< . > , < . > , < . > , < . >, < . >, < . >, < . >, < . >, < . >) with magnitude $< Pa >$**;**
4. gmESSI :: [Add_27NodeBrick_SurfaceLoad{PhyEntyTag , PhyEntyTag , Press1 , Press2 , Press3 , Press4 , Press5 , Press6 , Press7 , Press8 , Press9}]
   ESSI :: add load # < . > to element # < . > type surface at nodes (< . > , < . > , < . > , < . >, < . >, < . >, < . >, < . >, < . >) with magnitudes ($< Pa >$ **,** $< Pa >$ **,** $< Pa >$ **,** $< Pa >$, $< Pa >$, $< Pa >$, $< Pa >$, $< Pa >$, $< Pa >$**);**
5. gmESSI :: [Add_8NodeBrick_SurfaceLoad{PhyEntyTag , PhyEntyTag , Pressure}]
   ESSI :: add load # < . > to element # < . > type surface at nodes (< . > , < . > , < . > , < . >) with magnitude $< Pa >$**;**
6. gmESSI :: [Add_8NodeBrick_SurfaceLoad{PhyEntyTag , PhyEntyTag , Press1 , Press2 , Press3 , Press4}]
   ESSI :: add load # < . > to element # < . > type surface at nodes (< . > , < . > , < . > , < . >) with magnitudes ($< Pa >$ **,** $< Pa >$ **,** $< Pa >$ **,** $< Pa >$**);**

Chapter 4

Elemental Variational Commmands

1. gmESSI :: [Vary_20NodeBrick{PhyEntyTag , NumGaussPoints , material#1}]
   ESSI :: add element # < . > type [20NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

2. gmESSI :: [Vary_20NodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
   ESSI :: add element # < . > type [20NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

3. gmESSI :: [Vary_20NodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
   ESSI :: add element # < . > type [20NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

4. gmESSI :: [Vary_20NodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
   ESSI :: add element # < . > type [20NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

5. gmESSI :: [Vary_20NodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
   ESSI :: add element # < . > type [20NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

6. gmESSI :: [Vary_20NodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]

ESSI :: add element # < . > type [20NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

7. gmESSI :: [Vary_27NodeBrick{PhyEntyTag , material#1}]
   ESSI :: add element # < . > type [27NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

8. gmESSI :: [Vary_VariableNodeBrick{PhyEntyTag , material#1}]
   ESSI :: add element # < . > type [8_27_NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

9. gmESSI :: [Vary_27NodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
   ESSI :: add element # < . > type [27NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

10. gmESSI :: [Vary_VariableNodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
    ESSI :: add element # < . > type [8_27_NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

11. gmESSI :: [Vary_27NodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [27NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

12. gmESSI :: [Vary_VariableNodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [8_27_NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

13. gmESSI :: [Vary_27NodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [27NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

14. gmESSI :: [Vary_VariableNodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
    ESSI :: add element # < . > type [8_27_NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

15. gmESSI :: [Vary_27NodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [27NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

16. gmESSI :: [Vary_VariableNodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8_27_NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

17. gmESSI :: [Vary_27NodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [27NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

18. gmESSI :: [Vary_VariableNodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8_27_NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > and porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

19. gmESSI :: [Vary_ShearBeam{PhyEntyTag , CrossSection , material#1}]
ESSI :: add element # < . > type [ShearBeam] with nodes (< . >, < . >) cross_section = $< l^2 >$ use material # < . >;

20. gmESSI :: [Vary_DispBeamColumn3D{PhyEntyTag , NumIntegrPoints , SectionNumber , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [BeamColumnDispFiber3d] with nodes (< . >, < . >) number_of_integration_points = < . > section_number = < . > mass_density = $< M/L^3 >$ xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = (< L >, < L >, < L >) joint_2_offset = (< L >, < L >, < L >);

21. gmESSI :: [Vary_Beam_Elastic{PhyEntyTag , CrossSection , ElasticModulus , ShearModulus , Jx , Iy , Iz , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [beam_elastic] with nodes (< . >, < . >) cross_section = $< area >$ elastic_modulus = $< F/L^2 >$ shear_modulus = $< F/L^2 >$ torsion_Jx = $< length^4 >$ bending_Iy = $< length^4 >$ bending_Iz = $< length^4 >$ mass_density = $< M/L^3 >$ xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = (< L >, < L >, < L >) joint_2_offset = (< L >, < L >, < L >);

22. gmESSI :: [Vary_Beam_Elastic_LumpedMass{PhyEntyTag , CrossSection , ElasticModulus , ShearModulus , Jx , Iy , Iz , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [beam_elastic_lumped_mass] with nodes (< . >, < . >) cross_section = $< area >$ elastic_modulus = $< F/L^2 >$ shear_modulus = $< F/L^2 >$ torsion_Jx = $< length^4 >$ bending_Iy = $< length^4 >$ bending_Iz = $< length^4 >$ mass_density = $< M/L^3 >$ xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = (< L >, < L >, < L >) joint_2_offset = (< L >, < L >, < L >);

23. gmESSI :: [Vary_Beam_DisplacementBased{PhyEntyTag , NumIntegrationPoints , SectionNumber , Density}]
ESSI :: add element # < . > type [beam_displacement_based] with nodes (< . >, < . >) with # < . > integration_points use section # < . > mass_density = < M/L^3 > IntegrationRule = "" xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = (< L >, < L >, < L >) joint_2_offset = (< L >, < L >, < L >);

24. gmESSI :: [Vary_Beam_9Dof_Elastic{PhyEntyTag , CrossSection , ElasticModulus , ShearModulus , Jx , Iy , Iz , Density , XZPlnVect_x , XZPlnVect_y , XZPlnVect_z , J1_x , J1_y , J1_z , J2_x , J2_y , J2_z}]
ESSI :: add element # < . > type [beam_9dof_elastic] with nodes (< . >, < . >) cross_section = < $area$ > elastic_modulus = < F/L^2 > shear_modulus = < F/L^2 > torsion_Jx = < $length^4$ > bending_Iy = < $length^4$ > bending_Iz = < $length^4$ > mass_density = < M/L^3 > xz_plane_vector = (< . >, < . >, < . >) joint_1_offset = (< L >, < L >, < L >) joint_2_offset = (< L >, < L >, < L >);

25. gmESSI :: [Vary_HardContact{PhyEntyTag , NormalStiffness , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [HardContact] with nodes (< . >, < . >) normal_stiffness = < F/L > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

26. gmESSI :: [Vary_HardWetContact{PhyEntyTag , NormalStiffness , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [HardWetContact] with nodes (< . >, < . >) normal_stiffness = < F/L > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

27. gmESSI :: [Vary_SoftContact{PhyEntyTag , InitialNormalStiffness , Stiffningrate , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [SoftContact] with nodes (< . >, < . >) initial_normal_stiffness = < F/L > stiffning_rate = < $1/L$ > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

28. gmESSI :: [Vary_SoftWetContact{PhyEntyTag , InitialNormalStiffness , Stiffningrate , TangentialStiffness , NormalDamping , TangentialDamping , FrictionRatio , NormVect_x , NormVect_y , NormVect_z}]
ESSI :: add element # < . > type [SoftWetContact] with nodes (< . >, < . >) initial_normal_stiffness = < F/L > stiffning_rate = < m^-1 > tangential_stiffness = < F/L > normal_damping = < F/L > tangential_damping = < F/L > friction_ratio = < . > contact_plane_vector = (< . >, < . >, < . >);

29. gmESSI :: [Vary_Truss{PhyEntyTag , material#1 , CrossSectin , Density}]
ESSI :: add element # < . > type [truss] with nodes (< . >, < . >) use material # < . > cross_section = < $length^2$ > mass_density = < M/L^3 > ;

30. gmESSI :: [Vary_4NodeShell_MITC4{PhyEntyTag , material#1 , Thickness}]
ESSI :: add element # < . > type [4NodeShell_MITC4] with nodes (< . >, < . >, < . >, < . >) use material # < . > thickness = < L >;

31. gmESSI :: [Vary_4NodeShell_NewMITC4{PhyEntyTag , material#1 , Thickness}]
ESSI :: add element # < . > type [4NodeShell_NewMITC4] with nodes (< . >, < . >, < . >, < . >) use material # < . > thickness = < L >;

32. gmESSI :: [Vary_4NodeShell_Andes{PhyEntyTag , material#1 , Thickness}]
ESSI :: add element # < . > type [4NodeShell_ANDES] with nodes (< . >, < . >, < . >, < . >) use material # < . > thickness = < l > ;

33. gmESSI :: [Vary_8NodeBrick{PhyEntyTag , material#1}]
ESSI :: add element # < . > type [8NodeBrick] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

34. gmESSI :: [Vary_8NodeBrick_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1}]
ESSI :: add element # < . > type [8NodeBrick] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . >;

35. gmESSI :: [Vary_8NodeBrick_upU{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_upU] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

36. gmESSI :: [Vary_8NodeBrick_upU_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_upU] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

37. gmESSI :: [Vary_8NodeBrick_up{PhyEntyTag , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_up] with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

38. gmESSI :: [Vary_8NodeBrick_up_Variable_GaussPoints{PhyEntyTag , NumGaussPoints , material#1 , Porosity , Alpha , SolidDensity , FluidDensity , Perm_X , Perm_Y , Perm_Z , SolidBulkModulus , FluidBulkModulus}]
ESSI :: add element # < . > type [8NodeBrick_up] using < . > Gauss points each direction with nodes (< . >, < . >, < . >, < . >, < . >, < . >, < . >, < . >) use material # < . > porosity = < . > alpha = < . > rho_s = $< M/L^3 >$ rho_f = $< M/L^3 >$ k_x = $< L^3T/M >$ k_y = $< L^3T/M >$ k_z = $< L^3T/M >$ K_s = $< stress >$ K_f = $< stress >$;

Chapter 5

General Elemental Commmands

1. gmESSI :: [Add_Elements_To_Physical_Group{PhyEntyTag , PhysicalElementGroup}]
   ESSI :: add elements (< . >) to physical_element_group "*string***";**

2. gmESSI :: [Add_Self_Weight_To_Element{PhyEntyTag , field#1}]
   ESSI :: add load # < . > to element # < . > type self_weight use acceleration field # < . >;

3. gmESSI :: [Add_Damping_To_Element{PhyEntyTag , damping#1}]
   ESSI :: add damping # < . > to element # < . >;

4. gmESSI :: [Remove_Element{PhyEntyTag}]
   ESSI :: remove element # < . >;

5. gmESSI :: [Remove_Strain_From_Element{PhyEntyTag}]
   ESSI :: remove strain from element # < . >;

Chapter 6

General Elemental Variational Commmands

1. gmESSI :: [Vary_Damping_To_Element{PhyEntyTag , damping#1}]
   ESSI :: add damping # < . > to element # < . >;

Chapter 7

Material Variational Commmands

1. gmESSI :: [Vary_Linear_Elastic_Isotropic_3D{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio}]
   ESSI :: add material # < . > type [linear_elastic_isotropic_3d] mass_density = $< M/L^3 >$ **elastic_modulus =** $< F/L^2 >$ **poisson_ratio = < . >;**

2. gmESSI :: [Vary_VonMises{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio , VonMisesRadius , KinematicHardeningRate , IsotropicHardeningRate}]
   ESSI :: add material # < . > type [VonMises] mass_density = $< M/L^3 >$ **elastic_modulus =** $< F/L^2 >$ **poisson_ratio = < . > von_mises_radius =** $< F/L^2 >$ **kinematic_hardening_rate =** $< F/L^2 >$ **isotropic_hardening_rate =** $< F/L^2 >$ **;**

3. gmESSI :: [Vary_VonMisesArmstrongFrederick{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio , VonMisesRadius , ArmstrongFrederickHa , ArmstrongFrederickCr , IsotropicHardeningRate}]
   ESSI :: add material # < . > type [VonMisesArmstrongFrederick] mass_density = $< M/L^3 >$ **elastic_modulus =** $< F/L^2 >$ **poisson_ratio = < . > von_mises_radius = <> armstrong_frederick_ha =** $< F/L^2 >$ **armstrong_frederick_cr =** $< F/L^2 >$ **isotropic_hardening_rate =** $< F/L^2 >$ **;**

4. gmESSI :: [Vary_DruckerPrager{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress}]
   ESSI :: add material # < . > type [DruckerPrager] mass_density = $< M/L^3 >$ **elastic_modulus =** $< F/L^2 >$ **poisson_ratio = < . > druckerprager_k = <> kinematic_hardening_rate =** $< F/L^2 >$ **isotropic_hardening_rate =** $< F/L^2 >$ **initial_confining_stress =** $< F/L^2 >$ **;**

5. gmESSI :: [Vary_DruckerPragerVonMises{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress}]
   ESSI :: add material # < . > type [DruckerPragerVonMises] mass_density = $< M/L^3 >$ **elastic_modulus =** $< F/L^2 >$ **poisson_ratio = < . > druckerprager_k = <> kinematic_hardening_rate =** $< F/L^2 >$ **isotropic_hardening_rate =** $< F/L^2 >$ **initial_confining_stress =** $< F/L^2 >$ **;**

6. gmESSI :: [Vary_DruckerPragerNonAssociativeLinearHardening{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress , PlasticFlowXi , PlasticFlowKd}]
   ESSI :: add material # < . > type [DruckerPragerNonAssociateLinearHardening] mass_density = $< M/L^3 >$ **elastic_modulus =** $< F/L^2 >$ **poisson_ratio = < . >**

druckerprager_k = <> **kinematic_hardening_rate** = < F/L^2 > **isotropic_hardening_rate** = < F/L^2 > **initial_confining_stress** = < F/L^2 > **plastic_flow_xi** = < . > **plastic_flow_kd** = < . > ;

7. gmESSI :: [Vary_DruckerPragerArmstrongFrederickLE{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio , DruckerPragerK , ArmstrongFrederickHa , ArmstrongFrederickCr , IsotropicHardeningRate , InitialConfiningStress}]
ESSI :: add material # < . > **type** [**DruckerPragerArmstrongFrederickLE**] **mass_density** = < M/L^3 > **elastic_modulus** = < F/L^2 > **poisson_ratio** = < . > **druckerprager_k** = <> **armstrong_frederick_ha** = < F/L^2 > **armstrong_frederick_cr** = < F/L^2 > **isotropic_hardening_rate** = < F/L^2 > **initial_confining_stress** = < F/L^2 >;

8. gmESSI :: [Vary_DruckerPragerArmstrongFrederickNE{PhyEntyTag , ElementCommand , Density , DuncanChengK , DuncanChengPa , DuncanChengN , DuncanChengSigma3Max , DuncanChengNu , DruckerpragerK , ArmstrongFrederickHa , ArmstrongFrederickCr , IsotropicHardeningRate , InitialConfiningStress}]
ESSI :: add material # < . > **type** [**DruckerPragerArmstrongFrederickNE**] **mass_density** = < M/L^3 > **DuncanCheng_K** = < . > **DuncanCheng_pa** = < F/L^2 > **DuncanCheng_n** = < . > **DuncanCheng_sigma3_max** = < F/L^2 > **DuncanCheng_nu** = < . > **druckerprager_k** = <> **armstrong_frederick_ha** = < F/L^2 > **armstrong_frederick_cr** = < F/L^2 > **isotropic_hardening_rate** = < F/L^2 > **initial_confining_stress** = < F/L^2 >;

9. gmESSI :: [Vary_DruckerPragerNonAssociateArmstrongFrederick{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress , PlasticFlowXi , PlasticFlowKd}]
ESSI :: add material # < . > **type** [**DruckerPragerNonAssociateArmstrongFrederick**] **mass_density** = < M/L^3 > **elastic_modulus** = < F/L^2 > **poisson_ratio** = < . > **druckerprager_k** = <> **armstrong_frederick_ha** = < F/L^2 > **armstrong_frederick_cr** = < F/L^2 > **isotropic_hardening_rate** = < F/L^2 > **initial_confining_stress** = < F/L^2 > **plastic_flow_xi** = <> **plastic_flow_kd** = <> ;

10. gmESSI :: [Vary_CamClay{PhyEntyTag , ElementCommand , Density , M , lambda , Kappa , e0 , P0 , PoissonRatio , InitialConfiningStress}]
ESSI :: add material # < . > **type** [**CamClay**] **mass_density** = < M/L^3 > **M** = < . > **lambda** = < . > **kappa** = < . > **e0** = < . > **p0** = < F/L^2 > **Poisson_ratio** = < . > **initial_confining_stress** = < F/L^2 >

11. gmESSI :: [Vary_RoundedMohrCoulomb{PhyEntyTag , ElementCommand , Density , ElasticModulus , PoisonRatio , M , Qa , Pc , Heta , Eta0 , InitialConfiningStress}]
ESSI :: add material # < . > **type** [**roundedMohrCoulomb**] **mass_density** = < M/L^3 > **elastic_modulus** = < F/L^2 > **poisson_ratio** = < . > **RMC_m** = < . > **RMC_qa** = < F/L^2 > **RMC_pc** = < F/L^2 > **RMC_e** = < . > **RMC_eta0** = < . > **RMC_Heta** = < F/L^2 > **initial_confining_stress** = < F/L^2 >

12. gmESSI :: [Vary_SaniSand2008{PhyEntyTag , ElementCommand , Density , e0 , G0 , K0 , Pat , Kc , Alpha_cc , c , xi , Lambda , ec_ref , M , h0 , ch , nb , A0 , nd , p_r , rho_c , theta_c , X , z_max , cz , P0 , Algorithm , NumSubIncr , MaxIter , Tol1 , Tol2}]
ESSI :: add material # < . > **type** [**sanisand2008**] **mass_density** = < M/L^3 > **e0** = < . > **sanisand2008_G0** = < . > **sanisand2008_K0** = < . > **sanisand2008_Pat** = < *stress* > **sanisand2008_k_c** = < . > **sanisand2008_alpha_cc** = < . > **sanisand2008_c** = < . > **sanisand2008_xi** = < . > **sanisand2008_lambda** = < . > **sanisand2008_ec_ref** = < . > **sanisand2008_m** = < . > **sanisand2008_h0** = < . > **sanisand2008_ch** = < . > **sanisand2008_nb** = < . > **sanisand2008_A0** = < . > **sanisand2008_nd** = < . > **sanisand2008_p_r** = < . > **sanisand2008_rho_c** = < . > **sanisand2008_theta_c** = < . > **sanisand2008_X** = < . > **sanisand2008_z_max** = < . > **sanisand2008_cz** = < . > **sanisand2008_p0** = < *stress* > **sanisand2008_p_in** = < . > **algorithm** = < *explicit*|*implicit* > **number_of_subincrements** = < . > **maximum_number_of_iterations** = < . > **tolerance_1** = < . > **tolerance_2** = < . >;

13. gmESSI :: [Vary_Linear_Elastic_CrossAnisotropic{PhyEntyTag , ElementCommand , Density , ElasticModulusHor , ElasticModulusVer , PoissonRatioHV , PoissonRatioHH , PoissonRatioVV}]
ESSI :: add material # < . > **type** [**linear_elastic_crossanisotropic**] **mass_density** = < *mass_density* > **elastic_modulus_horizontal** = < F/L^2 > **elastic_modulus_vertical** = < F/L^2 > **poisson_ratio_h_v** = < . > **poisson_ratio_h_h** = < . > **shear_modulus_h_v** = < F/L^2 >;

14. gmESSI :: [Vary_Uniaxial_Elastic1D{PhyEntyTag , ElementCommand , ElasticModulus , ViscoElasticModulus}]
ESSI :: add material # < . > type [uniaxial_elastic] elastic_modulus = < F/L^2 > viscoelastic_modulus = < $M/L/T$ > ;

15. gmESSI :: [Vary_Uniaxial_Steel01{PhyEntyTag , ElementCommand , YieldStrength , ElasticModulus , StrainHardeningRate , a1 , a2 , a3 , a4}]
ESSI :: add material # < . > type [uniaxial_steel01] yield_strength = < F/L^2 > elastic_modulus = < F/L^2 > strain_hardening_ratio = < . > a1 = < . > a2 = < . > a3 = <> a4 = < . > ;

16. gmESSI :: [Vary_Uniaxial_Steel02{PhyEntyTag , ElementCommand , YieldStrength , ElasticModulus , StrainHardeningRate , R0 , cR1 , cR2 , a1 , a2 , a3 , a4}]
ESSI :: add material # < . > type [uniaxial_steel02] yield_strength = < F/L^2 > elastic_modulus = < F/L^2 > strain_hardening_ratio = < . > R0 = < . > cR1 = < . > cR2 = < . > a1 = < . > a2 = < . > a3 = <> a4 = < . > ;

17. gmESSI :: [Vary_Uniaxial_Concrete02{PhyEntyTag , ElementCommand , CompressiveStrength , StrainAtCompressiveStrength , CrushingStrength , StrainAtCrushingStrength , Lambda , TensileStrength , TensionSofteningStiffness}]
ESSI :: add material # < . > type [uniaxial_concrete02] compressive_strength = < F/L^2 > strain_at_compressive_strength = < . > crushing_strength = < F/L^2 > strain_at_crushing_strength = < . > lambda = < . > tensile_strength = < F/L^2 > tension_softening_stiffness = < F/L^2 >;

Chapter 8

Nodal Commands

1. gmESSI :: [Add_Nodes_To_Physical_Group{PhyEntyTag , PhysicalNodeGroup}]
   ESSI :: add nodes (< . >) to physical_node_group "*string*";

2. gmESSI :: [Add_Self_Weight_To_Node{PhyEntyTag , field#1}]
   ESSI :: add load # < . > to node # < . > type self_weight use acceleration field # < . >;

3. gmESSI :: [Add_Node_Load_Linear{PhyEntyTag , ForceType , Mag}]
   ESSI :: add load # < . > to node # < . > type [linear] [FORCETYPE] $=$ **<** *forceormoment* **>; //[FORCETYPE] = [Fx] [Fy] [Fz] [Mx] [My] [Mz] [F_fluid_x] [F_fluid_y] [F_fluid_z]**

4. gmESSI :: [Add_Node_Load_Path_Time_Series{PhyEntyTag , ForceType , Mag , SeriesFile}]
   ESSI :: add load # < . > to node # < . > type [path_time_series] [FORCETYPE] $=$ **<** *forceormoment* **> series_file = "***string***";**

5. gmESSI :: [Add_Node_Load_Path_Series{PhyEntyTag , ForceType , Mag , TimeStep , SeriesFile}]
   ESSI :: add load # < . > to node # < . > type [path_series] [FORCETYPE] $=$ **<** *forceormoment* **> time_step =** $< T >$ **series_file = "***string***";**

6. gmESSI :: [Add_Node_Load_From_Reaction{PhyEntyTag}]
   ESSI :: add load # < . > to node # < . > type [from_reactions];

7. gmESSI :: [Add_Node_Load_Imposed_Motion_Time_Series{PhyEntyTag , DofType , TimeStep , DispScale , DispFile , VelScale , VelFile , AccScl , AccFile}]
   ESSI :: add imposed motion # < . > to node # < . > dof < $DOFTYPE >$ **time_step =** $< T >$ **displacement_scale_unit =** $< L >$ **displacement_file = "***string***" velocity_scale_unit =** $< L/T >$ **velocity_file = "***string***" acceleration_scale_unit =** $< L/T^2 >$ **acceleration_file = "***string***";**

8. gmESSI :: [Add_Node_Load_Imposed_Motion_Series{PhyEntyTag , DofType , DispScale , DispFile , VelScale , VelFile , AccScale , AccFile}]
   ESSI :: add imposed motion # < . > to node # < . > dof < $DOFTYPE >$ **displacement_scale_unit =** $< L >$ **displacement_file = "***string***" velocity_scale_unit =** $< L/T >$ **velocity_file = "***string***" acceleration_scale_unit =** $< L/T^2 >$ **acceleration_file = "***string***";**

9. gmESSI :: [Add_Damping_To_Node{PhyEntyTag , damping#1}]
   ESSI :: add damping # < . > to node # < . >;

10. gmESSI :: [Add_Mass_To_Node{PhyEntyTag , MassX , MassY , MassZ}]
    ESSI :: add mass to node # < . > mx = < M > my = < M > mz = < M >;

11. gmESSI :: [Add_Beam_Mass_To_Node{PhyEntyTag , MassX , MassY , MassZ , ImassX , ImassY , ImassZ}]
    ESSI :: add mass to node # < . > mx = < M > my = < M > mz = < M > Imx = < ML^2 > Imy = < ML^2 > Imz = < ML^2 >;

12. gmESSI :: [Add_Master_Slave{PhyEntyTag , node#1 , MasterSlaveDofType}]
    ESSI :: add constraint equal_dof with master node # < . > and slave node # < . > dof to constrain < . >;

13. gmESSI :: [Add_MasterDof_SlaveDof{PhyEntyTag , node#1 , MasterDofType , SlaveDofType}]
    ESSI :: add constraint equal_dof with node # < . > dof < . > master and node # < . > dof < . > slave;

14. gmESSI :: [Fix_Dofs{PhyEntyTag , DofTypes}]
    ESSI :: fix node # < . > dofs < $DofTypes$ >**;**

15. gmESSI :: [Fix_All_Dofs{PhyEntyTag}]
    ESSI :: fix node # < . > dofs all;

16. gmESSI :: [Add_Single_Point_Constraint{PhyEntyTag , DofType , Val}]
    ESSI :: add single point constraint to node # < . > dof to constrain < $DofType$ > **constraint value of** < $DofUnit$ >**;**

17. gmESSI :: [Free_Dofs{PhyEntyTag , DofTypes}]
    ESSI :: free node # < . > dofs < . >;

18. gmESSI :: [Remove_Node{PhyEntyTag}]
    ESSI :: remove node # < . >;

19. gmESSI :: [Remove_Equal_Dof_Constrain{PhyEntyTag}]
    ESSI :: remove constraint equal_dof node # < . >;

20. gmESSI :: [Remove_Displacement_From_Node{PhyEntyTag}]
    ESSI :: remove displacement from node # < . >;

Chapter 9

Nodal Variational Commands

1. gmESSI :: [Vary_Damping_To_Node{PhyEntyTag , damping#1}]
   ESSI :: add damping # < . > to node # < . >;
2. gmESSI :: [Vary_Mass_To_Node{PhyEntyTag , MassX , MassY , MassZ}]
   ESSI :: add mass to node # < . > mx = < M > my = < M > mz = < M >;
3. gmESSI :: [Vary_Beam_Mass_To_Node{PhyEntyTag , MassX , MassY , MassZ , ImassX , ImassY , ImassZ}]
   ESSI :: add mass to node # < . > mx = < M > my = < M > mz = < M > Imx = < ML^2 > Imy = < ML^2 > Imz = < ML^2 >;
4. gmESSI :: [Vary_Master_Slave{PhyEntyTag , node#1 , MasterSlaveDofType}]
   ESSI :: add constraint equal_dof with master node # < . > and slave node # < . > dof to constrain < . >;
5. gmESSI :: [Vary_MasterDof_SlaveDof{PhyEntyTag , node#1 , MasterDofType , SlaveDofType}]
   ESSI :: add constraint equal_dof with node # < . > dof < . > master and node # < . > dof < . > slave;
6. gmESSI :: [Vary_Fix_Dofs{PhyEntyTag , DofTypes}]
   ESSI :: fix node # < . > dofs < *DofTypes* >**;**
7. gmESSI :: [Vary_Free_Dofs{PhyEntyTag , DofTypes}]
   ESSI :: free node # < . > dofs < . >;

Chapter 10

Singular Commands

1. gmESSI :: [Print{Exp}]
   ESSI :: print $<$. $>$**;**

2. gmESSI :: [Print_Node{PhyEntyTag}]
   ESSI :: print element # $<$. $>$**;**

3. gmESSI :: [Print_Single_Node{node#1}]
   ESSI :: print element # $<$. $>$**;**

4. gmESSI :: [Print_Node{PhyEntyTag}]
   ESSI :: print node # $<$. $>$**;**

5. gmESSI :: [Print_Single_Node{node#1}]
   ESSI :: print node # $<$. $>$**;**

6. gmESSI :: [Check_Mesh{FileName}]
   ESSI :: check mesh $<$ *filename* $>$**;**

7. gmESSI :: [Add_Acceleration_Field{field#1 , AccX , AccY , AccZ}]
   ESSI :: add acceleration field # $<$. $>$ **ax** $=$ $< L/T^2 >$ **ay** $=$ $< L/T^2 >$ **az** $=$ $< L/T^2 >$ **;**

8. gmESSI :: [Add_Self_Weight_To_All_Elements{field#1}]
   ESSI :: add load # $<$. $>$ **to all elements type self_weight use acceleration field #** $<$. $>$**;**

9. gmESSI :: [Add_Uniform_Acceleration_Series_To_All_Nodes{DofType , TimeStep , ScaleFactor , InitialVelocity , AccFile}]
   ESSI :: add uniform acceleration # $<$. $>$ **to all nodes dof** $<$. $>$ **time_step** $=$ $< T >$ **scale_factor** $=$ $< L/T^2 >$ **initial_velocity** $=$ $< L/T >$ **acceleration_file** $=$ **"***string***";**

10. gmESSI :: [Define_Rayleigh_Damping{damping#1 , a0 , a1 , StiffnessToUse}]
ESSI :: add damping # < . > type [Rayleigh] with a0 = $< 1/T >$ **a1 =** $< T >$ **stiffness_to_use =** $< Initial\_Stiffness|Current\_Stiffness|Last\_Committed\_Stiffness >$**;**

11. gmESSI :: [Define_Caughey3rd_Damping{damping#1 , a0 , a1 , a2 , StiffnessToUse}]
ESSI :: add damping # < . > type [Caughey3rd] with a0 = $< 1/T >$ **a1 =** $< T >$ **a2 =** $< T^3 >$ **stiffness_to_use =** $< Initial\_Stiffness|Current\_Stiffness|Last\_Committed\_Stiffness >$**;**

12. gmESSI :: [Define_Caughey4th_Damping{damping#1 , a0 , a1 , a2 , a3 , StiffnessToUse}]
ESSI :: add damping # < . > type [Caughey4th] with a0 = $< 1/T >$ **a1 =** $< T >$ **a2 =** $< T^3 >$ **a3 =** $< T^5 >$ **stiffness_to_use =** $< Initial\_Stiffness|Current\_Stiffness|Last\_Committed\_Stiffness >$**;**

13. gmESSI :: [Add_Domain_Reduction_Method{loading#1 , Hdf5InputFile}]
ESSI :: add domain reduction method loading # < . > hdf5_file = ”*string*”**;**

14. gmESSI :: [Add_Scaled_Domain_Reduction_Method{loading#1 , Hdf5InputFile , ScaleFactor}]
ESSI :: add domain reduction method loading # < . > hdf5_file = ”*string*” **scale_factor =** $< . >$**;**

15. gmESSI :: [Add_Section_Membrane_Plate_Fiber{section#1 , Thickness , material#1}]
ESSI :: add section # < . > type Membrane_Plate_Fiber thickness = $< L >$ **use material # < . >;**

16. gmESSI :: [Add_Section_Elastic_Membrane_Plate{section#1 , ElasticModulus , PoissonRatio , Thickness , Density}]
ESSI :: add section # < . > type Elastic_Membrane_Plate elastic_modulus = $< Pa >$ **poisson_ratio =** $< . >$ **thickness =** $< L >$ **mass_density =** $< M/L^3 >$**;**

17. gmESSI :: [Add_Section_Elastic3D{section#1 , ElasticModulus , CrossSection , Iz , Iy , Jx}]
ESSI :: add section # < . > type elastic3d elastic_modulus = $< F/L^2 >$ **cross_section =** $< L^2 >$ **bending_Iz =** $< L^4 >$ **bending_Iy=**$< L^4 >$ **torsion_Jx=**$< L^4 >$ **;**

18. gmESSI :: [Add_Section_FiberSection{section#1 , TorsionConstantGJ}]
ESSI :: add section # < . > type FiberSection TorsionConstant_GJ = $< Nm^2 >$

19. gmESSI :: [Enable_Output{}]
ESSI :: enable output;

20. gmESSI :: [Disable_Output{}]
ESSI :: disable output;

21. gmESSI :: [Enable_Asynchronous_Output{}]
ESSI :: enable asynchronous output;

22. gmESSI :: [Disable_Asynchronous_Output{}]
ESSI :: disable asynchronous output;

23. gmESSI :: [Enable_Element_Output{}]
ESSI :: enable element output;

24. gmESSI :: [Disable_Element_Output{}]
ESSI :: disable element output;

25. gmESSI :: [Output_Nth_Steps{Nth}]
ESSI :: output every $<.>$ **steps;**

26. gmESSI :: [Set_Output_Compression_Level{Level}]
ESSI :: set output compression level to $<.>$**;**

27. gmESSI :: [Define_Load_Factor_Increment{Incr}]
ESSI :: define load factor increment $<.>$**;**

28. gmESSI :: [Define_Constitutive_Integration{IntegrationAlgo}]
ESSI :: define NDMaterial constitutive integration algorithm $< IntegrationAlgo >$**;**

29. gmESSI :: [Define_Constitutive_Integration_With_SubIncrements{IntegrationAlgo , NumSubIncr}]
ESSI :: define NDMaterial constitutive integration algorithm $< IntegrationAlgo >$ **number_of_subincrements** $=<.>$**;**

30. gmESSI :: [Define_Constitutive_Integration_With_Tolerence{IntegrationAlgo , YfRelTol , StressRelTol , NumSubIncr}]
ESSI :: define NDMaterial constitutive integration algorithm $<[Forward\_Euler]||[Forward\_Euler\_Subincrement]||[Backward\_Euler]||[Backward\_Euler\_ddlambda]||[Backward\_Euler\_ddlambda\_Subinc$
yield_function_relative_tolerance $=<.>$ **stress_relative_tolerance** $=<.>$ **maximum_iterations** $=<.>$**;**

31. gmESSI :: [Define_Algorithm{AlgoType}]
ESSI :: define algorithm $<[With\_no\_convergence\_check]||[Newton]||[Modified\_Newton]>$**;**

32. gmESSI :: [Define_Convergence_Test{TestType , Tol , MaxItr , VrbLevl}]
ESSI :: define convergence test $<[Norm\_Displacement\_Increment]||[Energy\_Increment]||[Norm\_Unbalance]||[Relative\_Norm\_Displacement\_Increment]||[Relative\_Energy\_Increment]||[Relative\_Norm\_U$
tolerance $=<.>$ **maximum_iterations** $=<.>$ **verbose_level** $=<0|1|2>$**;**

33. gmESSI :: [Define_Physical_Node_Group{GroupName}]
ESSI :: define physical_node_group "*string***";**

34. gmESSI :: [Remove_Physical_Node_Group{GroupName}]
ESSI :: remove physical_node_group "*string***";**

35. gmESSI :: [Define_Physical_Element_Group{GroupName}]
ESSI :: define physical_element_group "*string***";**

36. gmESSI :: [Remove_Physical_Element_Group{GroupName}]
ESSI :: rempve physical_element_group "*string***";**

37. gmESSI :: [Print_Physical_Element_Group{GroupName}]
ESSI :: print physical_element_group "*string***";**

38. gmESSI :: [Print_Physical_Node_Group{GroupName}]
ESSI :: print physical_node_group "*string*";

39. gmESSI :: [Define_Solver{SolverName}]
ESSI :: define solver < [*ProfileSPD*]||[*UMFPack*]||[*Parallel*] >;

40. gmESSI :: [Define_Dynamic_Newmark_Integrator{Gamma , Beta}]
ESSI :: define [dynamic] integrator [Newmark] with gamma = < . > **beta** = < . >;

41. gmESSI :: [Define_Dynamic_Hilber_Hughes_Taylor_Integrator{Alpha}]
ESSI :: define [dynamic] integrator [Hilber_Hughes_Taylor] with alpha = < . >;

42. gmESSI :: [Define_Static_Displacement_Control_Integrator{node#1 , DofType , Incr}]
ESSI :: define [static] integrator [displacement_control] using node # < . > **dof [DOFTYPE] increment** < *L* >;

43. gmESSI :: [Define_Model_Name{ModelName}]
ESSI :: model name "*string*";

44. gmESSI :: [New_Loading_Stage{StageName}]
ESSI :: new loading stage "*string*";

45. gmESSI :: [Simulate_Using_Static_Algorithm{NumSteps}]
ESSI :: simulate < . > **steps using [static] algorithm;**

46. gmESSI :: [Simulate_Using_Transient_Algorithm{NumSteps , TimeIncr}]
ESSI :: simulate < . > **steps using [transient] algorithm time_step** = < *time* >;

47. gmESSI :: [Simulate_Using_Variable_Transient_Algorithm{NumSteps , TimeIncr , MinTimeIncr , MaxTimeIncr , NumIter}]
ESSI :: simulate < . > **steps using [variable transient] algorithm time_step** = < *time* > **minimum_time_step** = < *time* > **maximum_time_step** = < *time* > **number_of_iterations** = < . >;

48. gmESSI :: [Output_Non_Converged_Iterations{}]
ESSI :: output [non_converged_iterations] ;

49. gmESSI :: [Output_Support_Reactions{}]
ESSI :: output [support] [reactions];

50. gmESSI :: [Simulate_Eigen_Analysis{NumModes}]
ESSI :: simulate using [eigen] algorithm number_of_modes = < . >;

51. gmESSI :: [Simulate_Constitutive_Testing_Constant_Mean_Pressure_Triaxial_Strain_Control{material#1 , StrainIncr , MaxStrain , NumCycles}]
ESSI :: simulate constitutive testing [constant mean pressure triaxial strain control] use material # < . > **strain_increment_size** = < . > **maximum_strain** = < . > **number_of_times_reaching_maximum_strain** = < . >;

52. gmESSI :: [Simulate_Constitutive_Testing_Drained_Triaxial_Strain_Control{material#1 , StrainIncr , MaxStrain , NumCycles}]
ESSI :: simulate constitutive testing [drained triaxial strain control] use material # < . > strain_increment_size = < . > maximum_strain = < . > number_of_times_reaching_maximum_strain = < . >;

53. gmESSI :: [Simulate_Constitutive_Testing_Undrained_Triaxial_Stress_Control{material#1 , StrainIncr , MaxStrain , NumCycles}]
ESSI :: simulate constitutive testing [undrained triaxial stress control] use material # < . > strain_increment_size = < . > maximum_strain = < . > number_of_times_reaching_maximum_strain = < . >;

54. gmESSI :: [Simulate_Constitutive_Testing_Undrained_Simple_Shear{material#1 , StrainIncr , MaxStrain , NumCycles}]
ESSI :: simulate constitutive testing [undrained simple shear] use material # < . > strain_increment_size = < . > maximum_strain = < . > number_of_times_reaching_maximum_strain = < . >;

55. gmESSI :: [Simulate_Constitutive_Testing_Undrained_Triaxial{material#1 , StrainIncr , MaxStrain , NumCycles}]
ESSI :: simulate constitutive testing [undrained triaxial] use material # < . > strain_increment_size = < . > maximum_strain = < . > number_of_times_reaching_maximum_strain = < . >;

56. gmESSI :: [Simulate_Constitutive_Testing_BardetMethod{material#1 , ScaleFactor , SeriesFile , Sigma11 , Sigma22 , Sigma22 , Sigma12 , Sigma13 , Sigma13 , VrbseLevl}]
ESSI :: simulate constitutive testing [BARDETMETHOD] use material # < . > scale_factor = < Pa > series_file = "*string*" sigma0 = (< Pa > , < Pa > , < Pa > , < Pa > , < Pa > , < Pa >) verbose_output = < . >

57. gmESSI :: [Simulate_Constitutive_Testing_Direct_Strain{material#1 , ScaleFactor , SeriesFile , Sigma11 , Sigma22 , Sigma22 , Sigma12 , Sigma13 , Sigma13 , VrbseLevl}]
ESSI :: simulate constitutive testing [DIRECT_STRAIN] use material # < . > scale_factor = < . > series_file = "*string*" sigma0 = (< Pa > , < Pa > , < Pa > , < Pa > , < Pa > , < Pa >) verbose_output = < . >

58. gmESSI :: [Compute_Reaction_Forces{}]
ESSI :: compute reaction forces;

59. gmESSI :: [Remove_Imposed_Motion{motion#1}]
ESSI :: remove imposed motion # < . >;

60. gmESSI :: [Remove_Load{load#1}]
ESSI :: remove load # < . >;

61. gmESSI :: [Add_Linear_Elastic_Isotropic_3D{material#1 , Density , ElasticModulus , PoissonRatio}]
ESSI :: add material # < . > type [linear_elastic_isotropic_3d] mass_density = < M/L^3 > elastic_modulus = < F/L^2 > poisson_ratio = < . >;

62. gmESSI :: [Add_VonMises{material#1 , Density , ElasticModulus , PoissonRatio , VonMisesRadius , KinematicHardeningRate , IsotropicHardeningRate}]
ESSI :: add material # < . > type [VonMises] mass_density = < M/L^3 > elastic_modulus = < F/L^2 > poisson_ratio = < . > von_mises_radius = < F/L^2 > kinematic_hardening_rate = < F/L^2 > isotropic_hardening_rate = < F/L^2 > ;

63. gmESSI :: [Add_VonMisesArmstrongFrederick{material#1 , Density , ElasticModulus , PoissonRatio , VonMisesRadius , ArmstrongFrederickHa , ArmstrongFrederickCr , IsotropicHardeningRate}]
ESSI :: add material # < . > type [VonMisesArmstrongFrederick] mass_density = < M/L^3 > elastic_modulus = < F/L^2 > poisson_ratio = < . > von_mises_radius = <> armstrong_frederick_ha = < F/L^2 > armstrong_frederick_cr = < F/L^2 > isotropic_hardening_rate = < F/L^2 > ;

64. gmESSI :: [Add_DruckerPrager{material#1 , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress}]
ESSI :: add material # < . > type [DruckerPrager] mass_density = $< M/L^3 >$ elastic_modulus = $< F/L^2 >$ poisson_ratio = < . > druckerprager_k = <> kinematic_hardening_rate = $< F/L^2 >$ isotropic_hardening_rate = $< F/L^2 >$ initial_confining_stress = $< F/L^2 >$;

65. gmESSI :: [Add_DruckerPragerVonMises{material#1 , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress}]
ESSI :: add material # < . > type [DruckerPragerVonMises] mass_density = $< M/L^3 >$ elastic_modulus = $< F/L^2 >$ poisson_ratio = < . > druckerprager_k = <> kinematic_hardening_rate = $< F/L^2 >$ isotropic_hardening_rate = $< F/L^2 >$ initial_confining_stress = $< F/L^2 >$;

66. gmESSI :: [Add_DruckerPragerNonAssociativeLinearHardening{material#1 , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress , PlasticFlowXi , PlasticFlowKd}]
ESSI :: add material # < . > type [DruckerPragerNonAssociateLinearHardening] mass_density = $< M/L^3 >$ elastic_modulus = $< F/L^2 >$ poisson_ratio = < . > druckerprager_k = <> kinematic_hardening_rate = $< F/L^2 >$ isotropic_hardening_rate = $< F/L^2 >$ initial_confining_stress = $< F/L^2 >$ plastic_flow_xi = < . > plastic_flow_kd = < . > ;

67. gmESSI :: [Add_DruckerPragerArmstrongFrederickLE{material#1 , Density , ElasticModulus , PoissonRatio , DruckerPragerK , ArmstrongFrederickHa , ArmstrongFrederickCr , IsotropicHardeningRate , InitialConfiningStress}]
ESSI :: add material # < . > type [DruckerPragerArmstrongFrederickLE] mass_density = $< M/L^3 >$ elastic_modulus = $< F/L^2 >$ poisson_ratio = < . > druckerprager_k = <> armstrong_frederick_ha = $< F/L^2 >$ armstrong_frederick_cr = $< F/L^2 >$ isotropic_hardening_rate = $< F/L^2 >$ initial_confining_stress = $< F/L^2 >$;

68. gmESSI :: [Add_DruckerPragerArmstrongFrederickNE{material#1 , Density , DuncanChengK , DuncanChengPa , DuncanChengN , DuncanChengSigma3Max , DuncanChengNu , DruckerpragerK , ArmstrongFrederickHa , ArmstrongFrederickCr , IsotropicHardeningRate , InitialConfiningStress}]
ESSI :: add material # < . > type [DruckerPragerArmstrongFrederickNE] mass_density = $< M/L^3 >$ DuncanCheng_K = < . > DuncanCheng_pa = $< F/L^2 >$ DuncanCheng_n = < . > DuncanCheng_sigma3_max = $< F/L^2 >$ DuncanCheng_nu = < . > druckerprager_k = <> armstrong_frederick_ha = $< F/L^2 >$ armstrong_frederick_cr = $< F/L^2 >$ isotropic_hardening_rate = $< F/L^2 >$ initial_confining_stress = $< F/L^2 >$;

69. gmESSI :: [Add_DruckerPragerNonAssociateArmstrongFrederick{material#1 , Density , ElasticModulus , PoissonRatio , DruckerPragerK , KinematicHardeningRate , IsotropicHardeningRate , InitialConfiningStress , PlasticFlowXi , PlasticFlowKd}]
ESSI :: add material # < . > type [DruckerPragerNonAssociateArmstrongFrederick] mass_density = $< M/L^3 >$ elastic_modulus = $< F/L^2 >$ poisson_ratio = < . > druckerprager_k = <> armstrong_frederick_ha = $< F/L^2 >$ armstrong_frederick_cr = $< F/L^2 >$ isotropic_hardening_rate = $< F/L^2 >$ initial_confining_stress = $< F/L^2 >$ plastic_flow_xi = <> plastic_flow_kd = <> ;

70. gmESSI :: [Add_CamClay{material#1 , Density , M , lambda , Kappa , e0 , P0 , PoissonRatio , InitialConfiningStress}]
ESSI :: add material # < . > type [CamClay] mass_density = $< M/L^3 >$ M = < . > lambda = < . > kappa = < . > e0 = < . > p0 = $< F/L^2 >$ Poisson_ratio = < . > initial_confining_stress = $< F/L^2 >$

71. gmESSI :: [Add_RoundedMohrCoulomb{material#1 , Density , ElasticModulus , PoisonRatio , M , Qa , Pc , Heta , Eta0 , InitialConfiningStress}]
ESSI :: add material # < . > type [roundedMohrCoulomb] mass_density = $< M/L^3 >$ elastic_modulus = $< F/L^2 >$ poisson_ratio = < . > RMC_m = < . > RMC_qa = $< F/L^2 >$ RMC_pc = $< F/L^2 >$ RMC_e = < . > RMC_eta0 = < . > RMC_Heta = $< F/L^2 >$ initial_confining_stress = $< F/L^2 >$

72. gmESSI :: [Add_SaniSand2008{material#1 , Density , e0 , G0 , K0 , Pat , Kc , Alpha_cc , c , xi , Lambda , ec_ref , M , h0 , ch , nb , A0 , nd , p_r , rho_c , theta_c , X , z_max , cz , P0 , Algorithm , NumSubIncr , MaxIter , Tol1 , Tol2}]
ESSI :: add material # < . > type [sanisand2008] mass_density = $< M/L^3 >$ e0 = < . > sanisand2008_G0 = < . > sanisand2008_K0 = < . > sanisand2008_Pat = $< stress >$

sanisand2008_k_c = < . > **sanisand2008_alpha_cc** = < . > **sanisand2008_c** = < . > **sanisand2008_xi** = < . > **sanisand2008_lambda** = < . > **sanisand2008_ec_ref** = < . > **sanisand2008_m** = < . > **sanisand2008_h0** = < . > **sanisand2008_ch** = < . > **sanisand2008_nb** = < . > **sanisand2008_A0** = < . > **sanisand2008_nd** = < . > **sanisand2008_p_r** = < . > **sanisand2008_rho_c** = < . > **sanisand2008_theta_c** = < . > **sanisand2008_X** = < . > **sanisand2008_z_max** = < . > **sanisand2008_cz** = < . > **sanisand2008_p0** = < *stress* > **sanisand2008_p_in** = < . > **algorithm** = < *explicit|implicit* > **number_of_subincrements** = < . > **maximum_number_of_iterations** = < . > **tolerance_1** = < . > **tolerance_2** = < . >;

73. gmESSI :: [Add_Linear_Elastic_CrossAnisotropic{material#1 , Density , ElasticModulusHor , ElasticModulusVer , PoissonRatioHV , PoissonRatioHH , PoissonRatioVV}]
ESSI :: add material # < . > **type** [**linear_elastic_crossanisotropic**] **mass_density** = < *mass_density* > **elastic_modulus_horizontal** = < F/L^2 > **elastic_modulus_vertical** = < F/L^2 > **poisson_ratio_h_v** = < . > **poisson_ratio_h_h** = < . > **shear_modulus_h_v** = < F/L^2 >;

74. gmESSI :: [Add_Uniaxial_Elastic1D{material#1 , ElasticModulus , ViscoElasticModulus}]
ESSI :: add material # < . > **type** [**uniaxial_elastic**] **elastic_modulus** = < F/L^2 > **viscoelastic_modulus** = < $M/L/T$ > ;

75. gmESSI :: [Add_Uniaxial_Steel01{material#1 , YieldStrength , ElasticModulus , StrainHardeningRate , a1 , a2 , a3 , a4}]
ESSI :: add material # < . > **type** [**uniaxial_steel01**] **yield_strength** = < F/L^2 > **elastic_modulus** = < F/L^2 > **strain_hardening_ratio** = < . > **a1** = < . > **a2** = < . > **a3** = <> **a4** = < . > ;

76. gmESSI :: [Add_Uniaxial_Steel02{material#1 , YieldStrength , ElasticModulus , StrainHardeningRate , R0 , cR1 , cR2 , a1 , a2 , a3 , a4}]
ESSI :: add material # < . > **type** [**uniaxial_steel02**] **yield_strength** = < F/L^2 > **elastic_modulus** = < F/L^2 > **strain_hardening_ratio** = < . > **R0** = < . > **cR1** = < . > **cR2** = < . > **a1** = < . > **a2** = < . > **a3** = <> **a4** = < . > ;

77. gmESSI :: [Add_Uniaxial_Concrete02{material#1 , CompressiveStrength , StrainAtCompressiveStrength , CrushingStrength , StrainAtCrushingStrength , Lambda , TensileStrength , TensionSofteningStiffness}]
ESSI :: add material # < . > **type** [**uniaxial_concrete02**] **compressive_strength** = < F/L^2 > **strain_at_compressive_strength** = < . > **crushing_strength** = < F/L^2 > **strain_at_crushing_strength** = < . > **lambda** = < . > **tensile_strength** = < F/L^2 > **tension_softening_stiffness** = < F/L^2 >;

78. gmESSI :: [Add_Fiber{fiber#1 , material#1 , section#1 , CrossSection , FiberLocationX , FiberLocationY}]
ESSI :: add fiber # < . > **using material #** < . > **to section #** < . > **fiber_cross_section** = < *area* > **fiber_location** = (< L >,< L >);

79. gmESSI :: [Var{variable , value}]
ESSI :: < $Variable$ > = < *exp* >;

80. gmESSI :: [Include{FileName}]
ESSI :: include < *filename* >;

81. gmESSI :: [Bye{}]
ESSI :: bye;

82. gmESSI :: [Comment{//comment}]
ESSI :: ;

83. gmESSI :: [Newline{}]
ESSI :: ;

84. gmESSI :: [ESSI{EssiCommand}]
ESSI :: $< essi\_command >$**;**

Chapter 11

Special Commands

1. gmESSI :: [Write_Data{PhyEntyTag , FileName}]
   ESSI :: ;
2. gmESSI :: [Connect{PhyEntyTag , PhyEntyTag , PhyEntyTag , dv1 , mag , Tolerence , algo , noT , PhysicalGroupName}]
   ESSI :: ;