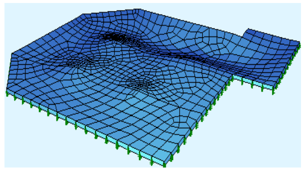
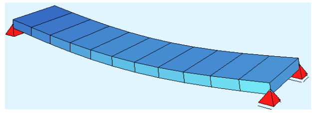
SOFiSTiK workshop May 2009 Nonlinear analysis

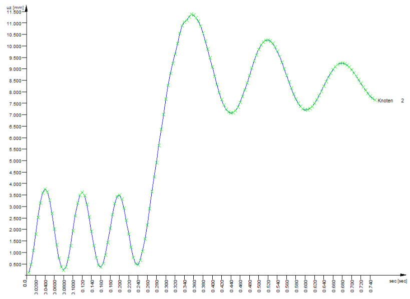
Example overview and file locations



Introduction nonlinear concrete slab:
ase.dat\english\nonlinear_quad\concrete_nonlinear.dat

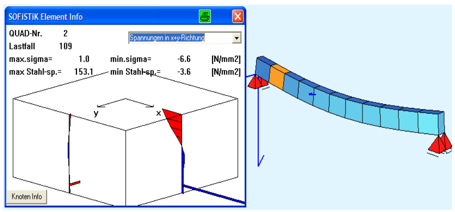


Simple quad beam cracked:
ase.dat\english\nonlinear_quad\concrete_creep2.dat

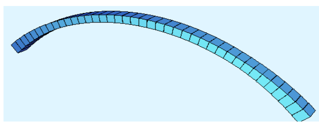


Same with dynamic cracking:
shows eigenfrequencies in cracked situation:
ase.dat\english\dynamics\step_nonl_concrete_girder.dat ------>

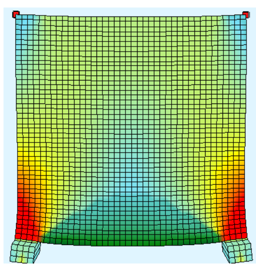
or: explosion_on_th3_quad_girder.dat
including TH3 cable effect of reinforcement



Same with steel fibre concrete:
ase.dat\english\nonlinear_quad\steel_fibre_concrete.dat ------>



Unreinforced concrete arch geometric nonlinear:
ase.dat\english\nonlinear_quad\arch_bridge.dat



Nonlinear disc analysis: concrete_wall.dat
sufficient with CTRL NLAY 2
= two layers are sufficient for pure disc analysis (SYST SPACE)!
But remember: pure disc systems have a bad convergence
in cracked analysis, because pure cracked regions
without stiffness may remain.

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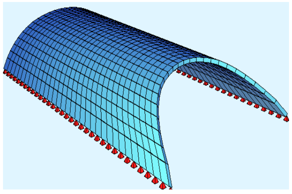
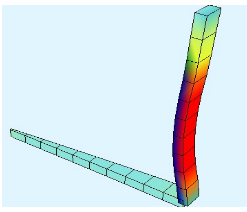
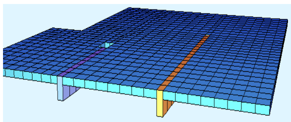
Nonlinear shell analysis, now incl. fire loading:
ase.dat\english\special\quads_on_fire.pdf .dat ------------------------>



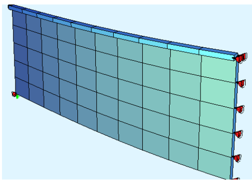
Rotational segment = very efficient,
especially for quick preanalysis and clear
nonlinear redistribution effects:
ase.dat\english\nonlinear_quad\concrete_tank_cracked.dat.dat



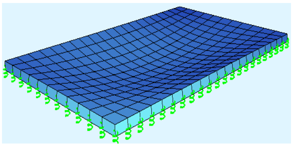
Quad+beam problem:
concrete_ex_quad.dat (not on ftp-example file available,
-> workshop cd or ask juergen_bellmann@sofistik.de)
The linear T-beam philosophy cannot work in nonlinear case,
because of the double defined concrete
-> best way is use of excentric quads ------------------------------------>



Lateral_buckling.dat
for TH3 buckling see ase9_quad_euler_beam.dat
and ase13_shell_buckling.dat
for beams see new ase11_girder_overturning.dat (April-2009)
and ase.dat\english\nonlinear_beam\aseaqb_4_lateral_buckl_prestress.dat



Nonlinear technique enbedded in CSM:
csm.dat\english\csm52_slab_state_ii.dat -------------------------------->



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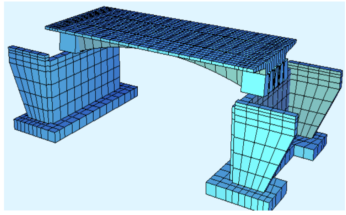
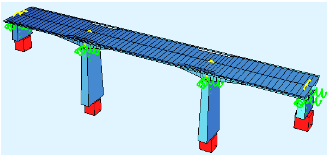
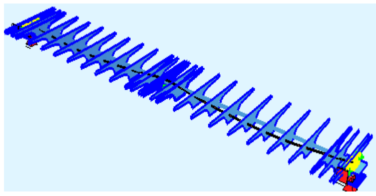
Example overview and file locations

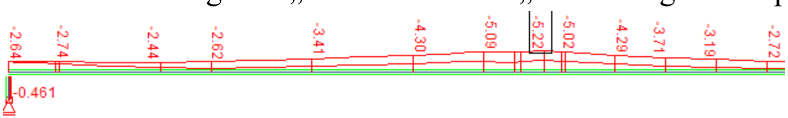


- Bridge wizard -> SSD task "beam and slab bridge"
  incl. curved bridges



- Design help in CSM:
  csm.dat\english\csm31_design.dat
  Please look at new plots in chapter in CSM manual:
  Theoretical backgroud „load cases“ and „CSM design concept“





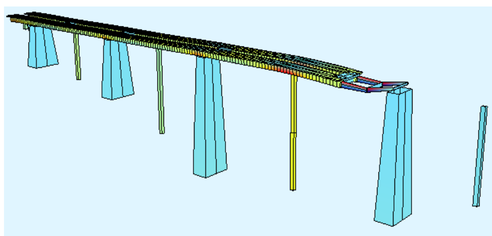
Max. min stresses Pk,inf decompression permanent on top uniaxial

–   Incremental_launching:

–

Main feature is the free positioning of support moving springs beyond the superstructure. If the moving spring finds an element in the node sequence of the MOVS input , the spring supports this two node subsystem like a balanced beam: the spring supports the two nodes - only the bending moment peak in the real beam above is missing. But for short superstructure beam elements (1m) this balanced beam represents the real width of the moving support area.
Please check this behavior in plot of beam MY in loadcase 902 of example
ase.dat\english\bridge\movs_incremental_launching_principle.dat

In this example the support springs move beyond the fixed bridge.
Please note that support positions are independent to superstructure nodes!



Alternatively the piers can be fixed while the superstructure moves:
Example with moving superstructure on fixed piers:
ase.dat\english\bridge\movs_incremental_launching_2.dat

Example with CSM including tendons and creep+shrinkage:
csm.dat\english\CSM41_launching_principle.dat
csm.dat\english\csm42_incremental_launching.dat
csm.dat\english\csm43_incremental_launching_circle.dat
new: csm45_launching_precamber.dat = launching of predeformed superstructure

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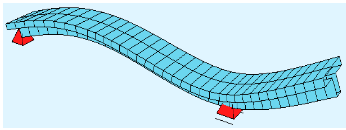
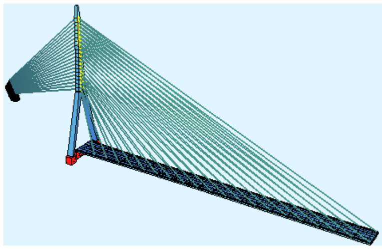
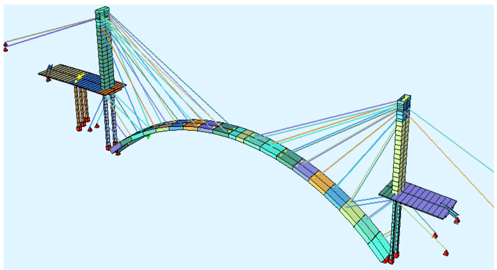
- Precamber with formwork-position-plot:
  csm.dat\english\csm26_precamber_spanbyspan.dat
  CS 9 shows necessary position of formwork before
  concrete is filled in – without deformation of formwork itself !!



- Force finding and precamber on cable stayed bridges
  Please start with force finding and only when forces are OK,
  continue with deformation formfinding:
  csm.dat\english\csm22_cable_stay_optimisation.dat
  csm.dat\english\csm23_cable_stay_optimisation_2.dat
  csm.dat\english\csm27_suspension_w_nonlopti.dat





Nice customer example (input file not available):
- Viadukt Predel: arch_bridge_stages_precamber.dat

- First animations can be made with ASE runs and
  CTRL SOLV 0
  = definition of group switchings without analysis !

  If you have problems with stability (instable system during CSM runs) please add
  CTRL ASE TEXT 'STEP 1 dt 10.0'
  and add additional dynamic stifness for temporary stability!

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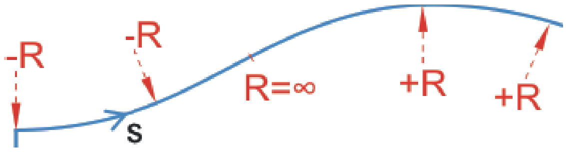
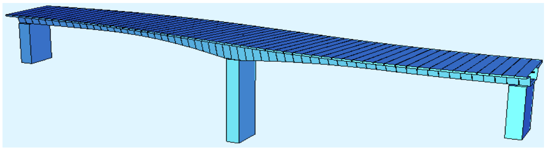
New CABD – Computer Aided Bridge Design Features:

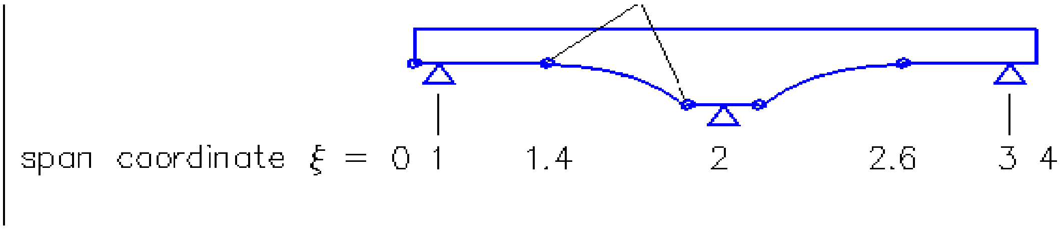
- csm.dat\english\cabd\ csm31_design_cabd.dat

Definition of bridge axis in horizontal and vertical alignment:





Axis variables defind alond the axis: here height:

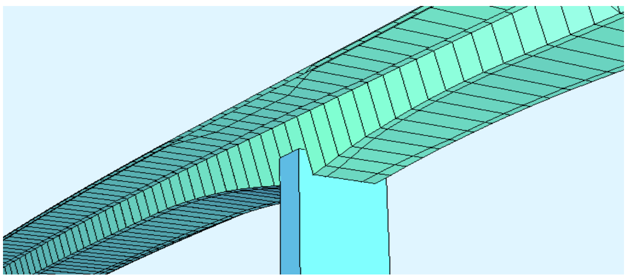


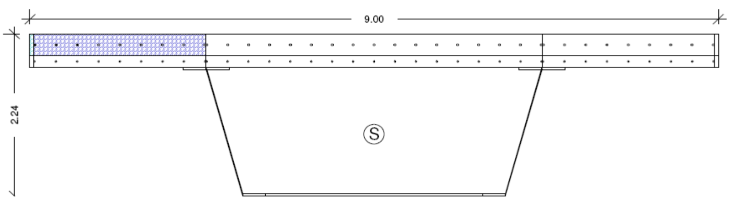

```
$ ------------------------ axis variables : -----------------------
$ Variable HEIGHT via xi:
 GAXV   S               V   TYPE ID='AX_1' NAME='HEIGHT'
    =#S_XI(0.0)       1.50   -
    =#S_XI(1.4)       1.50  D+  $ at xi=0.4 of span 1 !
    =#S_XI(2.0)-1.20 2.80  D+  $ 1.20 m before pier
    =#S_XI(2.0)+1.20 2.80  D-  $ 1.20 m after  pier
    =#S_XI(2.6)       1.50  D-
    =#S_XI(4.0)       1.50  D-
```

- csm.dat\english\cabd\ csm10_composite_cabd.dat:

Haunched composite bridge with erection construction stages

Features
* varying construction heigth
* varying blec thickness and width
* varying active width of concrete deck
* stepwise concreting
* cracked concrete stiffness (at piers)
* complex time based creep & shrinkage





Juergen Bellmann, SOFiSTiK