Fitzroy Systems

SAND - Structural Analysis and Design, & SCALE - Structural CALculations Ensemble, Information sheet 40; Jan 2014.

Support

(1) **Technical support**, for technical support for all aspects of SAND and SCALE please email Dr Ian Brown, ian@fitzroy.com tel 01284 754240.

(2) **Accounts**, if you have changed address or if there is a new contact person, please email: Jeanette Brown, jeanette@fitzroy.com or post to Lark Lodge, Fornham St Martin, Bury St Edmunds, Suffolk IP31 1SR, tel 01284 754 240.

Eurocodes

We have made significant progress in 2013 with an additional 39 proformas now having new or substantially revised Eurocode versions. There are now 375 proformas which show full calculations to the Eurocodes or full calculations to the British Standards, or are analytical and applicable to both codes.

We have completed the majority of all steel, reinforced concrete, piling, composite buildings, timber and masonry proformas. In 2014 we will continue development of the Eurocode versions of proformas.

Windows 8.1

All programs in the SAND and SCALE suites are fully supported and operational on all 32-bit and 64-bit desktop/laptop versions of Windows 8.1, Windows 8, Windows 7, Windows Vista and Windows XP.

List of SCALE proformas

To view the full list of SCALE proformas, click on the menu option File─>Display File (or File─>Print File to print); then in the File name box type scale.mnu and click Open. Proformas which have full Eurocode versions or are applicable to both are marked with an "(E)".

The SCALE user interface

In 2013, development has continued on improving the user friendliness of the next versions of SCALE, NL-STRESS etc. to make them behave more intuitively like Windows programs. It would be impracticable to release some parts of the suite updated, and some parts not updated, so work has focussed on getting new versions of all parts ready and fully tested and updating all the documentation. Consideration has been given to take into account possible future platforms on which SCALE may run, namely on tablet computers and on the web, to provide for a consistent user interface across all platforms. This will be available for download later in 2014.

Forthcoming changes include for example: improving the discoverability of proformas in the main menu, not interpreting Backspace at the start of the line as a fast forward, ability to use any directories for the installation and working directories, not writing to any files in the installation directory, adding ability to navigate solely with mouse or solely with the keyboard, making it easier to view the calcs mid-calculation, making it easier to go back and forwards when doing a calculation, ignoring clicks outside buttons or text fields, reducing the amount of temporary files written to during SCALE and NL-STRESS runs, and allowing SCALE to launch NL-STRESS & SCALE, and allowing NL-STRESS to launch SCALE as at present but without the jumps between different windows.

Work has also progressed on restructuring proformas to make the transition to a single executable program, this has the advantage that information could be kept in memory rather than saving to a multitiude of temporary files as at present, which would speed up and simplify the operation of the programs, and reduce the likelihood of problems occurring.

As outlined in the last newsletter we have extended the testing regimes to include NL-STRESS runs of the benchmark files and NL-STRESS data files, to check that any changes made to the SCALE and NL-STRESS programs do not affect the output calculations. As part of this testing framework, there is a pdf available to view on the download webpage that is now built automatically for each update, showcasing all the examples from all the proformas, and examples from most of the NL-STRESS data files, (~40,000 pages, 170MB, which if printed out double-sided would be as tall as a person!)

We have been focussing on getting all output to be identical between versions of SCALE and NL-STRESS built between different compiler setups (for both 32-bit and 64-bit executables, for both release and debug versions, using Microsoft Visual C++ 6.0, 2003, 2013, Compaq Visual Fortran, Intel Visual Fortran, and Apple Xcode 5 compilers).

Changes to SCALE program (Latest version is 4.91)

In addition to the 39 proformas with new or substantially revised Eurocode versions added in 2013, we have made amendments to a further 400 proformas as listed below.

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SC078, 83, Added design yield strength of reinforcement (fywd).
SC090, 91, 94, 95, 96, 97, 98, 99, Added variable name ccheck and option
        to use higher concrete grade strengths (i.e. fck>50 N/mm2),
        removed munits subroutine.
SC092   Removed munits subroutine, made cosmetic changes, removed
        'Longitudinal reinforcement' heading as this was appearing twice,
        added variable name ccheck and option to use higher concrete grade
        strengths (i.e. fck>50 N/mm2).
SC094   Added EC2 design option, made cosmetic improvements. Added formula
        for stress in parabola and flg and mpa are now reported, removed
        ccheck=1.0E39 and ccheck=0 from EC2 design option, added screen
        display notes for links and cover, revised min link size, added
        ecc1 & ecc2.
SC102   Revised text, made cosmetic changes., added supp' and rper, added
        default values supp'=1 to examples and rper used for slabs only.
SC104   Added option to use higher concrete grade strengths and column
        shear check, replaced Vz with VEd.
SC110   Added missing units and removed munits subroutine.
SC193, 195 Input value for axial load fixed.
SC210, 212, 214, 216, 218, 220, 224, Added default values to examples.
SC250, 253, Made cosmetic improvements.
SC267   Added default values to examples.
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SC396 **Added EC3 design option**, made cosmetic improvements, added STOP
       commands when H<Fy and when sw ≤ swf, enhanced diagrams, replaced
       pyp=TABLE(920,tpc,Grade) with pyp=TABLE(920,tpc,grade).
SC407 Defined modulus of rigidity as G=81000 N/mm2.
SC408 Added option to have unrestrained compression flange at point
       loads, replaced load with loads, enhanced green screen display,
       defined modulus of rigidity as G=81000 N/mm2, made cosmetic
       improvements, and set Mec=M.
SC409 Removed gamd, gami and Es from EC design option, only buckling
       curve d is now utilized, defined modulus of rigidity as G=81000
       N/mm2.
SC411 replaced UB and UC with UKB and UKC, made cosmetic improvements.
SC412 Made cosmetic improvements, added Ld=L*1000 mm to BS design option
       and deflection check to EC design option, added example default
       values dcheck=0 and dcheck=1.
SC114 Made cosmetic improvements, at interaction checks replaced < with
       ≤, enhanced diagrams and SUMMARY, added Ld=L*1000 mm to BS design
       option and deflection check to EC design option, added example
       default values dcheck=0 and dcheck=1.
SC415 Made cosmetic improvements.
SC416 **Added EC3 design option**, made cosmetic improvements, revised
       expression for distance a2 and text in classification section,
       replaced Rp>Rp with Rp>Rs, removed Rp1 and Rp2, and made bl user
       defined.
SC418 **Added EC3 design option**, made cosmetic improvements, replaced Hf>4
       with Hf≥4, replaced 'section is compact' with 'section is at least
       compact' and 'state' with 'stage', replaced s' with sw when
       checking weld strength of end plate, replaced Icx with Icy, revised
       expressions for FwEdw and hep, SUMMARY revised to suit stype=1 & 2,
       removed Wplz and dbu, revised expression for MwRd, introduced W32',
       updated reduced shear resistance section, made subroutine weldth
       external, proforma enhanced to accept bn=4 for both BS & EC design
       options.
SC419 **Added EC3 design option**, made cosmetic improvements, added cross-
       centres range (90 ≥ g ≤ 140), removed dbu, added SUMMARY notes
       replaced Avnet > Avlim with Avnet ≥ Avlim, deflection to span ratio
       now defined, replaced precast units with metal decking, revised
       MwRd expression, removed reduced shear resistance in the presence
       of torsion, proforma enhanced to accept bn=4 for both BS & EC
       design options.
SC421 **Added EC3 design option**, made cosmetic improvements, added (1=Yes ,
       0=No) to butt=???, made cosmetic improvements, proforma now stops
       when H<Fy, corrected some Fw units, replaced Epicbase with ecpic
       and enhanced shear resistance section.
SC422 **Added EC3 design option**, made cosmetic improvements, added mesage
       subroutine, scenario Pws < ΣPri changed to Pws ≥ ΣPri, cosmetic
       changes, replaced ff1<pyb, ff2<pyb, fs2<ssw, fs2<sspy with ff1≤pyb,
       ff2≤pyb, fs2≤ssw, fs2≤sspy respectively, added pic and pic2, added
       missing N to diagram, removed second calmt subroutine, revised
       example default values to get SUMMARY output, added scenario IF
       sfw<sww, removed picbeam subroutine as this was not used, and
       preloaded HSFG bolts to EC design option.
SC423 **Added EC3 design option**, made cosmetic improvements, added mesage
       subroutine, replaced db with bd, replaced Dbh=Db-2*Tc with Dbh=Db-
       2*Tb and web size with weld size (relating to ssr), pyb now appears
       once in output on page 1, removed vershr, added euvshr subroutine,
       added common subroutines euchkFc, updated diagrams, added N to BS
       diagram, removed throat thickness check, added factors 0.5 & 0.6 to
       all weld throat checks as per IStructE EC3 manual, updated eucalmt

and set tri1=486, replaced Uf with fub (EC design option), updated SUMMARY, made reference to the SCI publication in output, updated recommended values for e1 and e1', added scenario IF trow=2, added preloaded HSFG bolts to EC design option.

SC424 **Added EC3 design option**, made cosmetic improvements, added scenario IF rtype<>3, code=1 and mesage subroutine, renamed picexplt to pic2 and replaced ps in diagram with pes, replaced BSI with SCI, corrected pn and pes in diagrams, added more text, corrected variable names in diagrams, replaced Uf with fub, added e1'=ex when ptype=2 and preloaded HSFG bolts to EC design option.

SC425 **Added EC3 design option**, made cosmetic improvements, added IF rtype<>3 and mesage subroutine, added more text, updated diagrams, e1'=ex when ptype=2 and preloaded HSFG bolts to EC design option.

SC426 **Added EC3 design option**, made cosmetic improvements, replaced N≤0 with N<0, added scenarios IF stype<3 & IF rtype<3, replaced FvEd & FvRd with VwpEd & VwpRd respectively, added check on throat thickness of weld (beam web), added expressions for lamp and ro, replaced FEd with FcEd', replaced ff1<fyb, ff2<fyb, fs2<ssw, fs2<sspy with ff1≤fyb, ff2≤fyb, fs2≤ssw, fs2≤sspy respectively, added more text replaced UB & UC with UKB & UKC.

SC427 **Added EC3 design option**, made cosmetic improvements, added scenario IF rtype<>3 and mesage subroutine, and web bolt slip resistance check, defined e1'=e1 and bhole=1, added euhshr subroutine and added kbs.

SC432 Made cosmetic improvements.

SC434 Made cosmetic changes, set NL=0 for both EC and BS design options as proforma is for UDL only, enhanced diagrams, removed eunote subroutine as this was not used, proforma now stops when unitb>1.

SC436 Made cosmetic changes, enhanced diagrams, added option for unrestrained beam at point loads, when NL>1 the maximum BM is defined as Mec=M and displayed on screen.

SC437 Made cosmetic improvements and replaced secrhs with secRHS.

SC440 Made cosmetic improvements, added subroutine mesage, replaced < with ≤ for interaction checks, revised example default value for reduced moment in order to get to the end of calculation, Location: is now printed on line one of the output.

SC443 **Added EC3 design option**, made cosmetic improvements, added more text, added reference to NCCI SN008a-EN-EU and buckling length Lcr, replaced Kc with Kc' and KC with Kc, added variable names eta, eta1 and eta2.

SC444 Made cosmetic improvements, classification section replaced with secrhs, replaced < with ≤ at interaction checks.

SC445 Replaced UK and UC with UKB and UKC and made cosmetic improvements.

SC450, 451, Made cosmetic improvements.

SC452 Made cosmetic improvements, added example default values, added subroutine mesage to BS and EC design options, revised h/b > 2 to h/b ≥ 2 and added more text referring to curves d, c, and b.

SC453, 459, Made cosmetic improvements.

SC460 Made cosmetic improvements, added mesage subroutine, added b1 and b2 to main diagram on page 1.

SC463 Made cosmetic improvements and replaced Cm with Cmz.

SC464 Made cosmetic improvements.

SC465 Made cosmetic improvements, added combined bending and torsion interaction check, replaced secrhs with secRHS, added STOP command to Class 4 sections.

SC466 **Added EC3 design option**, made cosmetic improvements, corrected units, replaced Mv1 & Mv2 with Mv3 & Mv4 and modified expressions from quadratic to linear reduction (as per CIRIA/SCI publication

p41), replaced b'Tlim with c'Tlim, updated local instability section, added shear buckling check section.

SC467 **Added EC3 design option**, made cosmetic improvements, replaced mesage with text, enhanced green display diagrams, added heading 'Properties of steel cellular beam', added def and mesage subroutines, replaced Ma<Mmax with Ma ≤ Mmax and bending stress < bending strength with bending stress > bending strength, V(2) ≤ Pv replaced with V(2) ≤ Pvy and Pvyt/2 with Pvyt, enhance diagram of Vierendeel bending of Tees, introduced Pvh as this differs from Pv, added scenario IF Nc>1.

SC470 Made cosmetic improvements, made CHI subroutine external and removed Es from EC design option.

SC472 Buckling curve d only is now utilized.

SC474 Made cosmetic improvements.

SC476 **Added EC3 design option**, made cosmetic improvements, modified text, replaced 'I-column in simple construction' with 'I-column design', 'Radius of gyration about y-y' with 'Radius of gyration about x-x' and 'Slenderness (minor axis) with 'Slenderness (major axis), expression for equivalent slenderness +lamLT=0.5*L/(ry*10) corrected to +lamLT=0.5*L*1000/(ry*10), upgraded to SCI-P-263, added Uf1, Uf2, Uf3 and sway statement in SUMMARY, added STOP command when r≤0, removed wrongly defined d= +d from section properties, added more text, replaced h with h'.

SC478 Defined ctype' and btype'.

SC480 **Added EC3 design option**, made cosmetic improvements, removed munits, replaced > with ≥ where necessary, added code 1 needed for stype=3, replaced e2 with e1 in screen display diagram, revised second heading 'Web cleat bearing strength - supported beam' to 'Web cleat bearing strength - supporting member' replaced db to db1, added STOP command when N > c, modified expression Pr relating to web cleat, added subroutine Drhs, replaced 'end plate, with angle cleats, updated BS expressions for Mua and Mub, EC structural integrity checks added, introduced pyc to BS design option, replaced hsdp, hrdp, csdp, crdp with Hsdp, Hrdp, Csdp, Crdp, defined example default value dw=33 .

SC481 Made cosmetic changes, replaced p with p1, replaced BS85950 with BS 5950 enhanced diagrams, added/removed text, replaced e2b=e2-gn mm with e2b=zp-gn mm, tpmin with tpmax and tp<tpmin with tp>tpmax, updated expression for tpmax, set minimum limit for zp to 40 mm, added min limit for p2, increased minimum limit for e1 and e2, updated minimum limit for zp, redefined zp, beta & z expressions relating to bolts updated, replaced second VRdm=VRdp with VRdm=VRdn and VRdm=VRdp with VRdm=VRdn, replaced scenarios relating to 'Fin plate in bearing', replaced VRdb<VRdn with VRdg<VRdn and VRdp kN < VEd kN to VRdm kN < VEd kN, e1b is now user defined, replaced > with ≥ and fup with fus where applicable, replaced Bending resistance with Buckling resistance and lambdab≤30 with lamp<30 for both BS and EC design otions, replaced FRdb=FRdb1 with FRdb=FRdb2 and FEd > FRdb with FEd > FRdu, replaced ab3=fus/fus with ab3=fub/fus, added pyc, when ctype=1 Structural integrity heading now states 'universal section' in lieu of 'hollow section', replaced p1 with p in diagram, replaced 'zp' with 'a' in diagram, replaced scenario 'IF ctype=1' with 'IF ctype=1 AND strct=0'.

SC482 **Added EC3 design option**, made cosmetic improvements, removed munits, added subroutine message, enhanced SUMMARY, modified diagram text.

SC484 Replaced VRdm=VRdg with VRdm=VRdn, made cosmetic improvements, welding section updated, replaced all pys with pyc, modified Mua & Mub expressions for column (for BS design option), replaced p1<2*e2

with p1>2*e2 and p<2*e1 with p>2*e1, modified example default values to suit vertical pitch limits, dwm values revised, dbm replaced with dwm.

SC485 Made cosmetic improvements, replaced UC & UB with UKC & UKB, revised subroutine picplt, added pic2, VRd ≥ VEd and As FRd ≥ VEd, revised welding section, replaced, updated p1 upper limit, replaced dbm with dwm, limit for dwm=54 replaced with dwm=55.

SC486 **Added EC3 design option**, made cosmetic improvements, removed munits, enhanced Summary, removed N/mm2 used twice, added text to SUMMARY, revised example default values, replaced swt ≤ swfr with swt < swfr, added mesage subroutine, added pyh, replaced IF Pss3=Pss THEN Pss=Pss3 with IF Pss3<Pss THEN Pss=Pss3, replaced ff1<py and ff2<py with ff1≤py and ff2≤py, made eucalmt external subroutine, replaced Fw with FwEdf where necessary, added more text lines, added factors 0.5 & 0.6 for weld throat checks as per IStructE EC3 manual, added eupic1 & eupic2, updated recommended values for e1 and e1', added scenario IF trow=2 and preloaded HSFG bolts to EC design option.

SC487 **Added EC3 design option**, made cosmetic improvements, removed munits, added more pichch, replaced ff1<py and ff2<py with ff1≤py and ff2≤py, expression ped=Lc-(Do/COS(theta)+x+ex) replaced with ped=Lc-(Do+ex+x), updated recommended value for e1', enhanced SUMMARY diagram, added preloaded HSFG bolts to EC design option.

SC488 Made cosmetic improvements, repositioned Location: to line 1 of output, removed munits, added mesage, corrected axes for EC design option, removed BS Clauses 3.12.8.3 and 3.12.8.4 from the EC design option, replaced several < with ≤, replaced Ihdp 13 with ihdp 13, defined rhoc when stype=3.

SC489 Made cosmetic improvements, added mesage, relocated Location: to line one of output, replaced several < with ≤, removed BS Clauses 3.12.8.3 and 3.12.8.4 from the EC design option, replaced tp with tpm in SUMMARY (EC design option).

SC490 **Added EC3 design option**, made cosmetic improvements, removed munits, added scenario IF utype<>3 and mesage subroutine, added web plates text to SUMMARY, tension in flange is reported when F2>0, added scenarios IF F1>F2 THEN F=F1 ENDIF and IF F2>F1 THEN F=F2 ENDIF, added scenario IF M<0, replaced strength with stress.

SC491 **Added EC3 design option**, made cosmetic improvements, removed munits, added message subroutine and more text, replaced tpt<tp with tpt≤tp and Lc with hp, thickness +tb mm with thickness is +Tb mm, added pic1 & pic2, added full=2 when flage<>1, modified example default values, when swt<swfr proforma now stops, added scenarios x<0, x<1.5*Dh, ex<1.2*Dh, x<1.5*do and ex<1.2*do.

SC492 **Added EC3 design option**, made cosmetic improvements, removed munits, added section properties for stype=3 and mesage subroutine, replaced IF end<1.25*bdf-0.01 with IF end<2*bdf-0.01, added wording 'per shear surface' when inner=1, added coefficient kbs.

SC494 **Added EC3 design option**, made cosmetic improvements, removed munits, replaced ff1<265 & ff2<265 with ff1≤265 and ff2≤265, added mesage subroutine, replaced +M kNm > +Mc kNm with +M kNm ≤ +Mc kNm, replaced UB & UC with UKB & UKC, added e1'=e1 and preloaded HSFG bolts to EC design option.

SC496 **Added EC3 design option**, made cosmetic improvements, replaced mesage with text, removed references to column, column outstand replaced with Outstand, enhanced diagram, added stiff=2, length of weld specified as lw, removed Es from EC design option.

SC498 **Added EC3 design option**, made cosmetic improvements, removed munits, changed example default value for F, removed subroutine 'yield' as this was not used, updated limits for S1, S2, p1 and p3,

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            added preloaded HSFG bolts to EC design option, replaced V with Fv
            in diagrams, added eupic3 and eupic5.
SC528   Made cosmetic improvements.
SC530, 535, 537, 538, Made cosmetic improvements.
SC563   Number of segments now limited to 99.
SC564   To fit with new edit fileds in next version of SCALE, applied max
            limit of 99 to variables n nb nl nj ns nc nk nw ng nm nsp nac nilc
            njl nal nvl ncl nbm np.
SC566   Added note1, note2, enote1 & enote2, note2 revised text.
SC569   Enhanced EC3 and BS design options using amplified moment method
            made references to SCI publication P397, made cosmetic
            improvements.
SC570   Enhanced EC3 and BS design options using amplified moment method.
SC571   Enhanced EC3 and BS design options using amplified moment method.
SC572   Enhanced EC3 and BS design options using amplified moment method.
SC573   Enhanced EC3 and BS design options using amplified moment method.
SC574   Enhanced EC3 and BS design options using amplified moment method.
SC575   Enhanced EC3 and BS design options using amplified moment method.
SC576   Enhanced EC3 and BS design options using amplified moment method.
SC577   Enhanced EC3 and BS design options using amplified moment method.
SC578   Enhanced EC3 and BS design options using amplified moment method.
SC579   Enhanced EC3 and BS design options using amplified moment method.
SC580   Enhanced EC3 and BS design options using amplified moment method.
SC581   Enhanced EC3 and BS design options using amplified moment method.
SC597   added option to have frame sidesway checked, made cosmetic
            improvement, added more text to define missing units for sp1, ht1
            and Wk1 etc, enhanced green display diagrams.
SC702   Made cosmetic improvements and introduced Hr'.
SC748, 750, 756, 758, 759, 760, Made cosmetic improvements.
SC861   Corrected units of A(i).
SC924   Separate paramater tables, if used, now go to separate files, e.g.
            sc660.1.0001.cal, sc660.1.res sc924 can now be launched in batch
            mode, by adding variables e.g. ans=0 opn=2 nsref=660 npat=3 zni=10
            partab=8 to sc924.stk.
SP801   (SPADE) Option added to omit lines, now scales for negative numbers
            and exponent numbers added x and y axis labels graph plotting
            routine moved to sp007.pro for use by sc924.pro.
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Changes to NL-STRESS program (Latest version is 4.91)

For improved clarity: the benchmark (*.bmk) and NL-STRESS parametric data files (*.ndf) have been edited such that each statement is now on a line by itself; for files m101.ndf-m712.ndf, each m101.dat & m101.ndf etc. have been combined into one ndf file; the elastic only n***.ndf versions of each file have been removed. Fixed interlinking to SCALE for the plotting of the beam and column charts where applicable. To fit in with the file naming conventions nlkl001.ndf was renamed to nk001.ndf etc., the file names of the roof truss data files were also shortened.

The plot program has been revised to no longer capitalise the page headings, it can now be run in batch mode without any prompts by using a /b in fil.nam, e.g. nlkcmg.dat/P4PM/b, and page headings are now aligned for pdfs created for NL-STRESS plots with the .dat/.res/.cal page headings.

Downloading updates during 2014

Further updates in 2014 will be posted to the download website at the beginning of April, July and October, please visit the download website for the latest version of 2014.EXE.

Ian Brown 01/01/14