Fitzroy Systems

Lark Lodge, Fornham St Martin
Bury St Edmunds, Suffolk. IP31 1SR
Tel: 01284 754240
www.fitzroy.com

SAND - Structural Analysis and Design, &
SCALE - Structural CALculations Ensemble,
Information sheet 45; Jan 2019.

Support.

(1) **Technical support**, for technical support for all aspects of SAND and SCALE please email a marked up copy of the calculations in question to Dr Ian Brown ian@fitzroy.com.

(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.

Eurocodes.

All proformas now show full calculations to the Eurocodes or full calculations to the British Standards, or are analytical and applicable to both codes.

Windows 10.

All programs in the SAND and SCALE suites are fully supported, tested and operational on all 32-bit and 64-bit desktop/laptop versions of Windows 10, Windows 8.1, Windows 8, Windows 7, Windows Vista and Windows XP Service Pack 3.

Changes to SCALE program (Latest version is 5.21).

The main items outlined in the Jan 2018 newsletter's plans for 2018 have been completed, namely:
- Launched SCALE iPad app on the Apple App Store.
- Incorporated NL-VIEW (formerly 3dgui) structure visualisation into SCALE 5, for both Windows and iPad versions. Extended NL-VIEW to work for all 2D and 3D frame and grid analysis types, and for all linear and non-linear plastic and sway analyses.
- Added a file chooser for selecting the .dat file name from a list of files at the start of the proforma.
- Added a file chooser to copy file headings from an existing file.

SCALE version 5 has now been extended to include a built-in pdf viewer. The pdf viewer utilises the Google Chrome pdfium library, and like all the other components of SCALE this is built in-house from full source code, and doesn't require the user to install any extra libraries to use. This new pdf viewer speeds up the viewing of calcs at the end of a proforma.

SCALE version 5 also now includes a built-in copy of NL-VIEW (see section below), to visualise the results of an NL-STRESS analysis in 3D. SCALE 5 also includes all of SCALE, LUCID, SPADE, NL-STRESS, NL-PLOT and SCP (for creating pdf output) in one executable. This alleviates the problems jumping between executables on Windows.

Now that SCALE version 5 is substantially complete, the update now installs a desktop shortcut for it named "SCALE 5" (to program scale.exe), for both SAND and SCALE licences.

As SCALE now includes all the NL-STRESS features that were previously only included in the SAND suite, there is no longer a separate front screen for SAND.

SCALE version 5 retains the familiar scale ruler icon with a red stripe. The icon for SCALE version 4 has been changed to a scaler ruler with a blue stripe to differentiate between the old and new versions.

SAND and SCALE version 4 remain fully supported for users who are familiar with their interfaces, Any existing shortcuts to them remain unchanged, shortcuts can be created on new computers to the programs scale32.exe and sand32.exe respectively. Each front screen now includes a new button which will launch SCALE version 5 if required.

NL-VIEW (formerly 3dgui).

NL-VIEW is a post-processing program for NL-STRESS that lets you view structures, loadings and results for NL-STRESS analyses in 3D.

When viewing the pdf results of an NL-STRESS analysis, or a SCALE proforma that includes an NL-STRESS analysis, click on the button labelled "NL-VIEW" to switch to viewing the model in NL-VIEW. For further details, please see the NL-VIEW User's Manual, Section 6 in the help manual, scale.pdf. NL-VIEW allows you to:

- visualise results for all 2D and 3D frame and grid analysis types, and for all linear and non-linear plastic and sway analyses.
- rotate, pan and zoom, in real-time, a three-dimensional model of any NL-STRESS model, showing section sizes, member principal axes, and geometry to facilitate checking the input.
- view the deflected shape of the structure in three dimensions with the actual section sizes displayed (I-Sections, H-Sections and Rectangular sections are shown to scale) including any BETA rotation applied to the members, with the members coloured according to deflection.
- animate the deflected shape to help visualisation of the displacements, this is useful to quickly check if any parts of the structure are not connected as expected!
- view the deflected shape of the structure with the neutral axes of the members shown with different colours and line-types for different selected loadcases.
- view bending moments and shear force diagrams in three dimensions, with the structure represented by lines or the actual section sizes.
- save screenshots of the current view to the pdf results file.
- view the joint and member loads applied to the structure in three dimensions.
- utilise the power of the graphics processor using DirectX 9 (Windows) and OpenGL (iPad).

User's manuals.

The User's Manuals for SCALE, LUCID, SPADE, NL-STRESS, NL-VIEW, NL-PLOT have been updated and are contained in the file scale.pdf, which can be easily launched from the menu option Help->Help.

SCALE now available on the Apple App Store.

SCALE version 5 is now available on the Apple App Store. Monthly and annual in-app renewable subscription options are available. The SCALE app runs on all iPads with iOS 9.3 and above, i.e. on every iPad except the iPad 1 from 2010. The SCALE app includes the full versions of SCALE, LUCID, SPADE, NL-STRESS, NL-VIEW, NL-PLOT, and SCP (for creating pdfs). Click on the link on the fitzroy.com website, or search for "SCALE Structural Calculations" on the App Store.

New SCALE proformas added.

```
sc495   Cast-in plate to connect structural steel beam to concrete wall
sc803   Cantilever stair analysed as a space frame
sc804   Ring beam supported by vertical Tee columns
sc805   Curved semicircular balcony member
sc806   Space structure (square on square)
sc807   Shear (flexural) centre eccentricity example
sc808   Conical roof, ring beam at apex & at wall with optional columns
sc809   Orange segment roof truss
sc810   Spiral stair in reinforced concrete
sc811   Temporary works column outriggers for all bolted erection
sc812   Dynamical behaviour of 3D multi-storey frame
sc894   Curved beam with in-plane loading
sc895   Bridge abutment, vertical piles and optional raking piles
sc929   Ground slab subjected to loading from racks and/or fork lifts
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Parametric checking of SCALE proformas.

The parametric checking of proformas, to detect where users may experience problems and fix them, has been extended with 22 new .prm files and 75 modified .prm files being developed during 2018.

Changes to SCALE proformas.

In addition to the new proformas detailed above, we have made amendments to a further 160 proformas as listed below:

```
sc073   added missing (1=Yes, 0=No) for ansp prompt.
sc076   nbars now specified once, removed << at start of a line.
sc082   replaced bt with b, made b a user defined value for EC design
        option, added procedure conflx.
sc087   removed surplus routines, updated lx default values.
sc088   update text under NOTE for EC design and pwpsl routine.
sc119   added tsupp.
sc122   replaced tol with agec.
sc123   added more text relating to depth to Neutral Axis.
sc189   added expcl2, corrected chkrng, added missing default value for
        expcl2.
sc218   displaced diagram corrected.
sc224   corrected typo 'Bottom flange'.
sc250-257  regrouped code=1, 2 examples.
sc259   removed surplus code=1 before START command.
sc267   defined wwp before START.
sc271   added a1=0 before START, added << before // when type=6 to make it
        hidden, extended routine eunspa to cater for pk2>500 and removed a1
        before START, added modified euscr to proforma to avoid specifying
        surplus strength properties when GS=3.
sc272   extended routine eunspa to cater for pk2>500, added pkscr0 &
        euscr0, added << before // when type=4 to make it hidden, updated
        chkrng for SCh to accept user defined values, added modified euscr
        to proforma to avoid specifying surplus strength properties when
        GS=3, added pkscr0 & euscr0 where appropriate and removed surplus
        default values.
sc355   serM no longer input by user when stype exceeds 2.
sc274   replaced d with bd where appropriate.
sc275   replaced FvRd>Fd with FvRd>=Fd.
sc386   defined Wply=Wpl when section type stype=1, added scenario IF
        stype>1 to cfirer routine.
```

sc391   removed surplus DELTA routine.

sc455   updated 'Section classification' section, updated example default values.

sc460   pitch of haunch to horizontal gam is now worked out by the program, angles are now reported on page 2 of the output, added hidden diagram showing how haunch properties are calculated, updated expression for h1, added more text relating to haunch section properties and introduced depth FG.

sc481   set gamM2=1.1 in expressions for punching shear as per SCI AD422 and updated default value for sgrade.

sc487   replaced 'Tension force in top 2 bolt rows' with 'Tension force in top 3 bolt rows'.

sc494   replaced (extended end-plate) with (haunched) in headings.

sc495   released for general use, updated z1, z2 & z3, set DIGITS to 4 for punching shear checks, added nlper, n' and reference to Table 2.2, added more text and corrected diagram splitting on two pages.

sc506   added more screen display diagrams to assist user with the selection of dimensions.

sc511   added FAILcase routine.

sc591, 596, 830-837 updated PRINT DATA command.

sc660   replaced Option No. from (1 to 5) to (1 to 9), added pic4 & pic5, enhanced diagrams.

sc800   added option for concrete charts, made Young's modulus and Yield strength of steel user defined, removed references to concrete where not appropriate and updated title.

sc801   added option for concrete charts, enhanced diagram, shear modulus is now evaluated by the program added nseg & proforma number, added option to view general notes on screen, enhanced steel section properties selection, added lf, wr and xs ≥ zs, added more text, corrected expression for nm1 and updated some text lines.

sc802   modified line 6, added load factor lf, the modulus of rigidity is now evaluated by the program, added EGvals and more text, removed surplus subr.ndf, proforma number is now reported in output, enhanced selection of member section properties, removed mt & mt', replaced spro5 with spro6, removed references to SHS's and updated text for selecting properties of members.

sc803   enhanced diagrams, removed fig02, imposed load wi defined as -ve down, proforma number is now reported in output, updated title and added missing $100.

sc804   diagram text now refers to members 9-16, enhanced diagrams, proforma number is now reported in output, modulus of rigidity is now evaluated by the program, member selection for ring beam enhanced, replaced spro5 with spro6, added missing $100 and updated text for selecting properties of ring beam members.

sc805   replaced SDI with SCI, replaced kN/M with kN/m, added references to SCI P281, redefined ix, iy & iz, updated example section properties, text refers to XZ plane and not XY plane, added proforma No. to output and user defined moments required for LOADING CASE 2, modulus of rigidity and d are now evaluated by the program, added $9001and $100.

sc806   added more text, added << to fig03, proforma number is now reported in output, redefined nmd, added spro5, modulus of rigidity now evaluated by the program, added terms 'top layer', 'bottom layer' and missing $100.

sc807   Poisson's ratio is defined by the program, renamed 'p' with 'nu', made further enhancements, added references to 'torsional constant' and 2nd moment of area, proforma number is now reported in output, redefined iy & iz, repositioned expression for modulus of rigidity and added missing $100.

sc808 udl shown as –ve down, proforma number is now reported in output,
       added spro4, nseg and enhanced selection of steel member
       properties, corrected units and added missing $100.
sc809 example default values for sections now relate to CONIC sections,
       renumbered proforma, proforma number is now reported in output,
       added expression for G, enhanced selection of section properties
       and updated text for selecting member properties.
sc810 udl is now taken –ve down, replaced smry with sum & mfix with
       mfix2, added sumout routine and mfix1, proforma number is now
       reported in output, added missing $100.
sc811 added point loads option at joints 1, 2, 3 & 4, proforma number is
       now reported in output, redefined iy & iz, added expression for
       modulus of rigidity and axiyiz routine, enhanced selection of
       section properties, added missing $100.
sc812 weight of each floor is shown (–ve down), replaced w with –w in
       FORCE X and FORCE Z expressions, proforma number is now reported in
       output, added modulus of rigidity expression, section properties
       selection enhanced, updated text and added missing $100.
sc817 enhanced diagrams, replaced 'h' with 'h1' in diagrams (Option=1),
       added the term SUMMARY at the end of the PRINT command, proforma
       now uses beam chart only (column chart is no longer used for
       Option=2), proforma number is now reported in output.
sc818 enhanced diagrams, replaced default value hc=16 with hc=6 and
       nsg=16 with nsg=8, added nbs.
sc837, 838 replaced nu=3 with nu=0.3 and updated PRINT DATA command.
sc839–849, 851–854 updated PRINT DATA command.
sc850, 857, 859–861, 863–866, 868, 874, 875 added several default values.
sc855 added several default values, added ans2=1 before START, defined
       IZ1, IZ4, IZ6 when ans(1) ≥ 7 and added scenario IF sty(1)=7.
sc856 defined h1 & b1 for Option=4, defined mt when Option=3, added
       references to vm113.ndf, vm114.ndf & vm115.ndf, Option=1 default
       values updated, added EGvals to Option=3, removed references to mt.
sc858 added several default values and replaced 'picture' with pic1.
sc862 updated loading cases 2 & 3, removed command TABULATE following
       loading cases 2 & 3.
sc867 added several default values, removed mt,a(1), a(2), a(3), iz(1),
       iz(2), iz(3) from Option=2, proforma number now reported in output
       (Option=2, 3 & 4), removed loading cases 2 & 3 (Option=3 & 4).
sc871 corrected note relating to units.
sc872 updated PRINT DATA command, Young's modulus values offered on
       screen (Option<3), added variable name 'e' and matsel routine
       (Option<3), added spro1, enhanced selection of section properties,
       added DIGITS 3 and DIGITS 8 to Option=1 & 2, den1=sw/AX when sect=0
       and den=sw/AX1 when sect<>0, defined nseg (Option=1).
sc873 removed #~sc597.res, %LOADING CASE 1 : replaced with %LOADING CASE
       1:, added several %*and set optreq=2 before START.
sc876 proforma number is now reported in output, redefined span variable
       name from L to l, added spro1 to enhance member section selection,
       made nsg user defined, added pic1, ssarea & EGvals routines,
       updated diagrams, removed variable name mt and routine mempro.
sc877 proforma number is now reported in output, added EGvals routine and
       enhanced diagrams.
sc878 proforma number is now reported in output, replaced AX, AY with DY,
       DZ respectively.
sc879 proforma number is now reported in output, added EGvals.
sc880 proforma number is now reported in output, removed TABULATE ALL
       when mat=1, nseg is now user defined, reinstated TABULATE ALL,
       updated diagrams.
sc881 proforma number is now reported in output, removed TABULATE ALL,
       reinstated command TABULATE ALL, removed all references to mt,

MEMBER PROPERTIES simplified for Option=1, 2, 3, 4 & 5, made nsg user defined.

sc882   replaced nu=3 with nu=0.3. Feb 18 updated PRINT DATA command, proforma number is now reported in output, enhanced selection of section properties, added scenario IF sty(1)=5, IF sty(2)=5 and SECTION PROPERTIES 3 AS 2 & 4 AS 1, removed loading cases 2 & 3.

sc883   replaced nu=3 with nu=0.3, updated PRINT DATA command, proforma number is now reported in output, added spro2 to enhance member selection, in Option=3 replaced s2 with s3 to represent 3rd storey, removed loading cases 2 & 3.

sc884   updated PRINT DATA command, proforma number is now reported in output, added SPRO to enhance selection of member properties.

sc885   updated PRINT DATA command, proforma number is now reported in output, replaced dc & bc with dcap & bcap, evaluation of of ax, ay, izis is now carried out by the program, updated pilecap MEMBER PROPERTIES.

sc886-888 updated PRINT DATA command, proforma number is now reported in output, added spro to enhance section property selection, updated loading cases 2 & 3 and removed command TABULATE following loading cases 2 & 3.

sc889   updated PRINT DATA command, added option to use CHS and I-sections. Added Vierendeel frame with end verticals only (Option=2), defined mat values for Option=2, added option for concrete charts, proforma number is now reported in output, added lf & fys, removed TABULATE ALL, enhanced selection of steel section properties, introduced variable name mt', redefined variable name mt for Option=1, added nsg to Option=2, reinstated TABULATE ALL, redefined mt', replaced several mt with mat, replaced egvals with EGvals, added 4 command lines after SOLVE (Option=2), added missing $100 (Option=2) and removed loading cases 2 & 3.

sc890   updated PRINT DATA command, removed surplus TABULATE ALL command, enhanced selection of steel section properties, reinstated TABULATE ALL, MEMBER PROPERTIES section updated, nsg is no longer set as 12 in output, updated loading cases 2 and 3 and removed command TABULATE following loading cases 2 & 3.

sc891   updated PRINT DATA command, added spro to enhance section property selection, updated loading cases 2, removed command TABULATE following loading case 2, removed loading cases 2 & 3.

sc892   updated PRINT DATA command, proforma number is now reported in output, updated MEMBER PROPERTIES section.

sc893   updated PRINT DATA command, proforma number is now reported in output, set Young's modulus default value to E=210E6, updated MEMBER PROPERTIES section, redefined $9000 in Option=2.

sc894   replaced 1E6 with ax in MEMBER PROPERTIES, default value 1E12 for ax replaced with 1E6, proforma number now reported in output, replaced example default value ax=1E6 with ax=1, enhanced selection of section properties, added ans1, ans=2, spro1 and more text, added missing $100 and $9001, replaced ans1 with ans2, added ans=3.

sc895   enhanced diagrams, proforma number is now reported in output, added missing $100, updated CONSTANTS command line.

sc920, 923 updated example default values.

sc921, 922 updated MEMBER PROPERTIES section and some of the text lines.

sc924   updated PRINT DATA command, proforma number is now reported in output, added spro, enhanced diagram, added sc9200.pro, removed sc8000.pro, removed loading cases 2 & 3, updated example values.

sc925, 926 updated PRINT DATA command, proforma number is now reported in output, added spro, added sc9200.pro, removed sc8000.pro, updated example default values and added iyixaz routine.

sc927   updated PRINT DATA command, proforma number is now reported in output, added spro, added sc9200.pro, removed sc8000.pro, updated

example default values, replaced ig & is with iyg & iys
respectively, added iyixaz and IyIxAz routines.

sc928   updated PRINT DATA command, proforma number is now reported in
output, added spro, modern check is only used for comparison with
NL-STRESS analysis when sty1=1, added sc9200.pro, removed
sc8000.pro, updated example default values, replaced ig & is with
iyg & iys, respectively, added iyixaz and IyIxAz routines, removed
loading cases 2 & 3.

sc929   added variable names for modulus of subgrade reaction (msr) and
rack load Options 1,2 & 3, proforma number is now reported in
output, added missing $100, added missing units relating to
translation of rack in the X & Y directions, removed Wood-Armer
repetitive results.

sc930   added option to enter a central point load, proforma limited to
concrete and steel flat plates only, defined mt & charts, added
bmclch routine, proforma number is now reported in output.

sc940, 941, 942, 944, 945 proforma number is now reported in output,
updated MEMBER PROPERTIES section, user no longer can specify nb <
4, removed ax(1), ax(2) etc.

sc942, 943, 946 proforma number is now reported in output, updated MEMBER
PROPERTIES section, user no longer can specify nb<4, removed ax(1),
ax(2) etc., added mt=1, 2, 3 & 4.

sc947   proforma number is now reported in output, updated MEMBER
PROPERTIES section, user no longer can specify nb<4, removed ax(1),
ax(2) etc., added mt=1, 2, 3 & 4.

sc960-965 updated PRINT DATA command, proforma number is now reported in
output, added spro4 to enhance member selection.

sc966   updated PRINT DATA command, proforma number is now reported in
output, added spro4 to enhance member selection, updated example
default values to reduce side sway, introduced new variable names
m1 & m2.

sc980   updated PRINT DATA command, proforma number is now reported in
output, updated default value t(1) and enhanced diagram.

sc981   updated PRINT DATA command, proforma number is now reported in
output, added SPRO, and spro3, enhanced diagram, added Ex2, Ex3 and
Ex4, added pic1, section types are now st=1, 2, 3 & 4 and are all
steel sections i.e. CHS, I, H & RHS sections, updated text for
selecting properties of CHS members.

sc982   updated PRINT DATA command, proforma number is now reported in
output, enhanced diagrams and updated MEMBER PROPERTIES section.

sc983   updated PRINT DATA command, proforma number is now reported in
output, enhanced diagrams, MEMBER PROPERTIES section updated,
removed mat', added matsel which includes option for steel
sections, updated loading case 2, removed command TABULATE
following loading case 2 and removed loading case 3.

sc984   updated PRINT DATA command, proforma number is now reported in
output, enhanced diagrams, MEMBER PROPERTIES section updated, added
variable names m1 & m2.

sc985, 986   updated PRINT DATA command, proforma number is now reported
in output, added more text, type of fixity at supports (fix=-1) now
shown in output, added spro.

sc987   updated PRINT DATA command, proforma number is now reported in
output, added more text, type of fixity at supports (fix=-1) now
shown in output, added spro and expressions for iz.

sp004   updated UBS and UCS tables.

Plans for 2019.

- LUCID: update proformas to provide option to produce bar schedule automatically
- Add a feature to easily append new calcs to an existing calcs file.
- There are a lot of intermediate files being saved to disk, these could be stored in memory to speed up the program.
- Enable resizing of the SCALE window on the fly, without having to close and re-open SCALE.
- Combine the TAPE editor so it appears in the SCALE window.
- Combine the GUI32 data editor so it appears in the SCALE window.
- Extend the parametric checking to all SCALE proformas.

Please send any feedback, or feature requests, to ian@fitzroy.com

Downloading updates during 2019.

Further updates in 2019 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 2019.EXE.

Ian Brown 01/01/19