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Fitzroy Systems

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SAND - Structural Analysis and Design, &
SCALE - Structural CALculations Ensemble,
Information sheet 46; Jan 2020.

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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 in 2019 (Latest version is 5.51).

The main items outlined in the last newsletter as plans for 2019 have been completed, namely:

- LUCID proformas now provide an option to automatically generate and append the bar schedule into the calcs files after the detail drawings. The schedules can still be manually amended using LUCID option 910 if required.

- Added a feature to easily append new calcs to an existing calcs file.

- Have modified file saving routine - now 30% faster than last year.

- Have extended the parametric checking, there are now parametric files for 304 of the 410 main SCALE proformas.

The following improvements have been made:

- SCALE 5 final calcs now display directly on the screen from the calculations/results file rather than displaying a pdf file in an embedded pdf viewer. This speeds up the initial displaying of the final calcs, and removes the problems encountered with the two previous pdf viewers. You can still right click on the final calcs to bring up menu to rotate between portrait and landscape view.

- When viewing the list of proformas, the pop-up tooltips showing the descriptions of each proforma can now be toggled on and off with the menu option View->Show Tooltips for List of Proformas.

- Fixed potential bug in pdf creation.

- Renumbering of proforma numbers 10-50 in the Mathematics and Miscellaneous section.

- Added Browse button to select a different stack file at start.

- Fixed issues with changing to a different stack file.

- Stack file now fixed and offered again for all proformas.

- Fixed a long-standing corner case bug that caused SCALE to hang for very unusual stack files.

- Fixed pull-through of NL-STRESS results to SCALE proformas.

- Added import of stack variables to pull-through for SCALE 5.

- Fixed input of brackets and ampersands in text fields for SCALE 5.

- Proformas sc193, sc194, sc195, sc650, sc651, have been modified to save plots of cross sections etc. into the calcs files.

New option: appending calcs with FILE option.

Added new FILE option to SCALE 5, with a similar behaviour to version 4:

- Appends calcs together into one large output file.

- Automatic page re-numbering if necessary.

- Can also save a copy of the stack file.

- Starting page number now increments between proformas.

- FILE checks current file and target file are different.

- Appended file name remembered between proformas.

- Works with appending pages with NL-VIEW screenshots.

New option: Save as Word file.

SCALE 5 can now save to Word, in docx format.

- When viewing the final calcs, right click and select Save as Word...

- All drawings (NL-PLOT/LUCID/SPADE) are converted and embedded as svg vector graphics files, for crisp display and printing, and small file size.

- Fitzroy graphics characters for the inline diagrams are embedded as png bitmaps.

- Drawings and graphics characters are optimised and display correctly with the latest Word 2019 or Office 365 subscription on Windows and iOS. They may not display correctly in older versions of Word, or OpenOffice, or LibreOffice. These all have different formats, please let us know if there is a particular version you would like us to consider.

Changes to 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. Click on the NL-VIEW button on the results page after an NL-STRESS analysis to launch NL-VIEW.

- NL-VIEW now correctly displays combination load cases.
- COMBINE now displays displacements, forces and shears, but not forces.
- MAXOF/MINOF/ABSOF not displayed, but bugs fixed such that these don't affect other cases.
- Up to 50 load cases can now be displayed in NL-VIEW.
- NL-VIEW node, element and load labels now dynamically orientate and scale to fit the screen, and screenshot, rather than the model for greatly improved clarity.
- Fix for NL-STRESS Stability and Plastic analysis proformas.
- NL-VIEW load labels now correctly displayed in engineering notation.
- Screenshot pages added via NL-VIEW now have consistent page numbering, and increment next starting page number.
- Corrected double precision error associated with NL-VIEW.

User's manuals.

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

SCALE available on the Apple App Store.

SCALE version 5 is 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.

SCALE proformas added back to SCALE 5.

The proformas below now work correctly in SCALE 5, and complete the transition of outstanding proformas from version 4:

```
sc010   for creating blank sheets with headings for appending with the FILE
        option.
sc677   to convert parametric NL-STRESS data file to data only. Checked
        sc677 against 450 data files, with accompanying corrections to NL-
        STRESS sc800 and sc900 series proformas.
sc677   now called before gui, so all NL-STRESS SCALE proformas now open
        correctly in gui.
sc543   Pippard/MEXE analysis for unit applied load.
sc546   Pippard/MEXE analysis: C&U,EC, user defined bogies.
sc547   Pippard/MEXE analysis for user defined loading.
sc672   Post-processing NL-STRESS results.
sc677   Elimination of expressions from an NL-STRESS data file.
sc678   Guyed masts.
sc679   Circular tanks.
```

Parametric checking of SCALE proformas.

The parametric checking of proformas, to detect where users may experience problems and fix them, has been extended further in 2019 with 154 new .prm files and 69 modified .prm files being developed. There are now parametric files for 304 of the 410 main SCALE proformas.

Changes to SCALE proformas.

In addition to the proformas detailed above, we have made amendments to a further 215 proformas as listed below:

sc089   Removed surplus references to NRESP relating to pull through, added extra EDITs.

sc102   Fixed pull-through for version 5. Additional opening check on NRESP.

sc104   Fixed pull-through for version 5. Cosmetic improvements. Additional opening check on NRESP.

sc106   Fixed pull-through for version 5. Cosmetic improvements. Additional opening check on NRESP.

sc107   Fixed pull-through for version 5. Cosmetic improvements. Additional opening check on NRESP.

sc109   Shortened fork= line. Modified expressions for px and py, Example 2 slab thickness increased from 175mm to 200mm, removed % from expressions px, py & p1, renumbered Examples and added Example 6.

sc114, 115, 116 Replaced references to BD 37/01 with Departmental Standard CS 454.

sc122   Replaced references to BS EN 1991-1-1 with BS EN 1992-1-1.

sc123   Updated to Departmental Standard CS 454, two options are now offered for shear enhancement factor.

sc124   Program will now STOP if ans6=0 is selected.

sc126   Added flag=1, added Examples 8 & 9.

sc127   Updated to Departmental Standard CS 454.

sc128   Cosmetic improvements, enhanced diagrams, added Example 4 (Deck on box girder).

sc130   TABLE1 is now visible on screen, cosmetic screen changes, redefined ans1, ans2 default values removed from EC Examples, corrected units for HA UDL from kN to kN/m. Removed reference to TD 19/85 and BD 37/01, proforma now makes reference to BS 5400-2:2006 only.

sc131   Updated to Departmental Standard CS 454, removed MAXMIN routine, added parameter owt, routine text1 and Kfact.

sc133, 138, 139 Replaced references to BD 37/01 with Departmental Standard CS 454.

sc140,141,142 Replaced references to BD 37/01 with Departmental Standard CS 454.

sc135   Updated to Departmental Standard CS 454, two options are now offered for shear enhancement factor.

sc143, 144, 145 Replaced references to BD 37/01 with Departmental Standard CS 454.

sc146, 148, 165 Replaced references to BD 37/01 with Departmental Standard CS 454.

sc193   Fixed plots for Version 5.

sc194   Fixed plots for Version 5.

sc195   Fixed plots for Version 5.

sc218   Updated expression for Wsw.

sc221   Set a maximum value for parameter s, updated 'Sheeting profile properties' section, enhanced diagrams, added pic2 & Example 2.

sc222   NWC or LWC now reported in Section Summary.

sc224   NWC or LWC now reported in Section Summary.

sc225   Updated to Departmental Standard CS 454.

sc250   Fixed pull-through for version 5. Cosmetic improvements. Additional opening check on NRESP.

sc251   Fixed pull-through for version 5. Cosmetic improvements. Additional opening check on NRESP.

sc273   Replaced IF alp1'>alp2' with IF alp1'>=alp2' and IF alp1>alp2 with IF alp1>=alp2 to avoid assignment failure at line 1610.

sc300   Fixed pull-through for version 5. Cosmetic improvements. Additional opening check on NRESP.

sc305 Fixed pull-through for version 5. Cosmetic improvements. Additional opening check on NRESP.

sc310 Fixed pull-through for version 5. Added extra EDIT. Additional opening check on NRESP.

sc315 Fixed pull-through for version 5. Added extra EDITs, replaced F'>0 with F'>=0. Additional opening check on NRESP.

sc357, 360 Replaced references to BD 37/01 with Departmental Standard CS 454.

sc377 Removed references to BD 21/01, added reference to Departmental Standard CS 454 Section 10 [Ref 27.I], removed references to BD 13/90.

sc384 Removed surplus references to NRESP relating to pull through, added extra EDITs. Shortened supp= lines.

sc385 Removed surplus references to NRESP relating to pull through, cosmetic improvements, added extra EDITs.

sc386 Cosmetic improvements.

sc390 Fixed pull-through for version 5. Set NEd=0.01 and Nd=0.01 as minimum values, added EDIT. Additional opening check on NRESP.

sc391 Fixed pull-through for version 5. Defined Iz when NRESP>0, set Wplz=Wply, set NEd=0.01 and Nd=0.01 as minimum values, updated comp1 expression for minor axis bending, updated to make reference to Outside diameter and Thickness. Additional opening check on NRESP.

sc392 Cosmetic improvements, set Grade=355 for all Examples.

sc396 Added Lkrhs routine.

sc407 Reduced range of material thickness for (EC design option).

sc410 Fixed pull-through for version 5. Additional opening check on NRESP, shortened supp= and loadt= lines. Cosmetic improvements.

sc411 Fixed pull-through for version 5. Replaced UB & UC with UKB & UKC for EC design. Additional opening check on NRESP. Cosmetic improvements, added scenario IF rst1=1, added Example 6, Example 7 and scenario (IF c1<=1).

sc412 Fixed pull-through for version 5. Revised EDIT to include F and L. Additional opening check on NRESP, shortened supp= lines.

sc414 Fixed pull-through for version 5. Cosmetic improvements, updated cssp to make reference to Outside diameter and Thickness. Additional opening check on NRESP, shortened supp= lines.

sc418 Cosmetic improvements.

sc419 Cosmetic improvements.

sc421 Added more green display notes relating to welds.

sc424 Cosmetic improvements, general enhancements.

sc425 Further green screen display notes relating to welds, general enhancements.

sc426 Further green display notes relating to welds, replaced bps with bps1 where appropriate to consider fin plate.

sc427 Further green display notes relating to welds, redefined bn, defined As before slipres routine, added Example 5 & 6, defined n in expression FRd'=n*FRd (number of friction surfaces), added end plate bolt diameter to summary, set inner=0 to adopt outer splice plate only.

sc428 Replaced srstrnt with srstrn, cosmetic improvements.

sc429 Fixed pull-through for version 5. Added references to UKB & UKC. Additional opening check on NRESP. Replaced srstrnt with srstrn, cosmetic improvements, enhance section selection, added stype'.

sc431 Fixed pull-through for version 5. Enhanced display of Table 13. Additional opening check on NRESP. Added buckling resistance moment to SUMMARY.

sc434 Set parameter load=1 as this proforma is for UDL only (i.e. NL=0).

sc437 Set LTB=0 for EC, added missing default values to Example 2, made LTB user defined.

sc440   Fixed pull-through for version 5. Enhanced display of Table 13.
        Additional opening check on NRESP. Cosmetic improvements.
sc441   Set F=0.01 % NEd=0.01, Additional opening check on NRESP. cosmetic
        improvements, updated text, one DELTA routine removed as it was
        defined twice.
sc442   Fixed pull-through for version 5. Cosmetic improvements, set
        NEd=0.1 as a minimum value. Additional opening check on NRESP.
        Cosmetic improvements, enhanced DESIGN SUMMARY.
sc443   Replaced partial with partia, cosmetic improvements.
sc444   Fixed pull-through for version 5. Added EDIT relating to Np & Nv,
        revised EDIT relating to F & L, added pic1. Additional opening
        check on NRESP.
sc445   Fixed pull-through for version 5. Replaced UB & UC with UKB & UKC.
        Cosmetic improvements, replaced variable name lateral with latera.
        Additional opening check on NRESP.
sc457   Fixed pull-through for version 5. revised EDIT to include F & L.
        Additional opening check on NRESP.
sc458   Fixed pull-through for version 5. Cosmetic improvements, updated
        cssp to make reference to Outside diameter and Thickness, added
        pic1, revised EDIT to include F & L. Additional opening check on
        NRESP.
sc459   Replaced UB & UC with UKB & UKC. Additional opening check on NRESP.
        Cosmetic improvements, added Example 4, arch rise now needs to be
        defined when arc=5.
sc462   Cosmetic improvements, updated routine Lkus, added rtype (EC) and
        green screen display relating to welds, enhanced on screen notes
        relating to spacing sb, added further screen display diagrams to
        cater for Nb=4 & Nb=8 cases, modified diagram text relating to
        bolts.
sc464   Cosmetic improvements, rearranged commands for Examples.
sc465   Added Lkrhs to exclude CHS option as proforma is for SHS & RHS
        only.
sc466   Repositioned IF sw>tw, and added IF sww>tw, cosmetic improvements.
sc467   Cosmetic improvements, added extra EDITs.
sc470   Added green screen display notes relating to welds, added Example
        8, updated SUMMARY for double sided bearing stiffener (i.e. when
        ans9=1).
sc474   Cosmetic improvements, set E=210000 before START.
sc476   Cosmetic improvements.
sc477   Added extra EDITs and scenario IF brace=2, cosmetic improvements,
        replaced expression n=sigEd/fy0 with n=sig0Ed/fy0.
sc478   General cosmetic improvements.
sc479   Added extra EDITs.
sc480   Added extra EDIT, cosmetic improvements, modified expression for
        shear resistance of one bolt when ctype=2, added Example 8.
sc481   Parameter rest is now defined once by the user replaced scenario IF
        nn=1 with IF nn=1 OR nn=2, rest=0 defined before START, added
        default values for Lb to Example 1 and Example 4.
sc484   Cosmetic improvements, set the maximum Hollow-bolt diameter to
        20mm, added green screen display relating to Hollo-bolts.
sc485   Cosmetic improvements, set maximum Hollow-bolt diameter to 20mm,
        added Example 3, added green screen display relating to Hollo-
        bolts.
sc486   Added green screen display notes relating to welds, cosmetic
        improvements, replaced [/9 with /9.
sc487   Added green screen display notes relating to welds, cosmetic
        improvements.
sc488   Added green screen display notes relating to welds, cosmetic
        improvements.

sc489 Added further WARNINGs relating to baseplate size, replace +b+200 mm wth +b+2*tf mm, updated diagrams.

sc490 Replaced "beam splice" with "column splice", cosmetic improvements, added scenario IF bfp<bcp, stopped user from specifying db and nt twice.

sc491 Shortened rtype= lines, cosmetic improvements, added more screen green display relating to welds.

sc492 Cosmetic improvements.

sc493 Enhanced screen display, removed << from appearing in output.

sc494 Cosmetic improvements.

sc496 Cosmetic improvements, defined ae=0 before 'ans' for end plate type connection (code=2 only).

sc497 For haunch cutting replaced stype with type to display correct UC properties on screen.

sc498 Replaced variable name 'applied' with aload. Added/modified default values for Example 2, cosmetic improvements.

sc503 Cosmetic improvements.

sc525 Missing units for distance a1 now being displayed on screen.

sc528 Added ans11, replaced Floor thickness with Slab thickness.

sc530, 535, 536, 537, 538 Cosmetic improvements.

sc543, 546 Replaced assbri routine with ASSBRI.

sc547, 548 Updated to Departmental Standard CC 454. Replaced assbri routine with ASSBRI.

sc554 Cosmetic improvements.

sc560 Cosmetic improvements, stopped << appearing in output.

sc561 Replaced box with boxrec.

sc565, 566, 569, 570, 580, 581, 582, 590, 601 Cosmetic improvements.

sc603 Added extra EDITs.

sc604 Cosmetic improvements.

sc605 Added EDIT & pic routine.

sc608 Enhanced diagrams.

sc611 Cosmetic improvements, replaced LType=6/16 with LType=6, added pic routine.

sc612, 620, 621, 622 Cosmetic improvements.

sc623 Cosmetic improvements, removed surplus STOP.

sc624 Cosmetic improvements.

sc632 Modified text relating to distance to load P, cosmetic improvements, added Example 2.

sc639 Cosmetic improvements.

sc640 Cosmetic improvements, replaced Modulus of rigidity with Shearing modulus, redefine 'properties' routine to 'proper'.

sc642 Renamed variable name spans to nspans, added variable name nsp.

sc643 Cosmetic improvements, made optn=-1 hidden.

sc649 Cosmetic improvements, replaced T with t and D with h where appropriate (EC only), general enhancements.

sc650 Replaced (1-7) with (1-8) for option number. Fixes for options 7+8 for SCALE 4 and 5. Fixed plots for Version 5.

sc651 Cosmetic improvements, added extra EDIT and pic1, enhanced diagrams. Fixed plots for Version 5.

sc652 Cosmetic improvements.

sc653 Cosmetic improvements, added missing text "Distance to centre line" to diagram, replaced soffit with girder soffit, replaced beam with girder, removed references to Standard BD 21/01.

sc659 Cosmetic improvements, enhanced diagrams.

sc663, 664, 670, 680, 682, 687, 688, 689, 690, 692, 694 cosmetic improvements.

sc701 Added routine eudr1, replaced eudrift with eudr2, cosmetic improvements.

sc702 Added EDIT before Xt & Lu.

sc704 Cosmetic improvements, added Example 2 & Example 3.

sc705 Cosmetic improvements, added EDITs, enhanced on screen display
       tables.
sc706 Added EDITs, enhanced screen display.
sc707 Cosmetic improvements.
sc710 Added extra EDITs, made reference to (LL) & (IL).
sc711 Made reference to (LL) & (IL).
sc715 Added ans1=0 to Optn=1, added ans14, cosmetic improvements.
sc716 Added asslim routine which includes "Limiting conditions", made
       Cosmetic improvements, added more green screen display.
sc717 Cosmetic improvements, replaced Plaster/board load with False
       ceiling load for optn4, enhanced green screen display layout.
sc718, 720 Cosmetic improvements.
sc726 Cosmetic improvements, stopped << appearing in output.
sc750 Cosmetic improvements, set the depth of soil for passive resistance
       to dp in routine ULSp1, updated expressions for P1 and P2 for
       sliding resistance calculation and introduced more scenarios
       relating to expressions for parameters P1 & P2. Made general
       enhancements, added more screen text for dp, toe thickness 'd' is
       now defined earlier, replaced dp with dp' where appropriate, added
       further notes to 'Design Summary'.
sc751 Replaced variable name theory with stype, made Cosmetic
       improvements. shortened Ans= lines.
sc755, 768 Cosmetic improvements.
sc769 Cosmetic improvements, enhanced diagram.
sc771 Added further navigation symbols >> and >< relating to fast
       forward.
sc772 Updated on screen text, values for sigm'0 & sigm'1 are now
       correctly offered as user defined, defined a value for si(k+1).
sc775 Replaced F with Fs and gamma with gam, removed // appearing in
       diagram and added/modified text, introduced strip=2.
sc776 Updated default values r' & P'.
sc780 Added pic.
sc781 Renamed z with z' for option=1 only, cosmetic improvements.
sc782 Cosmetic improvements, removed default option, added ><.
sc786 **Added EC design option**, replaced FOSeb with FOSb and added Table
       1.3 before START.
sc787 **Added EC design option** and Table 1.3 before START.
sc788 Cosmetic improvements.
sc789 Removed ans1 as not used, cosmetic improvements.
sc791 Cosmetic improvements.
sc792 Replaced δa with δp in Kp expression text, cosmetic improvements.
sc794 Cosmetic improvements.
sc801 Replaced bmclch routine with bcwcha routine, removed references to
       variable name 'mat'.
sc805 Commented out description of alpha which caused conflict with sc677
       and gui.
sc850 GUI option removed.
sc855c Removed imposed load on rafters from LOADING CASE 3.
sc856 Replaced bmclch routine with bcwc routine.
sc876 Added nl to output to work with sc677 and gui.
sc878 Removed duplicate b+d input for Option 2. Cosmetic improvements,
       added extra EDITs. Added mat=1 wrapper around nu to work with
       sc677.
sc889 Replaced bmclch routine with bcwc routine, removed references to
       variable name 'mt'.
sc929 Adjusted comment lines so they will pull through to sc677 and gui.
sc940 Added missing example default values, replaced pltreq routine with
       plreq3 routine.
sc941, 942, 943, 944, 945, 946, 947 Replaced pltreq routine with plreq3
       routine.

Plans for 2020.

- There are still many intermediate files being saved to disk, these could be stored in memory to speed up the program.

- Enable the resizing of the SCALE window on the fly, without having to close and re-open SCALE.

- Combine the TAPE editor so it appears in a resizeable SCALE window.

- Combine the GUI32 data editor so it appears in a resizeable SCALE window.

- Extend the parametric checking to all SCALE/LUCID/SPADE/NL-STRESS proformas.

- Update SCP for printing directly from SCALE 5 rather than the current printing of pdf files.

- Add feature to import pictures for personalised header logos to SCALE 5.

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

Installation.

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 is the same scale ruler but with a blue stripe to differentiate between the old and new versions.

SAND and SCALE version 4 are included in the installation for users who are familiar with their interfaces. Any existing shortcuts you have 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.

Downloading updates during 2020.

Further updates in 2020 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 2020.EXE.

Ian Brown 01/01/20