

SAND - Structural Analysis and Design, & SCALE - Structural CALculations Ensemble, Information sheet 49; Jan 2023.

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 11.

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 11, Windows 10, Windows 8.1, Windows 8, Windows 7, Windows Vista and Windows XP Service Pack 3.

Main changes to SCALE program in 2022 (Latest version is 6.28).

- 9 new proformas and modifications to over 100 existing proformas as detailed below.
- When viewing the final calcs if you select “Edit” when displaying a page showing a drawing/plot then SCALE will automatically switch to TAPE to enable editing of the drawing. This also applies to NL-STRESS and SCALE option 15 for viewing previous calcs. Selecting “Edit” for a page containing just text will switch to editing that page of text as expected.
- Many improvements to stability and flow have been added to SCALE, for example entering a built-in proforma number, e.g. 15 or 18, directly at the Proforma Number page, now works ok.

User’s manuals:

- The User’s Manuals for SCALE, LUCID, SPADE, NL-STRESS, the NL-STRESS GUI, NL-VIEW, and TAPE are contained in the file [scale.pdf](#). This help manual can be easily launched from the menu option “Help->Help (pdf file)...”.
- The User’s Manuals are also available in a dynamic form, whereby the manual will change the displayed page to the current topic each time the menu option “Help->Help (dynamic)...” is selected. This is particularly useful when using TAPE, NL-VIEW and the NL-STRESS GUI.
- The User’s Manuals have been fully updated for all aspects of SCALE, for example section 2.19 describes how to use the File option at the end of a SCALE proforma to collate results files.
- Help for the NL-STRESS GUI has now been amalgamated into the main NL-STRESS chapter.

Top Menu items:

- The top menu item “Help” now has the options for “Directory...” and “Command prompt...” added to all screens. (The 3 dots signifying a new window will be launched.) These were previously in a “Utilities” top menu, but have been moved to avoid confusion with TAPE’s “Utilities” top menu.
- TAPE now has a full complement of top menu items: “File”, “Edit”, “View”, “Draw”, “Style”, “Fonts”, “Utilities”, “Help”; see the User’s Manual for full details.
- NL-VIEW 3D Viewer now has a full complement of top menu items: “File”, “View”, “Model”, “Results”, “Loading”, “Help”; see the User’s Manual for full details.
- The NL-STRESS GUI has the top menu item “View” added; see the User’s Manual for full details.

TAPE:

- TAPE now displays drawings using their actual colours, e.g. black on white, rather than the previous white, yellow, green and blue on dark blue.
- You can now cut and paste selected items between separate pages/files.
- You can now click and drag to pan the current view and zoom with the mouse’s scroll wheel, while in the middle of doing an action, e.g. moving selected items around or adding items.
- You can now adjust a selection region by dragging the sides/corners of the region.
- “Size” and “Rotate” options now have their own dialog screens to enter absolute values.
- The align grid to items feature is now fixed; and described in the User’s Manual.
- TAPE now displays NL-VIEW screenshots which have been added to the calcs; and allows notes and lines to be superimposed on the screenshots.
- TAPE now uses the bottom toolbar to display the current activity.

The NL-STRESS GUI:

- The management of load cases has been simplified, there are now four menu options to “Select”, “Edit”, “Add before” and “Add after”.
- The screens for COMBINE, MAXOF, MINOF and ABSOF, now have multiline edit fields to accommodate structures with a large number of load cases.

The NL-STRESS GUI’s Draw Structure:

- Draw Structure now uses the bottom toolbar to display the current activity.
- When “Joint” is selected, you can now adjust the joint number dynamically on the bottom toolbar for easier editing.
- When “Support” is selected, you can now click on joints to toggle them between supported and unsupported.
- When “Member” is selected, you can now adjust the member number dynamically on the bottom toolbar for easier editing.
- The grid size dynamically changes when zooming in and out, and the grid spacing can also be set from the menu option “Draw Structure->Grid settings”.
- Flickering display fixed.

SCALE available on the Apple App Store.

SCALE 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, the NL-STRESS GUI, TAPE and SCP (for creating pdfs). Click on the link on the fitzroy.com website, or search for “SCALE Structural Calculations” on the Apple App Store.

Plans for 2023.

- Add further SPADE proformas, if anyone has any structural drawings they would like to be automated using SPADE please email ian@fitzroy.com with details.
- Create training videos for all aspects of SCALE, LUCID, SPADE, NL-STRESS, NL-PLOT, NL-VIEW, TAPE, and the NL-STRESS GUI, and place them on the website.
- Add zoom facilities to the viewing calcs screen at the end of the proforma.
- Add thumbnail view scrollbar along the bottom of the calcs window, and a text search facility.
- There are still many intermediate files being saved to disk. Now that all of SCALE runs from one executable these files could be stored in memory to speed up the program, reduce conflict with antivirus checkers and cloud storage, and allow multiple copies of SCALE to run from one directory without clashes.
- Combine the NL-STRESS GUI's steel section table selector so it's available from within the SCALE proformas.
- Combine aspects of the NL-STRESS GUI with the NL-VIEW results viewer, so the user can easily make changes to the model and re-analyse on the fly.
- Introduce new NL-STRESS commands to generate plots using NL-PLOT and possibly NL-VIEW. Currently plots are achieved by the NL-STRESS proformas using parametric commands, but these commands are hard to follow and are removed before viewing the file in the NL-STRESS GUI, so an alternative would be useful.
- Add feature to import DXF and possibly PDF drawings to the NL-STRESS GUI to use as templates for creating a structure.
- Encode NL-VIEW screenshot .png files into the .cal file so the two files don't become separated.
- Editing calcs, add a way of deleting pages out of a set of calcs
- Add a redo option to TAPE.
- Make TAPE's undo stages match the user's actions, i.e. get undo to undo the last rotation of 100 selected items, rather than undoing the pasting of each rotated item one at a time.
- TAPE's dimension line, dashed line and centreline properties could be saved into the hpgl of the .cal file, and hence could retain those attributes, rather than be converted into normal lines.

Installation.

The 2023 update installs a desktop shortcut named "SCALE 6" (to launch program scale.exe), for both SAND and SCALE licences. For new installations of SCALE 6, the installer now looks for previous versions of SCALE 6, then SCALE 5, then SCALE 4 shortcuts to get the previous installation and working directories. You can delete any existing shortcuts to SCALE 5, as the target is the same.

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 6 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 still included in the installation for users who are familiar with their interfaces. Any existing shortcuts you have to them remain unchanged, shortcuts to the previous versions 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 6 if required.

New proformas.

- sc159 Structural robustness of concrete framed buildings. The building is assumed to be an in-situ reinforced concrete framed building. The Eurocode strategies for structural robustness and designing for the avoidance of disproportionate collapse as required by the UK Building Regulations will be considered by this proforma.
- sp204 Timber strap details. This option will detail strap details for:
- Typical gable wall
 - Typical purlin
 - Timber plate anchored to inner leaf
 - Rafter anchored to purlin
 - Rafters anchored to ridge member
 - Rafters anchored to collard wall and
 - Glulam purlins anchored to collard wall.
- sp641 Brick retaining wall. This option will detail a brick retaining wall, with steps or without steps along the wall height. The user has the option to set the step dimensions d2 and/or d3 to what is required e.g. when d2=d3=0 a constant wall thickness along the full height of the wall will be drawn.
- sp642 Typical joint in ground bearing slab. Four typical joints in ground bearing slab are offered as listed below:
- Typical transverse expansion joint
 - Typical longitudinal joint
 - Typical transverse contraction joint at construction joint
 - Typical transverse contraction joint at continuous pour.
- sp643 Underpinning details. This option will detail an existing masonry wall footing with underpinning. Several notes relating to anticipated sequence of work are offered with the option to add on plan, a suggested underpinning sequence, if required.
- sp644 Suspended floor typical perimeter wall details. Two typical perimeter details are offered as listed below:
- Typical perimeter wall supporting PC floor beams
 - Typical perimeter wall parallel to span of PC floor beams.
- sp645 Typical wall restraint details. Six typical joints, wall restraint details are offered as listed below:
- Wall head restraint using angles staggered on plan
 - Wall head restraint using DOVETAIL channels
 - Wall head restraint using galvanised L-STRAPS
 - Blockwork head restraint with sleeve
 - Detail for horizontal mid-height steel restraint
 - Wall head restraint using ANCON sliding anchors
- sp646 Typical lateral support to non-loadbearing partitions. This option will detail the wall head restrained using pressed metal angles fixed to slab soffit on alternate sides of the non-loadbearing partition.
- sp647 Typical masonry movement joint details. This option will detail eight typical masonry movement joint details (Option=1 to Option=8).

Changes to SCALE proformas.

In addition to the changes detailed above, we have made amendments to over 100 proformas, the main changes are listed below:

- sc035 added options 11-21, switched ans=1 and 10.
- sc269 added expression for kamp', added more text relating to f1, set ans5=1, added scenario IF GS<>3, Gmean values evaluated automatically, added reference to Jack Porteous & Abdy Kermani book.

sc274 updated diagrams, added more scenarios to accept 3, 4 or 5 bolts in one row for both overlapped and symmetrical joints.

sc339 updated expression for total load from accidental action to read $Ad=34*L1*L2$ kN as per SCI discussions, updated SUMMARY in routine colkey.

sc411 added more text, updated diagrams, added A, B and C to three headings, replaced "end of the haunch" with "sharp end of the haunch", added NOTE relating to point B.

sc418 added option to use Asymmetric SlimFlor Beams, updated expression for In-plane shear resistance, updated MwRd and MzRd, added flcon2 routine.

sc418a added missing fck default value to example, moved routine ASBeam to ec3sec.pro.

sc419 added option to use Asymmetric SlimFlor Beams, updated expression for In-plane shear resistance, updated MwRd and MzRd.

sc419a moved routine ASBeam to ec3sec.pro.

sc444 updated the Overall buckling check expressions relating to Clause 4.8.3.3.1 (Simplified method).

sc445 added scenario IF buckle=1 below scenario IF Lf=0 when code=2, made elastic modulus visible in output, added text (Simplified method).

sc446 added user defined section properties and, more text, added flag2=1 & flag2=2 needed for when stype=3, added more text to SUMMARY.

sc453 added scenarios IF stype=3 THEN h=od13 ENDIF IF stype=6 THEN h=od16 ENDIF, set Wply=Wply and Welz=Wely when stype=3 or 6, added scenario IF MyEd>0 and set psi=0 when MyEd=0 is selected by user.

sc457 made more section properties visible in output, added text (Simplified method).

sc463 set kw=0.7 and kzw=1.0, enhanced diagram.

sc466 enhanced diagrams, added variable name wopen, updated diagrams and added variable name R default values to example, removed wopen from before command START to suit PRM file (PARAMETER 3), updated diagrams, set $ht=(h-ho)/2$ mm for EC option, added heading "Properties of steel beam at CL of opening" to both BS and EC options, added variable names McRd' and Mc', set $df=(D-Do)/2$ for BS option, when MyEd ó McRd' program no longer prompts user for a response, added OPTION=2 for composite beam option, OPTION=1 is now for non-composite beam option, added heading "Beam shear and moment capacity" & "Beam shear and moment resistance", added example to deal with OPTION=2, added further text, added variable name yeff to OPTION 1, added routines pic1, pic2, pic3, scon and srpbs, enhanced diagrams, added scenario IF As>Ar and limits to the value of bs, added text to SUMMARY, added option to ignore the slab when evaluating the shear resistance of the composite beam.

sc467 replaced Westock with Westok, updated example default values, added variable name OPTION and more text relating to Free Software by Westok, added cnote routine.

sc468 added user defined section properties and further screen text.

sc477 replaced Brace member with Chord member, added overlap upper limit to 80% assuming hidden seem is welded.

sc478 replaced 'Bracing effective width' with 'Bracing effective width resistance', replaced $g>=t1+t2$ with $g>t1+t2$ for code=2 only.

sc493 replaced IF beff>beff with IF beff>beff1 for both code=1 and code=2, corrected expressions for NO2 relating to brace 2 (i.e. when IF $Ov2<80$), replaced beff1 with beff1, added overlap upper limit to 80% assuming hidden seem welded.

sc495 removed text not used relating to positive Rb (prying forces), clarified expression for FtEd' is per bar, enhanced diagrams.

sc548 updated equation E.2 for evaluating the Profile factor.

sc800 removed sense=7, removed nu for timber as this was not used.

sc801 removed sense=7, added text relating to zero supports, replaced number of supports from jx*jy to jx*jz, number of supports are no longer shown as zero, added variable name ns, removed nu for timber as this was not used, Char compressive strength of concrete fck is only reported in output when mt=1, removed nu for timber as this was not used.

sc802, 807, 940 removed sense=7, number of supports are no longer shown as zero.

sc803 to 805, 811, 876-879, 883 to 886 to 888, 927 to 929 - removed sense=7.

sc806 removed sense=7, added text relating to zero supports.

sc808, 809 removed sense=7, added text relating to zero supports, number of supports are no longer shown as zero.

sc810 removed sense=7, added text relating to zero supports, set vn=1 to view detailing notes on screen.

sc812 removed sense=7, added text relating to zero supports, introduced variable name ns, number of supports are no longer shown as zero, added nu to output.

sc856 Option=1 is now using type=1 and is compatible with Option=2, 3 and 4, set type=1 in Option=1, removed sense=7.

sc857 added routine gnotes and typan1, updated two stage approach to check the critical load factor, removed PAGELENGTH 4000 after command START, added more loading cases and TABULATE DISPLACEMENTS to some of the loading cases, removed datal routine, added more scenario IF stage=1 to routine axes1.

sc858 added routine gnotes and typan1, updated diagrams and loading cases, redefined loads, introduced further loading cases, removed PAGELENGTH 4000 after command START, removed datal routine, added scenario IF stage=1 to routine axes1.

sc859 added routine gnotes and typan1, updated diagrams and loading cases, redefined loads, introduced a further loading case, clarified snow load on plan, added TABULATE DISPLACEMENTS to loading cases, removed datal routine, added scenario IF stage=1 to routine axes1.

sc860 added gnotes and typan1, removed sense=7 and zero supports, redefined, enhanced diagrams, added more loading cases, proforma now checks the elastic critical load factor in Stage 1 and then proceeds to Stage 2, added EHF's at joints 3 and 31, added scenario IF stage=1 to routine axes1, added missing variable name wtcl needed when styl>3.

sc861 six truss options are now being considered, six external routine proformas are now called, added routines sgnotes & typan1 and defined amp=1 before, removed datal, data2 etc., rearranged sc861a to three stages: Stage 1 - initial sway analysis to determine the elastic critical load factor acr Stage 2: Elastic analysis to import into cal file. Stage 3: Elastic analysis as per stage 2 but modified dat file suitable for subsequent nls runs: changing page length and adding plots to the dat file. Stages 2 and 3 give identical results, only EC option is available, redefined loads, moved all procedures to routine proforma sc8000.pro.

sc861a renamed proforma from sc861 to sc861a, set example default value s4=1 to reduce deflections, added routine gnotes and typan1, updated diagrams and loading cases, redefined loads, introduced a further loading case, clarified snow load on plan, removed routine datal, added scenario IF stage=1 to routine axes1.

sc862a renamed proforma from sc862 to sc862a, replaced fig228 with pic2, added routine gnotes, typan1 and axes2, updated diagrams and loading cases, redefined loads, introduced a further loading cases, updated data2 routine, updated axes2, set number of supports from 0 to 2 when Option=2, added scenario IF stage=1 to routine axes2.

sc863a renamed proforma from sc863 to sc863a, added routine gnotes and typan1, updated diagrams and more loading cases, redefined loads, updated data3 routine, updated axes3.

sc864a renamed proforma from sc864 to sc864a, added routine gnotes and typan1, updated diagrams added more loading cases, redefined loads, clarified snow load on plan, updated data4 routine, updated axes4, updated example default values.

sc865a renamed proforma from sc865 to sc865a, added routine gnotes and typan1, updated diagrams and loading cases, redefined loads, introduced more loading cases, clarified snow load on plan, updated data5 routine, updated axes5.

sc866a renamed proforma from sc866 to sc866a, added routine gnotes and typan1, updated diagrams and loading cases, redefined loads, introduced further loading cases, clarified snow load on plan, updated data6 routine, updated axes6.

sc867 made general modification to all options, added more loading cases and two-stage analysis concept to all options, added axes1 to axes4 and data1 routines, replaced nsg with nseg, removed data1 routine, replaced MEMBER RELEASE with MEMBER RELEASES, added missing amp(EHF) to Option=3, added data1 routine, removed axes2, axes3 and axes4, data1 routine is now external routine.

sc868 added routine gnotes and typan1, updated diagrams and loading cases, redefined loads, removed data1 routine.

sc871 added routine gnotes, added typan1 routine to sc8000.pro, updated loading cases, proforma now checks the elastic critical load factor in Stage 1 prior to proceeding to Stage 2, added more text.

sc872 added routine gnotes, updated loading cases, proforma now checks the elastic critical load factor in Stage 1 prior to proceeding to Stage 2, added more text, removed Option=3 & 4, self-weight of arch is no longer overestimated when sect=1, removed fig281 and fig283, replaced ENDDFINE+w with ENDDFINE.

sc880 added routine gnotes and typan1, updated diagrams and loading cases, redefined loads, introduced further loading cases, proforma checks the elastic critical load factor in Stage 1 and then proceeds to Stage 2.

sc881 added gnotes routine, removed sense=7 and zero supports, redefined, enhanced diagrams, added more loading cases, proforma now checks the elastic critical load factor in Stage 1 and then proceeds to Stage 2.

sc882 removed sense=7 and zero supports, redefined distance b, enhanced diagrams, added more loading cases.

sc889 to 895, 925, 926 - removed sense=7, supports are no longer shown as zero.

sc924 removed sense=7, added scenario IF prop=0, updated JOINT RELEASES table.

sc941 removed sense=7, added text relating to zero supports, introduced variable name ns, number of supports are no longer shown as zero.

sc942, 944 to 947, 966, 984 to 987 removed sense=7, number of supports are no longer shown as zero.

sc943 removed sense=7, added text relating to zero supports, introduced variable name ns, number of supports are no longer shown as zero.

sc960 to 965, 980 removed sense=7.

sc981 removed sense=7, number of supports are no longer shown as zero, removed variable 'ei' as this was not used, IF ht=0 AND rt=0 AND rb=0 THEN rb=-1 scenario added to fix instability.

sc8000 added typan1, gnotes and asgn, updated typan1 and data1 routines, updated gnotes routine.

sp005 updated \$25, \$26, \$27 and \$28.

sp204 rafters are now to scale, removed all (NTS) references.

sp605 added ci=0, when no cavity insulation is present cip=0 and ci=0, added more text.

sp608 added ci=0, when no cavity insulation is present cip=0 and ci=0, added more text, added scenarios IF mem=1 AND id<>0 and IF mem=1 AND id=0, modified arrow to raft for labelling.

sp610 added ci=0, when no cavity insulation is present cip=0 and ci=0, added more text, modified arrow to hardcore.

sp612 added ci=0, when no cavity insulation is present cip=0 and ci=0, added more text.

sp613 added variable name cw and scenario IF cit=cw, when no cavity insulation is present cip=0 and ci=0, added missing concrete slab vertical line facing wall cavity.

sp614 added variable name cw and scenario IF cit=cw, when no cavity insulation is present cip=0 and ci=0, cavity insulation now placed at top of cavity fill, added scenario IF ci=1 THEN b'=b', added more text.

sp615 added several scenarios, replaced 'IF cip=1' with 'IF cip=1 AND ci=1', added missing IF cip=1 AND ci=2, replaced ip with cip, removed plabel 56 57 xa'+xap' ya' as it was not used, removed ip=2 as it was not used, set rlc=llc mm when wct=3.

sp616 added variable name cw and scenario IF cit=c when no cavity insulation is present cip=0 and ci=0, cavity insulation now placed at top of cavity fill, added scenario IF ci=1 THEN b'=b', added more text.

sp618 added variable name cw and scenario IF cit=cw, when no cavity insulation is present cip=0 and ci=0, cavity insulation now placed at top of cavity fill removed cits from b' expression when ci=1.

sp619 added ci=0, when no cavity insulation is present cip=0 and ci=0, added more text.

sp620 added variable name cw and scenario IF cit=cw, when no cavity insulation is present cip=0 and ci=0, cavity insulation now placed at top of cavity fill, added scenario IF ci=1 THEN b'=b', added scenario IF mem2=1 AND id>0 and IF mem2=1 AND id=0, set mem=1 when scd=0.

sp622 added variable name cw and scenario IF cit=cw, when no cavity insulation is present cip=0 and ci=0, cavity insulation now placed at top of cavity fill, added scenario IF ci=1 THEN b'=b'.

sp624 added variable name cw and scenario IF cit=cw, when no cavity insulation is present cip=0 and ci=0, added missing concrete slab vertical line facing wall cavity, cavity insulation now placed at top of cavity fill, added scenario IF ci=1 THEN b'=b' added more text, set mem=1 when scd=0.

sp630, 632, 634 added option for cavity insulation and cavity fill below ground, added text referring to granular layer at underside of slab, added more text.

Downloading updates during 2023.

Further updates in 2023 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 2023.EXE.

Ian Brown 01/01/23