



# Structural PANDA

User Guide Version 1

For release 1.3.2



# Contents

- 1. Introduction to PANDA
- 2. Getting started
- 3. Building Layout Inputs
- 4. Model Scope
- 5. Input Parameters
- 6. Running Parametric Analysis
- 7. Viewing Results
- 8. Exporting Results
- 9. Troubleshooting



# 1. Introduction to PANDA



# 1.1 Hi, I am PANDA

## Welcome to PANDA

- ❖ 50% of embodied emissions and 20% of costs from multi-storey buildings could be prevented through better early-stage design decisions.
- ❖ PANDA has codified the early-stage design process so is able to generate 1000's of detailed design solutions in a few minutes.
- ❖ PANDA provides a cost and carbon analysis for every solution to reveal better solutions, cheaper with less embodied carbon
- ❖ PANDA saves time, reducing the early-stage design process reduced by an average of two weeks reducing the direct design costs
- ❖ Organisations who use PANDA will win new project tenders in favour of those who don't.
- ❖ Other software solutions rely on existing designs to provide cost and carbon analysis. PANDA is in a unique space of being able to generate detailed design solutions and to provide the cost and carbon analysis for every option.

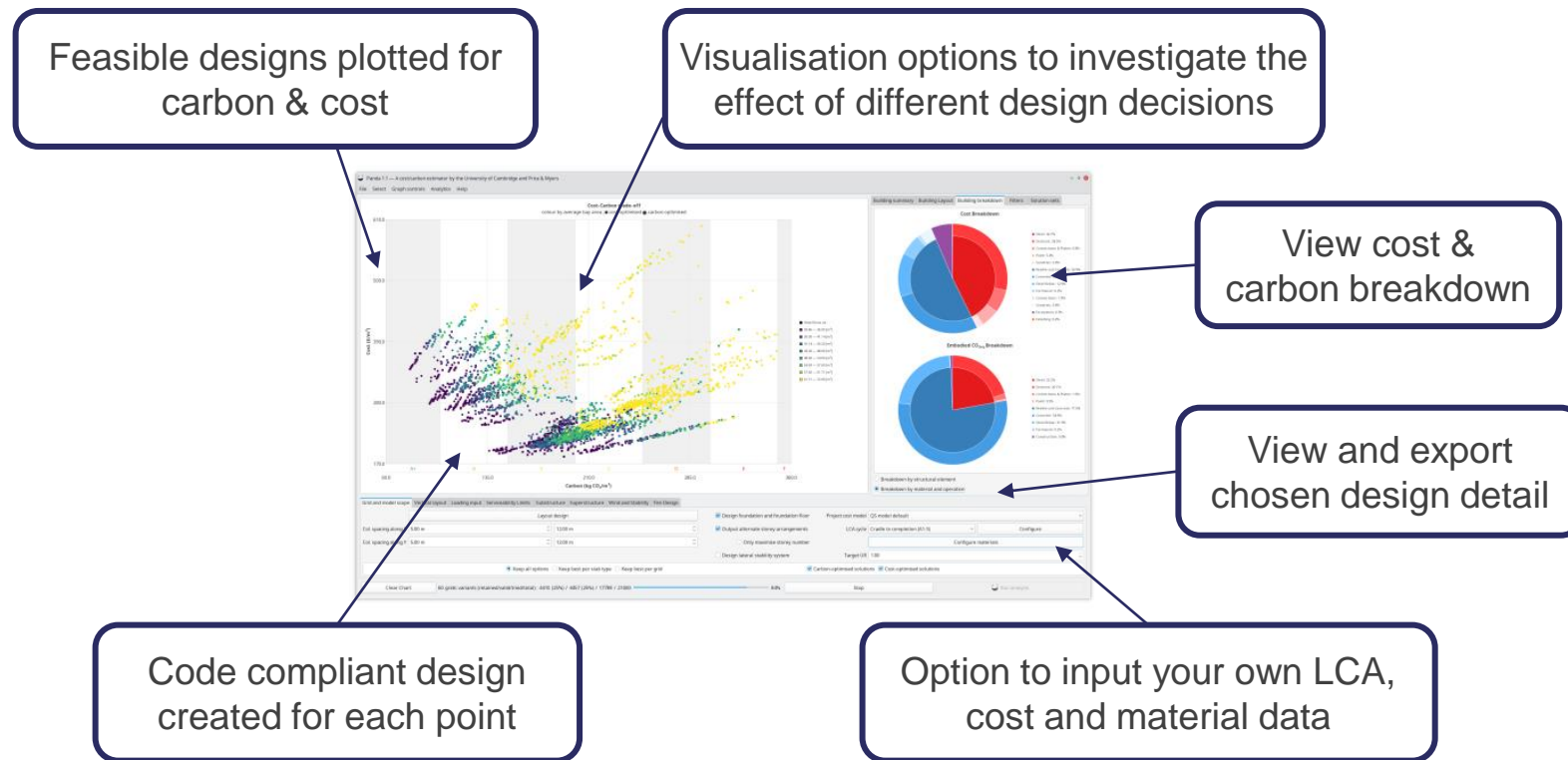


**P**arametric  
**A**nalysis &  
**N**umerical  
**D**esign  
**A**ssessment



# 1.2 PANDA gives you options

There are 1000's of options for every client brief, so how do you know that the concepts you select to develop are the best ones? PANDA lets you explore all the options so your team can make fast and informed decisions.





## 1.3 What can PANDA do?

### **Automated generation of cost and carbon for all possible design options**

- ❖ Full engineering report giving the complete design specs of every bay
- ❖ Embodied emission and cost breakdown for each design
- ❖ Visualise and filter results by brief requirements such as cost, carbon, layouts, foundation types, decking types,
- ❖ Export PANDA generated results in report format for client meetings

### **Automated Full Eurocode compliant design**

- ❖ steel, composite, CLT, softwood and precast frames concrete 2-way flat slabs and fabricated sections
- ❖ foundation design, including pad, piles and raft options
- ❖ flexible arrangement of facade loading and service integration options
- ❖ design for lateral stability and fire safety requirements
- ❖ vertical space optimization options
- ❖ circularity assessment

### **Use pre-set material, cost and carbon data or input your own datasets**

- ❖ euro, british and westok steel sections
- ❖ cost model validated by a QS,
- ❖ carbon data based on ICE and IStructE databases

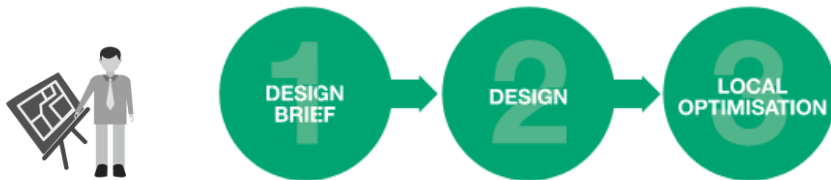


# 1.4 PANDA can get involved early

## PANDA can quantify the influence of early stage design decisions

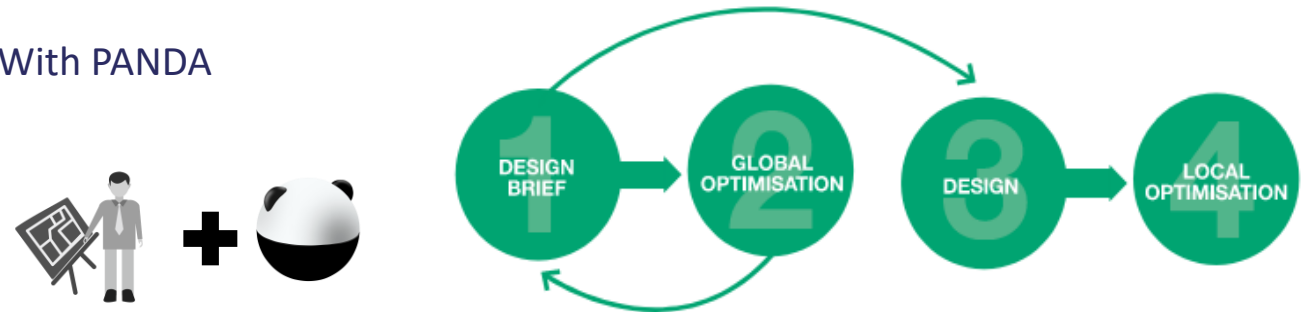
- ❖ The decisions taken in early design stages (RIBA 0-1) have most influence on embodied carbon and cost
- ❖ PANDA allows you to generate scheme designs for many different options to make better early stage design decisions and saving weeks of early stage design calculations
- ❖ PANDA can output reports to communicate the impact of these decisions to the wider team including the client, architect and QS enabling a more collaborative way of working.

### Before PANDA



Traditional workflow is linear meaning early design decision lock in higher cost and carbon

### With PANDA



PANDA generates 1000's of solutions in minutes allowing for an iterative design process and the opportunity to optimise the early design for cost and carbon



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## 2. Getting Started



## 2. Getting Started

This section will show you how to:

- 2.1 Install and update PANDA
- 2.2 Insert a licence key and request/release a seat
- 2.3 Connect to PANDA whilst off-line
- 2.4 Configure customer specific text files

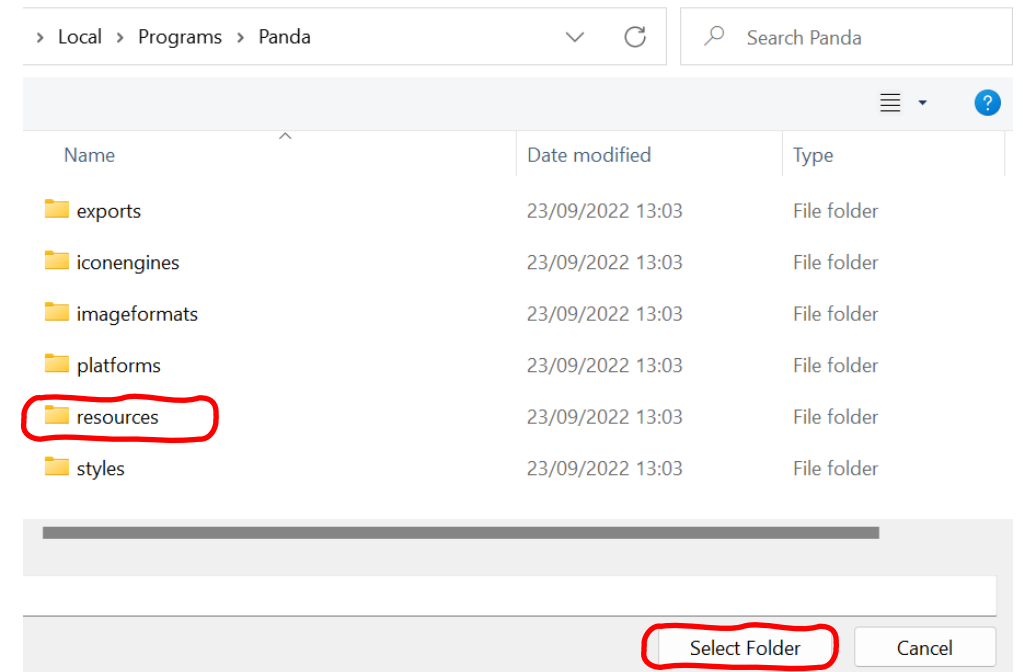
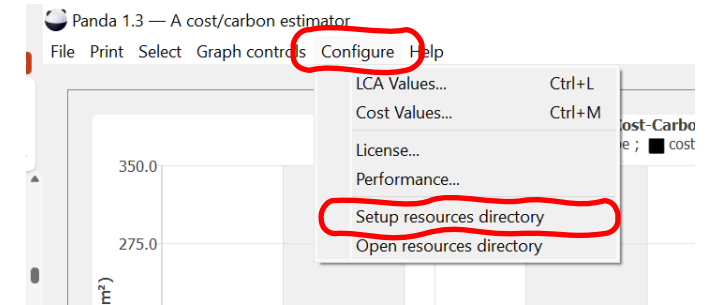


# 2.1 Installation

- Panda can be installed by downloading the latest version from:  
[https://drive.google.com/file/d/1oh9exOKaxScK\\_LRyluAkXxBfoqAfl4BO/view?ts=62723916](https://drive.google.com/file/d/1oh9exOKaxScK_LRyluAkXxBfoqAfl4BO/view?ts=62723916)
- PANDA will be updated with new features periodically, to install the updated version download the installer from the same link and override the previous file locations.
- After installing, you may need to set the resources directory

To set the resources directory location:

- click, 'configure' then 'set resources directory' from the main menu.
- Open the newly installed folder called 'Panda', and the subfolder 'resources'
- Click 'select folder'





## 2.2 Licence Key & Seat Requests

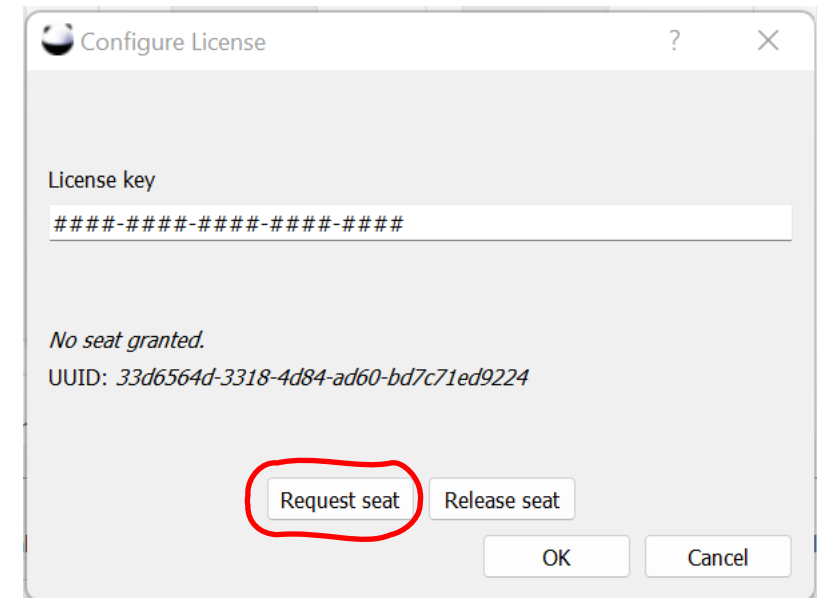
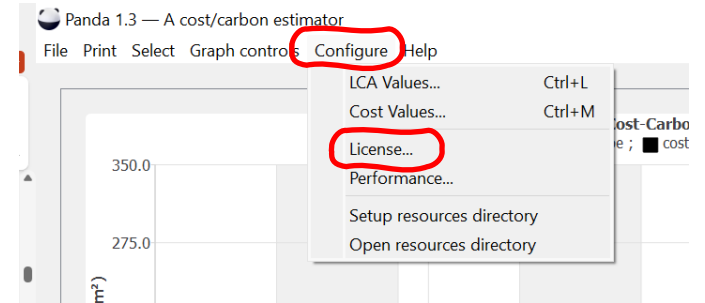
- After installation you will need to configure the licence key and request a seat. The number of seats available is determined by your licence plan.

To set the licence key:

- click, 'configure' then 'licence' from the main menu.
- Enter your 16 digit licence key in the dialogue box
- Click 'request seat' then 'ok'

To release the licence key, to enable another user to access PANDA

- Open the configure licence dialogue box and click 'release seat'





## 2.3 Connecting to PANDA offline

To support site visits, and internet instability it is possible to use PANDA offline.

To use PANDA offline:

- Request a seat whilst connected to the internet. This is required to validate your licence key.
- The licence key will remain active for 48 hours, even if you are not connected to the internet
- You must keep the PANDA application open whilst working offline

If you do not have internet access to validate your licence key, PANDA can not configure new solutions





## 2.4 Configuring customer specific text files

PANDA is not designed to be a black box. We encourage users to adapt the input files with your own data. It is possible to modify the input files for materials, carbon value and cost values using text files.

To use configure specific text files:

- Open the panda resources directory and click on 'resources'
- Individual text files can be edited and replaced with company specific values.
- Pre-set alternatives can be added to provide alternative cost/carbon models which can be loaded as per sections 4.5 & 4.6
- If you would like support in editing these files please send an email to:

[cyrille.dunant@structuralpanda.co.uk](mailto:cyrille.dunant@structuralpanda.co.uk)

The screenshot shows a file explorer interface for the 'Panda > resources' directory. The interface includes a search bar at the top right and a table listing the contents of the directory. The table has columns for Name, Date modified, Type, and Size. The 'spreadsheets' folder is highlighted in the list.

Name	Date modified	Type	Size
compositedeckings	23/09/2022 13:03	File folder	
genericConcreteDeckings	23/09/2022 13:03	File folder	
otherfloortypes	23/09/2022 13:03	File folder	
precastdeckings	23/09/2022 13:03	File folder	
presetAlternatives	23/09/2022 13:03	File folder	
sections	23/09/2022 13:03	File folder	
soils	23/09/2022 13:03	File folder	
spreadsheets	23/09/2022 13:03	File folder	
carbonvalues.txt	08/09/2022 17:09	Text Document	6 KB
constructionvalues.txt	08/09/2022 17:09	Text Document	12 KB
costvalues.txt	11/04/2022 17:32	Text Document	4 KB
physicalvalues.txt	11/04/2022 17:32	Text Document	1 KB
safetyvalues.txt	11/04/2022 17:32	Text Document	1 KB
sheetPiles.txt	11/04/2022 17:32	Text Document	9 KB



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# 3. Building Layout Inputs





# 3. Building Layout Inputs

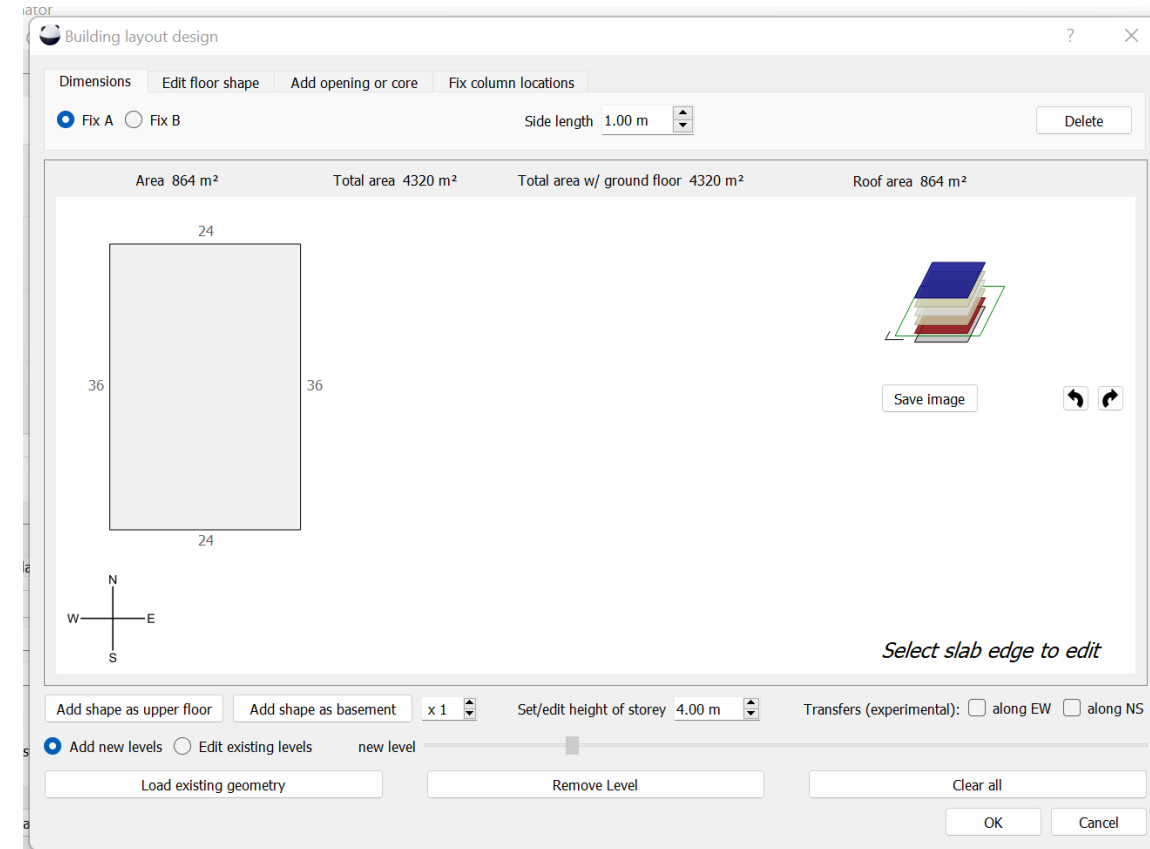
This section will show you how to:

- 3.1 Create a layout
- 3.2 Fix column positions
- 3.3 Set column spacing range
- 3.4 Match grid layout to a saved option



# 3.1 Layouts

- PANDA can handle any rectilinear shape
- Shapes can be changed from floor to floor (overhangs are not handled yet)
- PANDA will try all combinations of regular grids within column spacing limits
- Simpler shapes have higher potential for efficiency





# 3.1 Layouts

- Start PANDA
- Select the tab “Grid and model scope”
- Select “Layout design”:
- To input the pre-set geometry
  - Click “Add shape as upper floor” 4 times for a simple 4 storey building
  - Click “OK”
- Click “run analysis” to run PANDA for this geometry

Panda 1.3 — A cost/carbon estimator

File Print Select Graph controls Configure Help

### Cost-Carbon trade-off

colour by frame type ; ■ cost-optimised ● carbon optimised

Frame Type	Carbon (kg CO <sub>2</sub> /m <sup>2</sup> )	Cost (£/m <sup>2</sup> )
A++	0.0	50.0
A+	112.5	125.0
A	225.0	200.0
B	337.5	275.0
C	450.0	350.0

Grid and model scope Vertical layout Loading input Serviceability Limits Substructure Superstructure Cores and transfers Wind and Stability Fire Design

**Layout design**

Column spacing EW 5.00 m 12.00 m  
Column spacing NS 5.00 m 12.00 m

Keep all options  Keep best per slab type  Keep best per grid

Carbon-optimised solutions  Cost-optimised solutions  Match grids from saved options

Project cost model QS model default  
LCA cycle Cradle to completion (A1-5)  
Target UR 1.00

0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 100%

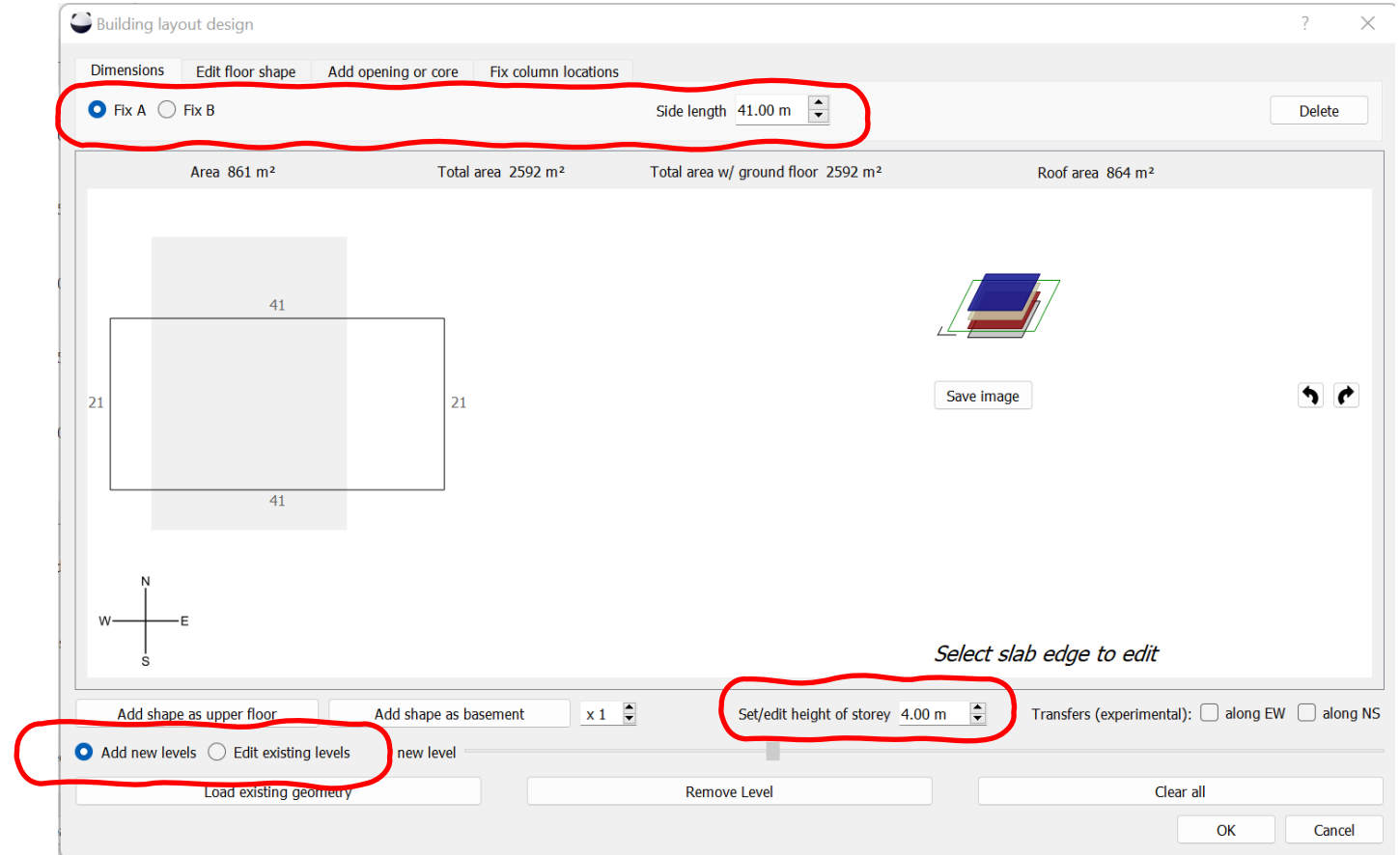
Run analysis



# 3.1 Layouts

To edit the geometry

- Select “Layout design”
- Select either ‘add new levels’ or ‘edit existing levels’
- Click on an edge,
  - Select offset point from ‘Fix A’ or ‘Fix B’ to set measurement direction
  - Input new “side length”
  - Set the height of the selected story
  - Click “Add shape as upper floor” or “add shape as basement to add the new geometry to the building
- Click “run analysis” to run PANDA for this geometry

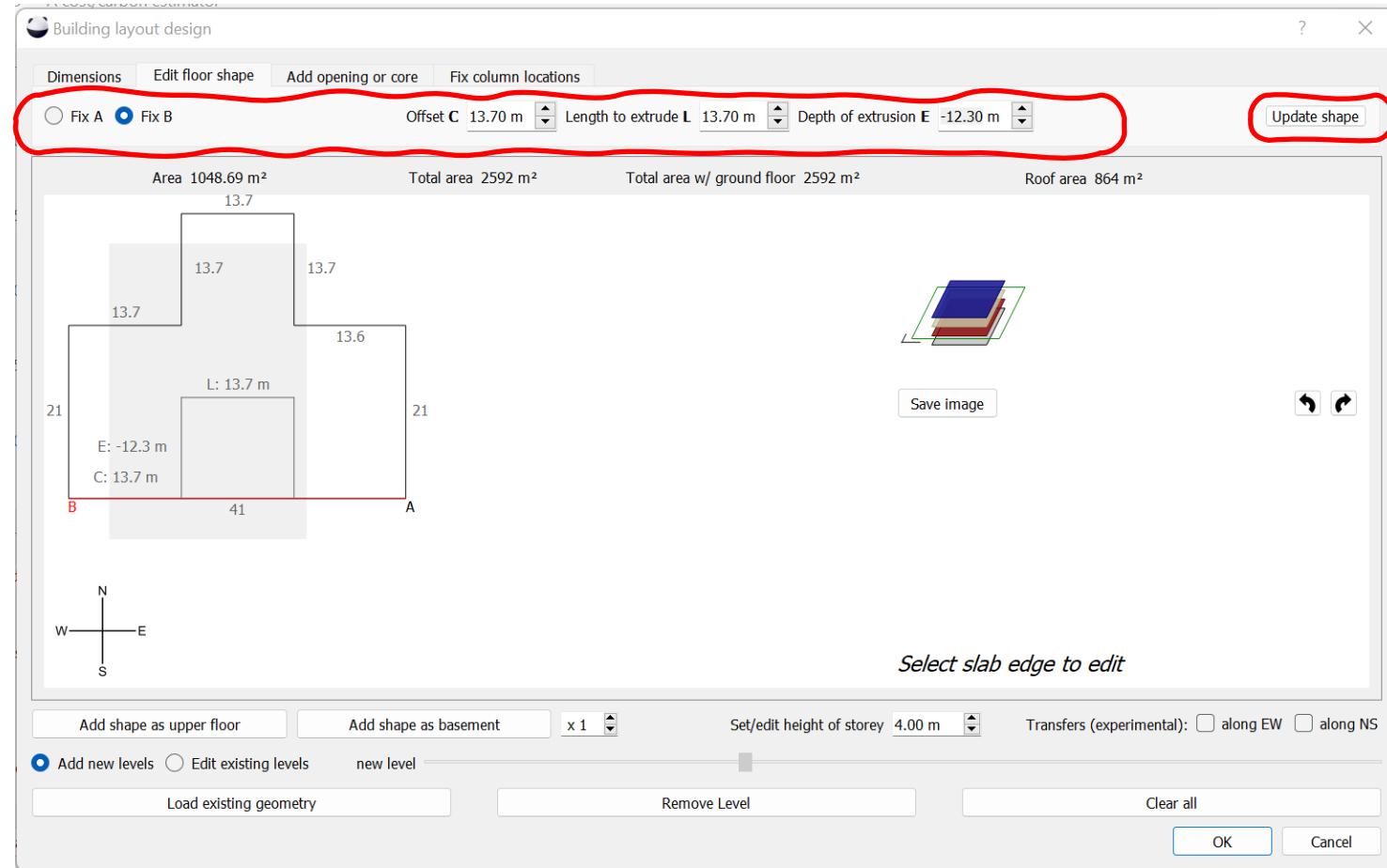




# 3.1 Layouts

To create an non rectangular shape

- Select “Edit floor shape” tab
- Click on an edge,
  - Select offset point from A or B to set measurement direction
  - Input offset dimensions “C”, “L” and “E” to create and position the new shapes
  - Click “update shape” before selecting the next edge to edit
  - Click “Add shape as upper floor” to add the new geometry to the building
  - Click “OK”
- Click “run analysis” to run PANDA for this geometry

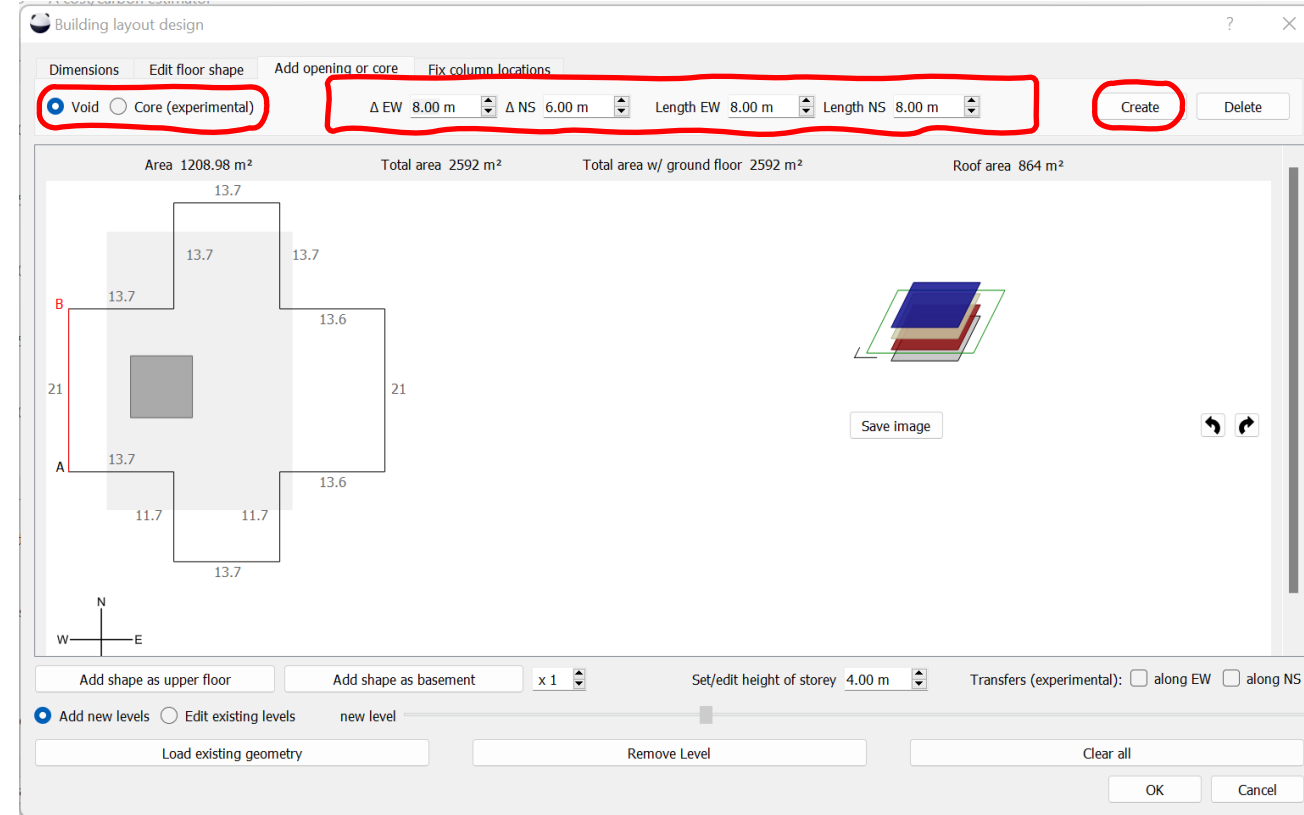




# 3.1 Layouts

To create an opening or core

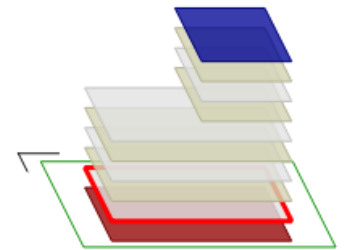
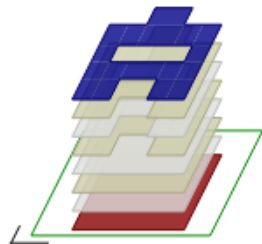
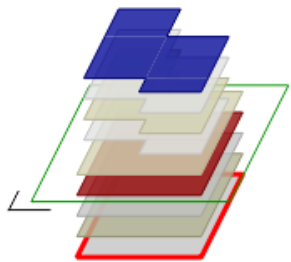
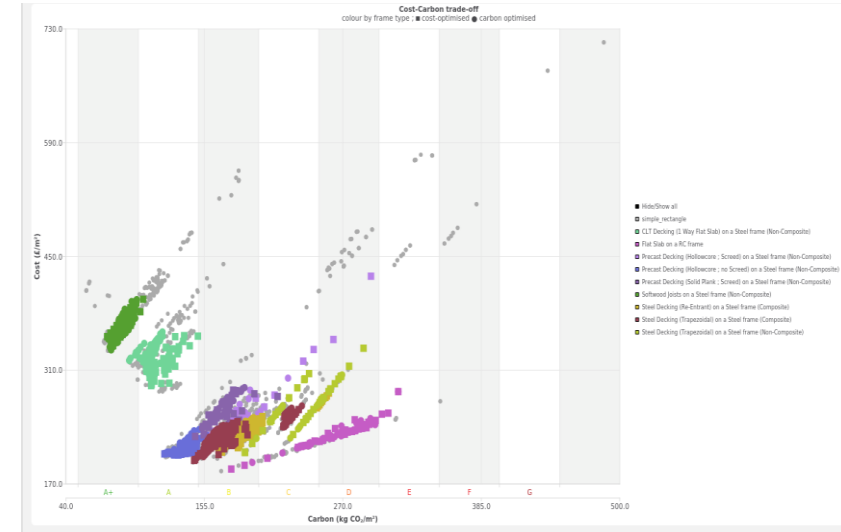
- Select “Add opening or core” tab
- Select ‘void’ or ‘core’ and click on a reference edge
- The void or core is drawn on the shape to set the geometry and location:
  - Set the values for “ $\Delta EW$ ”, “ $\Delta NS$ ”, “Length EW” and “Length NS”
  - Click “create”
  - Set the height of the selected story
  - Click “Add shape as upper floor” to add the new geometry to the building
  - Click “OK”
- Click “run analysis” to run PANDA for this geometry





# 3.1 Layouts

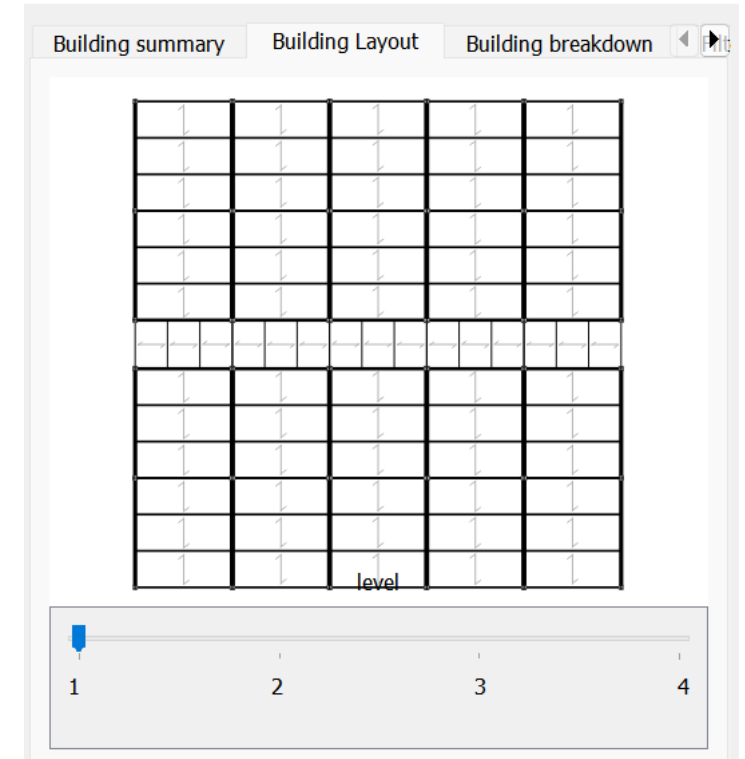
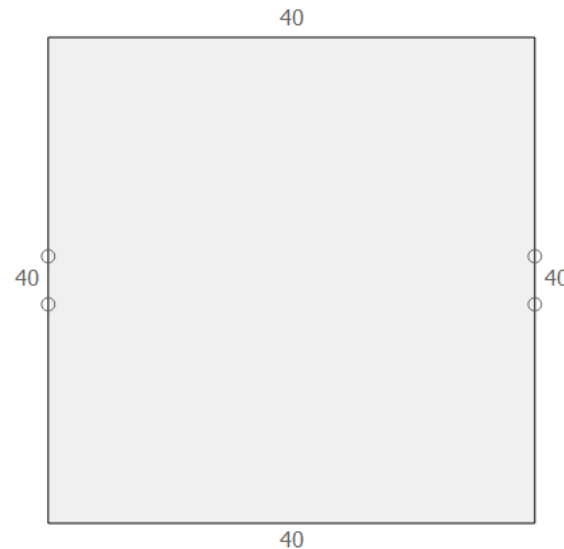
- Use “Layout design” to create buildings of various shapes
- Compare the graph of results for different shapes to see the impact geometry changes have on cost and carbon





## 3.2 Fix column positions

- Sometimes, the grid is only partially “free”
- Sometimes, you wish to represent non-square connections
- The key is to only add the minimum number of fixed columns: PANDA will automatically account for the implied other constraints.
- A single column fixed on a single floor will fix it for all floors and on the opposite wall.



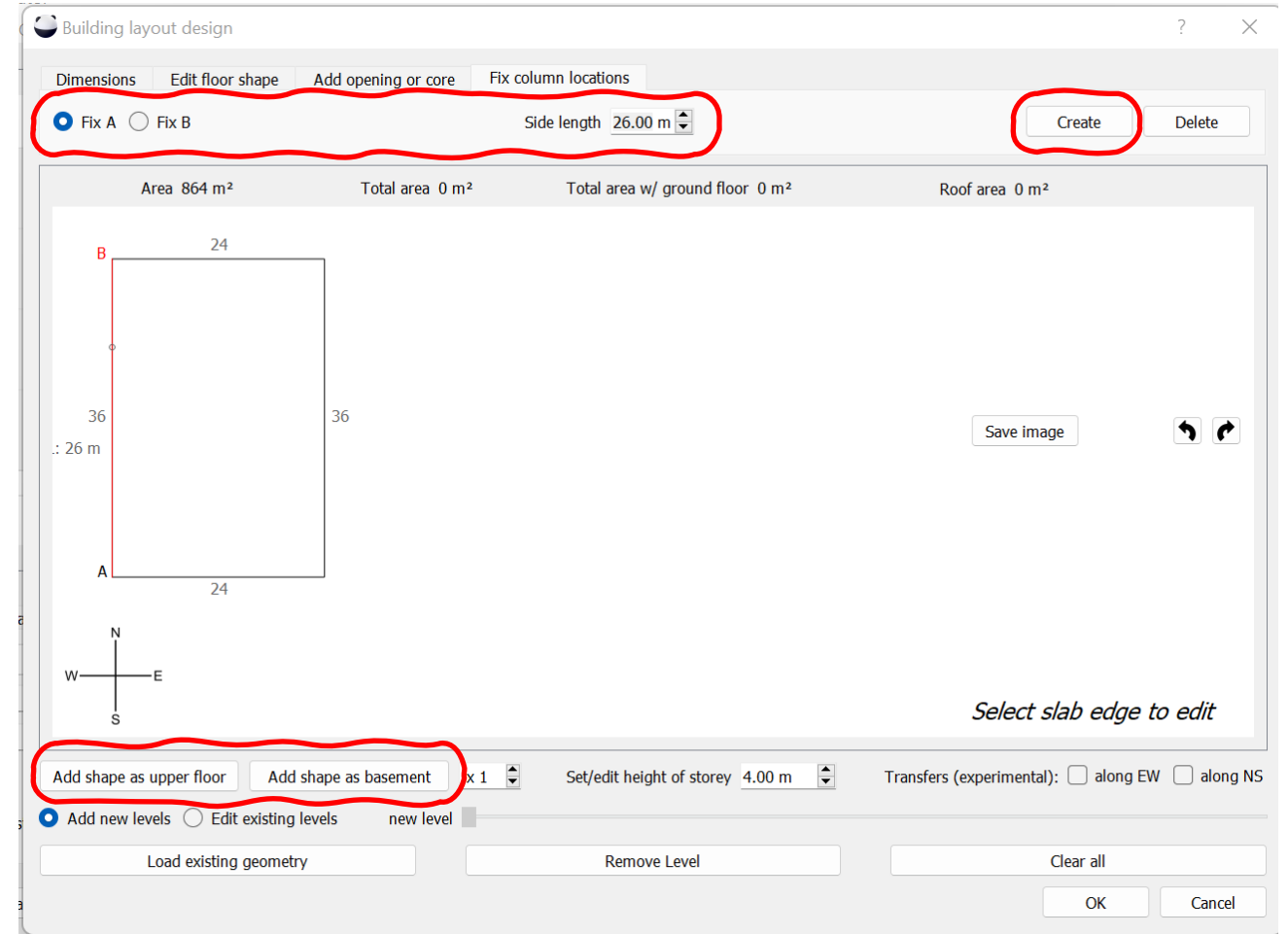




## 3.2 Fix column positions

To fix a column location in the “layout design” window:

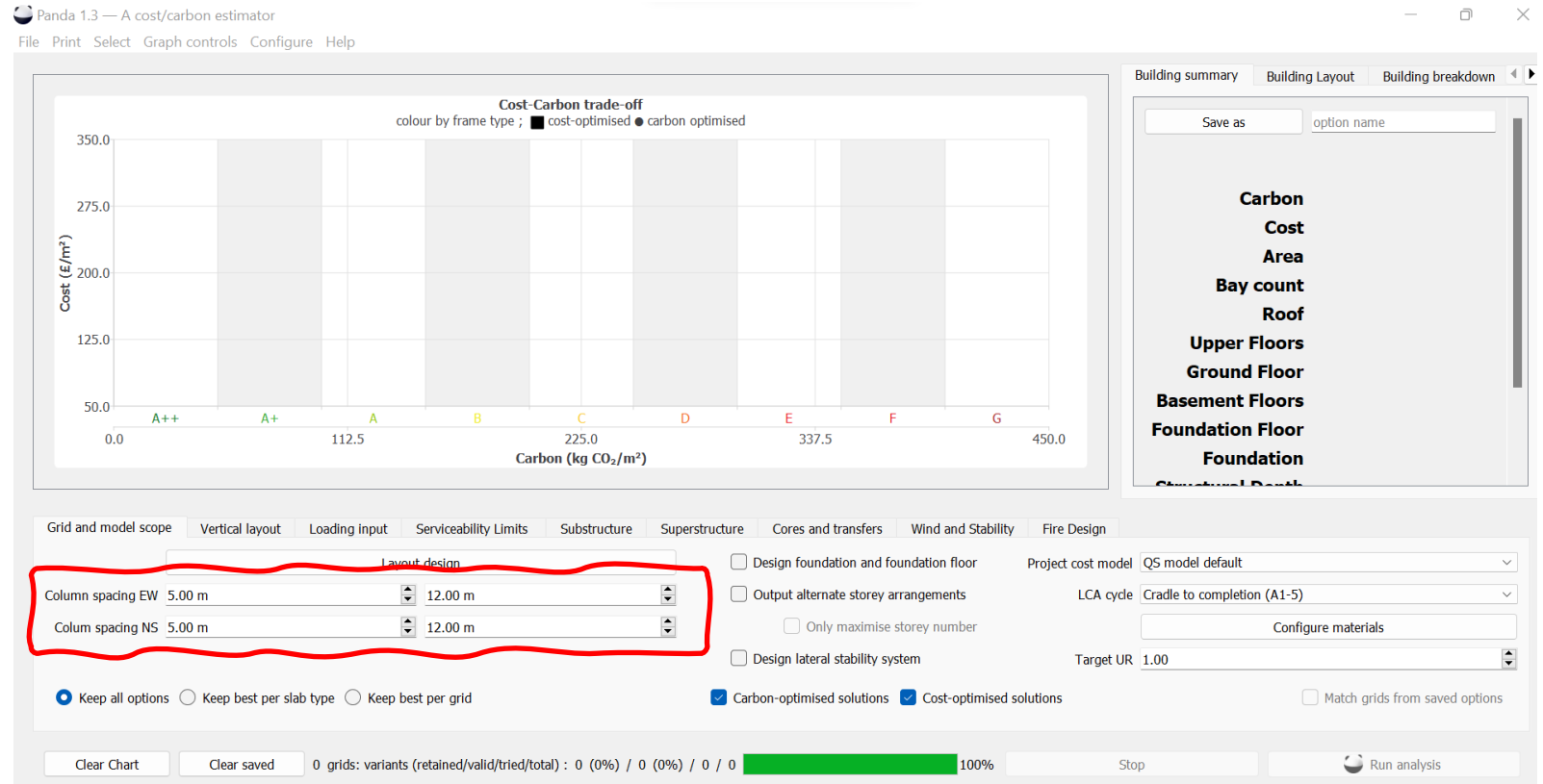
- Select “Fix column location” tab
- Click on an edge
  - Select “Fix A” or “Fix B” to set the measurement direction
  - Input side length to position column as desired
  - Click “create” before adding more fixed columns
- Click “Add shape as upper floor” or ‘add shape as basement’ to add the new geometry to the building
- Click “OK”





# 3.3 Set column spacing range

- There are frequently more options possible than you'd think if column spacing constraints are relaxed
- It may be useful to show the client the trade-offs for different spans in order to inform design decisions
- Most CO2 is lost because decks and spans don't match





## 3.3 Set column spacing range

- Select the tab “Grid and model scope”
- Set “Col. Spacing along EW” and “Col. Spacing along NS” to the minimum and maximum values you are willing to consider in each direction
  - If you set the same value for min and max, the grid will be fixed at that value
  - If you have a more complex geometry, it is advisable to leave this wide and use the fixed columns where required
- Click “compute” to re-run PANDA with these column spacing settings

Grid and model scope | Vertical layout | Loading input | Serviceability Limits | Substructure | Superstructure | Cores and transfers | Wind and Stability | Fire Design

Layout design

Column spacing EW 5.00 m 12.00 m

Column spacing NS 5.00 m 12.00 m

Keep all options  Keep best per slab type  Keep best per grid

Design foundation and foundation floor  Output alternate storey arrangements  Only maximise storey number  Design lateral stability system

Carbon-optimised solutions  Cost-optimised solutions  Match grids from saved options

Project cost model QS model default

LCA cycle Cradle to completion (A1-5)

Configure materials

Target UR 1.00

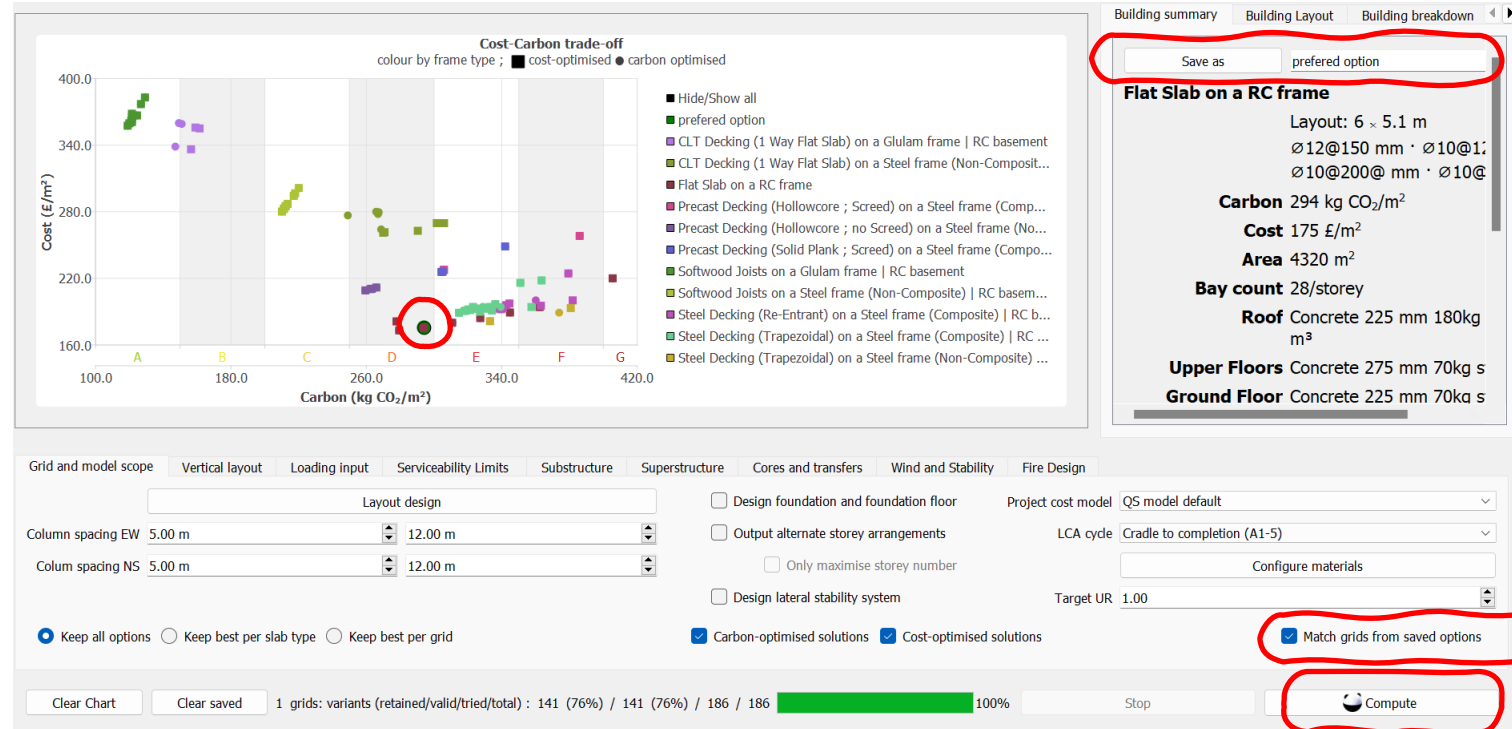
Clear Chart Clear saved 0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 100% Stop Run analysis



# 3.4 Matching a grid from a saved option

To run PANDA with a specific grid option:

- Set the layout geometry and click 'compute' to run PANDA for all grid options
- Save the preferred grid options
  - Select the preferred option by clicking the marker on the graph
  - In 'building summary' type in the name of the selection and click 'save as'
  - Repeat the process for all required grid options
- Tick 'Match grids from saved options' and click 'compute' to re-run PANDA for all possible designs or the selected grid options.
- The graph will limit the results to match the grid layout, the saved option is highlighted with a circle on the graph





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# 4. Model Scope



## 4. Model Scope

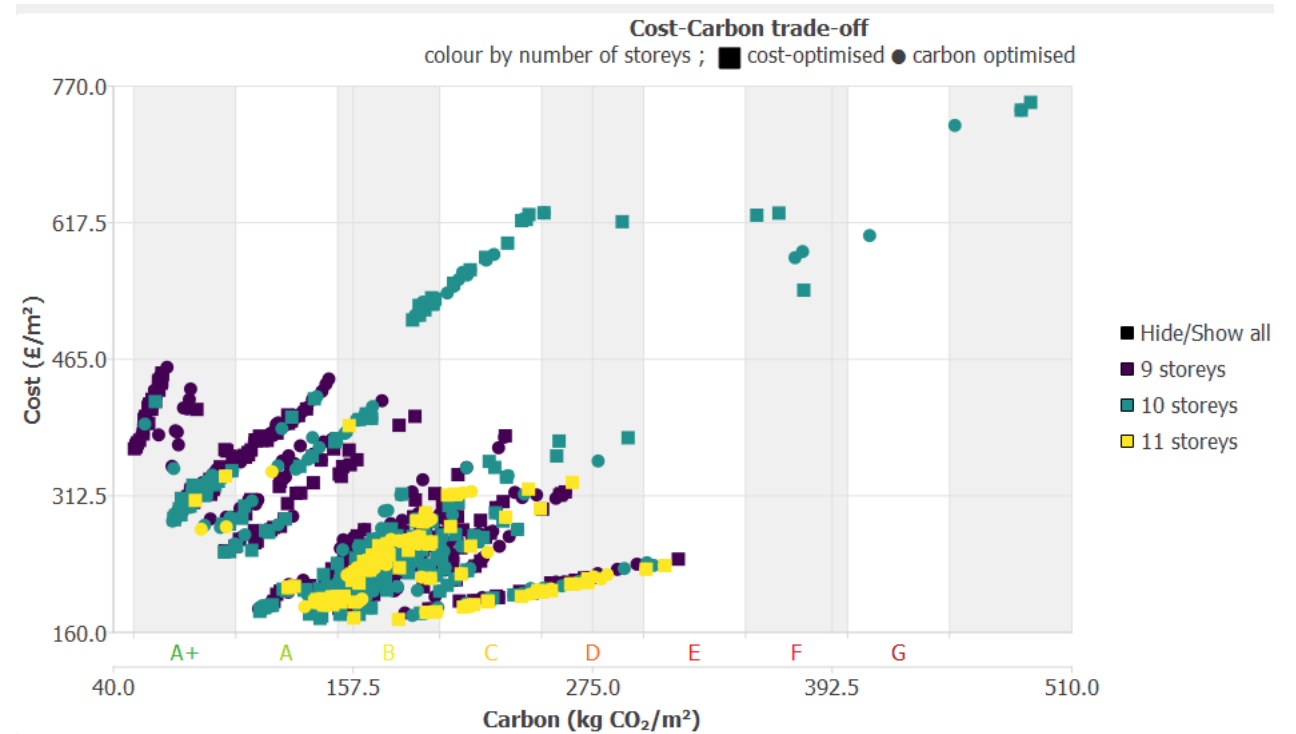
This section will show you how to:

- 4.1 Run vertical optimisation
- 4.2 Design foundation and foundation floor
- 4.3 Design a lateral stability system
- 4.4 Configure materials
- 4.5 Configure Cost Model
- 4.6 Configure LCA inputs
- 4.7 Set target utilisation ratio
- 4.8 Rationalising results



# 4.1 Run vertical optimisation

- On many projects the total building height is strictly limited
- This might lead to little space for structural zones
- Often, larger structural zone means higher efficiency
- But wouldn't a building with more storeys for the same height be more efficient?
- PANDA can give you answers

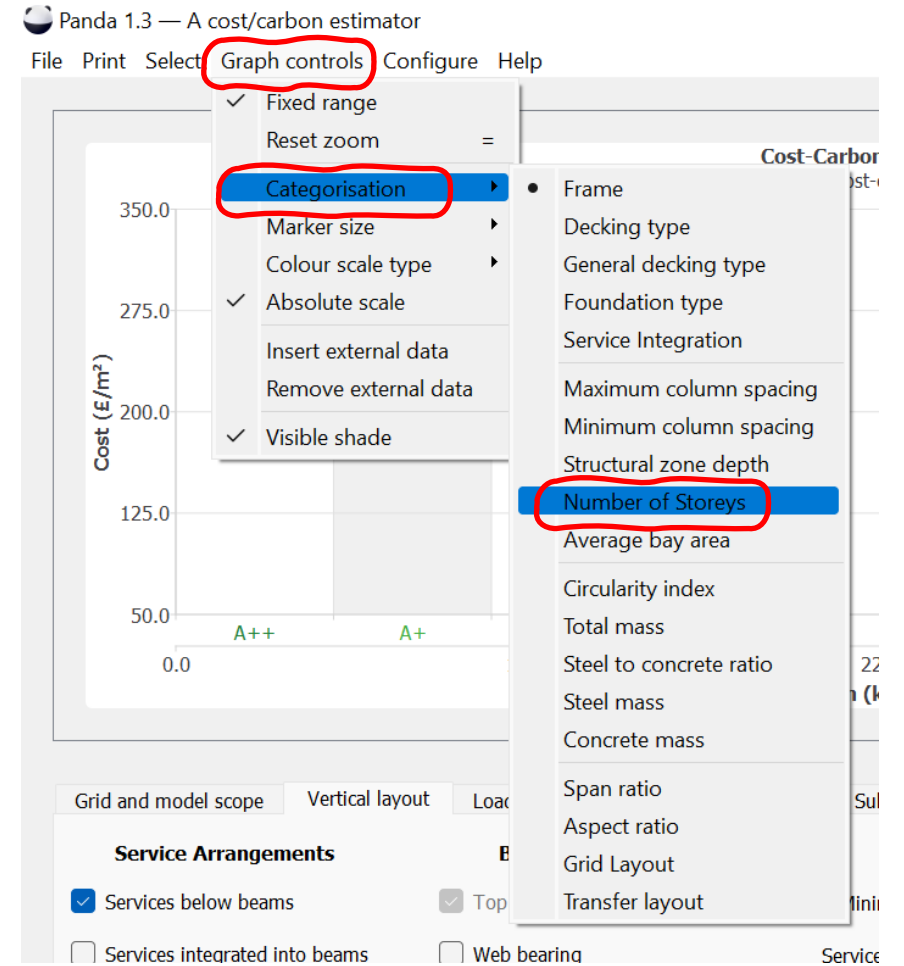






# 4.1 Run vertical optimisation

- In the “Grid and model scope” tab enable “Output alternate storey number”
- If you want to maximise the number of stories tick the additional box ‘only maximise story number’
- In “Layout Design” create a building with multiple storeys
- Click “compute” to re-run PANDA with vertical optimisation
- To view the vertical optimisation results select “Graph controls” then “Categorisation” and select “Number of Storeys”



Grid and model scope Vertical layout Loading input Serviceability Limits Substructure Superstructure Cores and transfers Wind and Stability Fire Design

Layout design

Column spacing EW 5.00 m 12.00 m

Column spacing NS 5.00 m 12.00 m

Design foundation and foundation floor

Output alternate storey arrangements

Only maximise storey number

Design lateral stability system

Project cost model QS model default

LCA cycle Cradle to completion (A1-5)

Target UR 1.00

Carbon-optimised solutions  Cost-optimised solutions

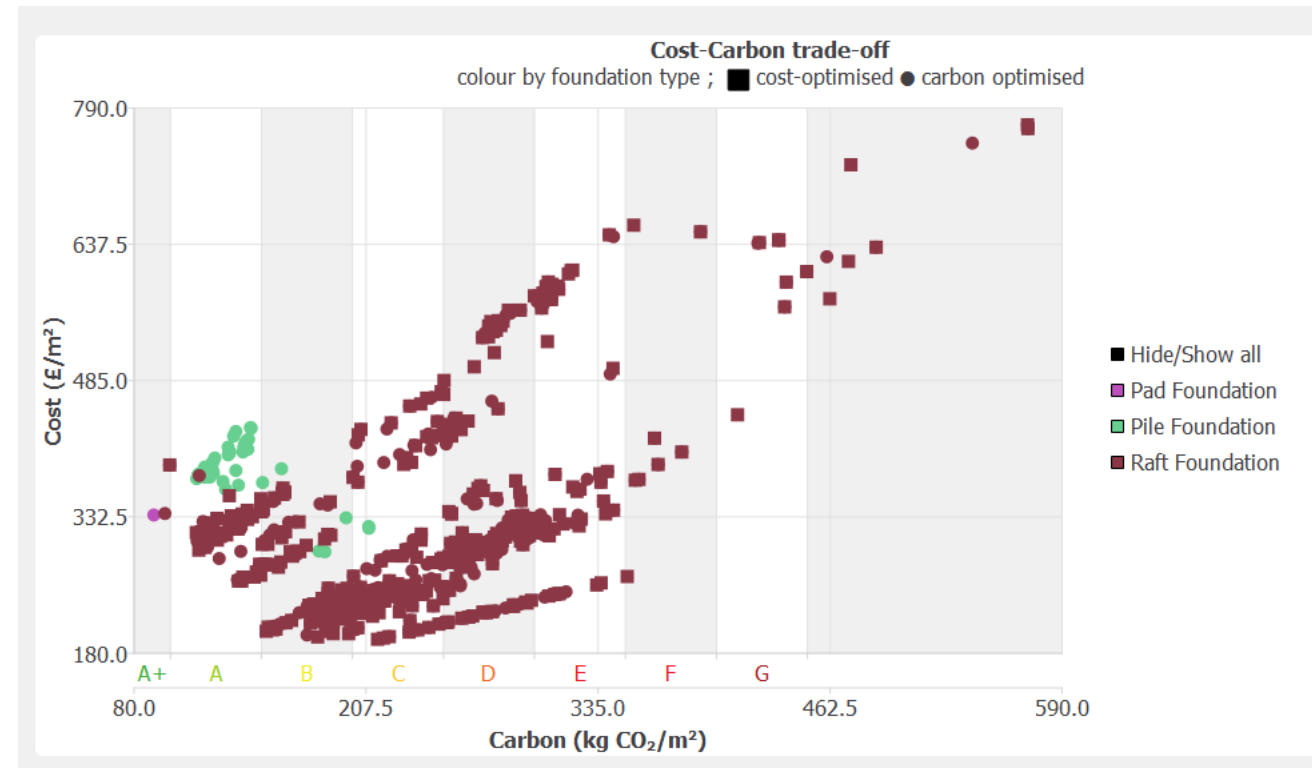
Keep all options Keep best per slab type Keep best per grid

Clear Chart Clear saved 0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 100% Stop



## 4.2 Design foundation and foundation floor

- PANDA designs foundations to EC
- It can use the results of a detailed geotech survey
- More commonly, use pile capacity table
- You'll find that using the reduced factor method combined with doing a survey will increase the number of piled options





## 4.2 Design foundation and foundation floor

- In the “Grid and model scope” tick to enable “Design foundation and foundation floor”
  - By default, the soil is a poor quality London clay, Retaining wall options are simple (just a wall) or piles, overlapping or not. Configuring the detailed substructure is covered in section 5.4
- Click “compute” to re-run PANDA with foundation design enabled
- To view the foundation design results select “Graph controls” then “Categorisation” and select “Foundation type”

Grid and model scope | Vertical layout | Loading input | Serviceability Limits | Substructure | Superstructure | Cores and transfers | Wind and Stability | Fire Design

Layout design

Column spacing EW 5.00 m | 12.00 m

Column spacing NS 5.00 m | 12.00 m

Keep all options |  Keep best per slab type |  Keep best per grid

Design foundation and foundation floor

Output alternate storey arrangements

Only maximise storey number

Design lateral stability system

Carbon-optimised solutions |  Cost-optimised solutions

Match grids from saved options

Project cost model QS model default

LCA cycle Cradle to completion (A1-5)

Configure materials

Target UR 1.00

Clear Chart | Clear saved | 0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 | 100% | Stop | Run analysis



## 4.3 Design a lateral stability system

- Lateral stability systems are designed according to their type: concrete and timber shear walls or steel bracing. The latter will also redesign columns to take the load
- Lateral stability can be:
  - None (assume a core does it)
  - Concrete shear walls (works on any structure)
  - Timber shear walls (for CLT frames)
  - Steel bracing (for steel frames)
- You can either force the choice, or let PANDA do it
- It may be useful to add this to have a more complete picture, but the impact is small and takes time to calculate.
- It is for the designer to know whether the core will provide stability.



## 4.3 Design a lateral stability system

To enable lateral stability in the model:

- In the “Grid and model scope” tab enable “Design lateral stability system”
- Input of specific stability requirements is covered in section 5.7
- Click “compute” to re-run PANDA with lateral stability design enabled
- Stability design detail can be viewed in the Engineering Report,
  - exporting the engineering report is described in section 8.2

Grid and model scope | Vertical layout | Loading input | Serviceability Limits | Substructure | Superstructure | Cores and transfers | Wind and Stability | Fire Design

Layout design

Column spacing EW 5.00 m | 12.00 m

Column spacing NS 5.00 m | 12.00 m

Keep all options  Keep best per slab type  Keep best per grid

Design foundation and foundation floor

Output alternate storey arrangements

Only maximise storey number

Design lateral stability system

Carbon-optimised solutions  Cost-optimised solutions

Project cost model QS model default

LCA cycle Cradle to completion (A1-5)

Configure materials

Target UR 1.00

Match grids from saved options

Clear Chart | Clear saved | 0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 | 100% | Stop | Run analysis



## 4.4, 4.5, 4.6 Configure materials, cost, LCA inputs

- Material, cost and LCA libraries are provided by PANDA, these can be edited by the user using the text input files, section 2.4
- The configure materials function enables the user to limit the choice of materials available to PANDA in each run
- The cost model has been developed with Gardiner and Theobald, and should reflect current pricing in the South of England, it is updated every 6 months.
- Configure costs allow preselection and customisation of alternative cost models
- LCA data is taken from the ICE v3 database, and applies the IstructE methodology. It uses average values as these are best to rank options
- Configure LCA allows preselection of the required LCA cycle and customisation of individual values





# 4.4 Configure materials

To configure materials:

- In the “Grid and model scope” tab click “Configure materials”
- Use the drop down menu’s to configure the material settings to meet your project requirements
- Select “Allow fabricated sections” option to increase the number of beam sized analysed

Select concrete and steel grades

**Steel configuration**

Column S355  Assume beams are laterally restrained  
Beam S355  Allow fabricated sections  
Beam selection Common UB/UC (and timber)  
Maximum beam length 12.00 m

**Concrete configuration**

Slab C32/40 Internal cover 25 mm  
Column C32/40 External cover 50 mm  
Pads C32/40 Max rebar length 12.00 m  
Screeds C20/25 Screed mesh A 142  
Piles C30/37 Screed lap allowance 10.0 %  
Pile caps C35/45 Concrete finishes Ordinary

**Timber grades**

Column glulam GL24h  
Beam glulam GL24h  
Column softwood C24  
Beam softwood C24

OK Cancel

Grid and model scope Vertical layout Loading input Serviceability Limits Substructure Superstructure Cores and transfers Wind and Stability Fire Design

Layout design

Column spacing EW 5.00 m 12.00 m  
Column spacing NS 5.00 m 12.00 m

Keep all options  Keep best per slab type  Keep best per grid

Design foundation and foundation floor  
 Output alternate storey arrangements  
 Only maximise storey number  
 Design lateral stability system  
 Carbon-optimised solutions  Cost-optimised solutions  Match grids from saved options

Project cost model QS model default  
LCA cycle Cradle to completion (A1-5)  
**Configure materials**  
Target UR 1.00

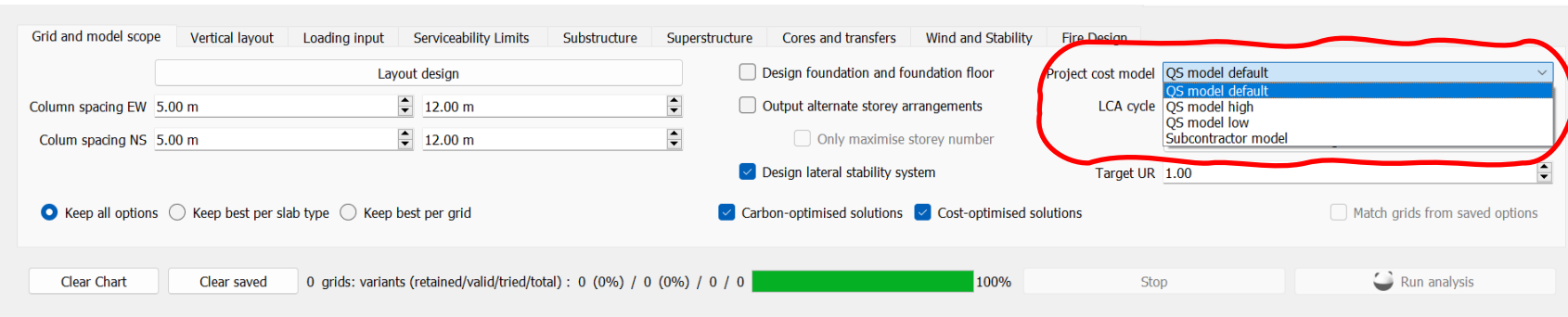
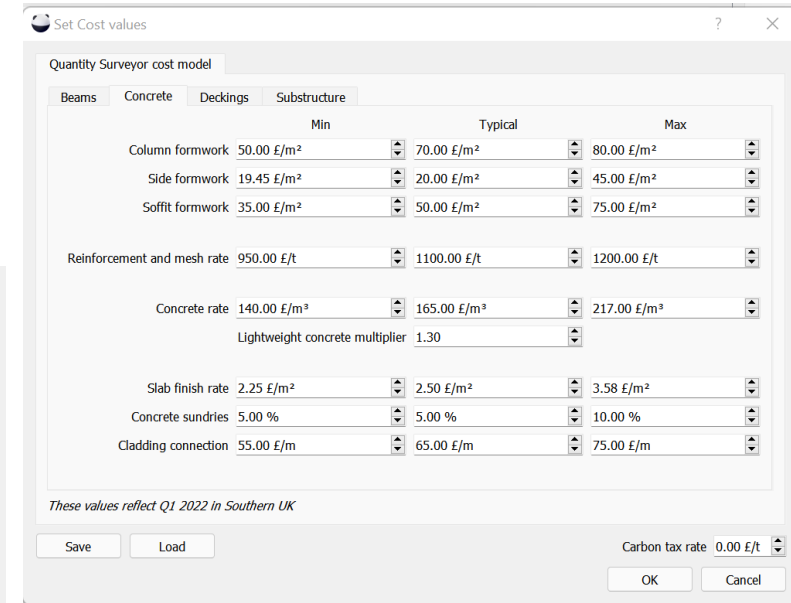
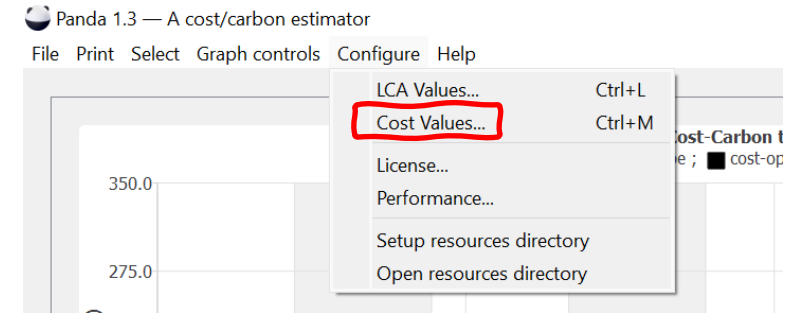
Clear Chart Clear saved 0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 100% Stop Run analysis



# 4.5 Configure cost model

To set the QS Model:

- In the “Grid and model scope” tab select from the default “project cost model” options using the drop down menu
- Alternatively input your own values using the “configure” and “Cost Values” main menu options
- Navigate through the “Set cost value” tabs to input your own SQ information for “Beams”, “Concrete”, “Deckings” and “Substructures”
- Click ‘load’ to select from alternative input files in the resource directory



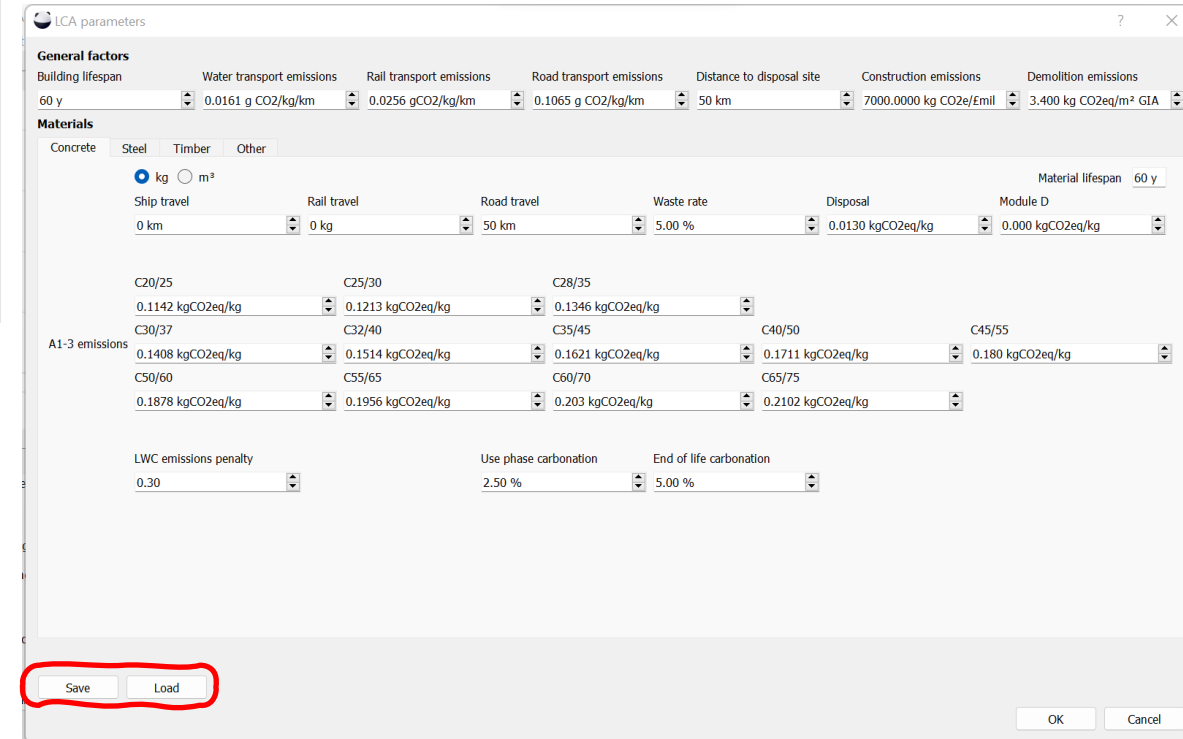
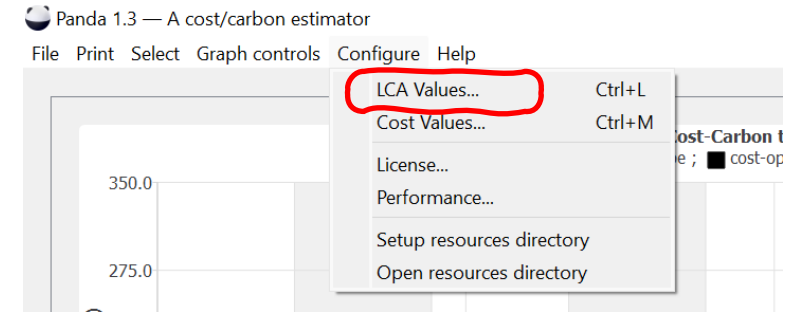
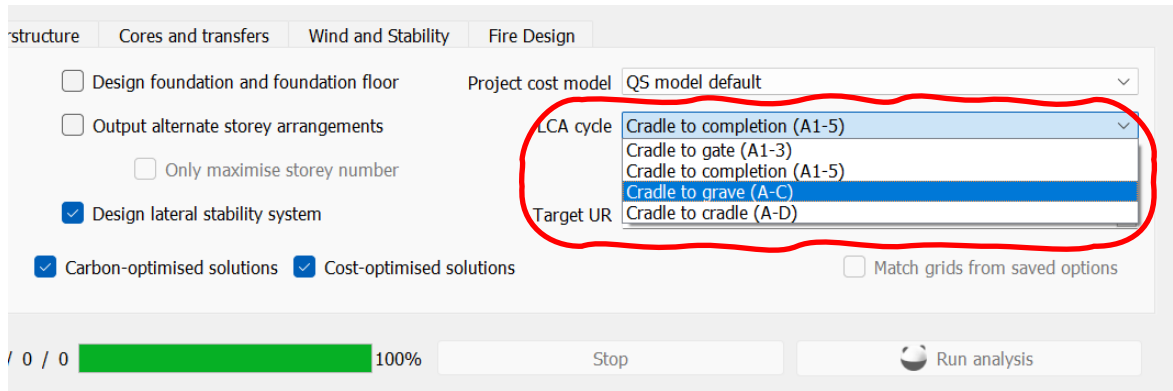




# 4.6 Configure LCA inputs

To set the LCA Model:

- In the “Grid and model scope” tab select from the default “LCA cycle” models using the drop down menu
- Alternatively input your own values using the “configure” and “LCA Values” main menu options
- Navigate through the “material” tabs to input your own LCA information for “Concrete”, “Steel”, “Timber” and “Other” materials. Click ‘save’ and ‘ok’.
- Click ‘load’ to select from alternative input files in the resource directory





## 4.7 Set target utilisation ratio

- By default, PANDA will return solutions with a target utilisation ratio (UR) of 1.00
- The UR can be changed in the 'grid and model scop' interface to limit solutions to lower utilisation ratios as per the safety requirements of your design criteria.

The screenshot shows the 'Grid and model scope' tab in the PANDA software interface. The 'Target UR' field is highlighted with a red circle and set to 1.00. The interface includes various settings for layout design, project cost model, LCA cycle, and optimization options.

Grid and model scope | Vertical layout | Loading input | Serviceability Limits | Substructure | Superstructure | Cores and transfers | Wind and Stability | Fire Design

Layout design

Column spacing EW 5.00 m | 12.00 m

Column spacing NS 5.00 m | 12.00 m

Keep all options  Keep best per slab type  Keep best per grid

Design foundation and foundation floor  Output alternate storey arrangements  Only maximise storey number  Design lateral stability system

Carbon-optimised solutions  Cost-optimised solutions  Match grids from saved options

Project cost model QS model default

LCA cycle Cradle to completion (A1-5)

Configure materials

Target UR 1.00

0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 100%

Clear Chart Clear saved Stop Run analysis



## 4.8 Rationalising results

- By default, PANDA will return two solutions for every iteration of design one optimised for cost, and the other optimised for carbon. PANDA will display all of these options generated.
- In order to reduce the number of options available to only those you are interested it may be useful to rationalise the results returned to the best solution for each slab type or each grid type. This can be done by ticking 'keep best per slab type' or 'keep best per grid'
- If you are only interested in optimising for cost or carbon, you can un-tick the box for either 'carbon-optimised solutions' or 'cost optimised solutions'

Grid and model scope | Vertical layout | Loading input | Serviceability Limits | Substructure | Superstructure | Cores and transfers | Wind and Stability | Fire Design

Layout design

Column spacing EW 5.00 m | 12.00 m

Column spacing NS 5.00 m | 12.00 m

Keep all options  Keep best per slab type  Keep best per grid

Carbon-optimised solutions  Cost-optimised solutions

Design foundation and foundation floor

Output alternate storey arrangements

Only maximise storey number

Design lateral stability system

Project cost model QS model default

LCA cycle Cradle to completion (A1-5)

Configure materials

Target UR 1.00

Match grids from saved options

Clear Chart | Clear saved | 0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0 | 100% | Stop | Run analysis



# Contents

- 1. Introduction to PANDA
- 2. Getting started
- 3. Building Layout Inputs
- 4. Model Scope
- 5. Input Parameters
- 6. Running Parametric Analysis
- 7. Viewing Results
- 8. Exporting Results
- 9. Troubleshooting



# 5. Input Parameters



# 5. Setting Inputs & Parameters

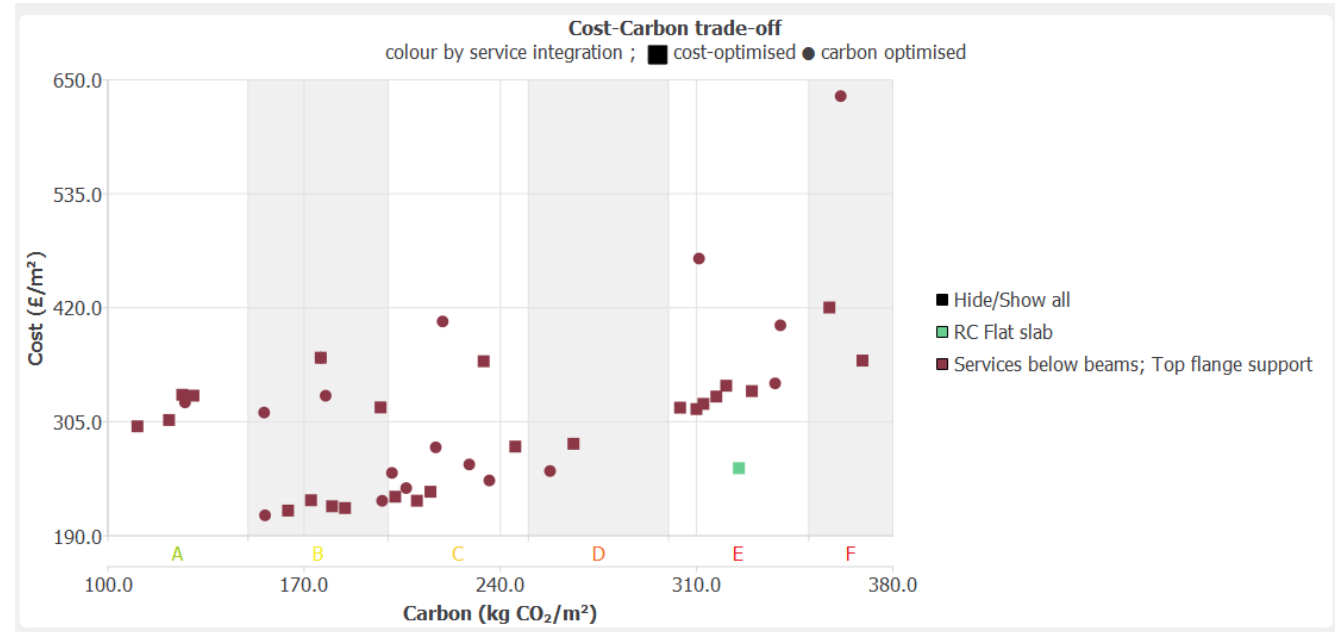
This section will show you how to:

- 5.1 Set the vertical layout
- 5.2 Set loading inputs
- 5.3 Set serviceability limits
- 5.4 Configure the substructure
- 5.5 Configure the superstructure
- 5.6 Add cores and transfers
- 5.7 Set wind & stability parameters
- 5.8 Set fire design parameters



# 5.1 Set the vertical layout

- PANDA can calculate service arrangement options below and/or integrated into the beams
- Bearing conditions can be set as top flange bearing and web bearing and/or bottom flange bearing
- The minimum service zone, service penetration zone, architectural floor finishes depth and clear head height can be set for all floors, or with separate values for the top floor, ground floor and basement.





# 5.1 Set the vertical layout

- Input a building geometry
- Select the “Vertical Layout” tab
- Tick the options for “Services below beams” and “Services integrated into beams” to include all service arrangement options in the analysis
- Tick the options for “Web bearing” and “bottom flange bearing” to include all bearing conditions in the analysis
- The default setting applies the same service values for each floor. Tick the “separate top floor” option and input a different set of values. This can also be done for a ‘separate ground floor’ and ‘separate basement’
- Re-run PANDA and colour the graph by “service integration” options to view the options

The screenshot shows the 'Vertical layout' tab in the PANDA software. The 'Service Arrangements' section has two checked options: 'Services below beams' and 'Services integrated into beams'. The 'Bearing Conditions' section has three checked options: 'Top flange bearing', 'Web bearing', and 'Bottom flange bearing'. The 'Separate top floor' checkbox is also checked. The 'Upper storeys' section has three input fields for 'Minimum service zone', 'Service penetration zone', and 'Architectural floor finishes', all set to 0 mm. The 'Clear head height' is set to 0.00 m. The 'Separate ground floor' and 'separate Basements' checkboxes are unchecked. The progress bar shows 100% completion. The 'Run analysis' button is visible at the bottom right.





## 5.2 Set loading inputs

- PANDA will calculate loading inputs for different building types
- Façade loading can be accounted for
- The superimposed dead load and imposed load can be set with separate values for the basement floor, ground floor, top floor and roof

Grid and model scope   Vertical layout   **Loading input**   Serviceability Limits   Substructure   Superstructure   Cores and transfers   Wind and Stability   Fire Design

Construction type	Foundation Floor	Basement Floors	Ground Floor	Upper Floors	Roof
B - Offices	Superimposed dead load, Gk	2.50 kN/m <sup>2</sup>	2.50 kN/m <sup>2</sup>	2.50 kN/m <sup>2</sup>	2.50 kN/m <sup>2</sup>
Façade loading input	Imposed load, Qk	2.50 kN/m <sup>2</sup>	2.50 kN/m <sup>2</sup>	2.50 kN/m <sup>2</sup>	0.75 kN/m <sup>2</sup>

Clear Chart   Clear saved   0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0   100%   Stop   Run analysis



## 5.2 Set loading inputs

- Input a building geometry and select the “Loading input” tab
- In the drop down menu change the “construction type” to select the building purpose
- Click on “Façade loading input” to add loading to represent a façade.
  - Set the façade load by area
  - Set the parapet load by area
  - Select which floors the façade should be applied to
- Set the superimposed dead load and the imposed load values for each floor
- Click “compute to re-run PANDA with the loading inputs set

**Construction type**

A - Domestic  
A - Domestic  
B - Offices  
C - Congregation  
D - Shopping  
E - Storage

Grid and model scope Vertical layout Loading input

**Construction type**

A - Domestic Super

Façade loading input

Configure façade loads

Façade load (by area) 2.50 kN/m<sup>2</sup> 0 kN for no façade

Parapet load (line load) 0.75 kN/m 0 kN for no parapet

Start façade load from foundations

Façade load only on foundation

Façade on every 1 Storeys, starting from 1

Keep all options  Keep best option

OK Cancel



## 5.3 Set serviceability limits

- Timber design has different recommended serviceability limit values from steel
- Look at the decking selection to check it matches your vibration target
- Concrete is designed following a d/s approach so does not have specific serviceability inputs in this tab.

Frequently serviceability limit values are set too high

- Input a building geometry and select the “Serviceability limits” tab
- Change the values and generate a new solution sets to get a feel of the impact of different serviceability limits on cost and carbon
- Different serviceability limits can be compared by overlaying saved graphs as per section 7.4

Grid and model scope	Vertical layout	Loading input	Serviceability Limits	Substructure	Superstructure	Wind and Stability	Fire Design
<b>Steel frame design</b>				<b>Timber frame design</b>			
	Primaries		Secondaries		Primaries		Secondaries
Total load deflection	1/ 250		1/ 250	Instantaneous imposed load deflection	1/ 300		1/ 300
Dead load deflection	1/ 200		1/ 200	Final imposed load deflection	1/ 200		1/ 200
Imposed load deflection	1/ 360		1/ 360	Final total load deflection	1/ 250		1/ 250
Natural frequency	4.0 Hz		4.0 Hz	Natural frequency	8.0 Hz		8.0 Hz



## 5.4 Configure the substructure

- PANDA is the only software available which automates the design for the substructure
- PANDA designs the:
  - Foundation floor
  - Soil and foundations
  - Retaining walls
  - Basement matching superstructure, or always concrete options

The screenshot shows the PANDA software interface with the 'Substructure' tab selected and highlighted with a red circle. The interface includes a navigation bar with tabs: 'Grid and model scope', 'Vertical layout', 'Loading input', 'Serviceability Limits', 'Substructure', 'Superstructure', 'Cores and transfers', 'Wind and Stability', and 'Fire Design'. Below the navigation bar, there are three buttons: 'Configure Foundation Floor', 'Configure Soil and Foundations', and 'Configure Retaining walls'. To the right, under the heading 'Basement Options', there are two checkboxes: 'Try basement floors matching superstructure' (unchecked) and 'Always try reinforced concrete basements' (checked). At the bottom of the interface, there is a progress bar showing '0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0' and a green progress bar at 100%. There are also buttons for 'Clear Chart', 'Clear saved', 'Stop', and 'Run analysis'.



## 5.4 Configure the substructure

- Input a building geometry and select the “Substructure” tab
- The buttons launch dialogues where you select the allowable options for
  - Configure Foundation floor
  - Configure Soil and foundations
  - Configure Retaining walls
- Change the basement options to include both “basement floors matching superstructure” and “reinforced concrete basements” to include all options in the analysis
- Click “compute to re-run PANDA with different substructure inputs set

The screenshot shows the 'Substructure' tab selected in a software interface. It contains three buttons: 'Configure Foundation Floor', 'Configure Soil and Foundations', and 'Configure Retaining walls'. To the right, there are two checkboxes: 'Try basement floors matching superstructure' (unchecked) and 'Always try reinforced concrete basements' (checked). At the bottom, there is a status bar showing '0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0' and a green progress bar at 100%.

The 'Configure Retaining Walls' dialog box is shown. It has two main sections: 'Design diaphragm retaining walls' (with a 'propped' checkbox checked) and 'Material input override'. Under 'Material input override', there are fields for 'Wall thickness' (200 mm), 'Wall reinforcement rate' (100 kg steel/m<sup>3</sup> concrete), and 'Simple wall' options. The 'Simple wall' section includes radio buttons for 'Contiguous piles' and 'Secant piles', and fields for 'Pile diameter' (450 mm), 'Capping beam depth' (750 mm), and 'Capping beam reinforcement rate' (100 kg steel/m<sup>3</sup> concrete). 'OK' and 'Cancel' buttons are at the bottom.

The 'Foundation Floor Options' dialog box is shown. It has two main sections. The first section includes checkboxes for 'Suspended 2-way slab' (checked), 'Suspended 1-way slab', 'Precast decking', and 'Infill blocks'. The second section is for 'Ground Bearing Slab', with a 'Depth' field set to 150 mm and a 'Slab Reinforcement Rate' field set to 5.00 kg/m<sup>2</sup>. 'OK' and 'Cancel' buttons are at the bottom.



# 5.4 Configure the substructure

- Click on 'Configure Soil and foundations' to open the geotechnical design tab
- Select preferred 'foundation options', 'pile load tests' and 'pile types'
- Add stratum layers to build up a soil model
- Soil models can be input manually or using a capacity table by ticking 'use capacity table' and selecting 'input table'
- Set the 'override' value for each option
- Soil configurations can be saved and loaded by clicking 'save soil'

Input Pile Capacity Table

**Pile capacity table**

Driven piles  Bored/CFA piles

Pile length	Pile Diameter: 300 mm	Pile Diameter: 450 mm	Pile Diameter: 600 mm	Pile Diameter: 750 mm	Pile Diameter: 900 mm
5.00 m	50 kN	100 kN	150 kN	200 kN	250 kN
10.00 m	100 kN	200 kN	300 kN	400 kN	500 kN
15.00 m	150 kN	300 kN	450 kN	600 kN	750 kN
20.00 m	200 kN	400 kN	600 kN	800 kN	1000 kN
25.00 m	250 kN	500 kN	750 kN	1000 kN	1250 kN
30.00 m	300 kN	600 kN	900 kN	1200 kN	1500 kN

Add a row      Delete last row

OK      Cancel

Geotechnical Design

**Foundation Options**

Pads  Strips  Piles  Raft

**Pile load tests**

Load tests to unfactored ultimate resistance (reduced model factor)  
 Load tests on >1% constructed piles to min 1.5x representative design loads (reduced pile safety factors)

**Pile types**

Driven piles  Bored/CFA piles

Depth of made ground/fill: 0.40 m  
Density value: 0.00 kN/m<sup>3</sup>  
Same density as top stratum  
Depth of groundwater table: 2.00 m

**Soil model**

**Stratum 0**      Thickness: 100.00 m      Up      Down      Delete stratum

Custom soil      Density: 19.00 kN/m<sup>3</sup>

Granular (friction angle or SPT)       Cohesive (undrained shear strength)       Rock (Allowable bearing pressure)

42.0 °      Friction Angle      75 kN/m<sup>2</sup> at top of stratum      0 kN/m<sup>2</sup>

0      SPT Value (# blows)      75 kN/m<sup>2</sup> averaged over stratum      0 kN/m<sup>2</sup>

0 kN/m<sup>2</sup> gradient over depth      0 kN/m<sup>2</sup> Cut-off

**Overrides - Safe Working Loads SLS**

**Pads**      **Strips**      **Raft**      **Piles**

Allowable bearing pressure      Allowable bearing pressure      Allowable bearing pressure      use capacity table

No override      No override      No override     

Soil name: no name

     OK      Cancel


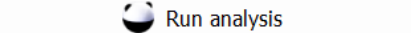


## 5.5 Configure the superstructure

- PANDA will default to look at all possible super structure options
- If required, superstructure options can be narrowed down by unticking superstructure options in this interface
- In some circumstances certain materials may need to be excluded from the analysis , for example is supply constrains mean it is not possible to access the material. These options can excluded from PANDA's analysis using the configure options in the super structure tab

Grid and model scope | Vertical layout | Loading input | Serviceability Limits | Substructure | **Superstructure** | Cores and transfers | Wind and Stability | Fire Design

Reinforced concrete frame design	Steel frame design	Timber frame design
<input checked="" type="checkbox"/> In-situ flat slab <input type="checkbox"/> In-situ waffle slab (experimental)	<input checked="" type="checkbox"/> Composite <input checked="" type="checkbox"/> Prefabricated <input type="checkbox"/> From span table	<input checked="" type="checkbox"/> Glulam <input checked="" type="checkbox"/> Softwood <input type="checkbox"/> Bespoke glulam sections
<input type="text" value="Configure in-situ slabs"/> <input type="text" value="Configure waffle slabs"/> <input type="text" value="Configure Columns"/>	<input type="text" value="Configure composite decks"/> <input type="text" value="Configure prefabricated decks"/> <input type="text" value="Configure slab types"/>	

Clear Chart | Clear saved | 0 grids: variants (retained/valid/tried/total) : 0 (0%) / 0 (0%) / 0 / 0  100% | Stop | 



# 5.5 Configure the superstructure

**Reinforced concrete frame design**

In-situ flat slab   Composite

In-situ waffle slab (experimental)   Prefabricated

From span table

Concrete design

**Slab configuration** min 150 mm max 400 mm increment 25 mm

**Available bar sizes**  ø6  ø8  ø10  ø12  ø16  ø25  ø20  ø32  ø40

Allow two size difference between adjacent rebars

Brittle finishes

**Base mat spacing** min 100 mm max 250 mm increment 25 mm

**Base mat bar sizes**  ø8  ø10  ø12  ø16  ø20  ø25  ø32

**Column strip length share** 0.25

**Hogging/Sagging share** Columns 0.375 m/m 0.275 m/m Middle 0.250 m/m 0.450 m/m

OK Cancel





# 5.5 Configure the superstructure

**Reinforced concrete frame design**

In-situ flat slab   Composite

In-situ waffle slab (experimental)   Prefabricated

From span table

**Concrete design**

**Slab configuration** min 75 mm max 150 mm increment 25 mm

**Base mat bar sizes**  ø8  ø10  ø12  ø16  ø20  ø25  ø32

Allow two size difference between adjacent rebars

**Rib depth** min 100 mm max 400 mm increment 50 mm

**Rib width** min 125 mm max 200 mm increment 25 mm

**Rib spacing** min 400 mm max 1500 mm

**Rib bar sizes**  ø6  ø8  ø10  ø12  ø16  ø25  ø20  ø32  ø40

**Column strip length share** 0.25

**Hogging/Sagging share** Columns 0.375 m/m 0.275 m/m Middle 0.250 m/m 0.450 m/m

OK Cancel



# 5.5 Configure the superstructure

**Steel frame design**

Glulam

Softwood

Bespoke glulam sections

**Timber frame design**

Configure Composite Deckings

**Steel Decking (Re-Entrant)**

- Kingspan Multideck 50-V3 LWC (Double Span ; Mesh & Deck ; Unpropped)
- Tata Comflor 51+ (Single Span ; Mesh & Deck ; Propped)
- Tata Comflor 51+ (Single Span ; Fire Bar ; Propped)
- Tata Comflor 51+ (Double Span ; Mesh & Deck ; Unpropped)
- Tata Comflor 51+ (Double Span ; Fire Bar ; Unpropped)
- SMD R51+ (Double Span ; Mesh & Deck ; Unpropped)
- CMF MetFloor 55 (Double Span ; Mesh & Deck ; Unpropped)
- CMF MetFloor 55 (Double Span ; Mesh & Deck ; Propped)

**Steel Decking (Trapezoidal)**

- Tata Comflor 60 (Double Span ; Mesh & Deck ; Unpropped)
- Tata Comflor 60 (Double Span ; Mesh & Deck ; Propped)
- Tata Comflor 60 (Double Span ; Fire Bar ; Unpropped)
- Tata Comflor 60 (Double Span ; Fire Bar ; Propped)
- SMD TR60+ (Double Span ; Mesh & Deck ; Unpropped)
- CMF MetFloor 60 (Double Span ; Mesh & Deck ; Unpropped)
- CMF MetFloor 60 (Double Span ; Mesh & Deck ; Propped)
- Kingspan Multideck 60 LWC (Double Span ; Mesh & Deck ; Unpropped)
- Tata Comflor 80 (Single Span ; Mesh & Deck ; Propped)
- Tata Comflor 80 (Single Span ; Fire Bar ; Propped)
- Tata Comflor 80 (Double Span ; Mesh & Deck ; Unpropped)
- Tata Comflor 80 (Double Span ; Fire Bar ; Unpropped)
- SMD TR80+ (Double Span ; Mesh & Deck ; Unpropped)
- CMF MetFloor 80 (Double Span ; Mesh & Deck ; Unpropped)
- CMF MetFloor 80 (Double Span ; Mesh & Deck ; Propped)
- Kingspan Multideck 80 LWC (Double Span ; Mesh & Deck ; Unpropped)
- Tata Comflor 225 (Single Span ; Fire Bar ; Unpropped)
- Tata Comflor 225 (Single Span ; Fire Bar ; Propped)
- SMD TR220 (Single Span ; Fire Bar ; Propped)

Select/deselect all

Minimum slab thickness 80 mm

**Total deflection limits**



# 5.5 Configure the superstructure

**Steel frame design**

**Timber frame design**

Glulam

Softwood

Bespoke glulam sections

Configure Prefabricated Deckings

**Softwood Joists**

- Softwood Joists (75mm C24@ 400mm c/c; 6.5Hz)
- Softwood Joists (75mm C16@ 400mm c/c; 6.5Hz)
- Softwood Joists (63mm C24@ 400mm c/c; 6.5Hz)
- Softwood Joists (63mm C16@ 400mm c/c; 6.5Hz)
- Softwood Joists (47mm C24@ 400mm c/c; 6.5Hz)
- Softwood Joists (47mm C16@ 400mm c/c; 6.5Hz)
- Softwood Joists (38mm C24@ 400mm c/c; 6.5Hz)
- Softwood Joists (38mm C16@ 400mm c/c; 6.5Hz)
- Softwood Joists (100mm C24@ 400mm c/c; 6.5Hz)
- Softwood Joists (100mm C16@ 400mm c/c; 6.5Hz)

**Precast Decking (Solid Plank ; Screed)**

- McCann Solid Composite (Unpropped)
- McCann Solid Composite (Propped)
- Flood Superwide Composite (Propped)

**Precast Decking (Hollowcore ; no Screed)**

- Millbank HollowCore
- McCann HollowCore
- Longley HollowCore
- Bison HollowCore

**Precast Decking (Hollowcore ; Screed)**

- Millbank HollowCore Composite (Unpropped)
- Millbank HollowCore Composite (Propped)
- Flood Supervoid Composite (Propped)

**CLT Decking (1 Way Flat Slab)**

- Stora Enzo (Single Span ; 8Hz ; 50mm Screed)
- Stora Enzo (Single Span ; 0Hz ; No Screed)
- KLH CLT (Single Span ; 6Hz ; No Screed)
- KLH (Single Span ; 8Hz ; 60mm Screed)
- KLH (Single Span ; 8Hz ; 25mm Screed)

Select/deselect all

Minimum precast plank depth 0 mm



# 5.5 Configure the superstructure

**Reinforced concrete frame design**

In-situ flat slab   Composite

In-situ waffle slab (experimental)   Prefabricated

**Configure Columns**  From span table

**Concrete design**

Min column size

Max column size

Column size increment

**Steel frame design** **Timber frame design**

Glulam

Softwood

**Configure slab types**  Bespoke glulam sections

**Dialog**

**Precast**

Concrete Shell



# 5.5 Configure the superstructure

To compare results with different superstructure configurations

- Input a building geometry and select the “Superstructure” tab
- Open each of the “configure...” options and remove materials which are not required
- Run PANDA and save the solution set as per section 7.4
- Use the “configure...” options to reduce the number of options further
- Click “compute” to re-run PANDA with the new superstructure inputs set
- The new results will appear on the graph as an overlay to allow the impact of reducing the number of superstructure options to be clearly seen against the original points (in grey)

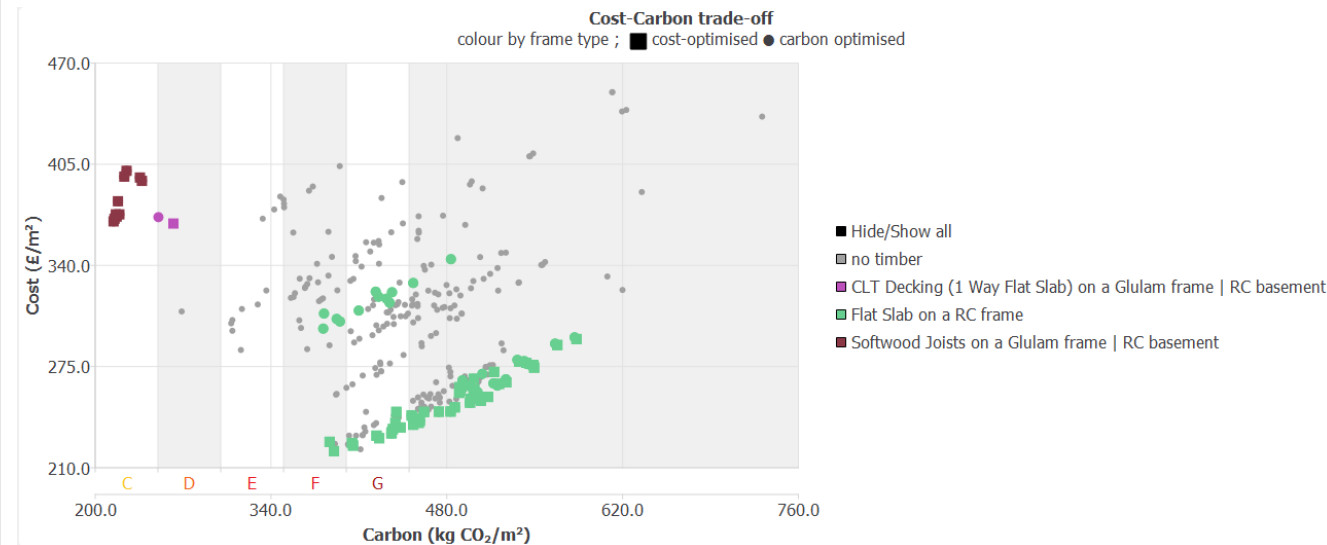
Building summary | Building Layout | Building breakdown | Filters | Solution sets

Save all buildings on chart

Save set as: no timber

Activate: no timber

Delete





# 5.6 Cores & transfers

A core's dimensions can be added so that the cost and carbon for the core are included in the analysis, but the core is not designed within PANDA.

Information for transfers can also be added, though this feature is still in development in v3.1

Inserting a core to the superstructure:

- Input a building geometry and select the “Cores and transfers” tab
- Click “add core”
- Input the core geometry
- Click “compute” to re-run PANDA with the addition of the core

Transfer layout	Steel	Concrete
2:1 offset	100.00 kg steel /m <sup>2</sup>	0.50 m <sup>3</sup> concrete/m <sup>2</sup>
2:1 aligned	100.00 kg steel /m <sup>2</sup>	0.30 m <sup>3</sup> concrete/m <sup>2</sup>
1:1 offset	100.00 kg steel /m <sup>2</sup>	0.20 m <sup>3</sup> concrete/m <sup>2</sup>
1:2 aligned	0.00 kg steel /m <sup>2</sup>	0.20 m <sup>3</sup> concrete/m <sup>2</sup>

Area of voids in core: 0.00 m<sup>2</sup>

Total length of core walls: 0.00 m

Wall reinforcement rate: 50.00 kg /m<sup>3</sup>

Core wall thickness: 200 mm

30 grids: variants (retained/valid/tried/total) : 194 (8%) / 194 (8%) / 2460 / 2460 100%



## 5.7 Set wind & stability parameters

- PANDA enables different terrains to be selected
- Values for the maximum lateral deflection, wind speed and altitude can be inputted
- Stability systems can be set to match the frame or be concrete shear walls
- To apply the wind and stability settings in computation, the 'design lateral stability system' must be ticked in the 'grid and model scope' tab.

Grid and model scope | Vertical layout | Loading input | Serviceability Limits | Substructure | Superstructure | Cores and transfers | **Wind and Stability** | Fire Design

Terrain category: III: Suburban (regular cover)

Max lat.  $\Delta$ /height: 1/300

Wind speed: 22 m/s

Altitude: 0 m

**Stability**

Same as frame

Best compatible

Concrete shear walls

Clear Chart | Clear saved | 30 grids: variants (retained/valid/tried/total) : 194 (8%) / 194 (8%) / 2460 / 2460  100%



## 5.7 Set wind & stability parameters

To include wind and stability parameters in the analysis

- Input a building geometry and tick the ‘design lateral stability system’ option
- select the ‘Wind and Stability’ tab
- Select the ‘terrain category’ from the dropdown menu
- Set the values for the ‘max lat.’, ‘wind speed’ and ‘altitude’
- Set the ‘stability’ option to “concrete shear walls”
- Click ‘compute’ to re-run PANDA and compare the results with the original analysis with the default stability setting of ‘same as frame’ or ‘best compatible’

The screenshot shows the 'Stability' settings panel in the PANDA software. The panel is titled 'Stability' and contains three radio button options: 'Same as frame' (checked), 'Best compatible', and 'Concrete shear walls'. Below the options is a 'Compute' button with a panda icon. The panel is part of a larger interface with tabs for 'Grid and model scope', 'Vertical layout', 'Loading input', and 'Serviceability Limits'. A dropdown menu for 'Terrain category' is open, showing options: 'III: Suburban (regular cover)' (selected), '0: Sea or Coast (exposed)', 'I: Lakes or Flat (no obstacles)', 'II: Plains (isolated obstacles)', and 'iV: Urban (dense cover)'.





## 5.8 Set fire design parameters

- Fire design is intrinsic to concrete design in the EC
- For steel, the appropriate layers of intumescent paint are accounted for
- For timber, layers of plasterboard are added as appropriate
- Currently a fire resistance of more than 60 min will return no timber options
- You can only select the fire resistance currently. In principle, advanced fire design can be done by PANDA but it's not currently found to be beneficial so it is not activated in the user interface.

Grid and model scope Vertical layout Loading input Serviceability Limits Substructure Superstructure Cores and transfers Wind and Stability **Fire Design**

Configuration Coating

Fire Rate Medium

**Fire resistance 60 min**

Area of vertical openings m<sup>2</sup> 5  Standard Fire Curve

Mean height of openings m 1.5

Thermal diffusivity 1000  Do fire check (slow)

Clear Chart Clear saved 30 grids: variants (retained/valid/tried/total) : 194 (8%) / 194 (8%) / 2460 / 2460 100% Stop Compute



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# 6. Running Parametric Analysis



## 6. Running Parametric Analysis

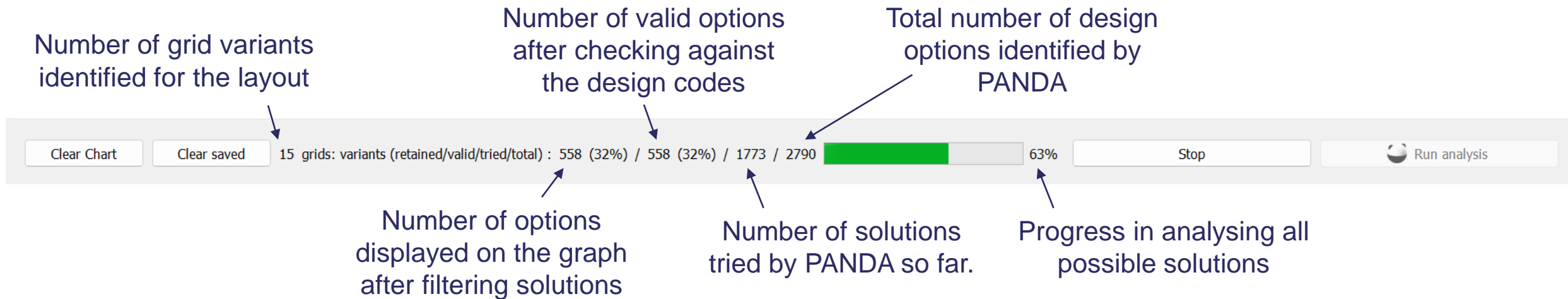
This section will show you how PANDA can:

- 6.1 Calculate all possible solutions
- 6.2 Optimise for cost and carbon
- 6.3 Save and load previous analysis



# 6.1 Calculating all possible solutions

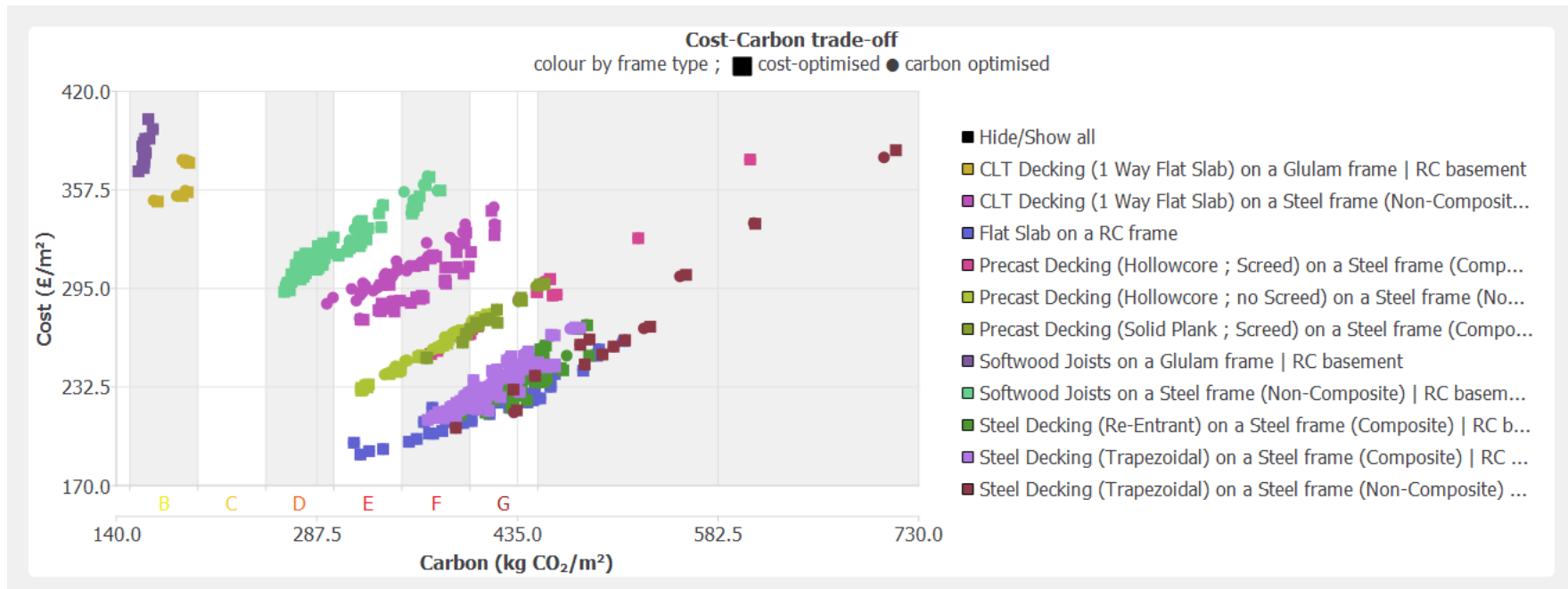
- PANDA does not read from a database and select possible solutions, it designs the building from scratch and checks compliance with Eurocodes for each design option.
- This is what makes PANDA unique and able to identify low carbon and low cost options which may have otherwise been missed.
- The number of possible grid layouts and design layouts are displayed next to the progress bar.





## 6.2 Optimising for cost and carbon

- For each possible solution, PANDA optimised the design for both cost and carbon
- Cost-optimised solutions are displayed on the graph with a square marker, carbon-optimised solutions have a circle marker
- You can chose to filter by either cost or carbon optimised solutions using the filter options in the information window





## 6.3 Save and load previous analysis

Each set up in PANDA can be saved and reloaded. To do this:

- Click 'file' then 'save building from the main menu
- Select from 'save building and soil configuration' or 'save building only'. Alternatively to save just the soil configuration select 'save coil configuration'
- Previously saved or soil configurations can be opened by selecting 'load...' from this menu
- Close PANDA and reopen the solution sets through activating the "saved solution set" option in the information tab, described in section 7.3
- PANDA does not save the results, you must recompute the analysis each time you open it.

The screenshot shows the PANDA software interface. The 'File' menu is open, with 'Save building' highlighted. The 'Save building' submenu is also open, showing options: 'Save building and soil configuration' (Ctrl+Shift+S), 'Save building only' (Ctrl+S), 'Load building configuration' (Ctrl+O), 'Save soil configuration', 'Load soil configuration', 'Export bill of materials' (Ctrl+B), 'Export chart data' (Ctrl+E), 'Open exports directory', and 'Exit' (Ctrl+Q). The main window displays a scatter plot of buildings, color-coded by frame type, with a legend on the right. Below the plot, a dialog box titled 'Save all buildings on chart' is open, showing 'Save set as' set to 'set 2' and 'Activate' set to 'set 1'. The 'Activate' dropdown is circled in red.



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# 7. Viewing results



# 7. Viewing Results

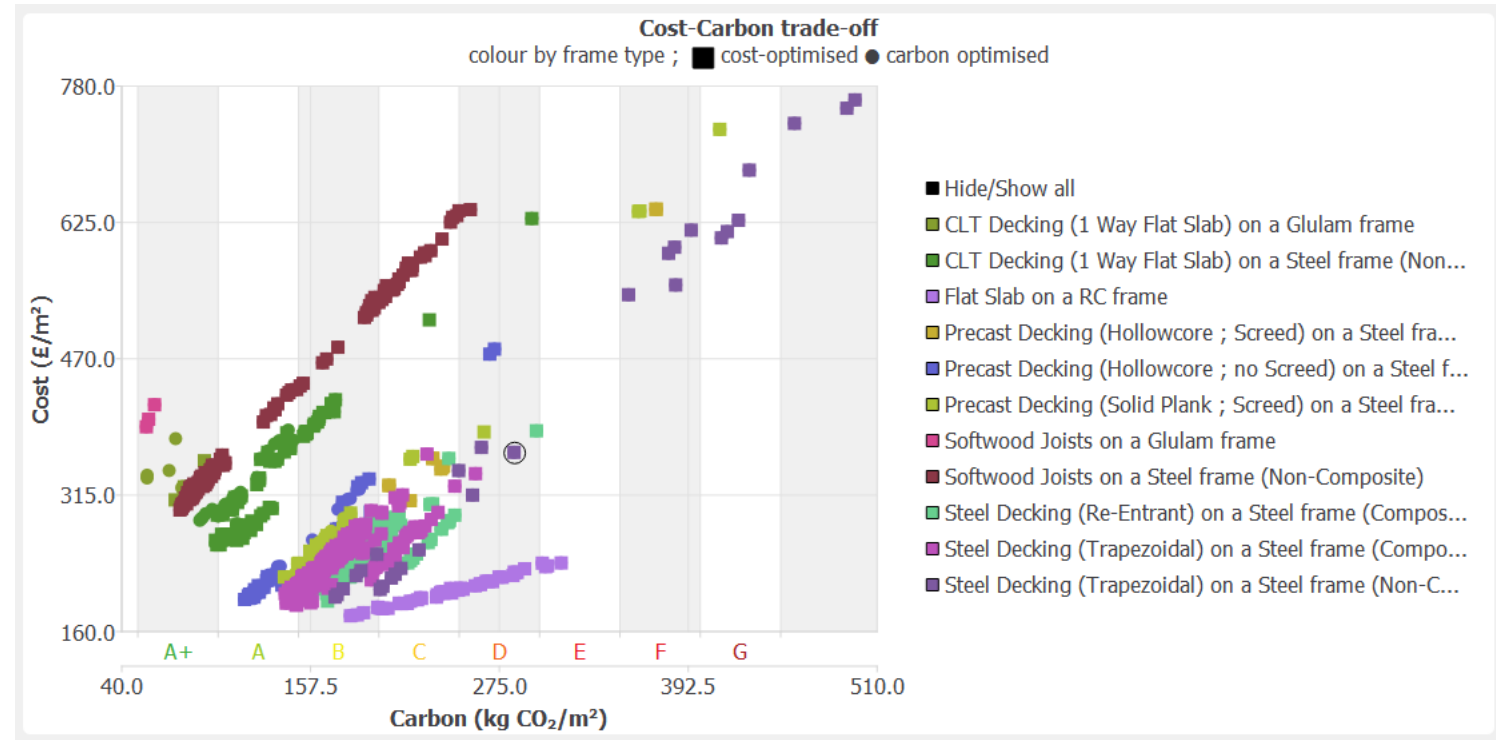
This section will show you how to view:

- 7.1 Building summary, layout & breakdown
- 7.2 Filter results
- 7.3 Save and compare solution sets
- 7.4 Select options
- 7.5 Change the graph display controls
- 7.6 External data for comparison



# 7.1 Building summary, layout & breakdown

- Results are all displayed on the cost/carbon graph and colour-coded according to the information you wish
- Selecting an individual point on the graph will provide more information for that solution





# 7.1 Building summary, layout & breakdown

Select an individual solution by clicking on the point on the graph review the information panel on the right of the screen:

- Browse through the “Building summary”, “Building layout” and “Building breakdown” tabs to view information on the selected solution
- Name and save an individual building using the ‘save as’ function in the ‘building summary’ tab, this enables you to select this option for report generation as described in section 8.
- The building layout tab shows the grid lay out for each floor
- Change floor by moving the slider left and right
- Select any bay to export the engineering report for the selected bay

Building summary | Building Layout | Building breakdown

Save as: option name

**CLT Decking (1 Way Flat Slab) on a Steel (Non-Composite) | RC basement**

Layout: 6 x 6 m  
Secondaries at mid point

**Carbon** 367 kg CO<sub>2</sub>/m<sup>2</sup>  
**Cost** 289 £/m<sup>2</sup>  
**Area** 13824 m<sup>2</sup>  
**Bay count** 24/storey  
**Roof** Stora Enzo (Single Span ; 50mm Screed) 240  
**Upper Floors** Stora Enzo (Single Span ; 50mm Screed) 240

Building summary | Building Layout | Building breakdown

level

-1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

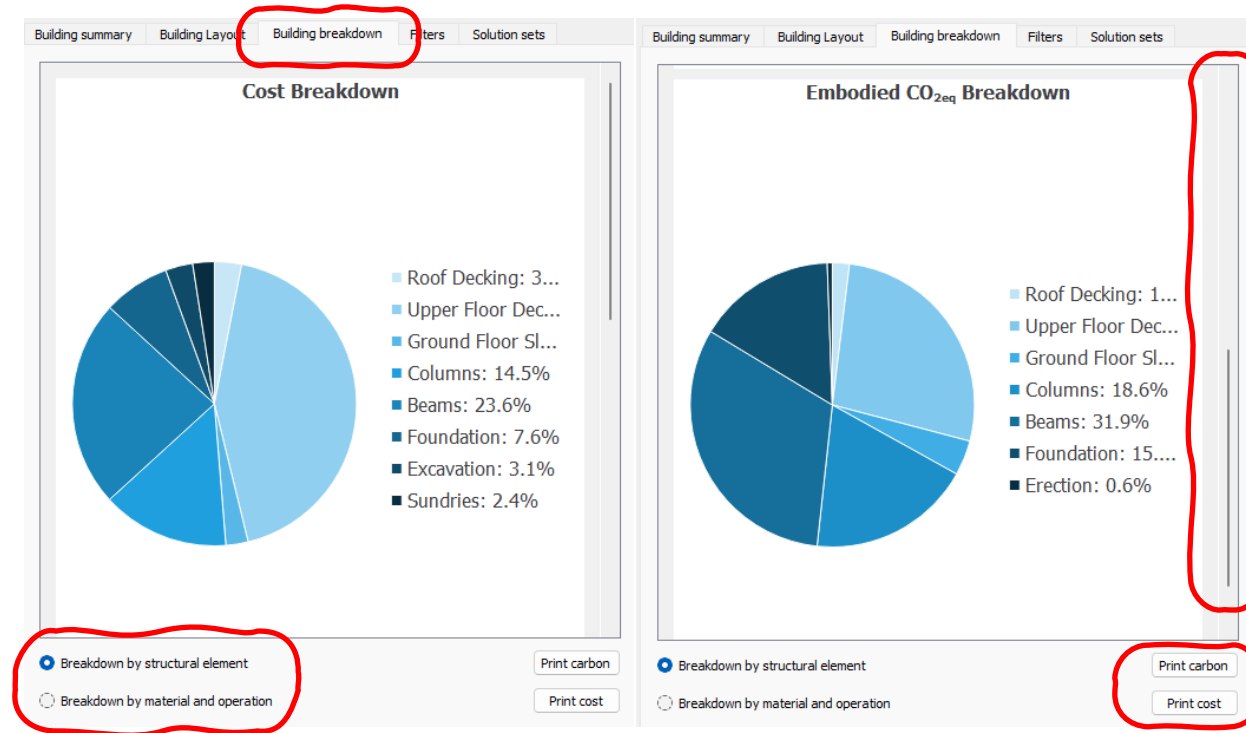
→ Export Engineering Report for selected bay



# 7.1 Building summary, layout & breakdown

To evaluate the cost and carbon breakdown for a selected solution:

- Click on the desired solution on the graph
- Select the 'building breakdown tab'
- Chose either 'breakdown by structural element' or 'breakdown by material and operation' to select the required display options.
- Use the scroll bar on the right hand side of the window to view the pie chart for the breakdown of embodied CO<sub>2</sub>





## 7.2 Filter the results

- Filtering solutions is key to narrowing down the schemes to bring forward to detailed design
- Cost and carbon are obvious high level filters, but in med-highrises storeys can be critical
- Structural height, grids, foundations are important when discussing with the team: architects, foundation and HVAC specialists may require different filter combinations
- If PANDA is open on a small screen, use the arrows to scroll across to the 'filters' and 'solution sets' tabs

Building Layout | Building breakdown | **Filters** | Solution sets

Carbon < 500 kg CO<sub>2</sub>/m<sup>2</sup>

Cost < 500 £/m<sup>2</sup>

Mass < 10000 kg/m<sup>2</sup>

Spacing > 0.00 m < 15.00 m

Aspect > 0.00 < 4.00

Struct height < 2000 mm

best carbon w/in 10.0 %  carbon optimised

best cost w/in 10.0 %  cost optimised

Grids | Deck systems | Foundations

Storeys | Deck types | Transfers

Save filter as: filter name

Delete filter | Activate filter

Apply filter | Default | Update



## 7.2 Filter the results

- Input geometry and run PANDA analysis and select 'Filters' tab in the information pane
- Edit the maximum allowable 'Carbon', 'Cost', 'Mass' and 'struct height' values
- Edit the range of allowable "spacing" and "aspect" values
- Check the 'best carbon' and 'best cost' options to display only solutions which are within a given percentage of the best result
- Limit solutions to display those optimised by cost or carbon by checking the "carbon optimised" and "cost optimised" options. Or set percentage values to only show solutions within a given range of the best possible solution
- Select "Grids", "Decking systems", "Foundations", "Storeys" and "Deck types" to limit the solutions displayed (images on next page)
- Check "apply filter" to apply the filter on the current solutions and those being calculated and click "update" to update the graph

ding Layout | Building breakdown | **Filters** | Solution sets

Carbon < 500 kg CO<sub>2</sub>/m<sup>2</sup>

Cost < 500 £/m<sup>2</sup>

Mass < 10000 kg/m<sup>2</sup>

Spacing > 0.00 m < 15.00 m

Aspect > 0.00 < 4.00

Struct height < 2000 mm

best carbon w/in 10.0 %  carbon optimised

best cost w/in 10.0 %  cost optimised

Grids | Deck systems | Foundations

Storeys | Deck types | Transfers

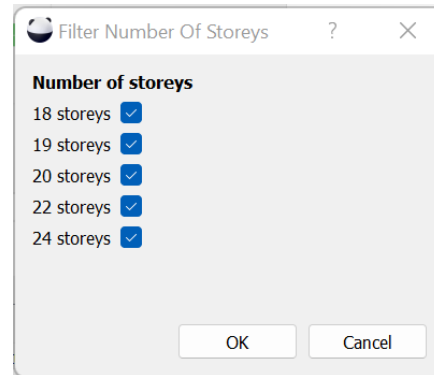
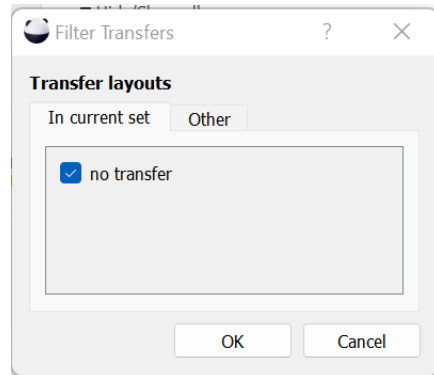
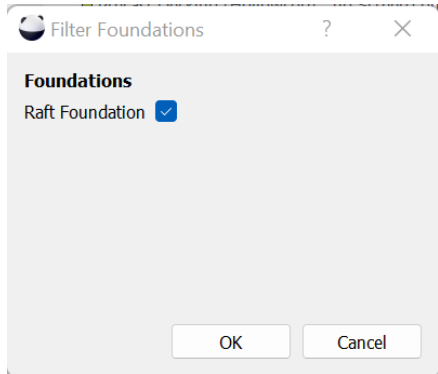
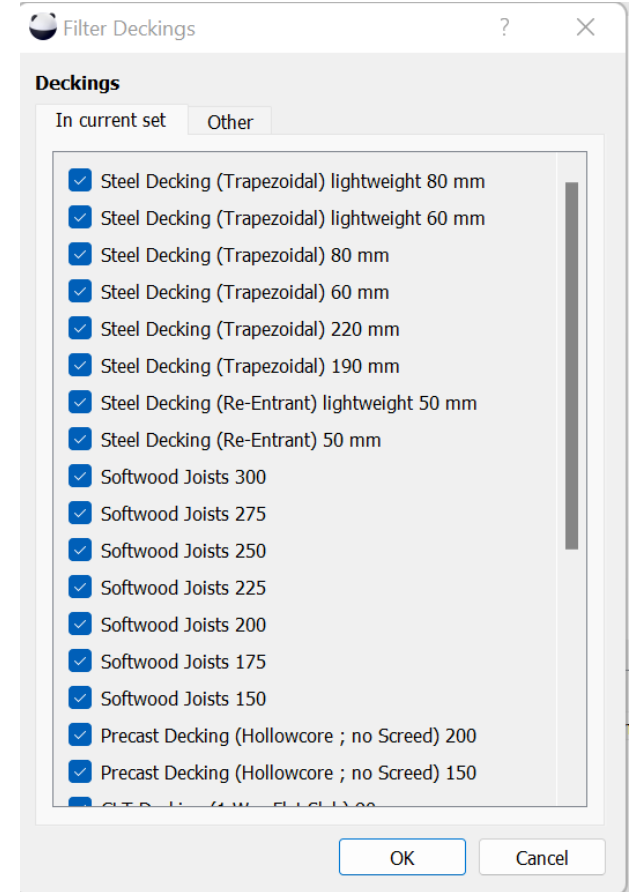
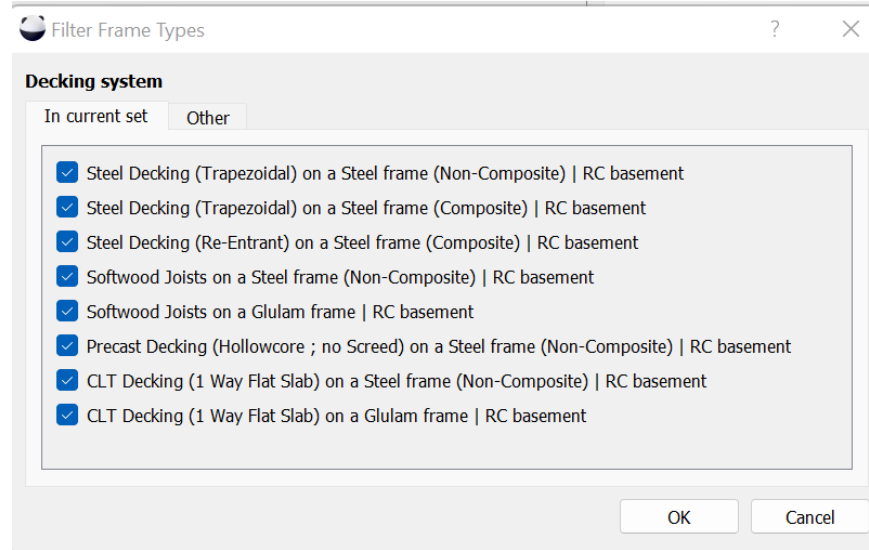
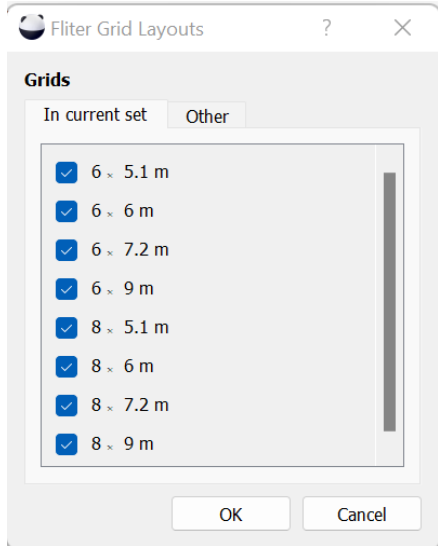
Save filter as | filter name

Delete filter | Activate filter

Apply filter | Default | Update



# 7.2 Filter the results







## 7.2 Filter the results

Saving filter options:

- Select the “Filters” tab in the information pane
- Input filter settings to suit the analysis
- Add a description for your filter to the “save filter as” box
  - Alternatively, select a previously saved solution from the drop down menu
- Click “Activate filters” to apply previously saved filter settings
- Check “apply filter” to apply the filter on the current solutions and those being calculated
- Press “update” to apply the new filter to the graph

ding Layout | Building breakdown | **Filters** | Solution sets

Carbon < 500 kg CO<sub>2</sub>/m<sup>2</sup>

Cost < 500 £/m<sup>2</sup>

Mass < 10000 kg/m<sup>2</sup>

Spacing > 0.00 m < 15.00 m

Aspect > 0.00 < 4.00

Struct height < 2000 mm

best carbon w/in 10.0 %  carbon optimised

best cost w/in 10.0 %  cost optimised

Grids | Deck systems | Foundations

Storeys | Deck types | Transfers

Save filter as | filter name

Delete filter | Activate filter

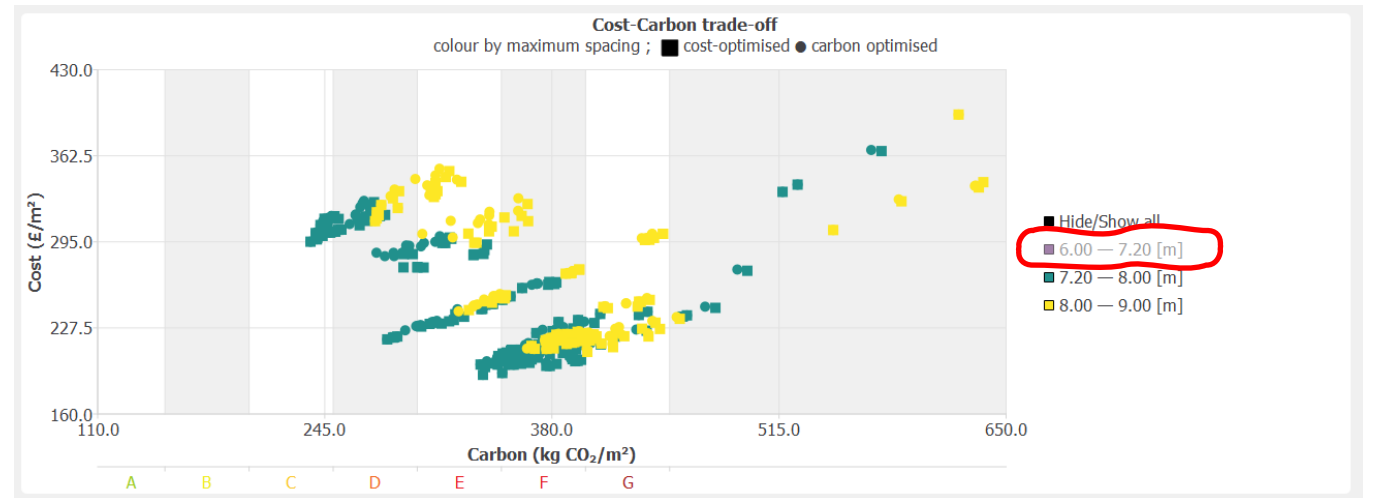
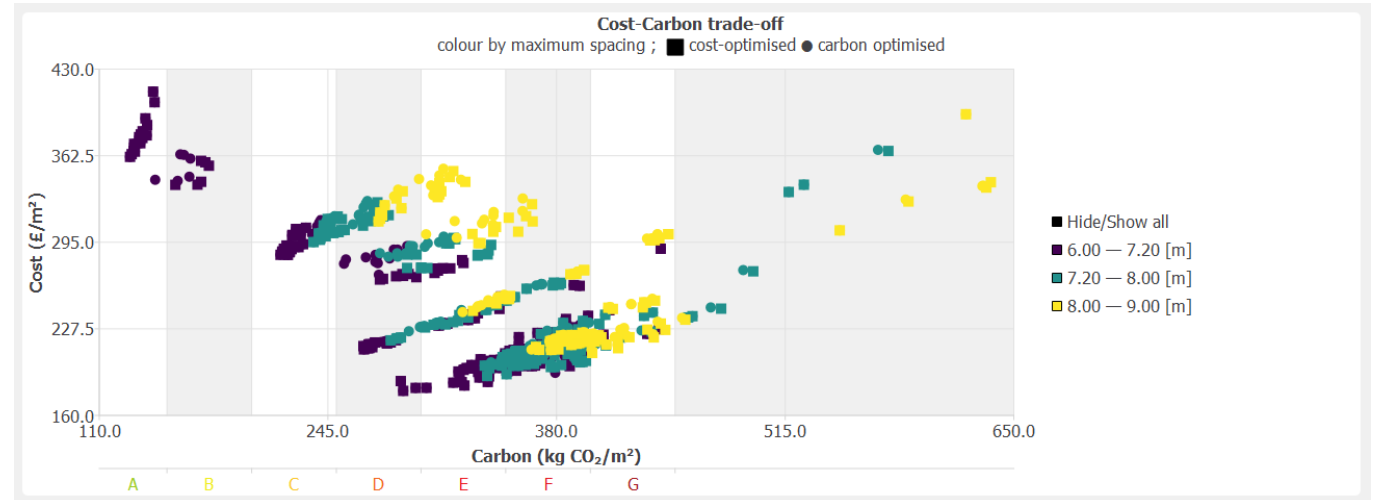
Apply filter | Default | Update



# 7.2 Filter the results

Results can also be filtered directly on the graph by clicking on the legend.

- Click the legend label to filter directly on the graph to hide results with that categorisation
- Click on the label again to redisplay these points on the graph.
- This function does not work whilst PANDA is still computing results, you must wait for the computation to finish before filtering results.





## 7.3 Save and compare solution sets

After filtering, the resulting solution sets can be saved

- Select the “Solution sets” tab in the information pane
- Add a description for your solution set to the “save set as” box
  - Or select a previously saved solution set from the drop down menu
  - Select activate to apply the selected solution set
- Individual buildings can be saved in the building summary tab.
- Close PANDA and reopen the solution set through activating the “saved solution set”
- If PANDA is rerun with a different configuration, the new results are overlaid with the saved set being shown as a reference (in grey)

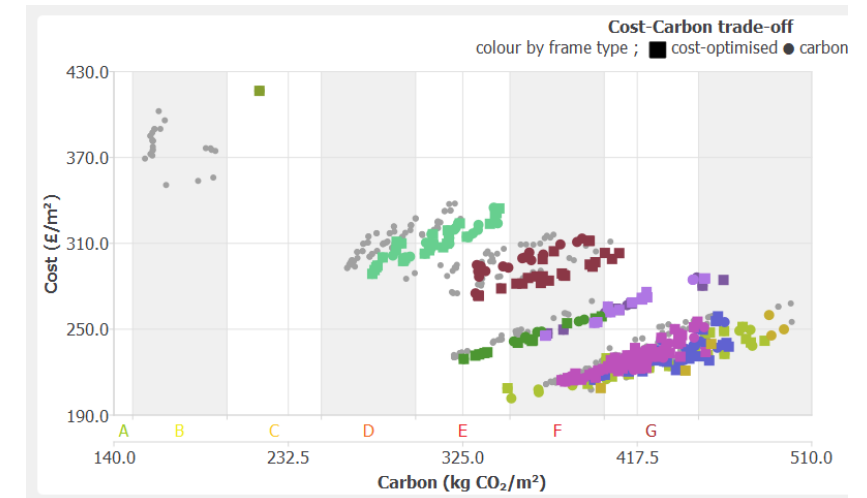
ding Layout Building breakdown Filters **Solution sets**

Save all buildings on chart

Save set as set name

Activate

Delete



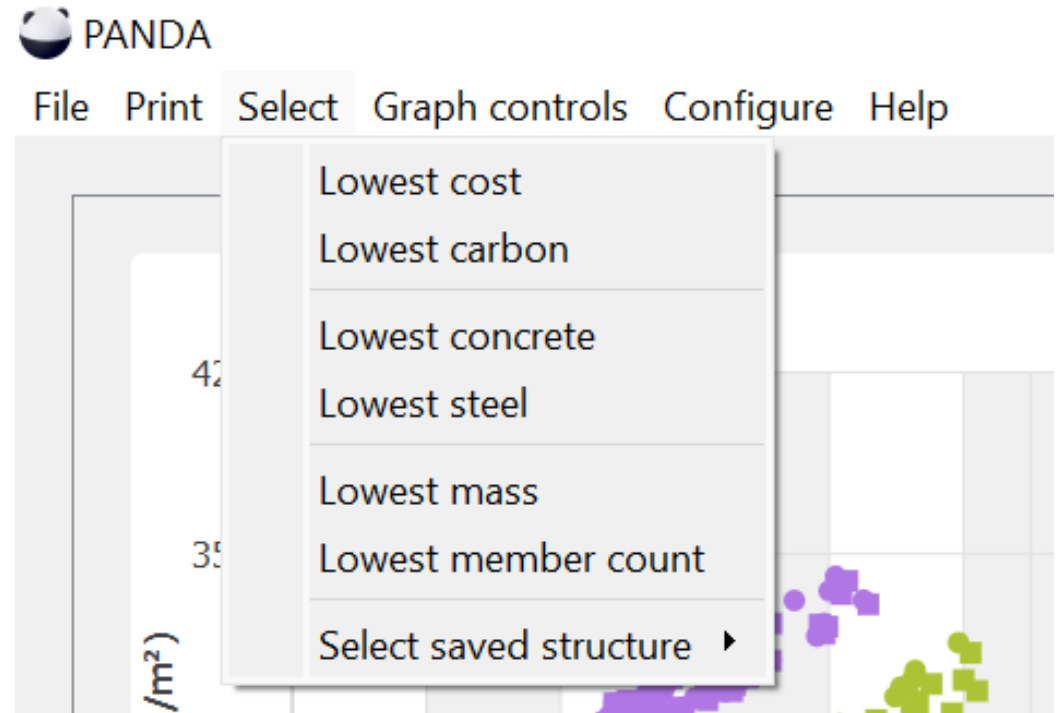


## 7.4 Select options

The select menu is a shortcut to select “remarkable” solutions. These are automatically identified by PANDA. Or can be added by the user using the ‘select saved structure’ option

To select a ‘remarkable solution’

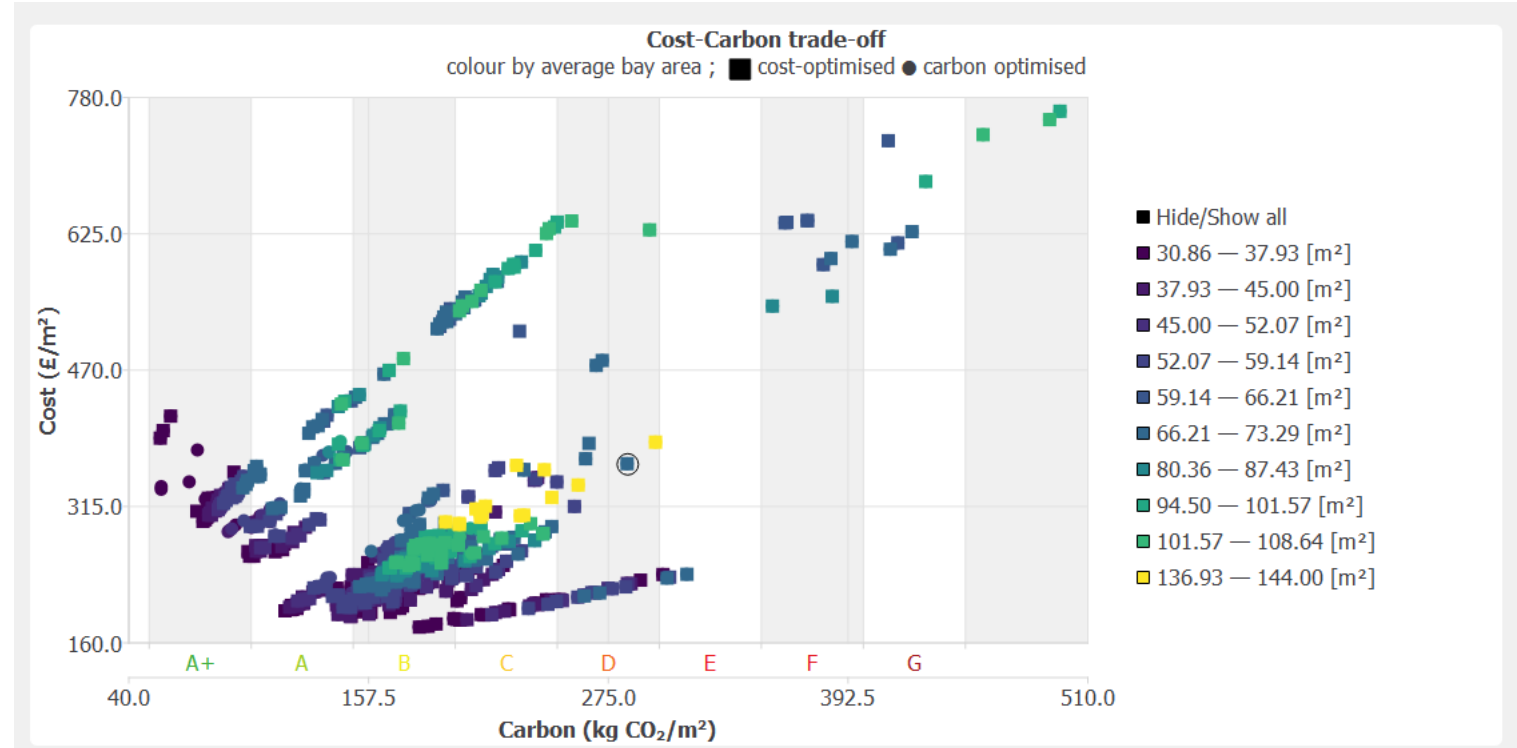
- Click ‘select’ from the main
- Chose the required solution from the list
- The solution will be highlighted with a black circle to identify it on the graph
- Individual buildings can be saved in the building summary tab. These solutions will then be displayed under the ‘select saved structure’ option.





# 7.5 Change the graph display controls

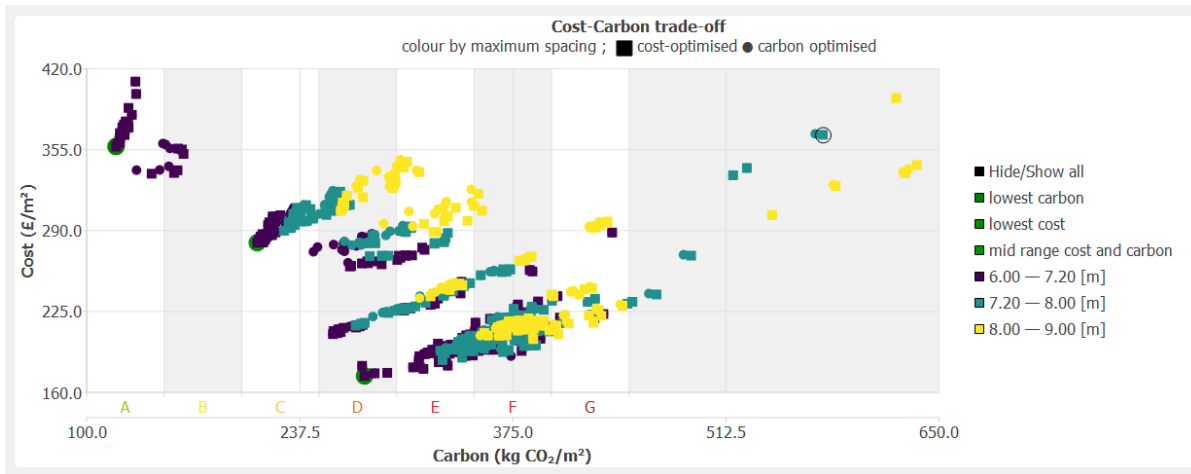
- Under graph control, you can adjust the size of the symbols, and colour-code the solutions according to various variables of interest
- Colour-scale is useful to have the colour reflect the value of the variable (as opposed to the decile)
- For example this image has the colour code displayed by average bay area.





# 7.5 Change the graph display controls

- Input geometry and run PANDA analysis
- Inspect Carbon-Cost plot
- Click on “Graph controls” and “categorisation” to display the results on the graph as per the different categorisation options
- The example below displays the results by maximum column spacing, which will be useful to discuss the cost and carbon impact of changing the maximum column spacing in the design.



PANDA  
File Print Select Graph controls Configure Help

Graph controls menu options:

- Fixed range
- Reset zoom
- Categorisation**
- Marker size
- Colour scale type
- ✓ Absolute scale
- Insert external data
- Remove external data
- ✓ Visible shade

Graph data:

- Cost (£/m²): 160.0, 225.0, 290.0, 355.0, 420.0
- Carbon (kg CO<sub>2</sub>/m²): 100.0, 237.5

Graph controls panel (highlighted in red):

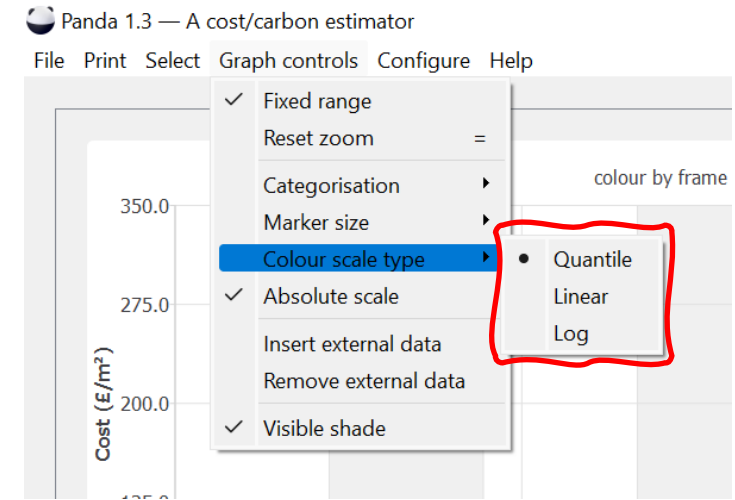
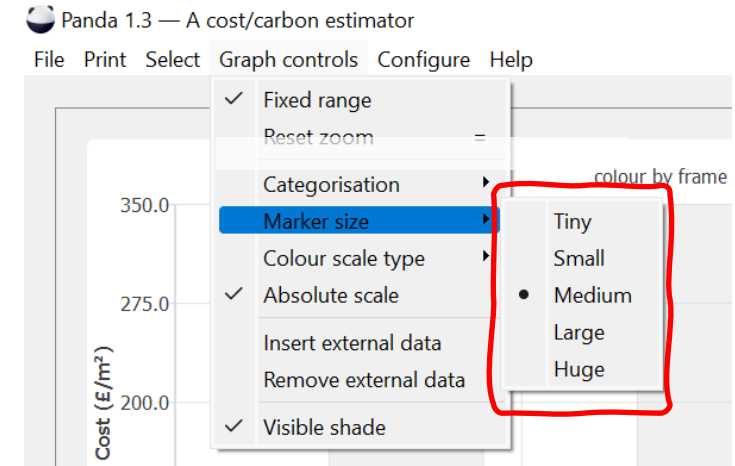
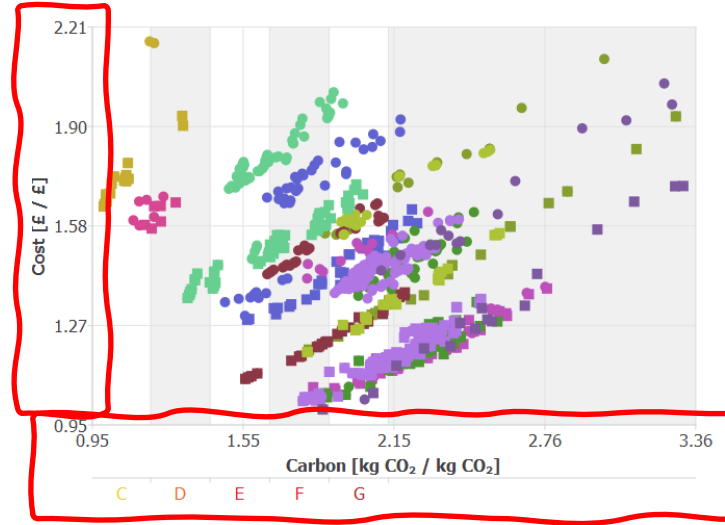
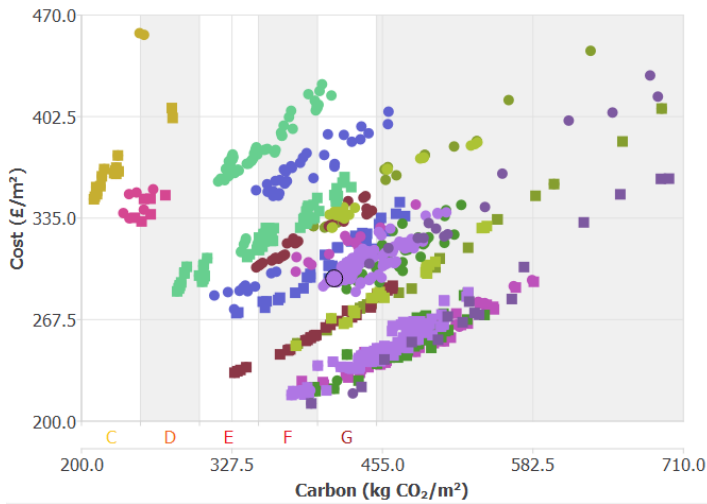
- Frame
- Decking type
- General decking type
- Foundation type
- Service Integration
- Maximum column spacing
- Minimum column spacing
- Structural zone depth
- Number of Storeys
- Average bay area
- Circularity index
- Total mass
- Steel to concrete ratio
- Steel mass
- Concrete mass
- Span ratio
- Aspect ratio
- Grid Layout
- Transfer layout

Grid and model scope: Vertical layout  
Column spacing EW: 5.00 m



# 7.5 Change the graph display controls

- Input geometry and run PANDA analysis
- Change the “marker size” to meet your preference
- Select “colour scale type” to switch between ‘quantile’, ‘linear’ and ‘log’ scales on the graph
- Select and deselect ‘absolute scale’ to change the axis from an absolute to a relative result.





# 7.5 External data for comparison

- Input geometry and run PANDA analysis
- Inspect Carbon-Cost plot
- Select 'graph controls' from the main menu
- Use the dialogue box for 'Insert external data' to manually add points to the graph. This is especially useful if you want to set a target performance and compare it to the results from PANDA
- To delete these points select 'remove external data'

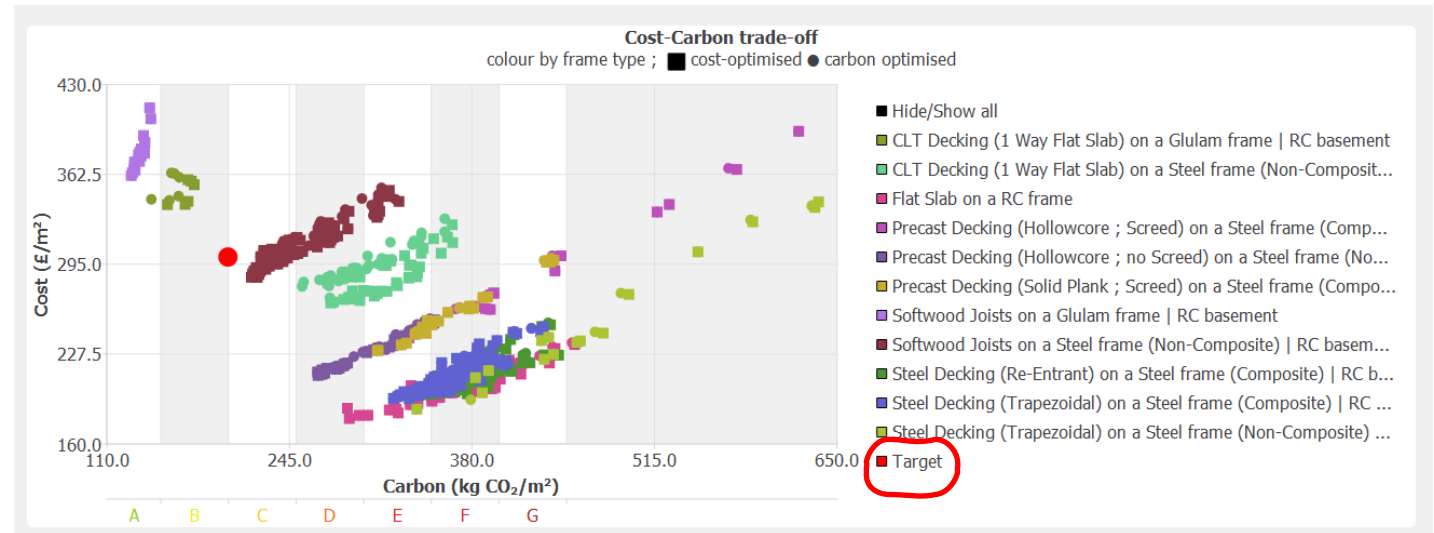
External data

Project name Target

Cost 300.00 £/m2

Carbon 200.00 kg/m2

OK Cancel







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# 8. Exporting results



## 8. Exporting results

This section will show you how to:

- 8.1 Export engineering reports for a selected bay
- 8.2 Print carbon & cost pie charts
- 8.3 Export Bill of Materials
- 8.4 Export chart data
- 8.5 Output summary data reports



# 8.1 Export engineering reports for a selected bay

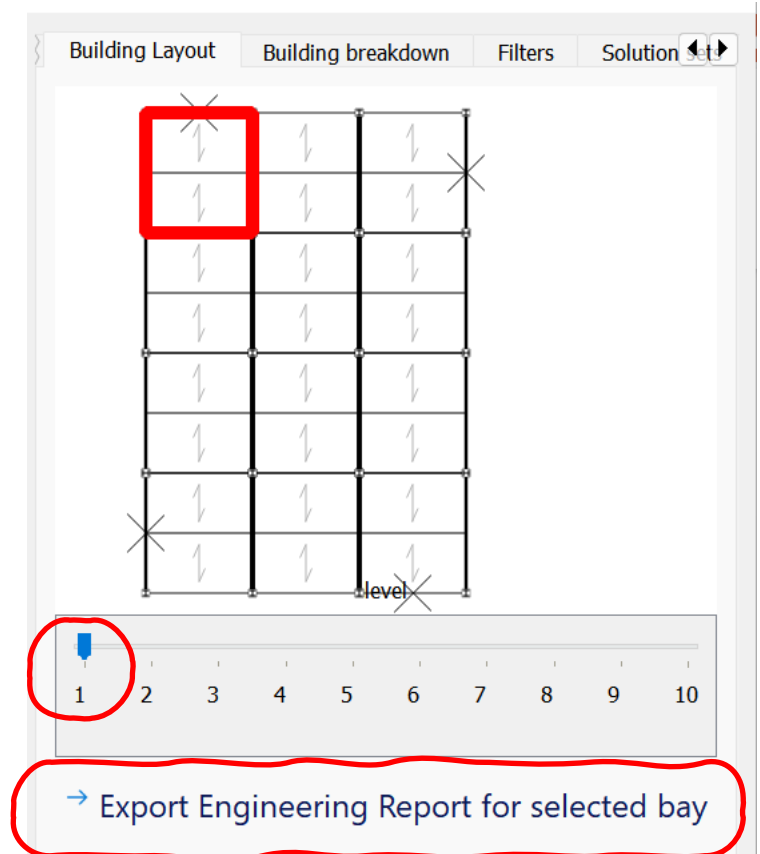
- PANDA does not read results from a database. It actually does engineering calculations
- You can select any bay in a building and print an engineering report which will give all the checks and their values
- That allows you to check that PANDA did an adequate job, but can also guide you for the more irregular parts of your building
- You can use PANDA as a quick and dirty engineering calculator...

	A	B	C	D
1	OVERALL/SUMMARY	STRUCTURE NUMBER	9150	
2	Geometry/Layout	No. of Above Ground Stories	10	
3		No. of Basement Stories	0	
4		Storey Height	4 m	
5		Shape	single rectangle	
6		Uniform Shape over Floors?	Yes	
7		Length X	24 m	
8		No. Bays X	3	
9		Column Spacing X	8 m	
10		Length Y	36 m	
11		No. Bays Y	4	
12		Column Spacing Y	9 m	
13		No. Internals per Roof Bay	1	
14		One Way Decking Span in Roof Bay	4.5 m	
15		Decking Span Direction in Roof Bay	Y	
16		No. Internals per Upper Floor Bay	1	
17		One Way Decking Span in Upper Floor Bay	4.5 m	
18		Decking Span Direction in Upper Floor Bay	Y	
19		Total Floor Area	7776 m <sup>2</sup>	
20	Construction Summary	Building Type	B Offices	



# 8.1 Export engineering reports for a selected bay

- Input geometry and run PANDA analysis
- Inspect Carbon-Cost plot and select an individual solution
- Select “Building Layout” tab in the information pane
- Select the individual bay which the report will be focused on
  - Change floor in the bay visualisation using the slider
- Select “export Engineering Report for selected bay”
- Engineering reports are CSV files. Import them in Excel telling it that they’re UTF-8 encoded.
- The files have a header giving general information, then detail the decking, then the columns

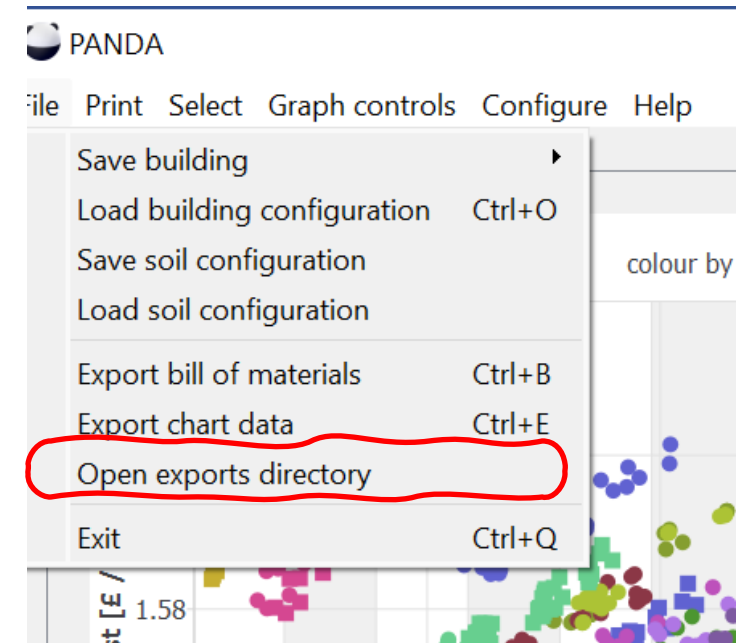




# 8.1 Export engineering reports for a selected bay

## Opening the Engineering Report:

- Engineering Reports are saved in a folder called “exports” located in the PANDA program files
- Quick access to the reports can be navigated using the “Open exports directory” option on the main “File” menu
- Export other information by clicking “file” then “Export bill of materials”, “Export chart data” or “Export chart image”
- Open and view these files from the export directory



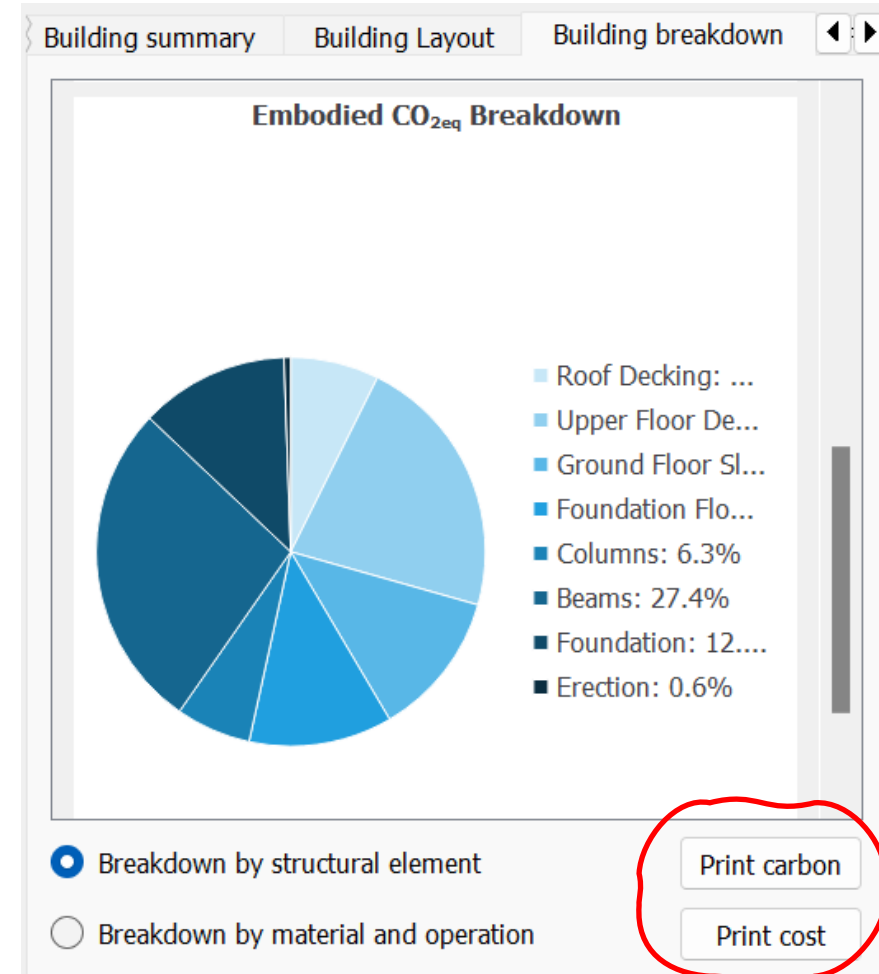


## 8.2 Print carbon & cost pie charts

- Images displayed for the cost and carbon pie charts can be printed and saved.

Printing the carbon and cost pie charts:

- Select the required point on the graph
- In the information window select 'building breakdown'
- Select 'print carbon' or 'print cost' to save the image as a separate file.
- Images are exported as a png file

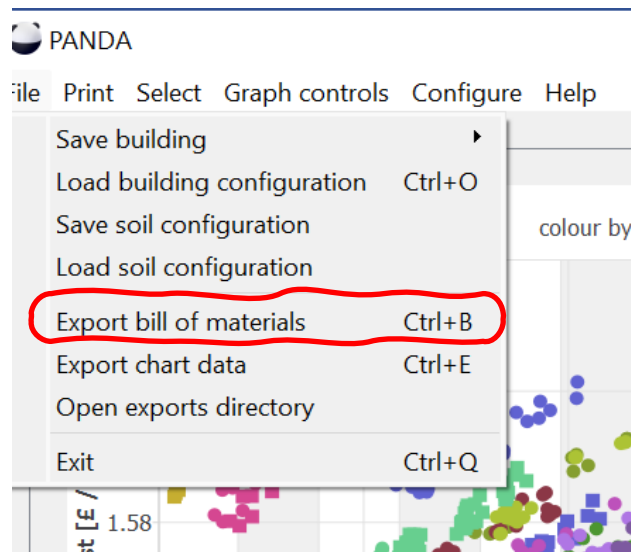




## 8.3 Export bill of materials

To export the Bill of materials:

- Select the required point on the graph
- Clicking “file” then “Export bill of materials”,
- Open and view these files from the export directory



	A	B	C	D	E
1	OVERALL/SUMMARY	STRUCTURE NUMBER	1612		
2	Geometry/Layout	No. of Above Ground Stories	4		
3		No. of Basement Stories	1		
4		Storey Height	4 m		
5		Shape	single rectangle		
6		Uniform Shape over Floors?	Yes		
7		Length EW	24 m		
8		No. Bays EW	4		
9		Column Spacing EW	6 m		
0		Length NS	36 m		
1		No. Bays NS	7		
2		Column Spacing NS	5.14286 m		
3		No. Internals per Roof Bay	2		
4		One Way Decking Span in Roof Bay	2.57143 m		
5		Decking Span Direction in Roof Bay	NS		
6		No. Internals per Upper Floor Bay	2		
7		One Way Decking Span in Upper Floor Bay	3 m		
8		Decking Span Direction in Upper Floor Bay	EW		
9		Total Floor Area	4320 m <sup>2</sup>		
0	Construction Summary	Building Type	B Offices		



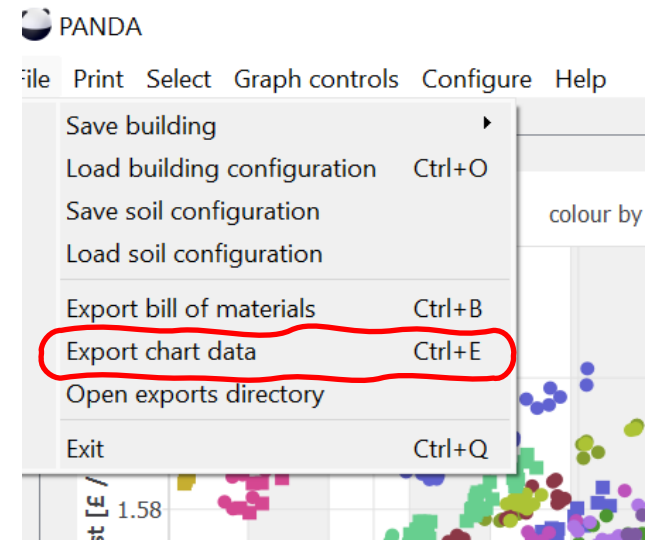
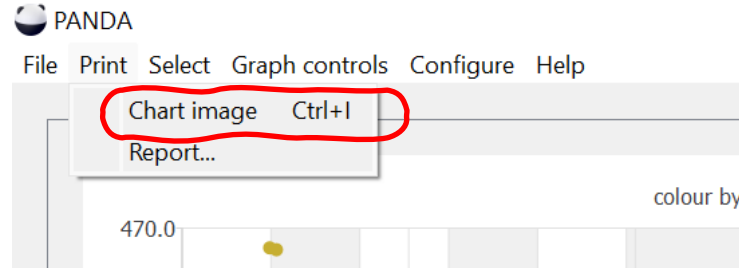


# 8.4 Export Chart data

Chart data can be down loaded to enable your own graphs and plots to be created.

To export the Chart Data:

- Select the required point on the graph
- Clicking “file” then “Export chart data”,
- Open and view these files from the export directory
- To save a copy of the chart image click ‘print’ and ‘chart image’



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	current																		
2	Life-cycle	Cradle to completion A1-5																	
3	Cost model	Default QS rates																	
4	Floor Area [m <sup>2</sup> ]	Carbon [kg]	Cost [£/m <sup>2</sup> ]	Carbon O <sub>2</sub>	Decking T <sub>1</sub>	Decking S <sub>2</sub>	General D	General D	Frame typ	Superstru	Basement	Foundatio	Foundatio	Max Span	Min Span	Avg Bay A	Avg Bay A:	Structural	Steel Ma
5	4320	374.6	317.837	Yes	Millbank F	Millbank F	Precast De	Precast De	Precast De	Steel	RC	Pile Found	Suspender	7.2	6	43.2	0.833333	0.6546	16418
6	4320	303.695	294.416	No	Softwood	Softwood	Softwood	Softwood	Softwood	Steel	RC	Pad Foun	Suspender	6	6	36	1	0.698	12665
7	4320	462.296	245.502	Yes	Concrete F	Flat Slab	RC Deckin	Flat Slab	Flat Slab	o RC	RC	Raft Foun	Raft	8	6	48	0.75	0.3	16970
8	4320	350.201	316.358	No	Softwood	Softwood	Softwood	Softwood	Softwood	Steel	RC	Raft Foun	Raft	7.2	6	43.2	0.833333	0.6282	14996
9	4320	402.191	419.161	Yes	Softwood	Softwood	Softwood	Softwood	Softwood	Steel	RC	Pile Found	Suspender	9	8	72	0.888889	0.8081	19577
10	4320	456.249	312.871	Yes	Tata Comf	Tata Comf	Steel Deck	Steel Deck	Steel Deck	Steel	RC	Pile Found	Suspender	8	6	48	0.75	0.5508	29621
11	4320	409.978	303.263	No	KLH CLT	(S KLH CLT	(S CLT Deckir	CLT Deckir	CLT Deckir	Steel	RC	Raft Foun	Raft	8	5.14286	41.1429	0.642857	0.6498	17196
12	4320	489.907	374.672	Yes	McCann S	McCann S	Precast De	Precast De	Precast De	Steel	RC	Pile Found	Suspender	9	6	54	0.666667	0.8276	23236
13	4320	476.338	246.083	No	CMF MetF	CMF MetF	Steel Deck	Steel Deck	Steel Deck	Steel	RC	Raft Foun	Raft	8	7.2	57.6	0.9	0.5498	20733
14	4320	351.135	315.557	No	Softwood	Softwood	Softwood	Softwood	Softwood	Steel	RC	Raft Foun	Raft	7.2	6	43.2	0.833333	0.598	15149
15	4320	427.904	234.884	No	CMF MetF	CMF MetF	Steel Deck	Steel Deck	Steel Deck	Steel	RC	Pad Foun	Suspender	6	6	36	1	0.538	18715
16	4320	492.966	262.512	No	Tata Comf	Tata Comf	Steel Deck	Steel Deck	Steel Deck	Steel	RC	Raft Foun	Raft	9	6	54	0.666667	0.6	22895
17	4320	407.974	220.061	No	SMD TR80	SMD TR80	Steel Deck	Steel Deck	Steel Deck	Steel	RC	Pad Foun	Suspender	6	5.14286	30.8571	0.857143	0.3914	18443
18	4320	353.897	304.877	Yes	Millbank F	Millbank F	Precast De	Precast De	Precast De	Steel	RC	Pile Found	Suspender	6	6	36	1	0.505	15295
19	4320	544.274	276.303	Yes	Concrete F	Flat Slab	RC Deckin	Flat Slab	Flat Slab	o RC	RC	Raft Foun	Raft	8	7.2	57.6	0.9	0.4	22425
20	4320	277.005	407.842	No	Softwood	Softwood	Softwood	Softwood	Softwood	Glulam	RC	Raft Foun	Raft	7.2	6	43.2	0.833333	1.025	65155

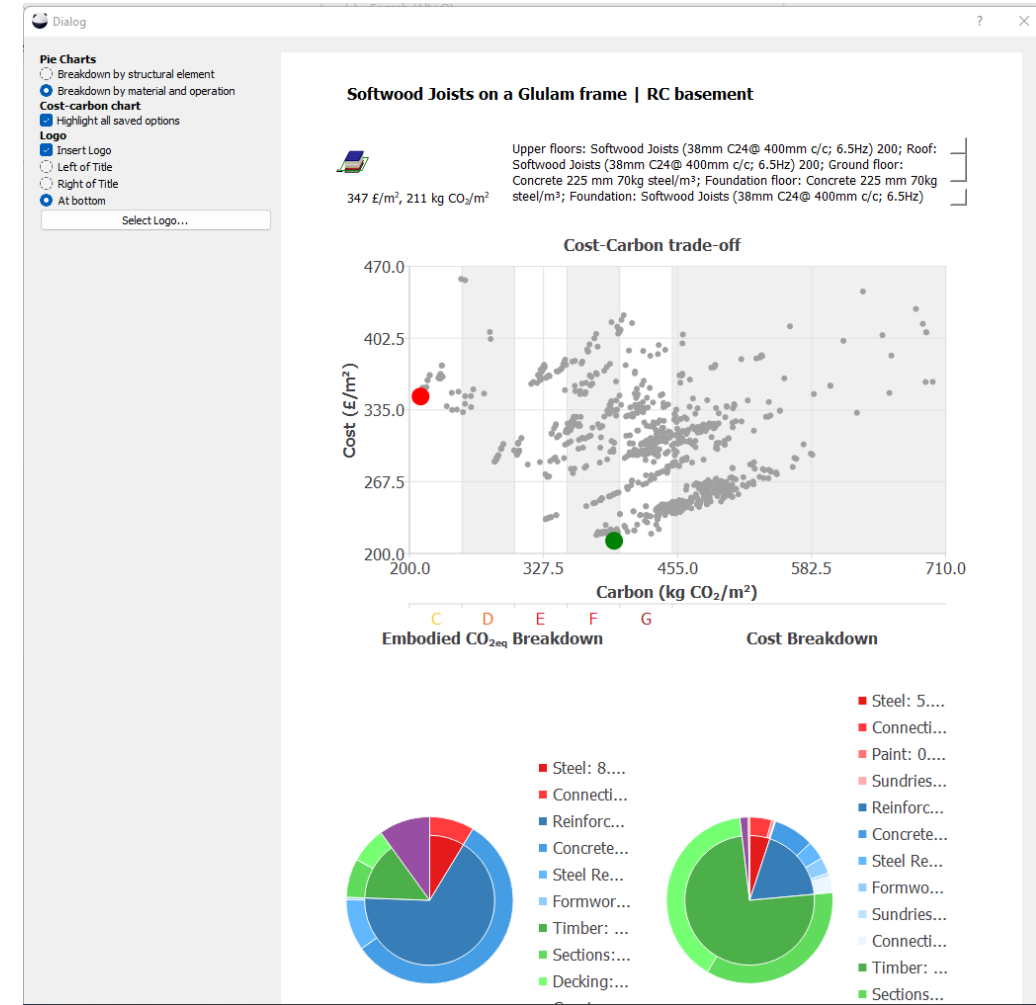
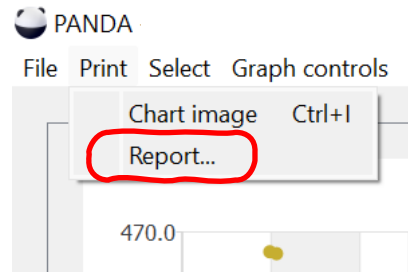


# 8.5 Output a summary data report

We have included a report generation feature to support meetings with clients and other stakeholders.

To export a summary data report:

- Select and save the solutions you'd like to include in the report.
- Click "print" then "report", to open the report dialogue
- Edit the report to add a logo, change the pie charts, and highlight saved options on the graph





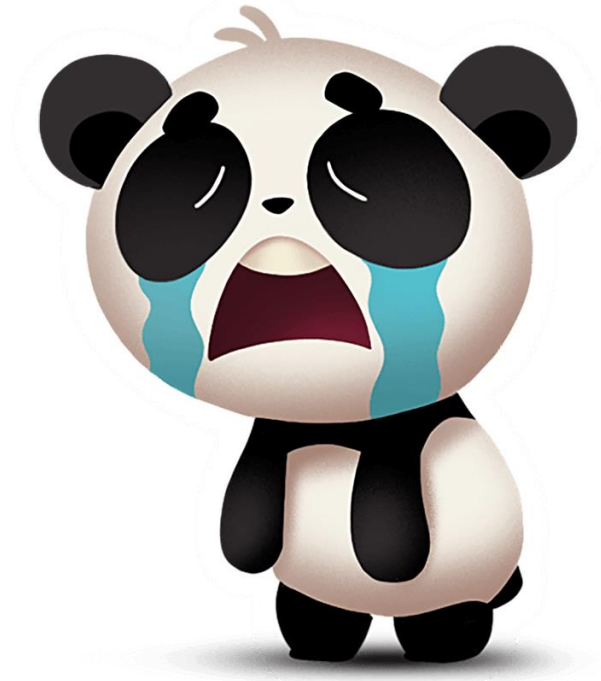
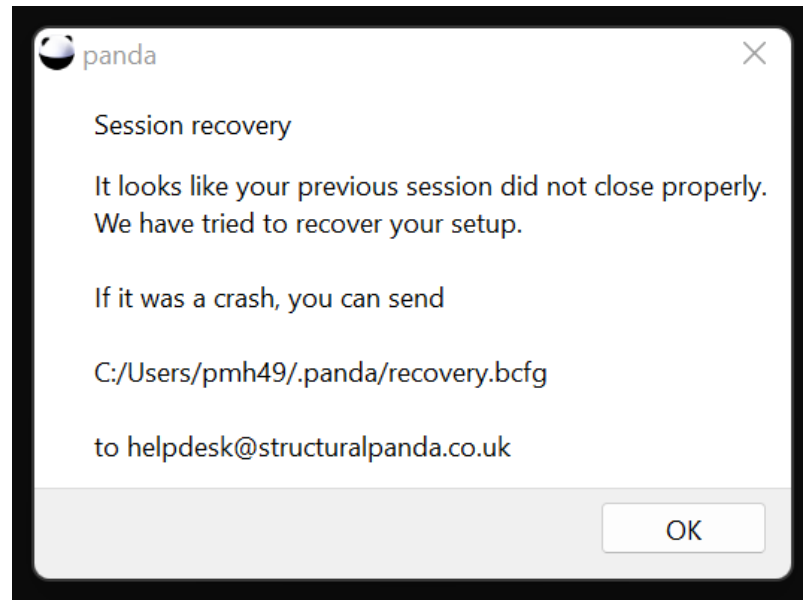
# 9. Troubleshooting



# 9.1 Crash reports

We are regularly developing PANDA and value your feedback

- when crashes occur, please let us know so we can investigate and fix problems.





## 9.2 Contact us for help

If you can't find the information you need in this guide, please don't hesitate to get in touch with us at:

[helpdesk@structuralpanda.co.uk](mailto:helpdesk@structuralpanda.co.uk)

We are always working to improve PANDA, if you have ideas for new features or improvements please get in touch. We'd love to hear them!

