SDE Digital Awards

Society of Digital Engineering

Best innovation

Entry Criteria

Open to any digital innovation. This may be a piece of software, a project process or other innovation that shows ground-breaking thought.

Entrant Details

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Entry description

Summary (100 words)

I developed an iOS application called "*Building Services Toolbox*", which can be installed onto any iOS device for free, anywhere in the world. The app provides a number of handy tools for carrying out quick checks and calculations while out of the office. It includes a duct sizer, a pipe sizer, a simultaneous demand calculator and a simplified daylight calculator. The app has received tremendous feedback and is currently in use by engineers and contractors around the world.

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Detailed description (500 words)

This entry is for a piece of software. Specifically, it is for an iOS application that is available for download from Apple's AppStore. The app may be installed on any iOS device (iPhone / iPad) free of charge. It is available anywhere in the world which has access to the AppStore. When the app is installed and launched, it presents a "*Home Screen*" with the following options to select from:

- Duct Sizer
- Pipe Sizer
- Multiple Load Pipe Sizer
- Simultaneous Demand
- Daylight Calculator
- Pipe Diameters
- Formulae

Each option provides either a tool or reference material for the user. Three of which are discussed below:

Duct Sizer

The Duct Sizer offers an intuitive user interface for sizing rectangular and circular ductwork. The first step is for the user to enter a flowrate (or alternatively, an area, height and ACH). Once the flowrate is entered, the resulting air velocity, pressure drop per meter and duct aspect ratio are shown within the duct itself. The user is free to adjust the height and width (or diameter if circular) of the duct and the results will update instantly. There are convenient options for "*Riser / Branch / Final*" which will automatically size the duct based on the limiting velocity. A settings page screen is also accessible which provides the methodology used and options for changing various parameters.

Pipe Sizer

The Pipe Sizer offers an intuitive user interface for sizing pipework. Similarly to the Duct Sizer, the user selects a flowrate and can then adjust the pipe size to see the resulting velocity and pressure drop. The pipe material is easily changed between Steel, Copper, UPVC and ABS. The user can then move up or down the corresponding pipe sizes (for the selected material). The user can also select a limiting pressure drop or velocity for automatically sizing the pipe. Again, a settings screen allows the methodology and parameters to be interrogated.

Simultaneous Demand

The Simultaneous Demand calculator allows the user to enter the number of WCs, WHBs, Showers etc served in order to determine the correct CWS, HWS, MWS and RWS (rain) pipework sizes required. The sizes are based on the assigned demand units and simultaneous demand. Again, the methodology, demand units applied and parameters applied can all be viewed and changed if required.

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What problems/issues/process or efficiency is it addressing? (500 words)

The problems/issues/process/efficiency that the app is addressing are:

- Provides a convenient way for an engineer to quickly perform design calculations
- Prevents delays caused by an engineer having to say "*I'll check that when I'm back at the office and get back to you*"
- Provides reference material for engineers while they're away from the office
- Offers transparency in all of its calculations and methodologies

I developed this app to help me with my day to day job. As a consultant mechanical engineer, I found myself doing the same rough calculations again and again while carrying out site inspections or attending design team meetings.

For example, during early stage design team meetings, preliminary sizes for service routes and risers may be required. Instead of trying to do a rough calculation by hand, I could use the app to size a number of pipes & ducts and then decide on an appropriate overall size requirement.

Another example of its usage, is when you're on site and need to made design changes quickly. For example, if a contractor brought my attention to a duct that was going to clash with something if installed at the size shown on the drawing, I could use the app to resize the ductwork (with an equivalent area) to a size that would avoid the clash. Having this ability to quickly redesign something meant that an issue could be resolved on site, rather than having to return to the office and later revert with a solution.

I had previous experience with some other software tools for doing simple calculations related to building services. However, the majority of them were presented as a "*black box*". You put in some data and it spits the answer back out. You've no idea what's happening under the hood, which is enough to make any engineer uncomfortable. By contrast, the Building Services Toolbox shows the exact formulae behind all of the calculations performed. It also offers the ability to change all of the parameters used, from the dynamic viscosity of air to the roughness factor of copper pipework.

While providing a method for doing calculations, the app is in no way intended to replace detailed design calculations.

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Who is this aimed at?

(types of organisation and/or job roles) (100 words)

This app was aimed at consultant building services design engineers, with an emphasis on mechanical. However, with its rise in popularity, it has been adopted by a much wider range of professionals. From the feedback received to date, it is used from consultancy directors right through to apprentice plumbers.

How does it work? (500 words)

The app was developed using XCode (an Integrated Development Environment) and was written in Swift (objective oriented programming language). It involved writing thousands of lines of code and developing specific programming libraries for dealing with building services related calculations.

How an iOS application is designed and operates is beyond the scope of a 500-word explanation. However, how the engineering features are provided can be briefly explained.

At the core of each tool/calculator, is a formula or number of formulae. These equations were sourced from well known engineering reference materials and are shown in full within the application. In order to use the formulae, a number of parameters have to be used. Examples of these were mentioned earlier in this submission, such as the roughness factor of copper pipework. This parameter is required to calculate the pressure drop through copper pipework of a given size and for a given flowrate.

While the calculations used are fairly straightforward, an engineer may not necessarily know the equation off the top of their heads. They are certainly not likely to know the appropriate parameters to use (but likely know where to look them up). What makes the app work, is that default parameters are provided for absolutely every parameter needed. Furthermore, these defaults can be adjusted by the user if required. However, most never really have to change.

For example, if a user is sizing a pipe for a given flowrate, they just select the pipe material (tap a button). The default pipe sizes and all the associated parameters which accompany the material are automatically used. If they find that a 42mm copper pipe is sufficient but would prefer to use steel, they just swap to steel and a 40mm size is offered instead with the calculated results using the correspond steel parameters. If they try the next size up, they're offered a 50mm pipe (instead of a 54mm copper pipe).

In summary, the engineering core of the app works off a set number of formulae and default parameters.

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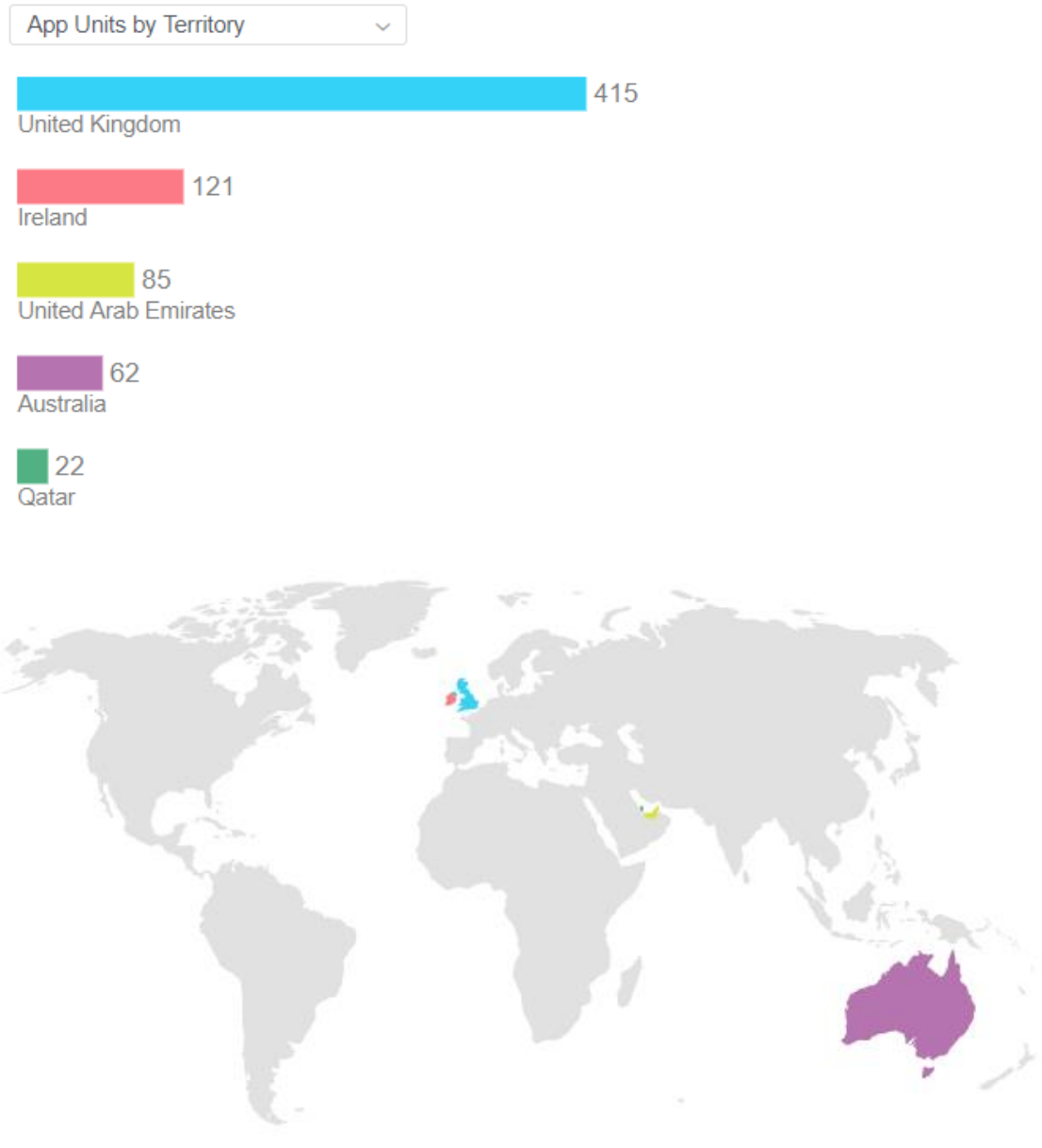
Measures of success (e.g. time/money/resource/societal/etc.) (250 words)

When I developed this app, I never had any intention of making money from it. All I wanted was to enable myself to do my job more efficiently. Having experienced the benefits of it myself, I opted to provide the app for free to anybody who wanted to use it for themselves. For this reason, I do not measure the app's success in terms of revenue (as there is none at all), but in the number of people who have found it genuinely useful in their day to day tasks. I certainly found it to be a massive time saver for my own job and have heard nothing but similar stories from those who I have received feedback from.

The images below show the users of the app by territory:

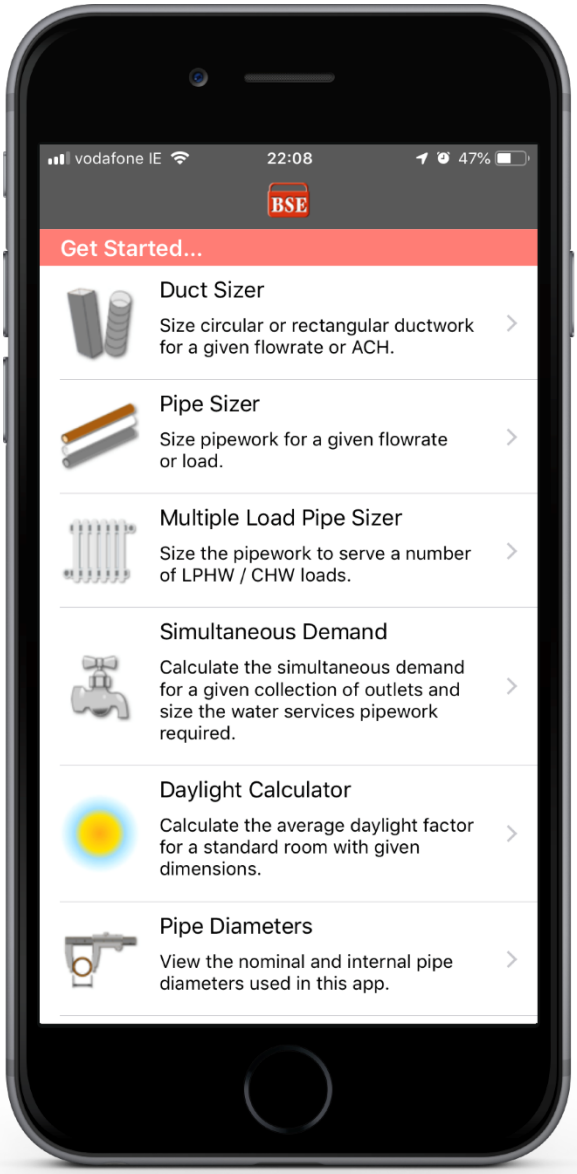


Supporting information (as required)

An app can never be fully explained in documentation. I would encourage you if possible, to download the app from the AppStore and try it yourself (if you have an iOS device). However, various screenshots of the app are provided on the following pages.

https://itunes.apple.com/ie/app/building-services-toolbox/id1118758962#?platform=iphone

AppStore Listing



Home Screen

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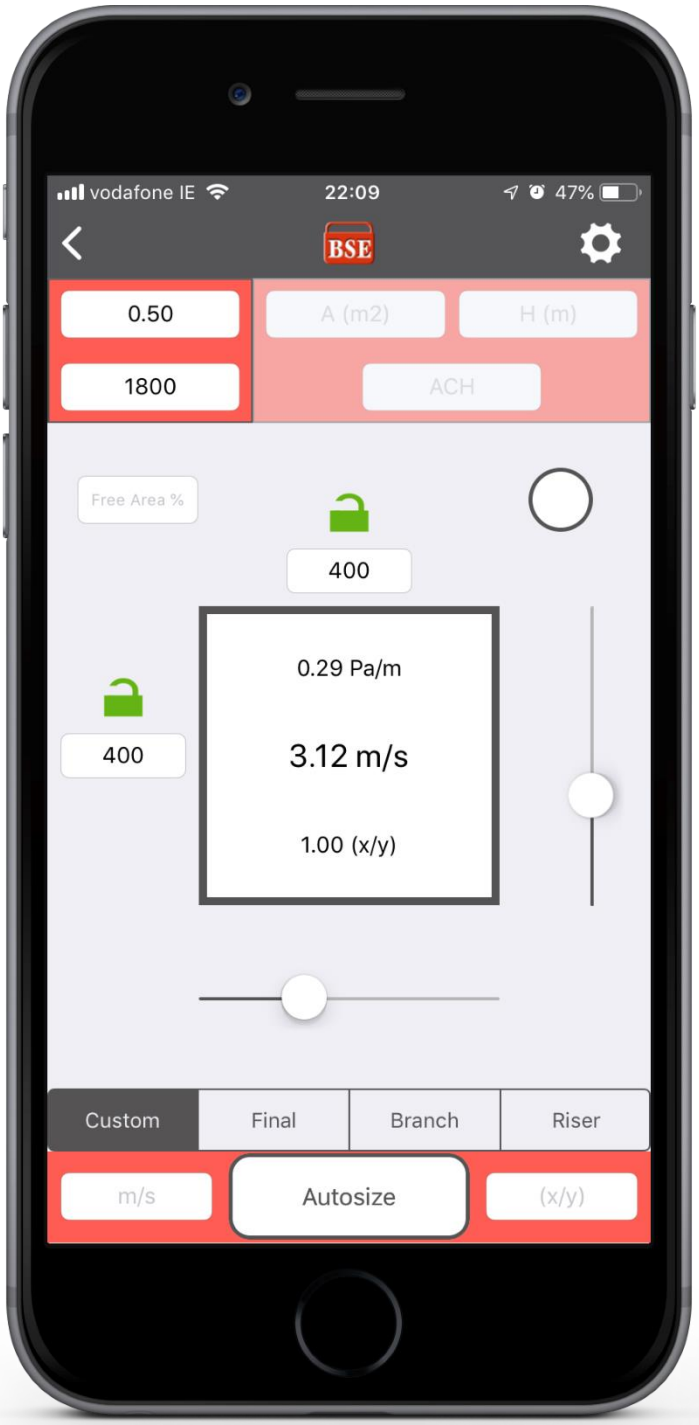
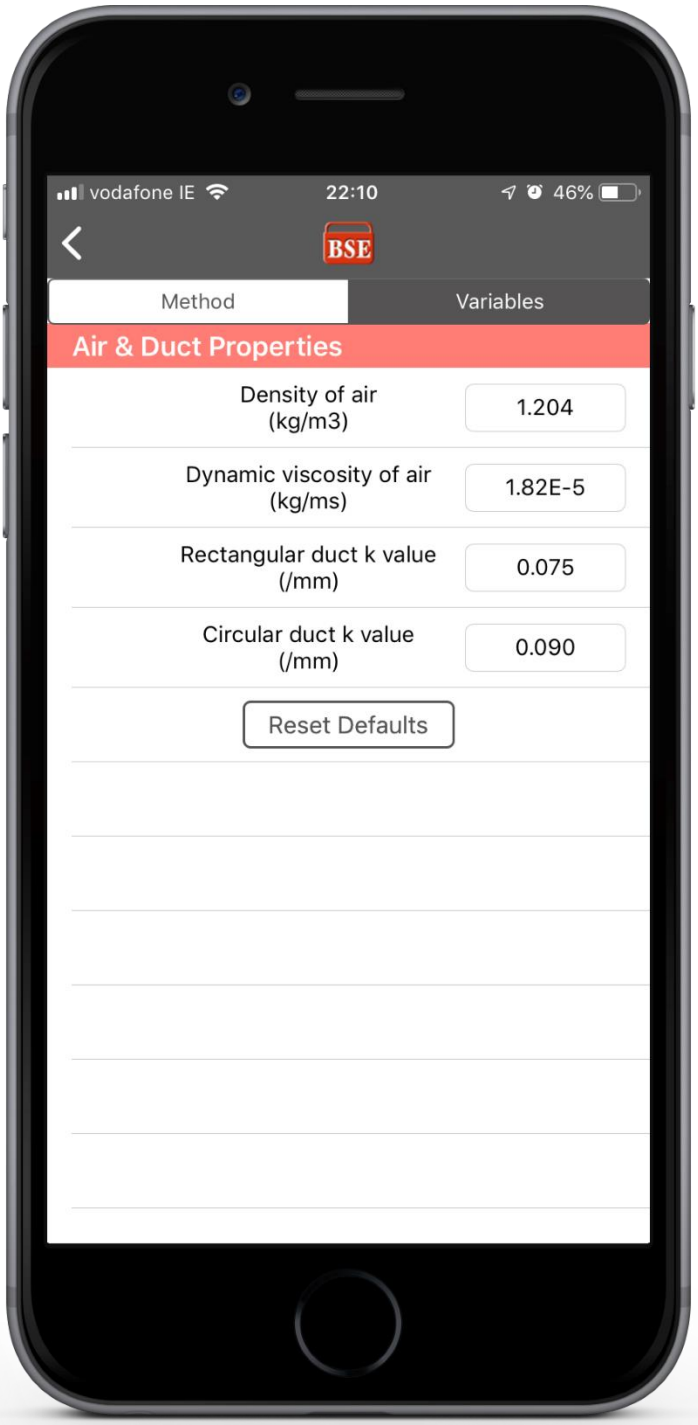


Duct Sizer



Duct Sizer Parameters

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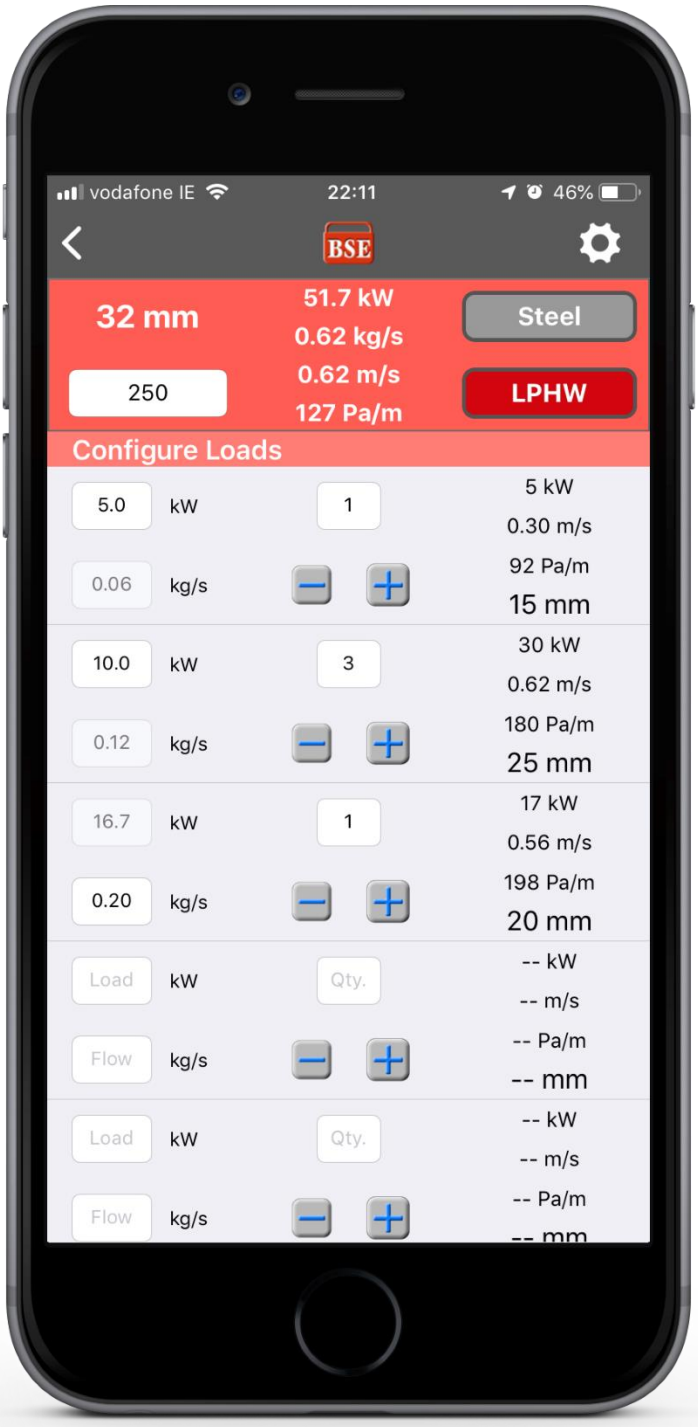
Pipe Sizer



Multiple Load Pipe Sizer

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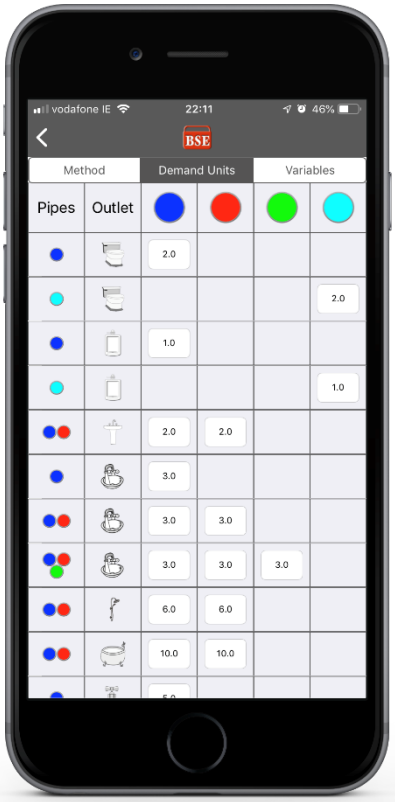
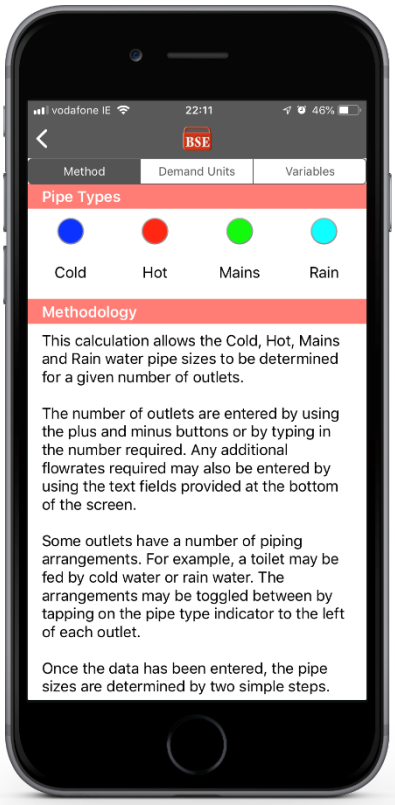
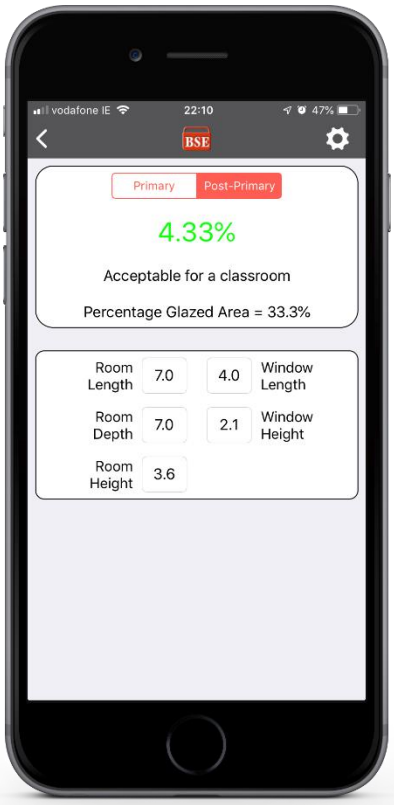
Simultaneous Demand



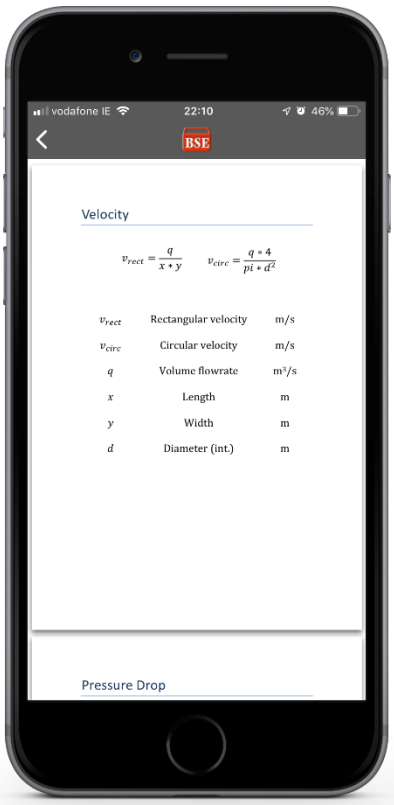
Demand Unit Configuration



Methodology



Daylight Calculator



Formula Viewer