STAIR DESIGN GUIDE

From FIRST IN ARCHITECTURE

01 - Ideas and Inspiration

Staircases can have a massive impact on a residential project. They can be a focal point of a space, provide light and interest, so it's important to take time to consider your options when designing the stairs in your project.

Some of the staircase design will be dictated by the space available, floor levels and so on.

However, there will be other aspects of the staircase design that you will have control over. Will the stairs be light or solid? Will they be simple or intricate? Will the stair serve another purpose like under stair storage? With the materials be robust or warm? Will the stair be wide or narrow, open or enclosed? Will the staircase have natural light, or a lighting scheme designed into the staircase?

Lets take a look at some of these ideas...

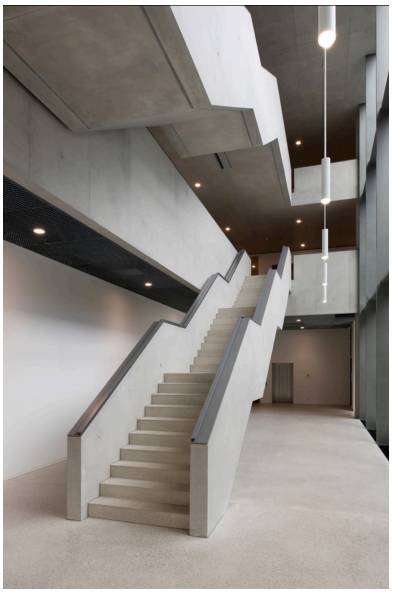
Lightweight Stair Ideas

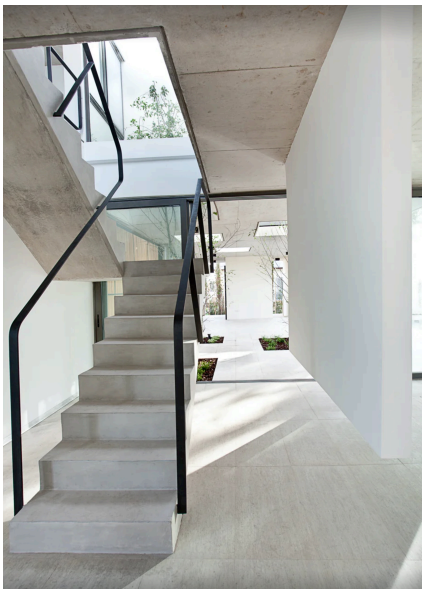
These stairs are all lightweight in appearance, often because they appear to be floating and therefore give the impression of weightlessness.

01
Wrap House by Apollo Architects & Associates, photo: Masao Nishikawa from dailytonic.com
02
Marretti Stairs
http://www.marrettistairs.com/staircase/catalogo_marretti.php?pagina=13&key=Hanging_staircases_Origami_1&id_pagina=185

03
Old Town House by Mario Martins Atelier
https://homeadore.com/2013/11/08/town-house-mario-martins-atelier/
04
Renovated Apartment in Buenos Aires
https://design-milk.com/renovated-apartment-buenos-aires/

Solid Staircase Ideas





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DLR Robotics and Mechatronics Centre Birk Heilmeyer und Frenzel Architeckten
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02
DLR Robotics and Mechatronics Centre Birk Heilmeyer und Frenzel Architeckten
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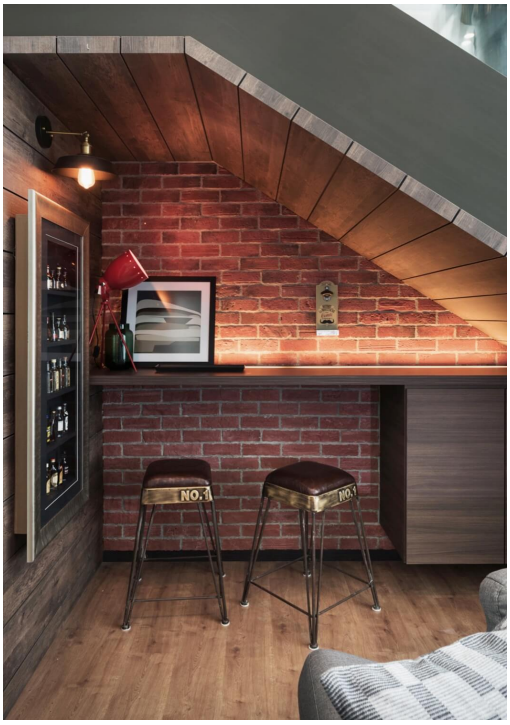
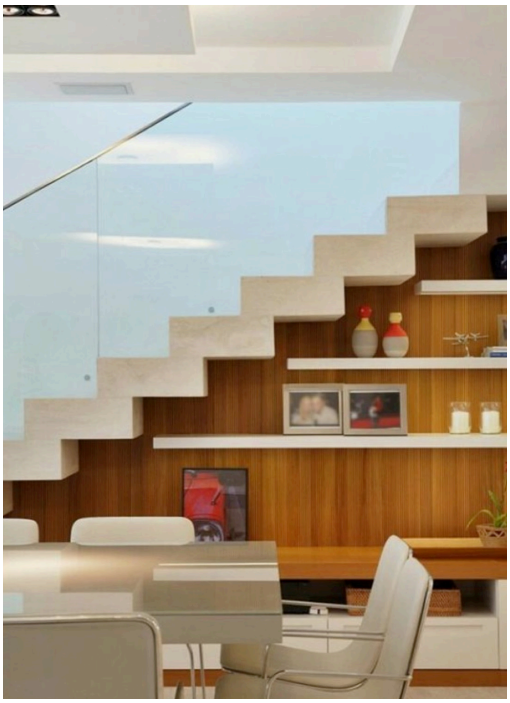
03
Pedro House by VDV ARQ
https://architizer.com/projects/pedro-house/

Under Staircase Storage Ideas





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https://www.archilovers.com/projects/204853/gallery?1872514
02
Pinterest
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03
https://www.reciclaredecorar.com/2016/09/ideias-para-usar-prateleiras-na.html
04
Architectural Digest

Narrow Staircase Ideas

01
Archdaily
https://www.archdaily.com/104506/volgadacha-house-buro-bernaskoni
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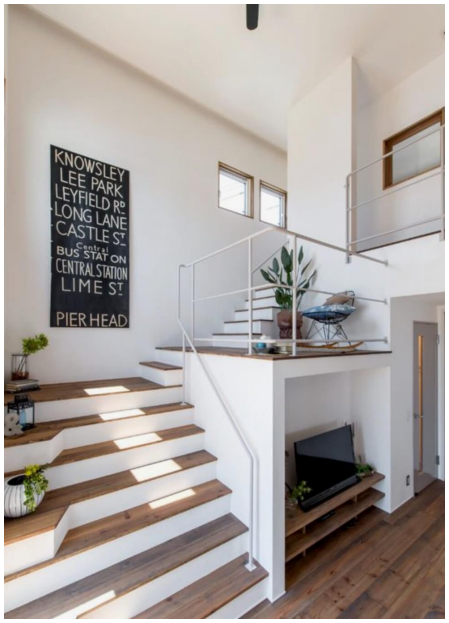
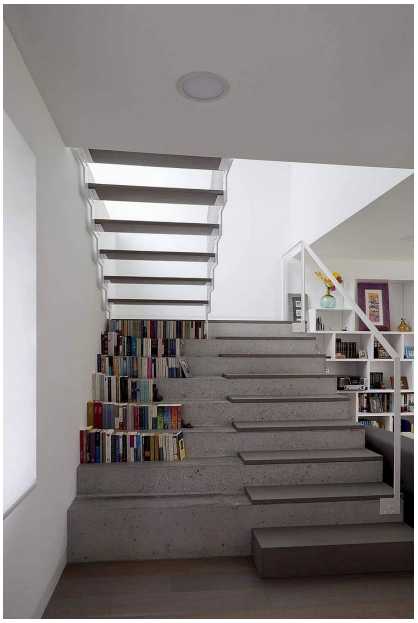
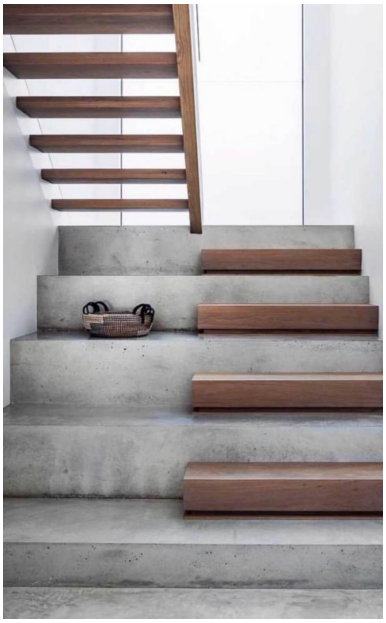
https://www.pinterest.co.uk/pin/369365606936524006/

Wide Stair Ideas







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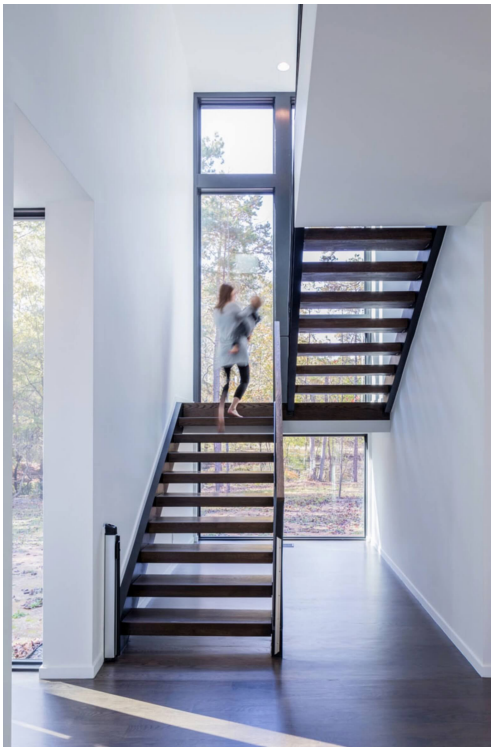
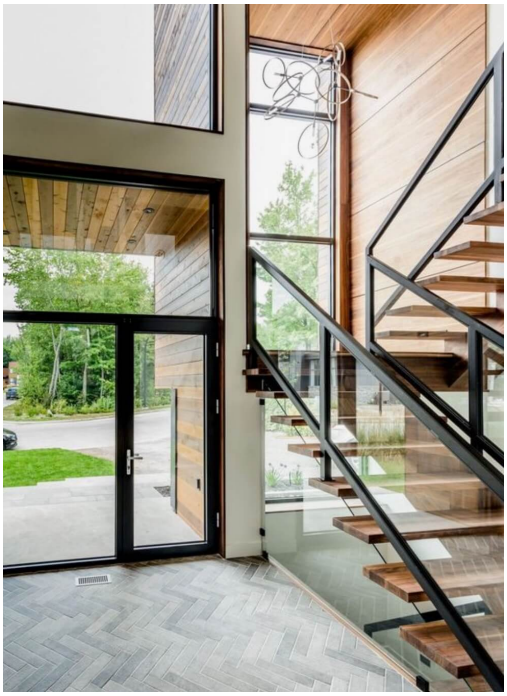
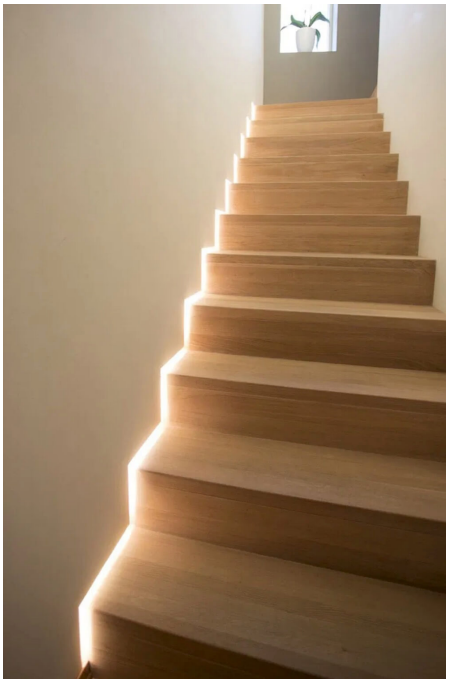
Natural Light Stair Ideas

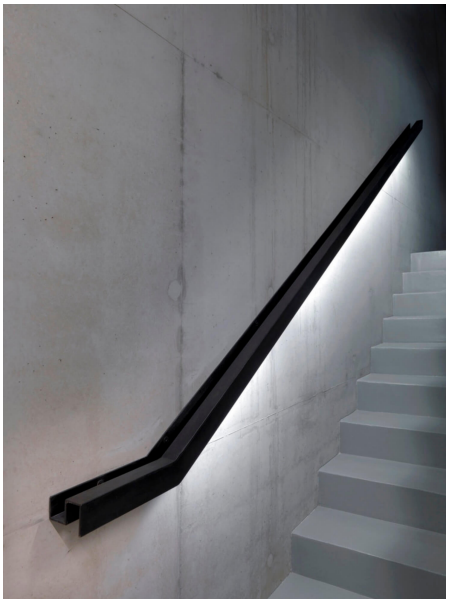




01
In Situ Studio
https://www.contemporist.com/house-surrounded-by-trees-overlooks-a-woodland-pond/
02
https://www.homestratosphere.com/entry-ideas/
03
Trendir - image credit Borje Muller
https://www.trendir.com/austrian-wooden-houses-timber-clad-inside-and-out/#more
04
Quattro - Luciano Lerner Basso - Archdaily
https://www.archdaily.com/781537/quattro-luciano-lemer-basso?ad_medium=gallery

Stairs with Integrated Lighting Ideas





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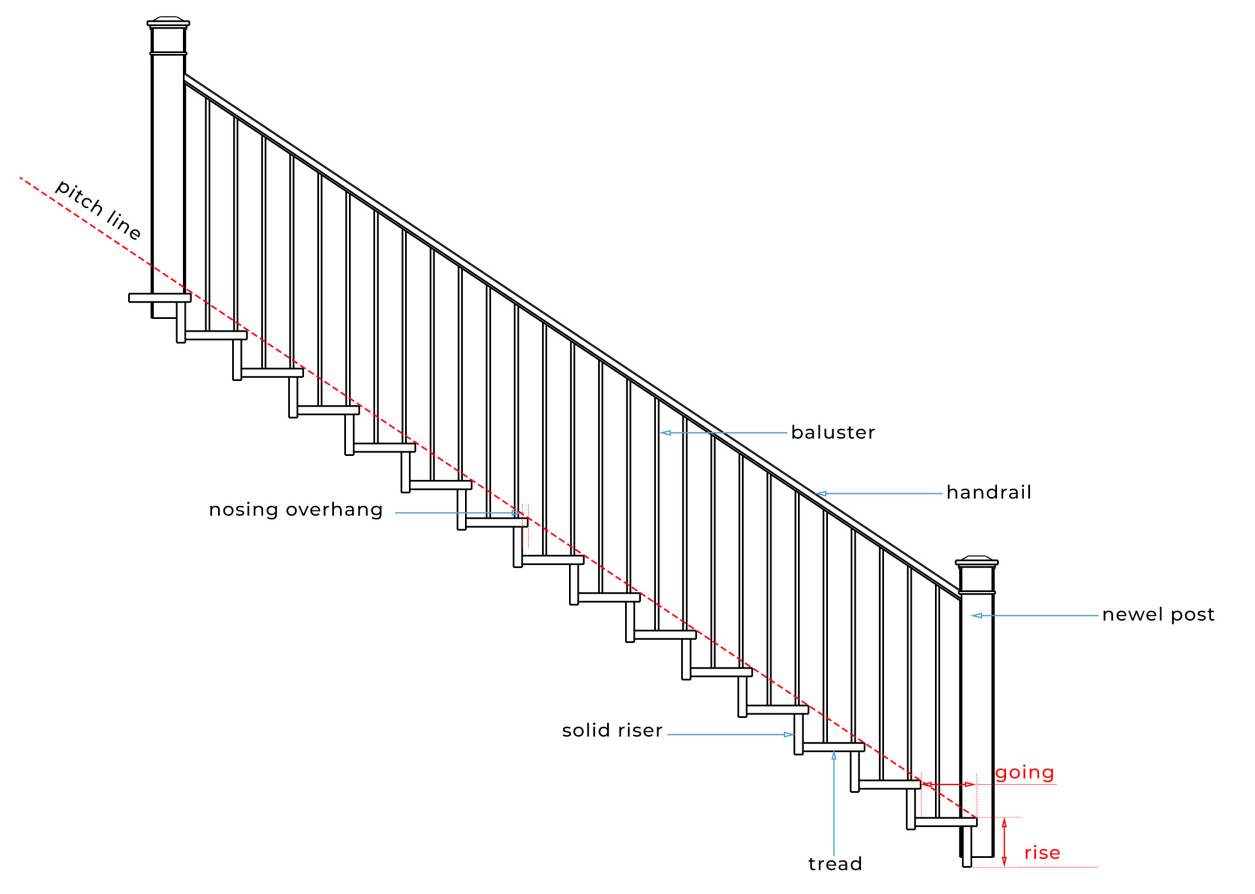
02 - Staircase Terms and Layouts

In this section of our stair guide we will look at the terminology of different parts of the stair, along with some different stair layouts that can be incorporated into your design.



Stair Components

Strings: A span of timber to which treads and risers are attached to support a flight or run of stairs. The string runs from top to bottom of a traditional timber staircase.

Tread: The horizontal part of the stair that is stepped on.

Risers: The vertical part of the stair. If the riser is solid, it is a solid riser, whereas if there is no solid part to the riser it is known as an open riser. The number of steps in a staircase is counted by the number of risers, not the number of treads.

Nosing: the edge of the tread projecting beyond the face of the riser.

Balustrade: A row of balusters (spindles) topped by a handrail serving as a safety guarding and along the edge of a staircase.

Handrail: The handrail is the top part of the balustrade, usually between 900mm and 1100mm high. The handrail should follow the stair from top to bottom to guide the user through the complete flight of stairs.

Newel: A large baluster or post acting as a structural element to anchor the balustrade to the floor or stair.

Winder: A stair that is narrower on one side to enable a turn in the staircase. A series of winders form a circular or spiral stairway.

Stair Terms

Flight: The flight is an uninterrupted series of steps.

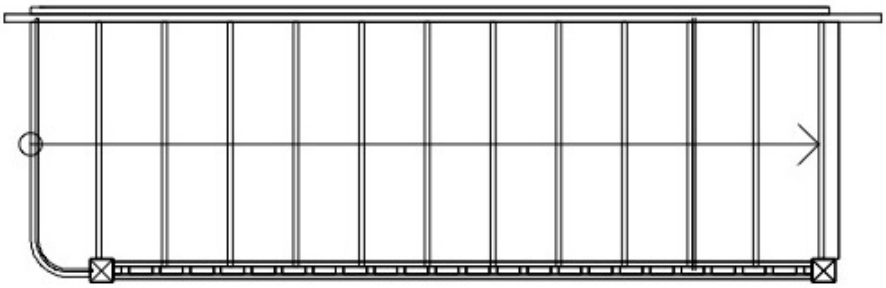
Rise: The rise is the height of an individual step. There are specified requirements in the building regulations for the rise of a step according the to use of the stairs - ie, private dwelling, public buildings etc.

Going: The going is the depth of the individual step, measured from nosing to nosing.

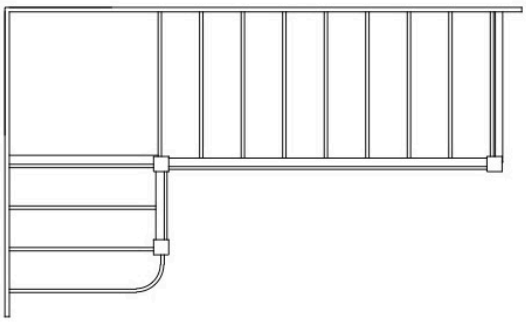
Pitch: The pitch is the angle of the staircase, again there are specific requirements on pitch according the the building regulations.

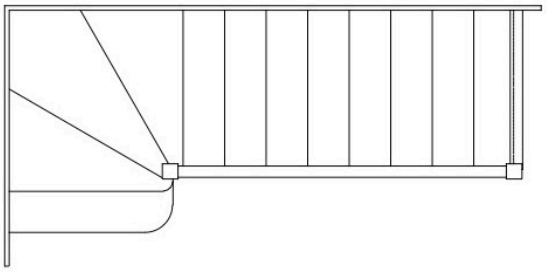
Stair layouts

Straight run stair

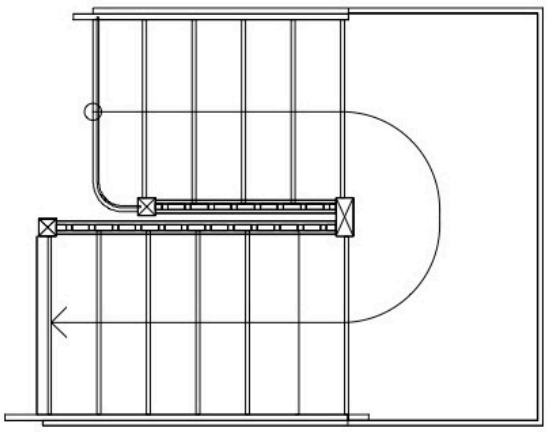


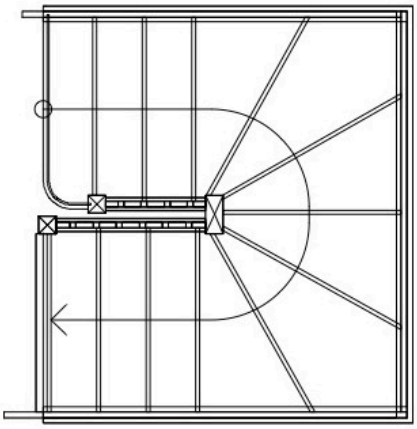
L-shaped stair (quarter turn) with landing and L-shaped stair (quarter turn) with winders



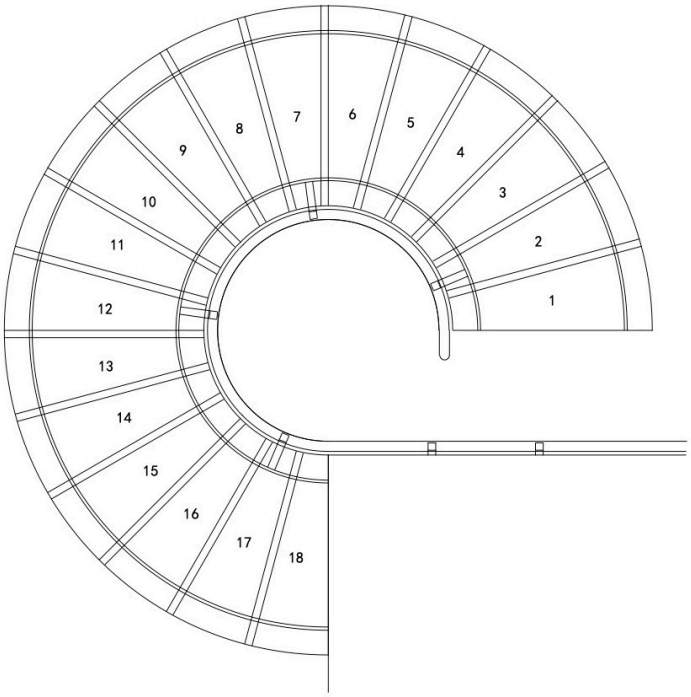


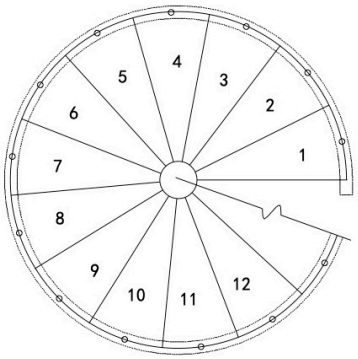
U-shaped stair (half turn or dog leg) with landing and U-shaped stair (half turn or dog leg) with winders



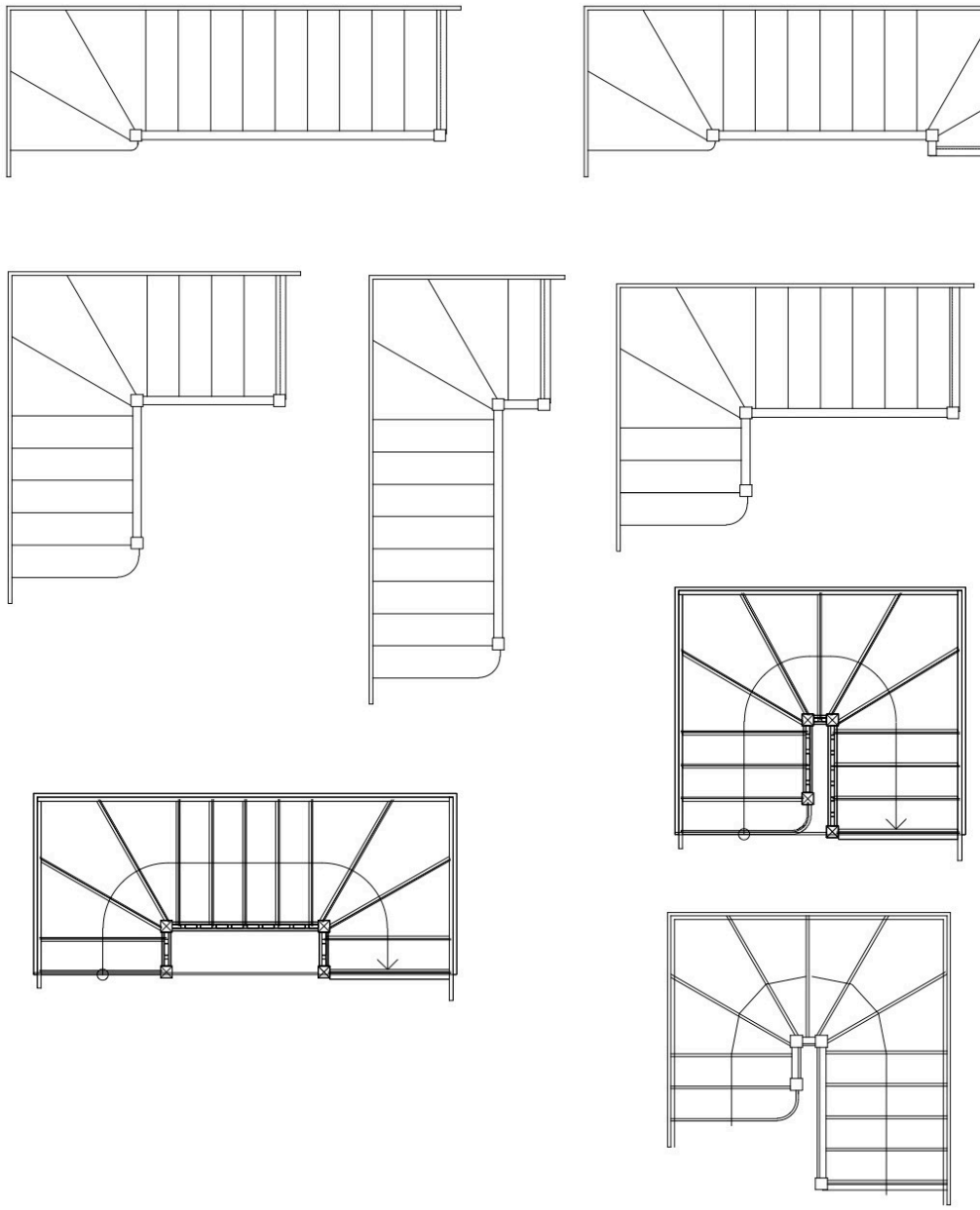


Spiral stair and Curved stair





Other Stair Layouts

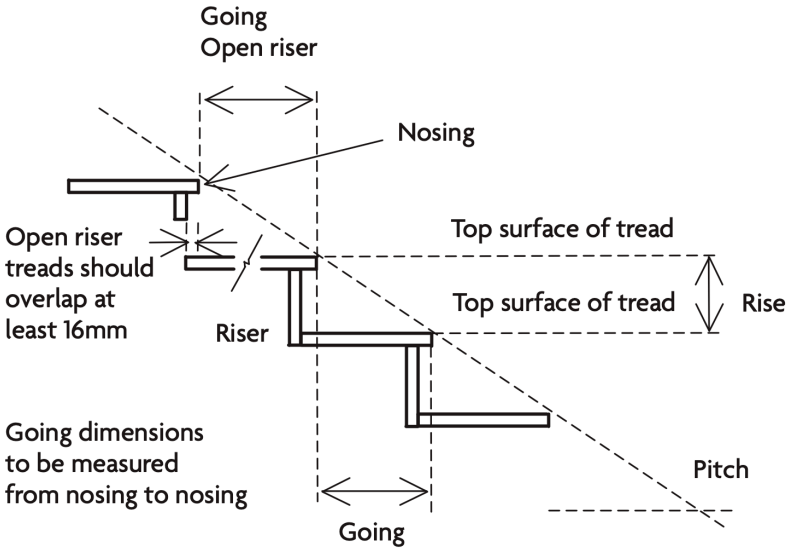


03 - Stair Regulations

Stair Design England Building Regulation Requirements (Private Dwellings)

The following notes refer to the English Building Regulation Requirements for designing a stair in a private dwelling from Approved Document Part K. Please refer to Approved Document Part B for recommendations and guidance for Fire Safety in stair design.

Rise and Going:



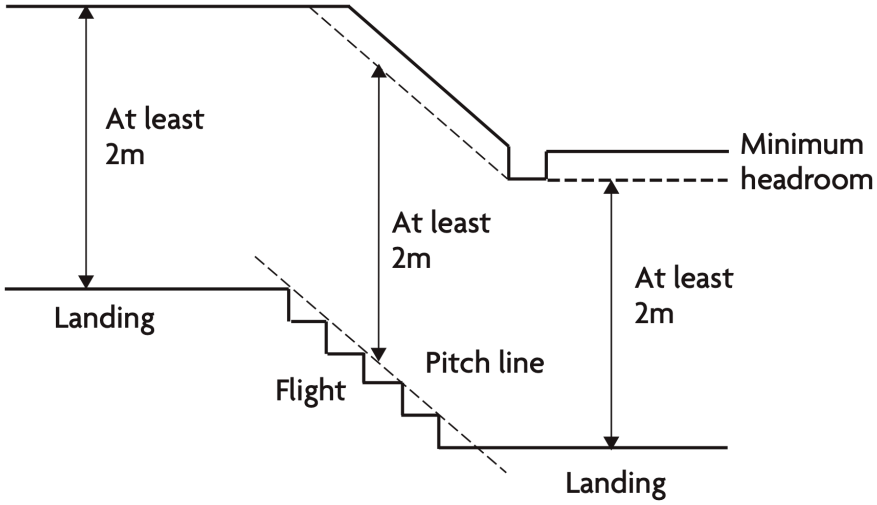
The rise of a stair must been between 150mm and 220mm, with any going between 220mm and 300mm and a maximum pitch of 42 degrees.

Rule of thumb: twice the rise plus the going or/ 2R + G should be between 550mm and 700mm

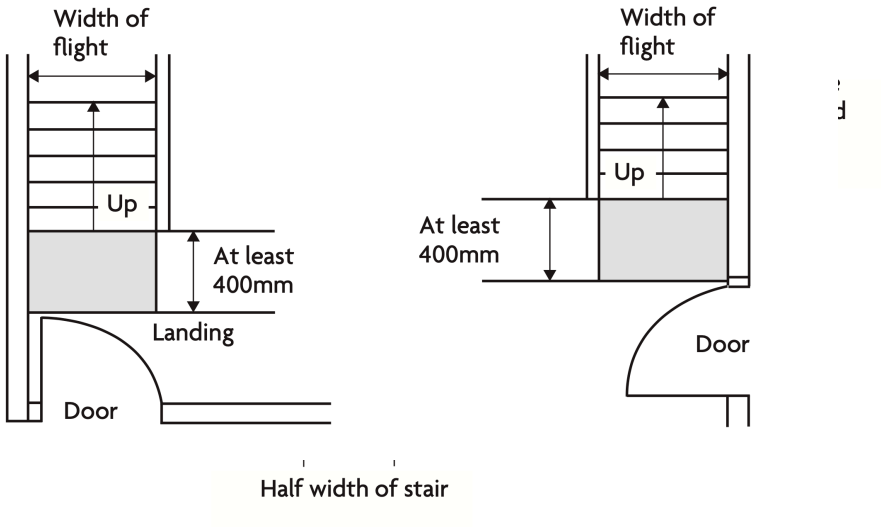
Steps may have open risers if the treads have an overlap of minimum 16mm, a 100mm diameter sphere cannot pass through the open riser.

Headroom:

Minimum headroom should be provided according to image below.



Where there is reduced headroom for loft conversions - a reduced headroom can be provided according to the image below.

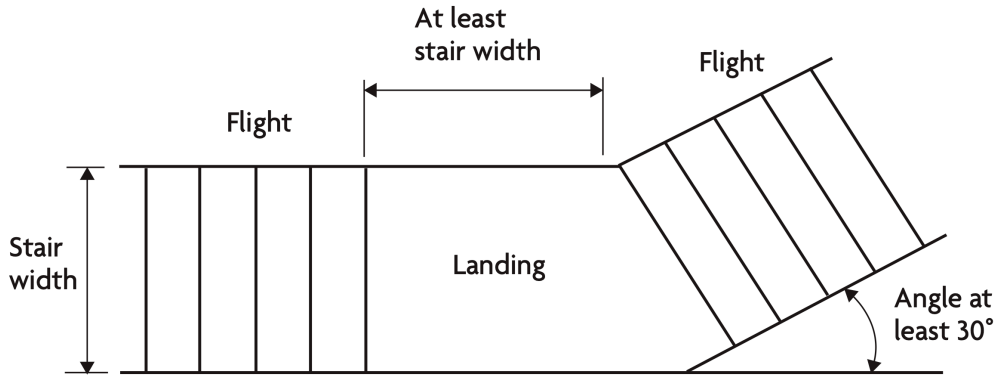


Width of Stairs

There are no specific requirements for the width of a stair to a private dwelling, however we recommend 900mm.

Length of flights of stairs

If a stair has more than 36 risers in a consecutive flight, a minimum of one change of direction between flight will be required. The change of direction must be a minimum of 30 degrees.



Landings

Landings must be level, and kept clear of all obstructions.

A landing must be provided at the top and bottom of every flight of stairs.

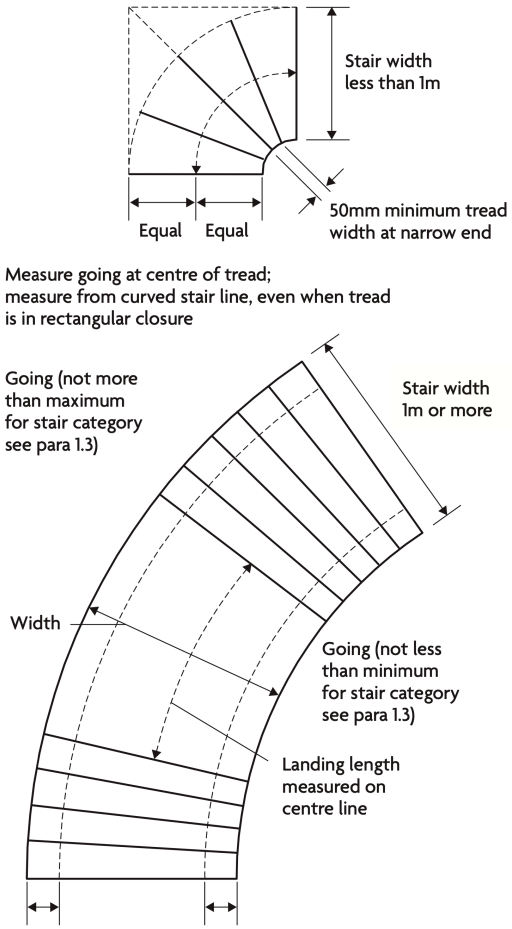
The landing distance in front of the top and bottom step must be longer than the width of the staircase.

A door may swing across a landing at the bottom of a flight of stairs but only as shown in the image below.

Tapered treads

If a stair consists of straight and tapered treads - ensure that the going of the tapered treads is not less than the going of the straight treads.

Refer to the diagrams below.



Handrails

The top of a handrail must be 900mm to 1100mm from the pitch line or floor.

If the stairs are 1000mm or wider, provide a handrail on both sides of the stair.

04 - Materials and Considerations of Design

In this section we will look at some of the considerations needed to design stairs.

Safety

Stairs form a primary means of escape to the outside in case of fire or emergency so it is important to ensure the stairs can be used safely. This includes ensuring handrails are fixed at

the right height and in accordance with Approved Document Part K, along with keeping rise and tread dimensions consistent.

Fire Safety

The building regulations should be consulted for all fire related requirements of a stair. The stairs are a principle means of escape and must be constructed of materials that are able to maintain a fire resistance for a specified period of time. Stair must also be protected from fire and smoke, and they must be constructed to allow for a safe escape from the building. Refer to Building Regulations Approved Documents Part B.

Consider things like integrity of materials during a fire and size of steps for ease of escape.

Sound

Materials for the stair treads should be designed to minimise impact sound from foot traffic. A metal or timber stair can be noisy when in use, but a concrete stair absorbs more sound. The materials chosen will depend on many factors including cost, client preferences, location, structural requirements and much more.

Materials

Internal stairs can be made out of a multitude of materials, such as timber, concrete, stone, metal and structural glass.

In a standard residential home timber is the most common material for stairs, often prefabricated off site.

Timber stairs can integrate easily into a design, and can be altered on site as needed. Timber has a relatively poor resistance to fire so they tend to be restricted to residential use only. There are many options for a timber stair design, given the versatility of the material. Timber stairs can be traditional in style or contemporary, with cantilever treads from the wall for example. In this case the structural support of the stair is concealed in the wall, from which the stair treads are cantilevered.

A softwood can be used for timber stairs, which is the more economical option, or hardwoods such as oak, walnut or ash can also be used that are more expensive but durable. Timber can also be incorporated with other materials, like metal or glass.

Concrete stairs can be made in situ using specific formwork to create the stair with a screed added afterwards to allow for a smooth finish. The finished stair can be polished, painted or clad in another material. Alternatively concrete stairs can be supplied precast in sections and assembled on site.

Concrete stairs will have a good fire resistance and better impact sound absorption. Stone stairs also have a good fire resistance and impact sound absorption and give a very solid feel to the staircase. For a strong and solid look, but reducing the cost, it is possible to clad stairs with a stone panel finish to get the desired stone appearance.

Glass stairs allow for light to flow easily between rooms or floors in the house. This is a great option to increase the natural light in a space. There are many ways glass can be used in stair design.

Metal stairs can be designed for an industrial heavier feel or be more lightweight and less heavy in appearance than timber. Metal is often used for balustrades in the form of light weight balusters, or even mesh or tension wires.

05 - How to Calculate Stairs

Working out stairs can sometimes be a bit of a headache. In this article we are going to look at how to calculate stairs, the quick and easy way to work out your stair requirements.
First, take a look at the regulations that we can use as a starting point for working out our risers and our going.

Table 1.1 Rise and going

	Rise*		Going*	
	Minimum (mm)	Maximum (mm)	Minimum (mm)	Maximum (mm)
Private stair[1,2]	150	220	220	300
Utility stair	150	190	250	400
General access stair[3]	150	170	250	400

Notes:
[1] The maximum pitch for a private stair is 42°.
[2] For dwellings, for external tapered steps and stairs that are part of the building the going of each step should be a minimum of 280mm.
[3] For school buildings, the preferred going is 280mm and rise is 150mm.

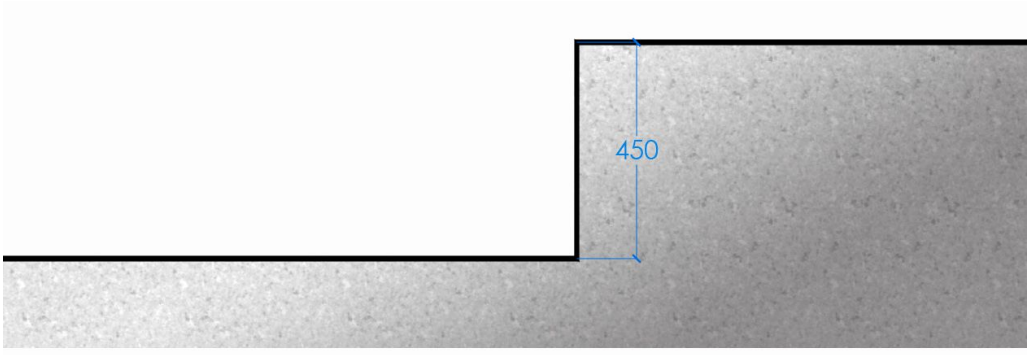
* The normal relationship between the dimensions of the rise and going is: twice the rise plus the going (2R + G) equals between 550mm and 700mm.

For existing buildings the dimensional requirements in Table 1.1 should be followed, unless due to dimensional constraints it is not possible. Any alternative proposal should be agreed with the relevant building control body and included in an access strategy (refer to Approved Document M).

For the purpose of the following examples we will look at the regulations for Private Stair.

Example 1

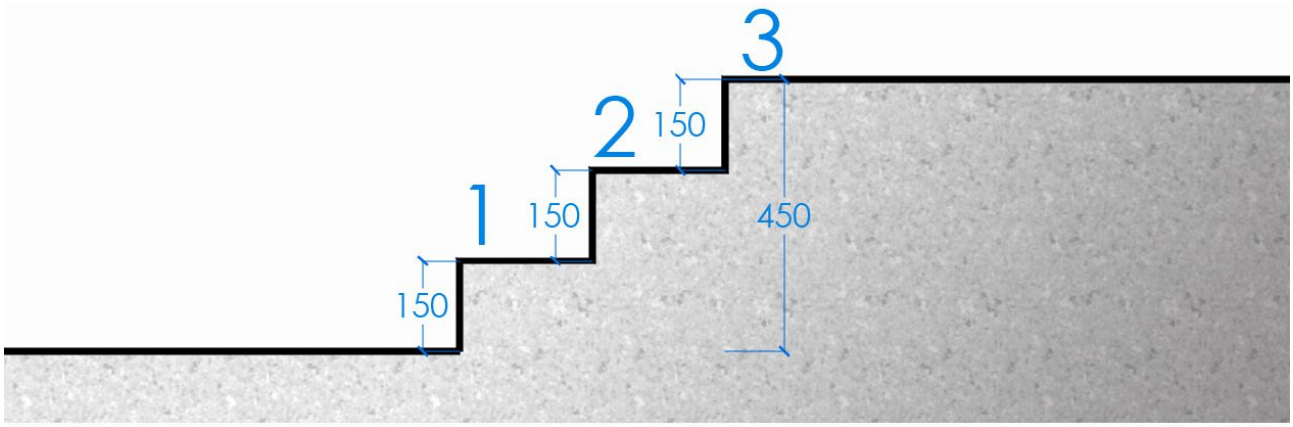
Determining the risers



Above we have a change in level that requires a few steps. There is a floor to floor level of 450mm.

If we refer to the regulations we can choose a riser height between **150mm and 220mm**.
Take the minimum riser height of 150mm. Divide the overall change in level (overall rise) by 150mm.
450mm / 150mm = 3

This tells us that with a riser of 150mm we will need 3 risers/steps.



Perhaps we decided we would rather have 2 steps instead of three. We can divide the change in level by the amount of steps we want:

450mm / 2 = 225mm

Having two steps will give us a rise of 225mm which according to the regulations above would be over the maximum allowance for a riser. So in this case we have to have a riser of 150mm giving 3 steps.

Determining the Going / Run

As indicated in the regulations above, a normal relationship between the dimensions of the rise and going is:

Twice the Rise plus the Going (2R + G) should be between 550mm and 700mm

To continue with the previous example let's select a low going of 220mm.

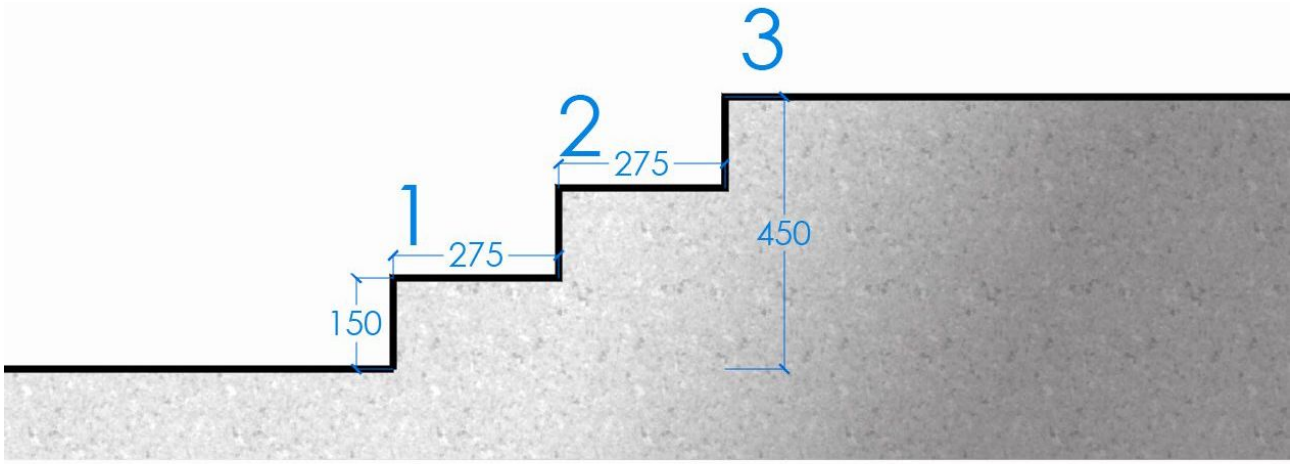
This gives us **2 x 150mm + 220mm = 520mm**

As we can see from the guidance above, it is recommended the outcome is between 550mm and 700mm

So let's now try 275mm

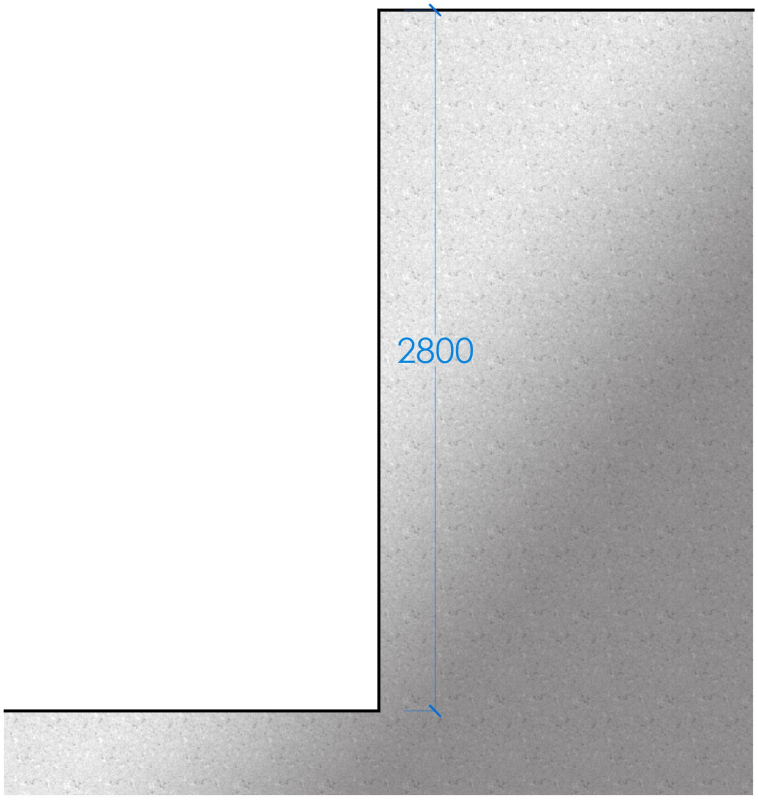
2 x 150mm + 275mm = 575mm

As we can see this is within the normal limits so we can happily go with 150mm risers and 275mm going.



Example 2

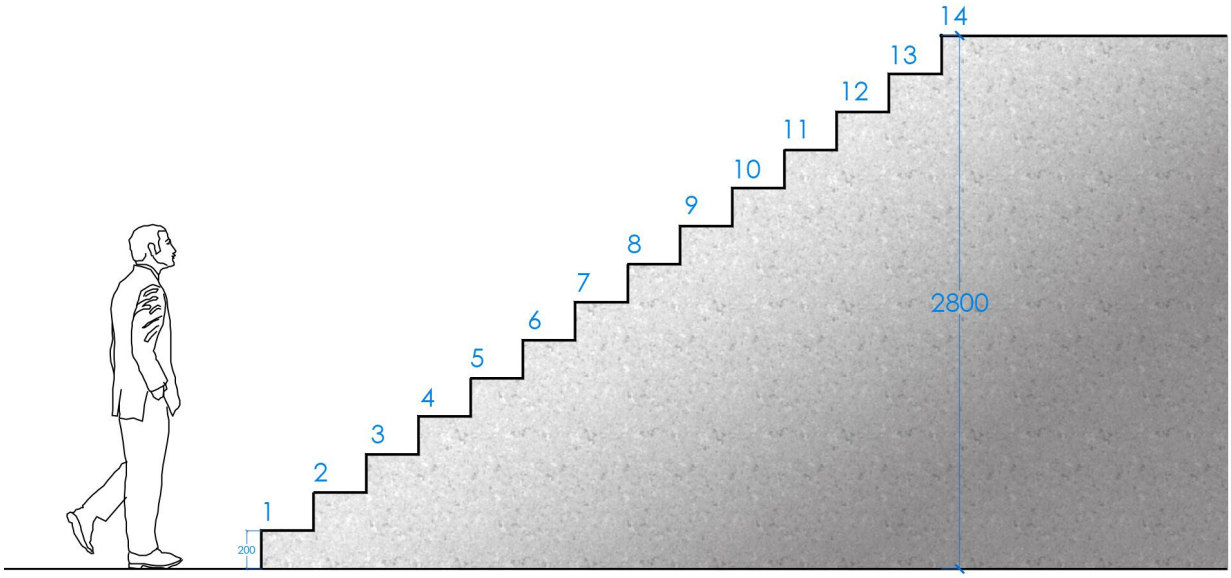
In this example we will take a Floor to Floor level of 2800mm (Total Rise).



If we refer back to the guidance we can use between 150mm and 220mm as a riser.
Take 200mm as a riser (a nice round number and not too shallow). Now divide the total rise by the suggested riser distance.

2800mm / 200mm = 14

This gives us 14 risers at 200mm



Referring back to the guidance we can have a going between 220 and 300mm
Lets take 275mm as a starting point.

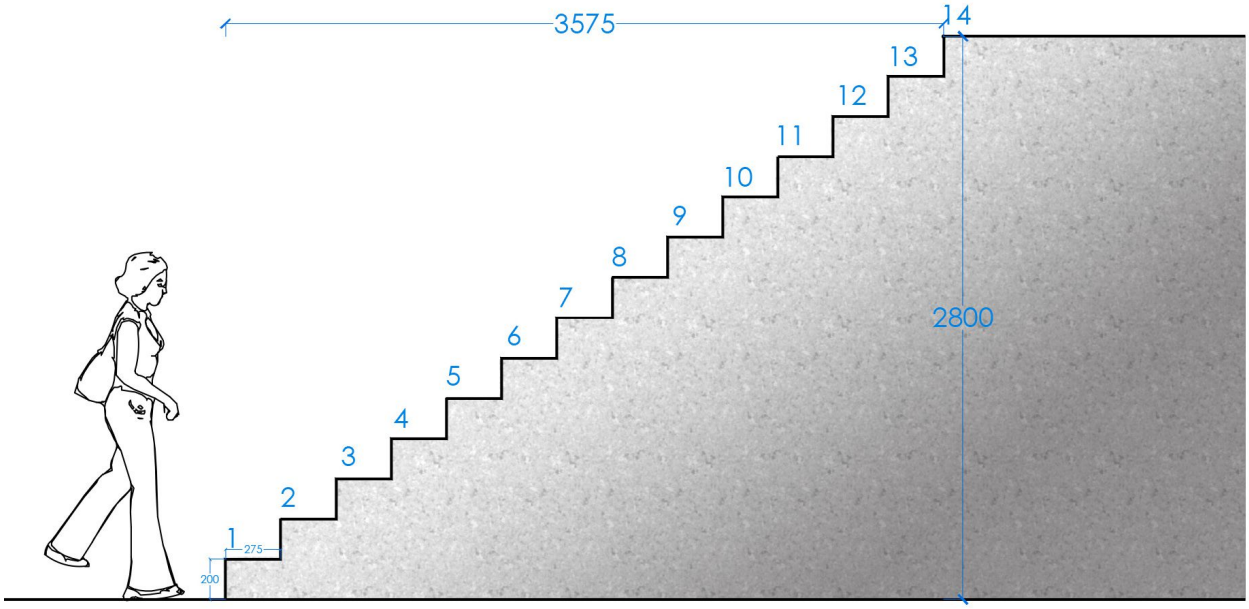
To check if this is ok we can carry out the **2R+G**

2 x 200mm + 275mm = 675mm

This is within the range of 550mm and 700mm so we can assume this is acceptable.

The image below shows the finished stair. Note that the total run does not include step 14.

[Be aware that according to the regulations a stair of 14 risers would require a landing – see further down this article for details]



How to work out the angle of the stair

We can also work out the angle of the stair (as according to the guidance it can be a maximum of **42 degrees**).

In order to work out our stair angle we can use a bit of basic trigonometry.

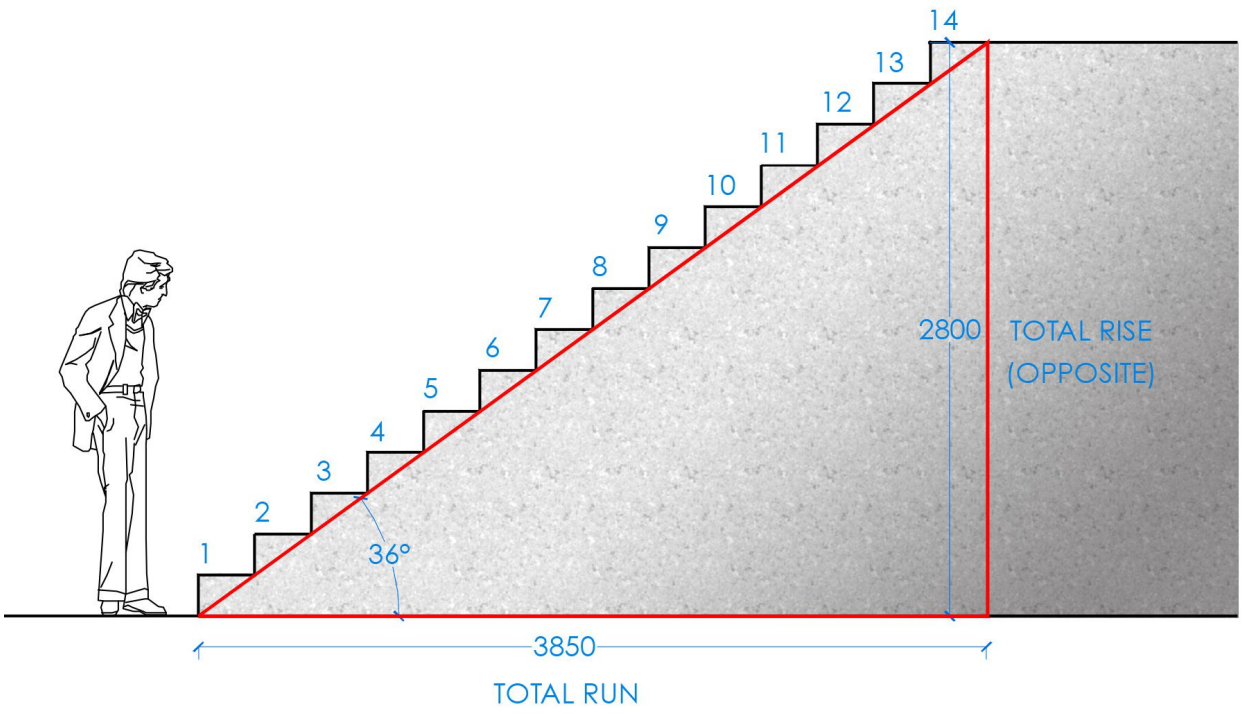
Total rise = 2800mm

Total run (when working out the angle) = no of risers x going

Total Run = 14 x 275mm

Total Run = 3850mm (note that when working out the angle the top step 14 is included in the total run)

Tan = Opposite / Adjacent



So:
Opposite / Adjacent =

2800 / 3850 = 0.72

Inverse Tangent of 0.72 =36 degrees

Any outcome of Opposite / Adjacent that is under 0.9 will be under 42 degrees.

You can also work out the angle by using the calculation run / rise. So for this example:

Run = 200

Rise = 275

200/225 = 0.72

Inverse Tangent of 0.72 = 36 degrees

I hope you found this guide useful.

Don't forget you can find all the original posts on **First In Architecture** - just search "Stairs".

We also have some useful CAD Blocks for Stairs here:

https://www.firstinarchitecture.co.uk/free-cad-blocks-stairs-02/

https://www.firstinarchitecture.co.uk/cad-blocks-stairs-01/

And this might be useful too:

https://www.firstinarchitecture.co.uk/how-to-calculate-slopes-and-gradients/

An article demonstrating how to calculate slopes and gradients.

Finally, head over to Pinterest and give us a follow - our Pinterest boards are full of Stair inspiration and a whole load more great architectural inspirational ideas and images.

First In Architecture on Pinterest