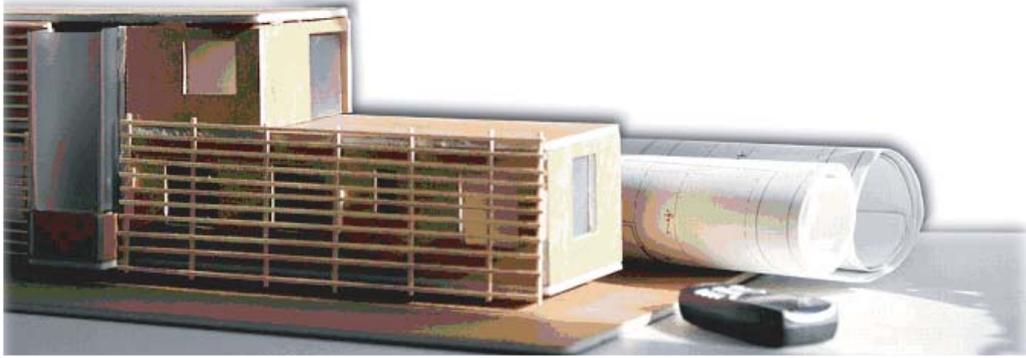


# Building shapes

Architects move from ideas to plans to models and finally their designs are built. **They have to be able to communicate their ideas.**

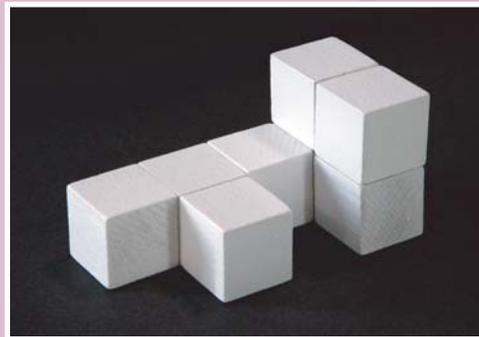


building for the future

Build a **hidden shape**...

with **8 cubes** and describe it to your partner.

Your partner has to try to build it just from your description.

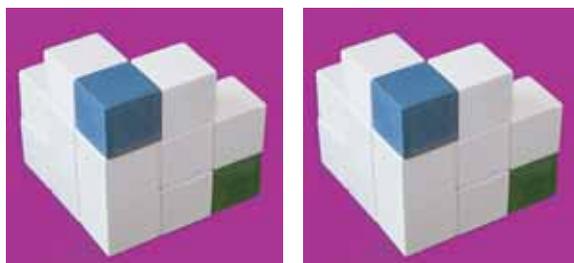


**Compare your shapes. Are they the same?**

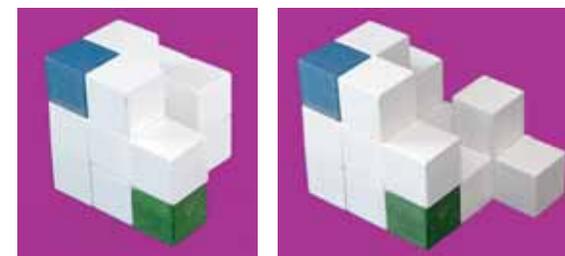
# Different views



These two models look the same ...



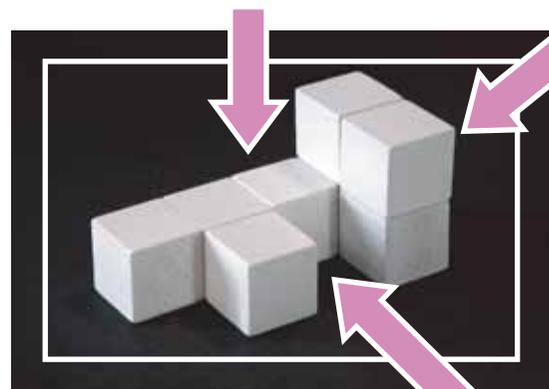
... but turn them to the left and view them from a different angle and they turn out to be quite different:



Plan view

Side view

One way round the problem is to think about the view from three different directions, from the **front**, from the **side**, and from the **top**...



... and then use a **code** to show how many cubes there are in any particular position.

Front view:

Front view code:



0	0	0	2
1	2	1	2

Plan view:

Plan view code:



1	1	1	2
0	1	0	2

Side view: Side view code:



1	1
2	4

Build a **hidden shape** from 5 cubes with your partner. Work together to write down the **code** for each view. Swap codes with another pair. Try to **build the new shape** just from the codes.

## Build this shape

....from its **front view**, **plan view** and **side view** codes.

front view

0	1	0
1	2	2

plan view

1	2	1
0	1	1

side view

0	1
2	3

## Build another shape

....with the same **side view** which would also fit into a 2 x 3 x 2 cuboid.

Record its **plan view** and **front view** codes.

How many shapes can you build with the **same side view**?

0	1
2	3

Which of these shapes can't be made?

front view

1	1	1
2	2	2
3	3	3

plan view

3	3	3
2	2	2
1	1	1

side view

3	0	0
3	3	0
3	3	3

front view

0	0	1
0	2	2
1	2	3

plan view

0	0	1
0	2	2
1	2	3

side view

0	0	1
0	2	2
1	2	3

front view

0	1	0
2	1	2
3	3	3

plan view

2	1	2
1	3	1
2	1	2

side view

0	1	0
2	1	2
3	3	3

front view

0	1	0
3	2	1
2	2	2

plan view

1	1	0
2	2	2
2	2	1

side view

0	1	1
1	3	2
1	3	3

front view

1	1	1
1	2	1
1	3	1

plan view

0	2	0
3	2	3
0	2	0

side view

0	3	0
1	2	1
1	3	1

## Building for the future : Architect's skills

### Description

This topic explores aspects of the 3-D thinking involved in developing architectural ideas to plans and models through a series of mathematical activities.

#### Activity 1: Building shapes

#### Activity 2: Different views

#### Activity 3: Decoding plans

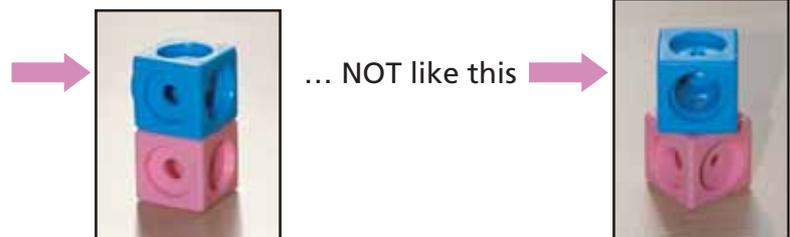
**Building shapes** introduces the architect's skills of listening to their clients and interpreting descriptions of their ideas. This activity invites one pupil to build a hidden shape and describe it for their partner who listens to the description and tries to make a copy of the builder's shape. Pupils could work in pairs or in small groups. They will need enough time so that each person in the group has the chance to be a builder.

### Resources

Multilink is available from Arnold.  
<http://www.nesarnold.co.uk/>



Multilink is a practical choice for the building material. Pupils may need telling that the cubes should be joined together so that the square faces are lined up like this:



The pupils might end up with a shape like one of these:



The builder's task is to describe their shape using only words. Some pupils will find this difficult and will need reminding not to use hand gestures. This activity will help them develop the accurate use of language to convey mathematical ideas. Comparison of the builder's shape with their partner's copied shape offers rich opportunities for mathematical discussion which emphasises and encourages the need to be unambiguous.

Increasing the number of cubes to 10, or even more, extends the activity.

# Building for the future : Architect's skills

**Different views** introduces some of the skills needed by architects when they draw different views and plans for a project. This activity is designed to engage pupils in visualising a three dimensional object from limited but sufficient information.

The task is to reduce different views of a simple multilink model to a code which describes the number of cubes to be found in each position. An example of this is included in the pupil activity sheet. This, or a similar example, can be used with the whole class to illustrate the method of coding as a starter activity. There is ambiguity over which side view to use in the example offered. This ambiguity could be addressed from the outset or you may want to leave this for the pupils to discover, offering them the opportunity for further mathematical thinking. The pupils may also question how to code "holes" in their models.

**You may want to make links with other conventions, for example, orthographic projections.**

In **Decoding plans** the pupils are first asked to build a shape from the codes for its front view, plan view and side view. This assumes experience with the coding developed in **Different views**. The other puzzles offer further challenges which engage pupils in thinking about different shapes with the same side view and which shapes are possible to build from given codes. You could also ask the pupils if they can make any more shapes in a  $3 \times 3 \times 3$  cube which have the side view

## side view

3	0	0
3	3	0
3	3	3

Alternatively, you could encourage your pupils to find out which of the shapes is completely determined by just one of its views.

## The mathematics

These activities will develop the process skills involved in understanding and making sense of mathematical information.

All of the activities require thinking about geometric information presented in a variety of forms. **Building shapes** will involve the use of the visualisation and mathematical vocabulary of 3-D shapes.

**Building shapes**, **Different views** and **Decoding plans** give opportunities for construction of models using the geometry of cubes and other shapes made from cubes. All three activities require the interpretation of geometric information presented in different forms, moving from one form of representation to another.