Here's what you need to know...

about nuts, bolts and washers.

See *Design & Make It! Resistant Materials Technology* Revised pages 120–121 (112–113 earlier edition).

KEYWORDS
Do you know what the following terms mean?
- Thread
- Diameter

Fixing It All Together

Deciding on the way in which different pieces of materials are joined together is an important part of the design process. There are a variety of pre-made components, such as screws and nails, and different adhesives that are available. Durability, safety, cost and ease of working all need to be taken into consideration. Ideally, there should be as few fastening operations as possible in order to reduce production time and costs.

Nuts and Bolts

Nuts and bolts are removable fastenings for metal and wood. A bolt has a screw thread. The nut fits on to the end of the bolt and it revolves up the screw thread towards the head. Bolts are usually used with a washer that is placed underneath the nut between the nut and the screw thread.

Types of nuts

There are a range of types of nuts to choose from.

- Hexagon: the basic nut, tightened with a spanner.
- Wing nut: used with removable fittings, tightened by hand.
- Locknut 1: used with a standard nut to stop the first nut from coming loose. The two nuts are tightened against each other.
- Locknut 2: nylock type nuts have a nylon insert and resist coming loose without a second nut being used.
- Cap nut: this gives a decorative finish at the end of a bolt.

Bolts

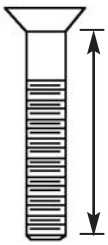
There are two main types of bolts to choose from.

- A standard bolt. This is only threaded for part of its length.
- Set machine screws. These are bolts that are threaded for their whole length. They are screwed into a threaded hole to fix two parts together.

Both types come in a variety of lengths and diameters.

There are many types of bolt heads, including slot head, countersink, and cheese head. Hexagonal or socket head screws are known as Allen screws.

Sizes of Bolts



Bolts are measured by the length of the body, not including the head.

'M' means the outside thread diameter in mm. The thread can be either coarse or fine.

Washers

Washers are available in a range of sizes and thicknesses. Their size is the diameter of the hole measured in mm. There are several types of washer:

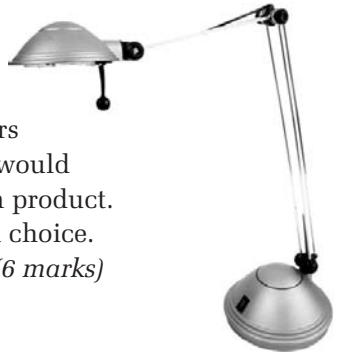
- Plain washer: used to spread pressure over a larger area and protect the surface of the part being joined.
- Spring lock washer: stops the nut from coming loose. Made from spring steel.
- Toothed washers: these have spikes that bite into soft material, providing extra grip.

Written Question

Spend about 6 minutes answering the following question. You will need some paper and something to write with.

Here is a list of products where a nut and bolt would be a suitable method of fixing.

1 A desk light where the arm can be adjusted to different angles.
2 A climbing frame in a children's play area.
3 A flat-pack bookcase.



For each of the three products above give details of the types of nuts, bolts and washers (if required) that you would specify for use in each product. Give a reason for each choice.

(6 marks)

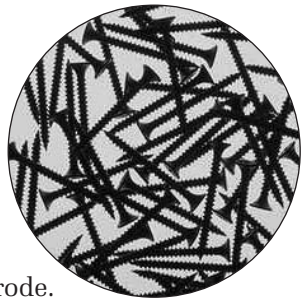
Here's what you need to know...

about different types of screws.

See *Design and Make It! Resistant Materials Technology*
Revised pages 101 and 120–121 (93 and 112–113 earlier edition).

KEYWORDS
Do you know what the following terms mean?
- Shank
- Gauge

Fastening Wood



Wood is often joined using screws made from steel, brass, aluminium and stainless steel. They are available in a variety of different finishes including: bright zinc plate, nickel plate, chrome plate, brass plate and black japanned.

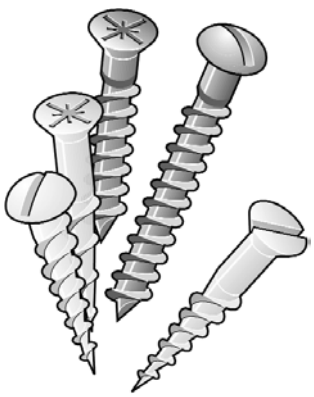
- The heads of steel screws should be painted with metal primer if they are used in damp conditions, as they corrode. Non-corroding steel screws are available.
- Brass screws are used with decorative brass fittings. They are expensive and break easily. It is important that the correct size of pilot hole is drilled first.
- Aluminium screws are useful for wood as they do not stain or rust.

Pieces of wood can also be jointed together without the need for fastenings or adhesives, though these are sometimes used as well to give extra strength. However, using joints can add a lot of time to the construction process. There is more information about using joints in Topic 7 section 4.

Sizes of Screws

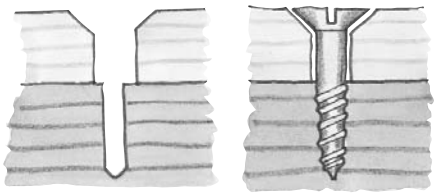
The size of a screw is the diameter of the shank, or unthreaded part. Screw size is measured by gauge numbers. These go from 4 to 12 in even numbers. 4 is small and 12 is large.

The length of a screw is measured from beneath the head to the tip. Each gauge of screw comes in a range of lengths, varying from 10mm to 100mm.



Clearance Holes and Pilot Holes

Clearance holes are drilled in the top piece of wood and need to be big enough to allow the shank of the screw to pass snugly through it. The pilot hole is drilled into the lower piece of wood and needs to be smaller than the threaded part of the screw.



Screw Heads

These come in a variety of types. Decorative press covers are available for Phillips and Pozidrive screws. Dome head screws have a metal dome and are usually used for mirror fixing. Countersunk headed screws need a countersunk hole for a flush surface finish.

Written Question

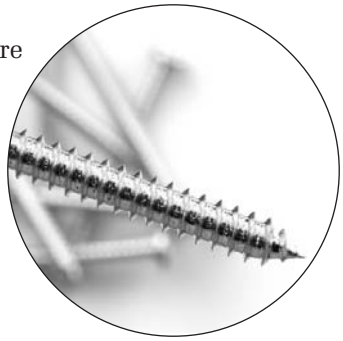
Spend about 8 minutes answering the following question. You will need some paper and something to write with.

Using words and drawings, explain fully the four main steps for joining two pieces of wood together using a countersunk screw. *(8 marks)*

Fastening Metal and Plastic

Self tapping screws are used to join thin sheet material together, or join to thin sheet metal or plastic. There are two types:

- Thread forming, which are pointed and are used for soft materials.
- Thread cutting, which are blunt-ended and can be used on all materials.



Here's what you need to know...

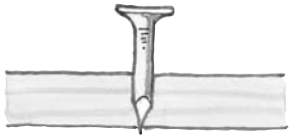
about the use of nails, pins and rivets.

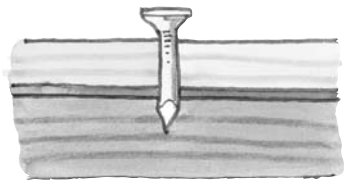
See *Design and Make It! Resistant Materials Technology*
Revised pages 62, 100
(54, 92 earlier edition).

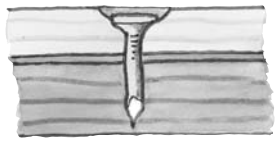
KEYWORDS
Do you know what the following terms mean?
- Nails and pins
- Rivets

Nails and Pins

Nails are metal pins with heads. They are used to join two pieces of wood and/or manufactured board together. The head stops the nail from being pulled through the top piece of wood or manufactured board if the two pieces are pulled apart.







There are many different types of nail that can be specified, but the most common are:

- Round wire nail: used for general carpentry.
- Lost head wire nail: used for general carpentry. The head is not exposed, so should be used where appearance matters.
- Oval wire nail: oval, so less likely to split wood.
- Panel pin: general purpose. The head can be punched beneath surface of wood and filled.
- Hardboard nail: used for hardboard. Made of copper, it will not discolour paint.
- Staple, square: used for upholstery.
- Tack: used for upholstery.
- Decorative upholstery nail: used for exposed upholstery fixings.
- Gimp pin: used for fixing upholstery braid.

In the building industry there are special nails for almost every job, from attaching laths in a roof (lath nails), to rough fixing into masonry (cut clasp nails).

Rivets

Rivets are a quick and convenient method that is often used to join sheet metal together. They are usually made from aluminium, but also come in copper and stainless steel.

Common diameters are 3, 4 and 5mm and they are available in three different lengths.
They are often used with backing washers.

To fix rivets a hole needs to drilled that is just big enough to allow the rivet to pass snugly through it. The rivet is then inserted using a pop riveter or rivet pliers.

Written Question

Spend about 6 minutes answering the following question.
You will need some paper and something to write with.

Different nails and pins are designed for different purposes.
Explain what each of the following types are intended to do.
Give an example for each answer.

i) A lost-head wire nail. *(2 marks)*
ii) A decorative upholstery nail. *(2 marks)*
iii) A panel pin. *(2 marks)*

Here's what you need to know...

about fixings and fittings.

See *Design and Make It! Resistant Materials Technology*
Revised page 120 (112 earlier edition).

KEYWORDS
Do you know what the following terms mean?
- Fixings
- Hinges

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Go to:
www.artex-rawlplug.co.uk/immediacy-663

Fixings and Fittings

There is a vast range of ready-made fixings and fittings available in DIY shops. Sometimes a manufacturer will design specific fittings for use with their own products. These fittings save time and money for manufacturers who do not have to invest in people and machinery to make traditional joints.

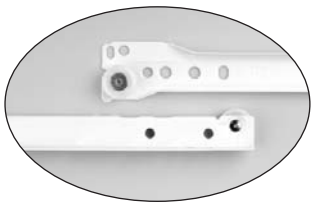
Knock-down Fittings

Modern furniture is often made using manufactured boards and is available as self-assembly packs. This method of producing furniture has led to a revolution in KD or knock-down fittings. These are designed to be as 'user-friendly' as possible.

KD fittings also mean that furniture can be produced in flat packs. In this way, storage space at shops and factories is saved, and transport costs from factory to showroom are reduced. Many items can be taken home from the shops by the customer, saving the cost of delivery.

Fixings and Fittings for Wood

Examples of KD fittings for wood are holes which are pre-drilled for screw fittings, plates and inserts already attached to the individual pieces, and multiple holes drilled for a choice of door and shelf positions. Many of these types of construction are held together using dowel pegs.



Fixings and Fittings for Metal

There is a wide choice of mechanical fastenings for metal and the method chosen will depend on a number of factors. The physical conditions in which the product will be used, for example, the levels of humidity and the physical characteristics needed by the joint, for example, corrosion, are important.

Hinges

Hinges come in a variety of types for different uses. The main types are butt, piano, back flap, and flush. Rising butt and tee hinges are used on doors.

Written Question

Spend about 8 minutes answering the following question. You will need some paper and something to write with.

Modern flat-pack furniture that uses KD (knock-down) fittings offers advantages to both consumers and manufacturers of the furniture.

i) Give two advantages of flat-pack furniture using KD fittings for the consumer. *(4 marks)*

ii) Give two advantages of flat-pack furniture using KD fittings for the manufacturer. *(4 marks)*

Here's what you need to know...

about adhesives.

See *Design and Make It! Resistant Materials Technology*
Revised pages 63 and 102 (55 and 94 earlier edition).

KEYWORDS
Do you know what the following terms mean?
- Natural adhesives
- Synthetic adhesives
- Polymers
- Resin

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Go to:
www.azom.com/Applications.asp

Adhesives

Adhesives hold two surfaces together in what is usually a permanent joint. As the range of manufactured materials is developed, so too has the need for a range of specialised adhesives to join them with. Designers need to make sure they specify the appropriate adhesive.

There are a wide variety of adhesives, both natural and synthetic.

Natural adhesives (glues) are animal or vegetable-based products, made, for example, from bones, fish and plant extracts. A glued joint relies on two things, a good fit and a clean surface.

Synthetic adhesives are mainly polymers. They have strength and flexibility. Thermoplastic resin-based adhesives are softened by heat.

- Epoxy resin (Araldite) is very adaptable. It dries within 48 hours. It is is best for joining metal to wood, metal to metal and acrylic to wood, metal and acrylic.
- Urea formaldehyde is a two part adhesive.
- Synthetic resin, such as Cascamite is a dry powder that is mixed with cold water.
- PVA (polyvinyl acetate) (Resin W) is white, ready mixed liquid. It is best for joining wood to wood and for joining expanded polystyrene to anything!
- Contact adhesive (Thixofix) is a synthetic rubber colution that sticks on contact. It is good for joining a wide range of materials: fabric to wood, metal, acrylic and melamine, melamine to melamine, and to wood, metal and acrylic and rubber to rubber and to wood, metal, acrylic, melamine and fabric.
- Acrylic cement (Tensol), used for plastics, has strong fumes.
- Latex fabric glue (Copydex) is rubbery and white solution that provides an immediate bond and is best for joining fabric to fabric.
- Hot glue (Bostick) is an adhesive that bonds as it cools.

Applying Adhesives

There are some important things to remember when applying adhesives. These need to be planned for in the production process. For example:

- surfaces to be joined will need to be clean, dust free and dry.
- equal, or varying parts of resin, hardener or curing agent will need to be mixed together in the correct amount using a clean container or piece of card and a spatula.
- even layers need to be applied to the surfaces to be joined.
- excess adhesive needs to be wiped off immediately.
- the structure needs to be held securely while drying, using a clamp, or masking tape if it is an awkward shape that needs to be supported.

Written Question

Spend about 5 minutes answering the following question. You will need some paper and something to write with.

Explain carefully the steps for using epoxy resin adhesive.

(5 marks)