

## **Methods of Fastening the Elements of the Node**

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### **ABSTRACT**

*Rolled steel is used in the manufacture of building structures such as frames and frames of industrial buildings, farms for various purposes. It is used for columns and beams, both integral and composite sections, for the construction of stairs, various masts and towers.*

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Metal structures are mostly used in industrial and civil construction buildings with significant spans in length.

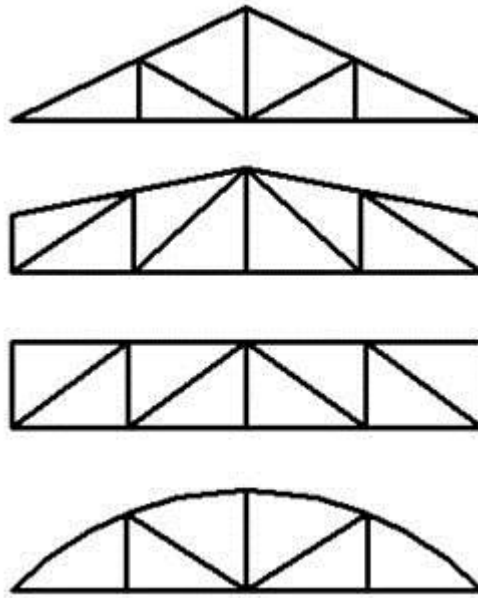
Metal building structures are made of carbon steel of ordinary quality and low-alloy structural steel. For the manufacture of mass building structures, rolled steel (hot-rolled profiles) are most often used. Along with hot-rolled profiles, thin-walled profiles are also used, formed in a cold state by stamping, flexible or rolled from a steel sheet or tape.

The configuration of the cross section determines the profile of the rolled steel and its name. Below are the most common profiles of rolled steel: angular equal-pole, angular unequal-pole, T-bar, I-beam, channel, etc.

Rolled steel is used in the manufacture of building structures such as frames and frames of industrial buildings, farms for various purposes. It is used for columns and beams, both integral and composite sections, for the construction of stairs, various masts and towers.

The truss is a load-bearing structure and is a "flat" rod system designed to maintain the covering of the building.

According to their outline, farms can be triangular, polygonal, with parallel belts, segmented, etc. The truss grid consists of upper and lower belts, struts and braces. The junction of the individual elements of the truss grid with each other is called a node. Unlike the other nodes of the farm, the node at the place of the "fracture" of the upper belt is called the ridge node, and the node of the supporting part of the farm is the support node. The distance between the truss supports is called the truss span. The distance between the nodes of the farm, measured horizontally, is called a panel.



**Figure 1 – Outlined In the nodes, the elements of the truss grid are connected by means of a steel sheet (shaped) using rivets or welding.**

The dimensions and shape of the shape depend on the forces acting in the node, the location of the lattice elements in relation to the node, the length of the welding seams to the shape of the individual elements of the truss grid converging at the node.

MK features (advantages and disadvantages), requirements for them

Metal structures have the following advantages:

1. Reliability. The material (steel, aluminum alloys) has a large uniformity of structure.
2. Lightness. Metal structures are the lightest.
3. Industriality. The manufacture and installation of metal structures is carried out by specialized organizations using high-performance equipment.
4. Impenetrability. They have high strength and density, impermeability to gases and liquids.

**Metal structures have disadvantages:**

1. Corrosion. Insecurity from a humid environment, an atmosphere polluted with aggressive gases, steel corrodes (oxidizes) and collapses. Therefore, special alloying elements are included in steel, covered with protective films (varnishes, paints, etc.).
2. Low fire resistance. Steel at a temperature of 200The modulus of elasticity decreases with, and at a temperature of 600C, the steel completely passes into a plastic state. Aluminum alloys pass into a plastic state at 300C. Therefore, metal structures are protected by fire-resistant linings (concrete, ceramics, special coatings, etc.).

When designing metal structures, the following requirements must be taken into account: Operating conditions; metal economy (high cost); transportability (transportation in parts or in whole with the use of appropriate vehicles); manufacturability – the use of modern technological techniques that reduce labor intensity.

High-speed installation. Assembly in the shortest possible time.

Durability is determined by the terms of physical and moral wear and tear.

Aesthetics. The design should have harmonious forms.

The main principle of design is to achieve three main indicators: saving steel, increasing labor productivity in manufacturing, reducing labor intensity and installation time, which determine the cost of

the structure.

This is achieved through the use of low-alloy and high-strength steels, economical rolled and bent profiles, the introduction of spatial, prestressed, hanging, tubular, etc. structures into the construction, the improvement of calculation methods and the search for constructive optimal solutions using computers. In addition, standard solutions have been developed for frequently repeated structural elements - columns, trusses, crane beams, window and lantern openings, radio masts, towers, power line supports, tanks, etc.

#### Main profiles of long products

Rolled products in metallurgy are products obtained on rolling machines by hot, warm or cold rolling

High - grade metal products can be of the following types:

- simple (circle, square, hexagon, flat section strip);
- reinforcement is a metal product used for reinforcing reinforced concrete structures;
- shaped:
  1. General (mass) consumption (Rebar, Wire rod, Beam, Channel, Corner, Hot-rolled square, Circle, Strip, Hexagon);
  2. Special purpose (broad and narrow gauge railway rails, tram rails, profiles of agricultural machinery, shipbuilding, oil and electric industries).

According to the size of the profile, long products are divided into:

- large — round steel with a diameter of 80-250 mm, square steel with a side of 70-200 mm, periodic reinforcing profiles No. 70-80, angular steel with a shelf width of 90-250 mm, channels and I-beams, conventional and lightweight 360-600 mm high, special wide-band I-beams and column profiles up to 1000 mm high, hexagonal steel up to No. 100, rails railway with a mass of 1m length 43-75 kg, strip steel up to 250 mm wide, etc.;
- medium — round with a diameter of 32-75 mm, square with a side of 32-65 mm and hexagonal up to No. 70, steel periodic reinforcement profile No. 32-60, I-beams up to 300 mm high, channels from 100-300 mm high, narrow gauge rails R18-R24, strips with a cross section up to 8x145 mm, various shaped profiles for industry purposes, etc.;
- small — round steel with a diameter of 10-30 mm, square steel with a side of 8-10 mm, periodic reinforcing profile No. 6-28, angular steel with a shelf width of 20-50 mm, channels No. 5-8, strip steel up to 60 mm wide, hexagonal steel up to No. 30 and a variety of shaped profiles for industry purposes of equivalent sizes.

According to the type of surface treatment , long products are divided into:

- polished;
- mirror;
- calibrated;
- Matte.

Today, long products are widely used in industry, construction, mechanical engineering, oil production, and energy complexes. Agriculture cannot function normally without the use of long products.

Long products are manufactured on a rolling machine using hot or cold rolling technology. Carbon steel of standard quality is used for production. Sometimes low-carbon steels are used for the manufacture of long products. Long products are divided into two main profiles: mass consumption and special purpose. Long products for special purposes are made on an individual order.

#### Metal processing by pressure

Metal pressure treatment is based on the use of plastic properties of materials. These properties allow you to change the shape and dimensions of the workpiece under the influence of external forces (pressure) and

maintain the resulting shape and dimensions after the termination of the forces. To increase the plasticity, the metal is heated to a temperature at which its plastic properties are most fully manifested.

Metal forming is characterized by high productivity and economical consumption of metal compared to casting and machining, and, in addition, improves the mechanical properties of cast metal.

There are the following main methods of metal processing by pressure: rolling, drawing, pressing, free forging, stamping.

Rolling is the compression of the workpiece between rotating rolls. The rolls can be smooth — for rolling sheets and tapes and with clippings (stream) — to obtain the details of the shaped profile. There are hot (heated billet) and cold rolling. The complex of equipment used for rolling is called a rolling mill.

Rolling mills are subdivided according to the nature of the rolling process and products into blumings, slabs, sheet-rolled, wire, and varietal, pipe-rolling and special.

The blumings produce large square blanks — blums. Long products with cross sections in the form of a square, circle, rectangle, triangle, segment, rhombus, corner, channel, brand, I-beam, etc. are obtained from blums on rolling mills.

Large rectangular billets — slabs are rolled on slabs, from which smaller rectangular billets and sheets are then produced on sheet rolling mills. Wire mills are designed to produce wire with a diameter of 5-10 mm.

Seamless and seam (welded) pipes are produced at pipe rolling mills. With the help of special mills, a variety of workpieces are rolled, for example, railway wheels, wagon axles, etc.

Drawing is the process of stretching the workpiece through a gradually narrowing hole (drawing eye). As a result, the cross-section of the workpiece decreases, and its length increases. The drawing eye is the main part of the drawing — the working organ of the drawing mills on which this operation is performed. Drawing is performed in a cold or hot state. The starting material for drawing is hot-rolled long products (round, square, hexagonal, etc.), wire, pipes made of steel, non-ferrous metals and alloys. Drawing is used to produce small-diameter wire, thin-walled pipes, shaped profiles, as well as for calibration, i.e. giving accurate dimensions and high quality of the surface of the product. By cutting shaped profiles, ready-made parts are obtained - dowels, guides, etc.

Pressing is a type of metal processing by pressure, in which metal enclosed in a closed form is squeezed out through a hole with a smaller area than the cross-sectional area of the source material. As a result, the pressed metal takes the form of a rod, which can be simple or complex, solid or hollow, depending on the shape and size of the hole. Ingots of aluminum, copper and their alloys, as well as zinc, tin, lead, etc. are pressed.

Forging, as well as casting, has long been a well-known method of metalworking. There is a distinction between forging without the use of stamps, the so-called free forging, and forging in stamps - stamping.

Free forging consists in the following. The workpiece is heated in a heating furnace to a temperature at which the metal becomes more plastic. After that, the workpiece is placed on an anvil and hammer blows give it the necessary shape. The product obtained as a result of forging is called forging.

There are manual and machine forging. Hand forging is used in individual production to perform minor repairs. Machine forging — forging on hammers and presses — is used in serial and mass production. It is many times more productive than manual and allows you to process very large parts.

With the help of manual and machine forging, forgings of various shapes can be obtained. However, due to the length of the process, free forging is not always advantageous in mass production. In this case, stamping is more productive and economically justified. When stamping, the shaping of the part occurs in the die and is determined by its configuration. Stamping is carried out on presses and hammers.

Stamping with preheating of workpieces is called hot, without heating — cold.

There are three-dimensional and sheet stamping. Hot volumetric stamping is mainly used in mass and mass production and allows you to obtain products with high accuracy of shape and size. Cold volumetric

stamping is used for small forgings.

Flat or spatial thin-walled products made of steel, non-ferrous metals and alloys are manufactured by sheet stamping. With cold sheet stamping, blanks with a thickness of several hundredths of a millimeter to 4 mm are used, with hot — with a thickness of more than 4 mm. The products obtained by sheet stamping are highly accurate and do not need further processing by cutting.

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