Plasticine House

Menu

Different Types, Grades and Sizes of Rebar in Construction

Building residential, commercial, or industrial structures using concrete requires rebar to improve its tensile and yield strengths. Whether building foundations, walls, bridges, or other projects, there are different grades, sizes, and types of rebar to choose from. It is important to choose the appropriate rebar as it can ultimately affect the longevity and success of the build.

The type of rebar affects its resistance to corrosion. The grade determines its maximum tensile and yield strength, while its size or diameter what type of construction it can be used for. The most

commonly used rebar for residential construction projects is 60 grade deformed carbon steel in #3, #4, and #5 sizes.

In this guide, we'll explain the purpose of rebar in construction and what it is used for. We'll identify the different types of rebar, where best to use them, and their pros and cons. Plus, discuss the different grades and sizes of rebar. Our goal is to provide you with the information necessary to decide what rebar is best for your projects.

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What Is Rebar in Construction?

Rebar or reinforcing bars are hot-formed steel rods used in construction to improve the tensile strength and durability of **concrete or masonry**

structures. They are typically laid or erected within forms or hollow cores prior to the pouring of concrete.

Rebar often forms a steel skeleton-like framework within footings, walls, slabs, columns, roofs, bridges, driveways, highways, and other concrete construction projects.

Concrete has great compression strength, but it can crack or break under stress. Rebar is used to help improve concrete's resistance to loads and prevent it from cracking under stress. It adds strength to the concrete, which means it can support or withstand heavier loads without cracking or breaking. The added strength can also reduce construction costs by decreasing the thickness of the concrete structure.

Steel and concrete have similar thermal coefficients, so they will expand and contract together to maintain the cohesion of the concrete structure. Rebar allows concrete to span further, reach higher, support more weight, and withstand more stresses.

The type, size, and grade of rebar, plus its spacing are affected by the size, purpose, climatic variations, geographic location, and type of construction.

What Is Rebar Used For?

Rebar is used to increase the durability, longevity, stability, and tensile and yield strength of concrete. It helps prevent cracking and reduces the costs and mass by enabling the use of thinner concrete structural solutions.

Concrete and steel also have similar thermal coefficients. This allows them to bond together and expand or contract to heat and cold at much the same rate. Thus further helping with the structural integrity of concrete.

Rebar is used in many facets of residential, commercial, and industrial construction to aid concrete under tension or other external forces. It helps concrete span further and support more, and allows thinner concrete components to withstand more too. It strengthens footings, foundations, floors, walls, ceilings, columns, and roofs.

Rebar also adds strength to the concrete components of many transportation routes, water and sewage infrastructures, dams, and bridges. Plus electrical transmission and lighting posts and many other uses, including ornamental applications.

Different Types of Rebar

Rebar or reinforcing steel bars are an invaluable component of concrete construction. It is available in different lengths, diameters, and grades, which affect how much strength the rebar adds to the concrete. However, some different types of rebar affect not only the strength but also the longevity and durability of concrete structures. Selecting the correct type of rebar is as important as the diameter and grade.

Rebar is typically made of different types of steel. Low-carbon steel is mostly iron and ferrite with 0.04% to 0.30% carbon content and only trace amounts of alloys. Medium carbon steel contains 0.31% to 0.60% carbon, and high carbon steel contains between 0.61% and 1.99% carbon. Steel with higher carbon content is typically referred to as cast iron.

Rebar is also made of alloy steel which combines carbon steel with manganese, chromium, aluminum, copper, nickel, titanium, silicon, or other elements. Stainless steel rebar contains 11% chromium. Other types

typically have a protective coating to prevent moisture damage or improve the bond with the concrete. Steel has a similar thermal expansion coefficient to concrete, improving expansion and contraction compatibility.

Mild Steel Bar

Hot-rolled mild steel or low-carbon steel contains between 0.05% and 0.25% carbon and is mostly iron and ferrite, with no significant amounts of alloys. It is more magnetic than other types of steel and is also more susceptible to oxidization or rust. To prevent rust, the steel must be treated or coated.

Mild steel is typically smooth sided so it doesn't bind well with concrete unless bent prior to pouring or embedding. It has a tensile yield strength of around 40,000 psi and is used for a variety of construction and manufacturing purposes, as well as for decorative uses

The low carbon and alloy content of mild steel make it easier to machine and weld. Mild steel can be pulled, rolled, or shape into wire, flat or square bars, round rods or bars, or sheet steel. It has greater ductility than higher carbon or alloy steels.

Mild steel is used for structural purposes, and also to make signs, decorations, furniture, automobiles, fencing, wire, and nails. It is less expensive, making it more common and popular.

Deformed Steel Bar

Deformed steel bars or rebar are made of hot-rolled steel and naturally cooled. They can be made of mild or low, medium, or high-carbon steel or steel alloys. The steel is referred to as deformed steel due to the pattern of raised ribs, knots, ridges, or lugs impressed into its surface.

Low-carbon steel rebar is commonly used in construction and for decorative purposes. Its lack of alloys or coating makes it less expensive, but also susceptible to corrosion in high moisture locations. Most building codes require specific types of deformed rebar in maritime areas or moist climates so the steel retains its stability, strength, and durability.

1. Carbon Steel

Carbon steel, also known as tempered steel rebar or black bar, is the least expensive and thus most commonly used for residential and commercial concrete construction. It is strong and durable but corrodes easily when exposed to high moisture or high-humidity locations.

Low, medium, and high carbon steel rebar are used in footings, foundations, floors, walls, ceilings, roofs, and numerous other construction projects to improve the tensile strength of concrete. It is available in different diameters, lengths, and grades depending on project specifications.

Best for residential and commercial construction in low moisture areas and for decorative or artistic applications.

Pros

- High bearing capacity
- Great tensile strength
- Bendable and versatile
- Lower carbon content is more weldable

Cons

- Susceptible to corrosion
- Heavy

2. Stainless Steel

Stainless steel rebar is an alloy steel that has an 11% chromium content. It is used in high moisture environments or those where high salt exposure is possible.

It is also used where galvanized steel can't be used due to the reactive potential of its zinc content. Due to its high resistance to corrosion, stainless steel is more expensive, and typically only used when there are no alternatives.

Best for concrete projects where salts, moisture, or high humidity could corrode steel and shorten structural longevity.

Pros

- Versatile and bendable
- Increased structural longevity
- Reduced maintenance and repair costs
- Same bearing and tensile strength as carbon steel

Cons

- High initial cost
- Difficult to find

3. Galvanized

Galvanized rebar is carbon steel that has been coated with zinc and then goes through a cold or hot plating process or electroplating to seal the zinc coating. The zinc and plating process provides the steel with durable protection from corrosion.

Galvanized rebar is more expensive than epoxy-coated rebar, which is more resistant to corrosion. However, the durability of the galvanized coating makes it more difficult to damage than the epoxy coating. So, it is a good choice for structures exposed to high humidity or water.

Best for structures exposed to high humidity or water

Pros

- Same tensile strength as carbon steel rebar
- 40 X more resistant to corrosion than carbon steel
- Equal bearing strength to other tempered steel rebars
- The zinc coating withstands shipping and installation better than other coatings

Cons

- The galvanized coating can crack, chip, or flake
- More expensive than some other options

4. GFRP

Glass fiber reinforced polymer (GFRP) rebar is made of interlaced glass fibers and fiberglass resin formed into sticks or bars. It looks like deformed steel rebar, but is significantly lighter and has a higher tensile strength.

The lighter weight makes it easier to handle and transport, which can reduce handling and shipping costs. GFRP is 100% resistant to corrosion by water, salts, and other elements. Plus, it is an ideal thermal insulator and doesn’t conduct or interfere with electrical or magnetic waves or impulses.

GFRP is also less expensive than metal rebar by length, although by ton it is more expensive; but then you’re also getting significantly more pieces

per ton.

Best for laboratories, research centers, MRI rooms, communication structures, mines, and bridges, plus all structures exposed to saltwater, water, high humidity, and everywhere steel rebar can be used.

Pros

- Stronger and more durable with higher tensile strength than carbon steel rebars
- Nonconductive heat, electrical, and magnetic properties
- More resistant to corrosion than any other rebar
- 75% lighter than steel of equivalent diameter

Cons

- It cannot be bent

5. Epoxy-Coated

Carbon steel rebar with a thick epoxy coating is referred to as epoxy-coated rebar or green rebar. The epoxy protects the steel from corrosion by moisture and salts, making it a good choice for structures exposed to salts, water, and high humidity.

Unfortunately, the epoxy coating can easily be damaged, so has to be handled with great care. All cuts and scratches need to be patched or repaired with a manufacturer-approved epoxy repair material.

Best for bridges, roadways, underground structures, plus marine, offshore, and other structures exposed to moisture, high humidity, and salts.

Pros

- 40 to 50 times more corrosion-resistant than carbon steel rebar
- Same tensile strengths as galvanized or black bar rebar
- Greater structural longevity
- High structural strength

Cons

- Epoxy coating is easily damaged
- Even a pinhole can allow corrosion to occur

6. Expanded Metal

Expanded steel is a strong, versatile, open diamond patterned 'rebar' or mesh, cut or stretched from a flat sheet of carbon steel. It is available in different thicknesses and open-pattern sizes for different uses or purposes. It is similar to welded wire fabric (WWF) but has smaller openings.

Expanded metal is commonly used for thick plaster, stucco, concrete walkways, or patios that don't need to support heavy traffic. It is also used for fencing and floor or ceiling grates, plus other applications. The mesh is available in standard, grating, flattened, and decorative or architectural sheets.

Best for thick plaster, stucco, concrete walkways, or patios that don't need to support heavy loads.

Pros

- Easy to cut
- Variety of uses
- Durable and strong, yet flexible for shaping
- Available in different thicknesses and pattern sizes

Cons

- It won't support heavy traffic or loads
- Sharp edges

7. Basalt Rebar

Basalt or volcanic rock is used to manufacture basalt rebar. Basalt has a comparatively higher iron and magnesium content, resulting in a rebar that is 2 to 3 times stronger than carbon steel rebar. Basalt steel is also 4 to 5 times lighter than carbon steel of similar thickness or diameter.

It is also resistant to rust, acids, alkali, and moisture, and its thermal expansion coefficient is the same as concrete. Plus, it doesn't conduct electricity or RF Energy and is non-magnetic. Basalt steel requires no special coating, is easy to cut, produces 60% less CO2 emissions in the manufacturing process, and provides project savings in labor and material costs.

Best for communication and data centers, laboratories, Hospitals, bridges, roads, underground structures, and all structures exposed to moisture, high humidity, and salts.

Pros

- 2 to 3 times stronger than carbon steel
- 4 to 5 times lighter than steel of similar thickness or diameter
- Resistant to rust, chemicals, acids, alkali, salt water, and moisture
- Less weight and greater strength results in lighter or thinner concrete construction

Cons

- Presently not well known or identified in building codes
- Not bendable or weldable

8. European Rebar

European rebar is similar to regular carbon steel rebar but utilizes a different measurement system. It is also alloy steel with a blending of manganese. The manganese makes the rebar less expensive and easier to bend. It is still durable and strong and improves the tensile strength of concrete. Unfortunately, its bendability makes it less suitable for areas prone to hurricanes, tornadoes, and earthquakes.

Best for low-density housing and commercial projects, driveways, sidewalks, and structures in stable weather and geological areas.

Pros

- Low cost
- Helps strengthen concrete
- Improve tensile strength of concrete
- Ideal for most concrete projects

Cons

- Bendability
- Not suitable for areas prone to hurricanes, tornadoes, and earthquakes

Rebar Grades

The structural integrity of concrete structures depends on the size and spacing of the rebar within the pour, its placement in the structure, and the grade of the steel. Rebar is produced in different grades which are determined by its maximum tensile strength, yield strength, chemical composition, and its elongation percentage. The elongation percentage defines the ductility of rebar so that it bends without cracking.

Structural plans commonly identify the grade of rebar that should be used in concrete projects to provide the minimum yield and tensile strengths. Higher grade steel can be used, but lower grade can't be.

Rebar grades in the U.S. are identified based on the steel's minimum yield strength measured in kilo-pounds per square inch or KSI – also known as 1000psi. So, the minimum yield strength of 40 grade rebar is 40 KSI or 40,000psi.

The most commonly used rebar grades are 40, 60, and 75. Greater strength grades such as 80, 100,120, and 150 are also available for structures

requiring a greater yield and tensile strength. Grades less than 40, as well as grades 50 and 55, are no longer in use.

Today, the most commonly used grade of rebar in concrete construction is 60. Grade 40 could be used in many builds, but the cost difference for a 50% increase in strength isn't significant, so many builders upgrade to 60 grade rebar. However, 40 grade rebar is often used to reinforce brick and masonry construction as well as light residential projects.

To identify the grade of steel, look for markings along the sides of the steel, they are often within the raised pattern or ribs on the bar. For example, H 4 S 60. The first stamped marking identifies the manufacturing mill, the second is the size of the rebar, the third is the type of steel, and the last identifies the grade.

Reinforcement Bar Sizes

Rebar sizes tend to be standardized for the country they are manufactured in or for. The U.S.A. uses bar sizes in inches based on the number of 1/8" units. So, #5 rebar is nominally 5/8" in diameter. Each U.S. diameter also has a 'soft' metric size for use in Canada, Europe, and the rest of the metric-using world. The 'soft' measurements are the size in millimeters rounded to the nearest whole number.

Canada's standard rebar works in both U.S. and European markets, as well as their own. Their sizes are typically rounded to the nearest 5, so 11.3mm (3/8") diameter rebar rounds to 10M and 16.0mm (5/8") rounds to 15M. It should be noted though, that while 10M is 'nominally' 3/8" diameter, so equivalent to a #3 U.S. rebar, its actual diameter is not the same.

The European Union has standardized its rebar to reflect the true nominal diameter of the steel rods, with 6mm being identified as 6,0 and 14mm as 14,0. The Table below compares U.S. and Canadian rebar sizes.

U.S.A and Canadian Rebar Sizes					
Bar Sizes			Nominal Diameter		
U.S. Sizes	'Soft' Metric	Canadian Sizes	Inches	U.S. 'Soft' Millimeter	Canadian Millimeter (M)
#2	#6	–	1/4	6.35	–
#3	#10	10M	3/8	9.525	11.3
#4	#13	12M	1/2	12.70	12.7
#5	#16	15M	5/8	15.875	16.0
#6	#19	20M	3/4	19.05	19.5

#7	#22	–	7/8	22.225	–
#8	#25	25M	1	25.40	25.2
#9	#29	–	1-1/8	28.65	–
#10	#32	30M	1-1/4	32.26	29.9
#11	#36	35M	1-1/2	35.81	35.7
#14	#43	45M	1-3/4	43.0	43.7
#18	#57	55M	2-1/4	57.30	56.4

The size or diameter of the rebar affects its tensile and yield strengths, and thus its uses. Here are some typical uses for the most common rebar sizes:

#3 or 10M – The narrow 3/8" diameter makes this rebar easier to bend and cost-effective for use in artistic or decorative works, as well as structural projects. It is commonly used in swimming pools, driveways, sidewalks, patios, and most residential construction.

#4 or 12M – The slightly wider 1/2" diameter increases the tensile and yield strength to strengthen concrete so it supports heavier loads and use. It is commonly used for slab foundations, footings, columns, highways, and commercial structures, but often is also found in residential concrete walls, floors, arches, and beams.

#5 or 15M – At 5/8" in diameter, this rebar is used to strengthen high-use structures experiencing heavier loads, such as highways, bridges, structural beams, retaining walls, loading zones, and industrial structures.

Rebar of greater diameters is typically used for structures experiencing heavier loads and forces. They are typically reserved for high rises, multi-

story garages or shopping malls, multilane highways, infrastructure, and other commercial and industrial complex uses.

Conclusion

Rebar is an essential structural component of concrete construction. The structural integrity and longevity of concrete structures depend on the size, spacing, and placement of the rebar within the concrete. The type and grade of steel are also vital to the tensile, yield, structural strengths, longevity, and success of the build.

Hopefully, you have a better understanding of the different types, grades, and sizes of rebar and their uses, and are better prepared for your concrete project.

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