Modern American Journal of Engineering, Technology, and Innovation
ISSN(E): 3067-7939
Volume 01, Issue 03, June, 2025
Website: usajournals.org

DESIGN OF WELDED STRUCTURES

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Abstract:
This article analyzes the process of designing welded structures and provides information about its basic principles, methodologies, and welding methods. The article covers important aspects of the welding process - strength, stability, energy efficiency and quality. It also considers possible problems in the design of welded structures and methods for their solution. Detailed information is provided on welding methods, including technologies such as argon, electric, spot, micro, reverse and laser welding. This article provides the knowledge necessary for the effective design of welded structures in industrial and architectural fields.

Keywords: Welding. Structures. Strength. Sustainability. Energy efficiency. Quality. Materials. Design. Technological process. Control

Welded structure design is the development of a model for parts or parts that will be prepared and assembled using non-detachable welding. The purpose of the design is to ensure the strength, reliability, and technological feasibility of the structure, as well as to consider the operating conditions.

Stage projection

The process of designing welded structures includes several stages:

1. Technical proposal. The client will apply to the project team with the assignment and work-related documentation.
2. Draft design. Sketches are developed based on the concept, the constructor describes the details of technical solutions, and sketches of complex elements.
3. Technical project. Based on the developed design solutions, a master plan is developed, and general drawings are made.

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4. Work project. All parts of the structure are thoroughly worked out, drawings and descriptions are compiled for each part, which are combined into a single package of documents - working documentation.

Calculation Methods

Two basic methods are used to calculate the welding structure:

1. By permissible stresses. The stress in the graduated section of the part is compared with the allowable stress, which constitutes a certain part of the material's yield strength. The coefficient of storage thickness depends on the character, for example, thick sheets and other conditions.
2. By limiting conditions. The working conditions of the structure, the homogeneity of the material, are taken into account.

Program provision

Different programs are used to design welded structures, for example:

- Advance Steel. Allows you to create three-dimensional models of construction and automatically create working drawings.
- Tekla Structures BIM. It is used for drawing metal structures, supports the 3D image mode of the finished product.
- Bocad-3D. Allows you to create a three-dimensional model, after which the program automatically creates drawings and specifications.

Primary project

Some primary designs of welded structures:

- Welding factory design. Material is considered, weldability is evaluated, welding method is selected, and welding materials are selected.
- Calculation of crane welding maybe. Non-nuclear and extra-nuclear loads are determined, and the types and dimensions of the angles are selected.
- Tank design. The technological process of manufacturing the welded structure is being considered, and joints and specifications are being developed.

Types of Welded Structures

Welded structures are divided into many types. Some of them are as follows:

Recycling structures : These types of structures are mainly used in industrial facilities. They are specially designed to withstand a wide range of stresses.

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Architectural structures: Welded elements that define the appearance of buildings and ensure their stability.
Transport Structures: Structures of cars, trains, and other vehicles.

Basic Design Principles
When designing welded structures, it is necessary to consider a number of basic principles:
1. Strength: The structure must be strong enough to perform its function. This depends mainly on the properties of the material and the welding method.
2. Stability: The ability of a structure to withstand external influences (shock, vibration, weather conditions).
3. Energy efficiency: Minimizing energy consumption in the production and operation of structures.
4. Quality: Strict controls are required to ensure the quality of the welding process and materials.

Design Process
The process of designing a welded structure consists of several stages:
1. Analysis : The first step in the design process is to analyze the requirements and conditions. This step determines the project's purpose, location, loads, and other important parameters.
2. Design : In this phase, construction drawings and technical specifications are prepared. Initial design options are developed and tested.
3. Material Selection : The material selection process is carried out taking into account the quality and properties of the metal to be welded.
4. Choosing a welding method : The method used in the welding process (e.g., argon welding, electric welding) is also important.
5. Production process : A production process is planned to implement the project, where all technical guidelines and standards are taken into account.
6. Control and quality assurance : Strict control must be established to ensure the quality of welded structures. Weld quality control methods are used in this process.

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Problems and Solutions

A number of problems may arise during the design of welded structures. These include:

1. Poor quality of materials: Poor quality of selected materials can reduce the strength of the welded structure. In this case, it is necessary to reconsider the materials.
2. Technological errors: Technological errors that occur during the welding process, such as uneven welds, negatively affect the strength of the structure. Quality control and preparation are necessary to solve this problem.
3. Changing conditions and loads: Changing conditions and loads during the design process can affect the performance of the structure. To avoid this, a flexible design approach is recommended.

What Welding Methods Are Used?

1. Argon Welding (TIG) :
   - It melts metal with the help of electricity and protects it from oxidation with the help of an inert gas.
   - Ideal for delicate welds.
2. Electric welding (MIG/MAG) :
   - It is an automatic or semi-automatic method that uses a continuous wire to melt adjacent metal.
   - Systematic and efficient, widely used in many industrial sectors.
3. Spot Welding :
   - It welds metal plates at short distances using high current.
   - It is mainly used in the automotive industry.
4. Micro Welding :
   - It is used for welding very thin metal parts, for example, in the electronics and instrument industries.
5. Reverse Welding :
   - Typically used for joining thick metal sheets, it is characterized by high energy consumption.
6. Laser Welding :
   - It melts and joins metal parts using high-voltage laser light.

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- Good choice for speed and accuracy.

Each of these welding methods has its own advantages and disadvantages and is selected during the design process, taking into account specific conditions and requirements.

Quality Control

Quality control plays an important role in the design of welded structures. It includes the following aspects:

1. Material Selection:
   - The selection of quality materials is essential for the success of the welding process. The mechanical properties, corrosion resistance, and other parameters of the materials are tested.
2. Welding Process Control:
   - During the welding process, the actions and conditions (temperature, electric current, welding speed) must be carefully controlled. This helps to ensure the quality and strength of the weld.
3. Visual Control:
   - Detecting defects by visualizing welds. This process checks for uneven welds, gaps, or impact marks.
4. Check for irregularities:
   - Internal defects in the weld are detected using radiographic (X-ray) and ultrasonic (ultrasonic) inspection methods.
5. Certification:
   - Certification and training courses should be provided for workers and equipment performing the welding process. This process helps to ensure quality and monitor compliance with standards.

Quality control ensures the reliability and long-term suitability of welded structures, while increasing safety in construction and industry. Effective quality control during the design process is essential for ensuring the overall success of the project.

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Conclusion

Designing welded structures is a complex and in many ways unique process, consisting of a number of principles and stages. During the design process, it is necessary to take into account such key aspects as strength, stability, energy efficiency, and quality. Taking into account all the issues, we will be able to create high-quality and durable welded structures. Therefore, it is necessary to carefully plan and control the welding process, as well as to use modern technologies.

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