

SPOT WELDING OF HONEYCOMB STRUCTURES

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Abstract. Honeycomb structures are used to prepare meals water jet cutting machines for textile. These honeycomb structures are made of stainless steel sheet thickness of 0.1 - 0.2 mm. Corrugated sheet metal strips are between two gears with special tooth profile. Hexagonal cells for obtaining these strips are welded points between them. Spot welding device is three electrodes in the upper part, which carries three welding points across the width of the strip of corrugated sheet metal. Spot welding device filled with press and advance mechanisms. The paper presents the values of the regime for spot welding.

1. Introduction

The paper presents the technology for producing a honeycomb structure (Fig. 1). This honeycomb structure is used as a table on which are placed sheets of blank material at cutting water jet. Using cutting waterjet can cut metal materials, plastics, and textiles. The structure whose manufacturing technology is shown below, is used for the cutting of fabrics.

To produce the required structure will require an additional operation by cold plastic deformation, to bring its flat sheet state in the form required for future operations welding points (Fig. 2). Roll type 316 stainless steel sheet, thickness 0.1mm, will be distorted by two wheels conjugates having a special profile (reference creamier angle is 30 °, 20 °, not as with traditional gears). The calculation of these cogwheels will be performed using Autodesk Inventor software projected office assisted. Generating cogwheels by entering parameters. The solids will be generated automatically based on the previously introduced features.

It will choose a pressure welding process through the points of contact electrical resistance. Pressure welding is a process of producing a welded joint by plastic deformation of parts in place of welding of a compression action, leading to adjacent atoms near the surfaces between the parts to be joined and they show mutual attraction forces. Plastic deformation of the parts is facilitated by locally heating the joint site, which can be made by various methods, the most convenient being the electrical



Figure 1. Welded honeycomb structure.

heating Joule effect, which has the advantage of limited heated area. In the pressure welding, the joint can be produced by the interatomic cohesive forces, without the need for filler materials, or streams of protective gas, and the joint strength is obtained for the same level as the base material.

If the local heating is performed by Joule-Lenz effect, i.e. electrical resistance, the yield and high productivity. The current technique used widely these



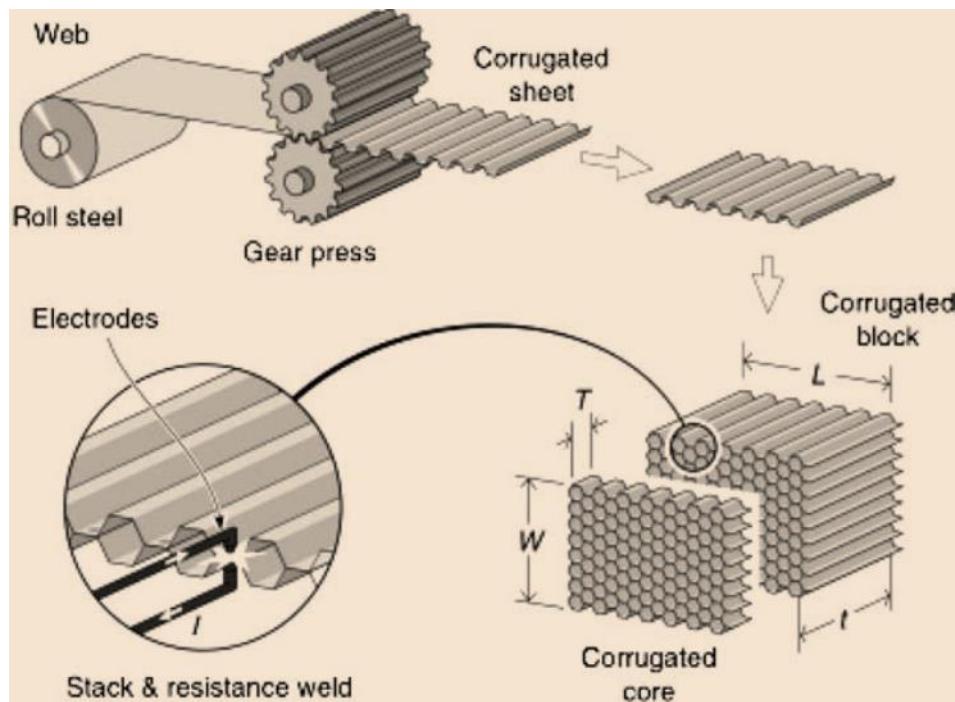


Figure 2. Low relative density metallic honeycomb cores for sandwich panels can be made by a sheet crimping process. The stacked sheets can be bonded by resistance welding (shown) or with an adhesive. The cores can be cut and adhesively bonded to face sheets to create sandwich panels [1].

processes, especially in the production of large series or mass in the automotive, aviation, machinery, electronics, consumer goods, etc. The number of processes for welding machines resistance of the machine is close to the electric arc.

The process of welding by pressure has the advantage that workplaces are clean because it does not give off gases, smoke, or metallic vapour and are not soiled by the heads of electrodes, fluxes or slag resulting typically processes for welding by melting also does not produce radiation that require special protection of the eyes or face.

To achieve a weld point it is necessary to comply with the following conditions:

- Electrical contact to be made after the parts has been properly tightened between the electrodes;
- Interruption of electrical to achieve when the clamping force is high, which cools and strengthen the welding point.

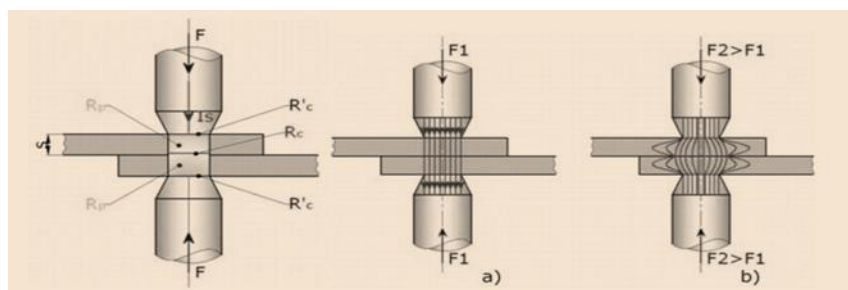


Figure 3. Contact resistances between system elements welded (R'_c - Contact resistance electrode – track; R_c - Contact resistance of parts; R_p - Resistance own components (metal column crossed by electric current for welding I_s): a) ideal distributed power lines; b) the real distribution of power lines.

2. Results and discussions

After the maximum temperature in the welding pressure welding methods can be divided into three groups:

- Cold welding: The temperature in the shaping of the weld is lower than the recrystallization temperature of the material to be welded.
- Heat sealing the solid state: the temperature in the formation of the weld is between the melting temperature and the crystallization of the material to be welded.
- Hot-melt welding: The temperature of the formation parts in the weld zone is equal to or higher than the melting temperature of the material.

Typically, increasing the temperature allows decrease the compression force and vice versa, without combining quality to suffer.

Making the weld can be done in air, vacuum or protective gases, vacuum and gas protecting welding instead of atmospheric oxygen ingress.

The characteristics listed above as to perform a welding pressure welding process using the points needed:

- A force exerted perpendicular to the surface to be welded;
- An electric current corresponding intensity, voltage and frequency.

The technology involves welding points correlating parameters of the welding regime:

- contact diameter electrodes d [mm];
- welding current I [A];
- connection time t [s];
- contact force F [daN].

There are two types of welding regimes:

- Soft regimes characterized by high connection time (1.5...3)s, low current strength and low downforce. These regimes are used to weld steel parts with low carbon high thickness (> 1 mm);
- Harsh regimes characterized by short duration, high current intensity and high pressure forces. These regimens are used for welding pieces of stainless steel, aluminum and its alloys and thin sheets.

Research overview

Welded honeycomb structure dimensions are shown in Figure 4.

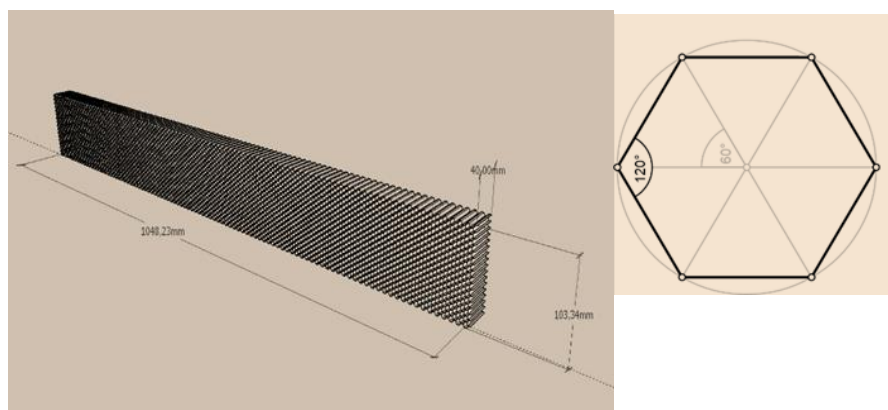


Figure 4. The size of the honeycomb structure imposed.

Welding regime parameters can be calculated with empirical relationships. They are dependent on the thickness of the parts to be welded.

- Thickness components S (mm):

Due to the requirement of strength and at the same time to benefit from a lower weight as the whole system will be adopted thick sheets of welded 316 stainless steel, with a value of 0.1 mm.

- The diameter of the tip electrode contact (mm)

Width of 40mm of the structure being imposed three welding points (Figure 5).

Electrode tip diameter is determined by the thickness of the parts to be welded and is approximately equal to the diameter welded point. The diameter of the electrode is done with the relationship:

$$b_y = 2s + (2 \dots 2.5) \text{ mm}$$

Where: s is the thickness of welded components (maximum limit was chosen $s = 0.1 \text{ mm}$)

result:

$$de1 = 2 \times 0.1 + 2 = 2.02 \text{ mm to } 2 \text{ mm is adopted.}$$

- The diameter of the lower electrode:

Due to the mounting structure welded identic the classic with two electrodes, cannot apply. Use a combination of classical electrodes, previously calculated and fixed-position electrodes (Fig. 5).

These electrodes fixed position will have a dual role, both electrode classic, driving current to achieve the weldment and supporting structure during the welding process.

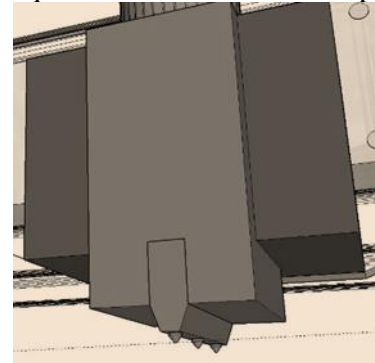


Figure 5. Top electrode shape.

Will be adopted according to the mounting size of the structure.

- Welding current strength can be determined by the relationship:

$$I = 6.500 \times s \text{ [A]}$$

With increased current intensity increases and the size of the core melted. Further increase is not possible because current electrical contact resistance between the two parts remains the same but increase inadmissible imprint of electrodes on the pieces.

$$I = 6500 \times 0.1 = 650 \text{ A}$$

- Duration of press:

Determine the type regime, relations:

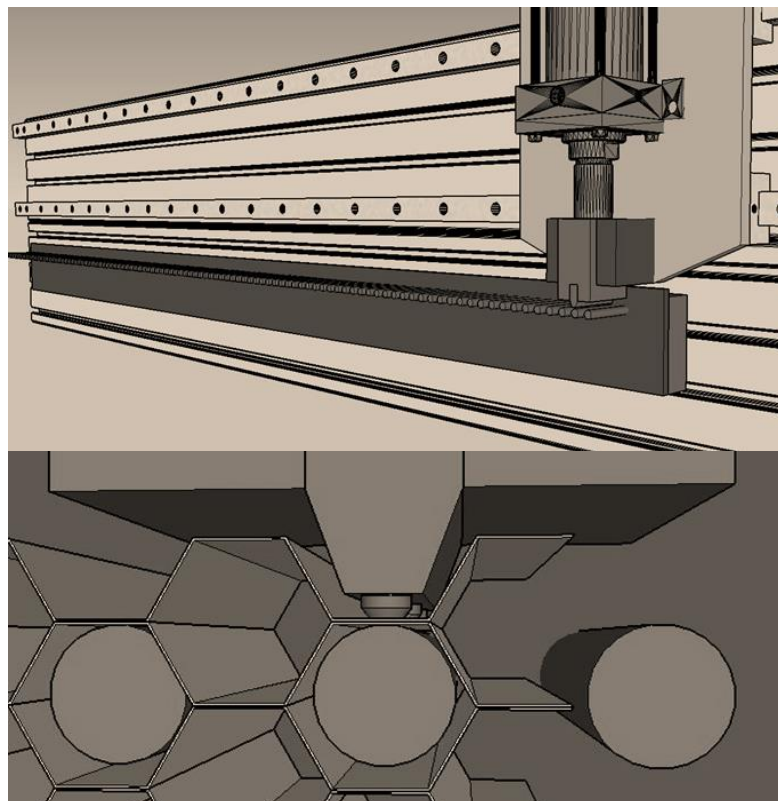


Figure 6. The principle of spot welding honeycomb structure.

-for harsh regimes: $t = (0.1 \div 0.2) \times s$

$$t = 0.2 \times 0.2 = 0.04 \text{ s}$$

-for soft regime: $t = (0.8 \div 1) \times s$

$$t = 0.8 \times 0.2 = 0.16 \text{ s}$$

Due to the nature of the material, namely the presence of a large percentage of alloying elements (Cr), and relatively low thickness sheets of welded for this operation will use a harsh regime.

• Thrust force is calculated with

$$F = (50 \div 250) \times s \text{ [daN]}$$

If increases downforce is reduced contact resistance of parts which makes it no longer necessary to provide heat welding and electrodes print pronounced dimples on tracks (footprints).

$$F = 50 \times 0.1 = 5 \text{ [daN]}$$

• Diameter welded point

d_p = diameter welded point;

$$d_p = 1.1 \times [\text{mm}]$$

$$d_p = 1.1 \times 2 = 2.2 \text{ mm}$$

In the case of the machine (Fig. 7) may be used a few modular elements, namely:

- Items support;
- The elements that determine the motion of the tool port-electrode-axis machine;
- Port-electrode tool;
- Support port-electrode.

3. Conclusions

The machine of the spot welded structure of honeycomb type (Figure 7) can be carried out under optimum conditions in Figure 4 with the proposed structure. Subsequent research will improve machine operation by automating the process of spot welding.

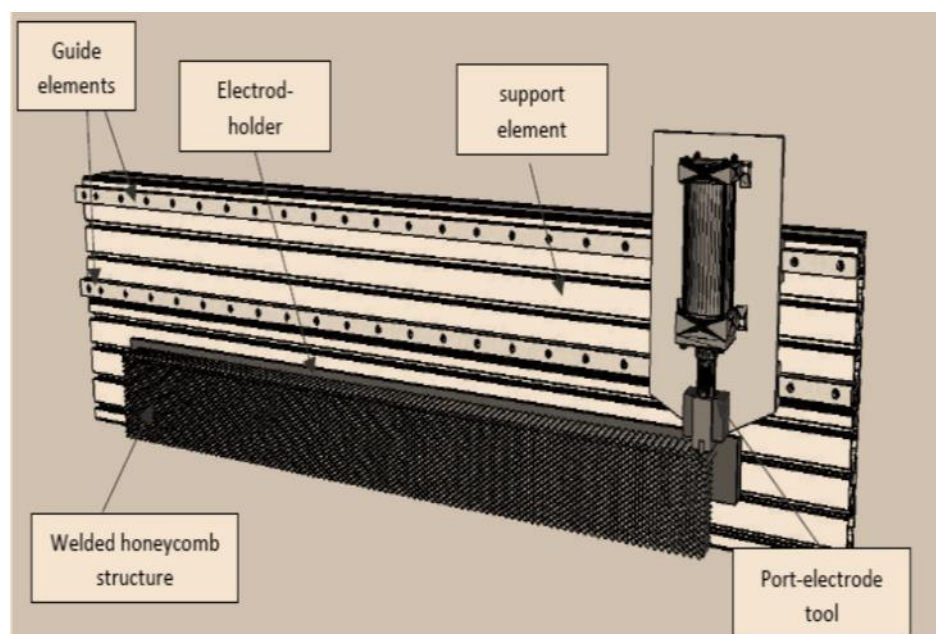


Figure 7. Welding equipment honeycomb structure.

4. References

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