CHAPTER 8

CONCLUSION

This research is concerned with the study and analysis of appropriate spot weld distribution among the welding stations of body shop to improve the quality and productivity.

- A mathematical model has been developed to calculate the number of geometry spots by establishing process design criteria with experimental analysis.

- To implement the proposed method, a spot weld assignment software program has been developed in product design environment. This method has been implemented using CATIA V5 software.

- The developed method provides valuable results for appropriate spot allocation among the welding stations.

- Even a single geometry fixture reduction will have a huge positive effect for a considerable improvement in productivity and capital investment reduction.

- The proposed method offers many advantages including,

  1. Significant improvement in dimensional accuracy, which is elaborated in chapter 8.1

  2. Significant improvement in productivity, which is elaborated in chapter 8.2

  3. Equipment reduction in Body shop, which is elaborated in chapter 8.3
8.1 SIGNIFICANT IMPROVEMENT IN DIMENTIONAL ACCURACY

There are no significant deviations observed between post geometry spot welding and re-spot welding with the implementation of GSDM. The method has achieved the dimensional accuracy of assembly within ± 0.5 mm in geometry station and retained the same in re-spot station due to appropriate spots selection and execution. Achievement of lower deviations against the tolerance limit helps to achieve better accuracy in assembly of vehicle aggregate parts in assembly shop.

Improvement of dimensional accuracy reduces reworks in the later stage at vehicle assembly shop. The fit & finish of the vehicle will improve significantly.

8.2 SIGNIFICANT IMPROVEMENT IN PRODUCTIVITY

Improving productivity in body shop is one the major objective of this research. Achieved a significant improvement in productivity of body shop with the implementation of Geometry Spot Distribution Model (GSDM).

- Achieved, 82 seconds savings in cycle time with the application of GSDM methodology in the existing production cell. 82 seconds saving per vehicle is a worthy figure of 11% for the production cell considered in this study

- Identified the maximum possibility to reduce 42% of geometry spots in an existing model with application of GSDM methodology

- Achieved 11% to 17% work content reduction with the application of GSDM in the studied models 1 to 5. Reduction of
work content in a body shop is directly benefits manpower reduction in manual and semi-automated shops.

8.3 EQUIPMENT REDUCTION IN BODY SHOP

The proposed methodology is optimizing the welding fixtures and weld guns in body shops. The reduction of equipment directly benefits reduction of energy consumed for operation. The reduction of fixtures and weld guns impacts in reduction of compressed air and water consumptions.

8.4 REDUCTION OF PROCESS AREA IN SHOP LAYOUT

Reduction of fixtures in a body shop reduces the foot print of process area in shop floor. In a shop floor more than 60% of floor space is being occupied with the process equipment. Fixture is a major equipment in body shop, which occupies more space. Reduction of center floor sub-assembly fixture CF_2 discussed in this work saved the floor space of $1.4 \text{ m}^2$

Length of the fixture = 1 m

Width of the fixture = 1.4 m

Area = $L \times B = 1 \text{ m} \times 1.4 \text{ m} = 1.4 \text{ m}^2$

8.5 INDUSTRIAL APPLICATION

The advancement in implementation of the spot assignment in 3D CAD will enhance process planning accuracy and helps to maintain a standard procedure for spots distribution by keeping quality and productivity intact.

The developed methodology for appropriate spot weld distribution among the welding stations for body shop is simple to use for the product and process designers during any new product planning, and this can also be used for optimization of any existing cells of the body shops.
Implementation of spot weld distribution through an automated assignment in product design software will help the product designer enforce the critical geometry spot distribution. Creation of geometry spot annotation in product design ensures standard distribution of geometry spots with high accuracy, irrespective of the manufacturing location of the product.

**SCOPE FOR FURTHER WORK**

This study has brought a new direction to improve productivity in body shop with minimizing the process time of spot welding in geometry stations and adding maximum parts in geometry stations to improve productivity.

The work can be further extended to the following context,

1) The possibilities of adding maximum parts in a geometry stations with different fixturing concepts

2) Gap analysis on automated and semi-automated body shops

3) Reduction of riveting process time line using the similar methodology

4) Analysis of process area reduction with minimizing fixture footprint

5) Study and enhancement of integrated design and manufacturing system to improve productivity and quality

**LIMITATIONS OF THE STUDY**

This study is limited with the discussion of automotive car bodies produced with spot welding process. The bodies that are made with other joining technologies for various purpose is not included in the study.