ABSTRACT: Mistake proofing is about preventing mistakes from disrupting production or wasting staff time in rectifying mistakes. With mistake proofing solution many repetitive task that depend upon the memory of worker are build into the process itself. In automobile vehicle where as center pillar is available and it is present between the front door and rear door of a motor vehicle. Where as in the center pillar we are facing problems due to inappropriate holding of jigs while processing, inorder to rectify these problem we are using the jigs works on the principle of pneumatic system it has six single acting cylinder arrangement and then four limit switches are used to sense the proper holding process of jigs.

KEY WORDS: b-pillar, single acting cylinders, limit switches, tooling pin, clamping device.

I. INTRODUCTION

Mistake proofing (or as its more commonly known Error Proofing) is about preventing mistakes from disrupting production or wasting staff time in rectifying mistakes. Mistakes may still happen, but through using error proofing techniques the chances of them occurring (and time spent rectifying them) is greatly reduced.

The underlying philosophy of Mistake-Proofing explicitly recognizes that:

- People forget and make errors
- Machines and processes fail and make errors
- The use of simple mistake-proofing ideas and methods in product design and process design can eliminate both human and mechanical errors.

In order to eliminate mistakes, we need to modify processes so that it is impossible to make them in the first place. With mistake-proofing solutions, many repetitive tasks that depend upon the memory of the worker are built into the process itself. Mistake-proofing frees the time and minds of the workforce to pursue more creative and value-adding activities. Mistake proofing can be done by design; designing the workstation differently, designing the machinery differently and so on. So it is not just about changing the way that the work force works, it is about ensuring that they have the correctly designed equipment to work productively. One fundamental aspect of mistake proofing is having the right mindset and these needs to be across the board, from the top echelons of management, right down to the factory floor. Mistake proofing needs to become the predominant culture within the organization, with everyone recognizing that mistakes cost a lot of money in terms of the labor time lost in putting things right. Mistake-proofing also involves a change in the mindset of the organization. Organizations must establish a mistake-proofing mindset that promotes the belief that it is unacceptable to allow for even a small number of product or service defects. In companies that have a six-sigma initiative, the six-sigma objective translates into a goal of less than 3.4 defects per million opportunities or 3.4 DPMOs for short.

II. LITERATURE REVIEW

1. Dr. Ramzi Hammani explains about the types of poka yoke, how does poka yoke works, short cuts, benefits and uses of poka yoke.
2. Mr. C. Venkataswamy, Mr. T. Naganna, Mr. Nirmith Kumar Mishra says about the modelling and analysis of b-pillar using different materials.
3. Mr. Evren Altino, Mr. Hakan Kayserili, Mr. Ahmet Mert Explains about the vehicle safety objectives and by changing the loading method for welding process.
4. S. Venkata Krishnan, K. Banithia, S. Srikari, M. L. J. Suman explains to helped in solving roof collapse problem along with reduced b-pillar intrusion y 28.31%.
5. M. Fathil C. Ibrahim, N. Azinee Said discuss about the fabrication process via machining process and finally analysis process by comparing outcome the distributor and piston in conventional method and using jig.

6. Anil S. Badiger, R. Gandhinathan, V. N. Gaitnode, Rajesh S. Jangaler tells the improved OEE resulted increase in availability, better utilization of resources.

III. PROBLEM IDENTIFICATION
While performing a number of operations in any jig, it is necessary to follow a sequence. It is very important that the sequence should not change and correct operation, should be performed at the right time. If the sequence is not followed adverse effects may result. The main problem in a welding assembly jig occurs in bracket loading. Each operation [clamping, locating, loading and ejection] as a separate DCV. In this jig, unloading of bracket should be followed by unclamping. But when unclamping is done without unloading the bracket it results in increase of scrap and also the loading pin and the brackets are broken.

IV. B-PILLAR ANALYSIS
The B-pillar was analysed by applying a force of 140kN evenly across its outer surface. The loaded structure was constrained on both the lower and upper surface. However, the constraints may not fully represent the exact life scenarios as the surfaces welded to the car body is an extended surface from the top and bottom. The scenario was assumed because of the close proximities of the stress values from the analysis of the real-life scenario and the assumed test setup. Nevertheless, this may have decreased the precision of the analysis on the B-Pillar by 15% whopping or less. These constraints positioned the Figure model in all the six degrees of freedom. Initial FEA of the original B-Pillar and assumed test setup are presented in below

The analysis was carried out with HYPERMESH, and H3D plots of displacement, as well as von Mises stress, were produced. The maximum displacement was 5.9mm while the maximum stress was 1646MPa. The stress plot in CATIA FEA analyser produced the maximum stress that occurred along the edges of the constraints. However, the HYPERMESH solver showed stress concentrations on the edges as well as the centre of the B-Pillar. In actual vehicles, the B-pillar displacements are higher in real life than that obtainable in the assumed load case.
There are two categories of meshes namely, 2D and 3D meshes, which each has various types. 3D meshes apply 3D properties and shapes on the model and produce relatively accurate results but the major disadvantage of this type of mesh is high computation time.

V. SPECIFICATIONS OF B-PILLAR

<table>
<thead>
<tr>
<th>Component</th>
<th>Minimum Thickness (mm)</th>
<th>Material</th>
<th>Density (Kg/m³)</th>
<th>Young’s Modulus (MPa)</th>
<th>Yield Strength (MPa)</th>
<th>Tensile Strength (MPa)</th>
<th>Poisson’s Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Pillar</td>
<td>1.4</td>
<td>CF/Steel</td>
<td>1650</td>
<td>21000.03</td>
<td>800</td>
<td>1600</td>
<td>0.3</td>
</tr>
<tr>
<td>Reinforce</td>
<td>2.0</td>
<td>High</td>
<td>1650</td>
<td>21000.03</td>
<td>1500</td>
<td>1700</td>
<td>0.3</td>
</tr>
</tbody>
</table>

VI. VON MISES STRESS AND FACTOR OF SAFETY

Von Mises stress is the design criterion used in ductile materials to analyse failure. It helps verify how a design performs under a system of forces. It predicts whether failure will set in or not. If at any point in the model, von Mises stress induced in a material is higher than the yield strength of the material in the design, failure occurs. Details of the material used in the design of the B-Pillar are shown in Table 2. The factor of safety (FS) for this report may be determined based on the material property or the load safety factor. This can be determined as shown in equ(1).

\[
\text{Factor of safety (FS)} = \frac{\text{Yield strength}}{\text{Allowable or design Stress}} \quad \text{(1)}
\]

From Equation (1), the allowable or design stress can be expressed as:

\[
\text{Allowable or design Stress} = \frac{\text{Yield strength}}{\text{Factor of safety (FS)}} \quad \text{(2)}
\]

The B-pillar can be modelled as point load with the maximum deflection given as:

\[
\delta_{\text{max}} = \frac{PL^2}{48EI} \quad \text{(3)}
\]

where \(E\) = Young’s modulus, \(P\) = load, \(I\) = second moment of area, and \(L\) = length of the B-pillar.

Applying Eq. (3) to the theoretical calculation gave a maximum deflection of 4.04 m, approximately equal to 4040 mm. However, the value was too high and cannot be used in the design. For uniformly distributed load which is usually the case in collisions involving side impact of a vehicle, the deflection can be expressed as Eq. (4).

\[
\delta_{\text{max}} = \frac{5wL^4}{384EI} \quad \text{(4)}
\]

\[
\delta_{\text{max}} = \frac{5PL^2}{384EI} \quad \text{(5)}
\]

where \(w\) = uniformly distributed load.

Applying Eq. (5) in the theoretical calculation gave a maximum deflection of 52.6mm. Making \(I\) the subject of the formula, the maximum deflection value was less than 40mm as shown in Eq. (6):

\[
I = \frac{5PL^2}{384E\delta} \quad \text{(6)}
\]

Applying Eq. (6) in the theoretical calculation gave a deflection value of \(2.17 \times 10^{-4}\)m. From the deflection standpoint, \(I\) should be greater than \(2.17 \times 10^{-4}\)m. To determine the allowable stress, the equation used is given as:

\[
\sigma = \frac{yP}{8I} \quad \text{(7)}
\]

Applying Eq. (7) gave the stress value of 1590.91 MPa. Making \(I\) the subject of the formula, stress value less than 1590.91 MPa can be obtained as shown in Eq. (8).
\[ I = \frac{yP_l^2}{8\sigma} \] ......(8)

The factor of safety is the ratio of failure load to the design load. It can as well be the ratio of yield stress to the allowable/design stress. To design the B-Pillar, the ratio of yield strength to tensile strength for the B-Pillar outer material was used. Applying the factor of safety to the yield strength of 800 MPa reduced the allowable stress to 640 MPa. The design was therefore done to ensure the von Mises stress within 640 MPa range.

VII. ELASTIC REGION AND ULTIMATE TENSILE STRENGTH:

The ultimate load defines the value of load at which a system fails and this depends upon the ultimate tensile strength of the material [25] given as in Eq. (9).

\[ \sigma_u = \frac{P}{A_0} \] ......(9)

where \( F \) = Applied load at the point of failure and \( A_0 \) = Original cross-sectional area of the B-pillar.

This may be considered in cases where the B-pillar is in tension due to the crash impact on the vehicle. Under this condition, the load \( (P) \) is considered as stress by calculation and \( A_0 \) which is the original area of the B-pillar is given.

\[ A_0 = \frac{1}{4} \pi d_0^2 \] ......(10)

where, \( d_0 \) = Original diameter of the beam

The elastic limit or yield point is the point at which a material deforms plastically under a system of forces. This point is defined by the yield strength of the material. It is the maximum stress within a system that causes the material to undergo plastic deformation.

VIII. RESULT

The summary of the initial and final B-Pillar design analyses. Judging from the results obtained for mass, displacement, and von Mises stress, there is a distinctive difference in the values obtained from the original and final analyses, implying that the final (optimised B-Pillar) B-Pillar analysis can perform optimally in severe conditions.

<table>
<thead>
<tr>
<th>Description</th>
<th>Initial Analysis</th>
<th>Final Analysis (Optimised)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Max von</td>
<td>Max von</td>
</tr>
<tr>
<td>Name B-Pillar</td>
<td>Mises stress</td>
<td>Mises stress</td>
</tr>
<tr>
<td>Load Case</td>
<td>140kN</td>
<td>Displacement</td>
</tr>
<tr>
<td></td>
<td>5.9mm</td>
<td>Displacement</td>
</tr>
<tr>
<td>Analysis</td>
<td>Static</td>
<td>Initial Mass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final Mass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.27kg</td>
</tr>
</tbody>
</table>

IX. REFERENCE

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