Product Development Techniques Implementation for Bottle Holder

[1]Avinash Chavan, [2]R. K. Agrawal
[1]Student of M.E., [2]Associate Professor
Department of Mechanical Engineering
Yadavrao Tasgaonkar College of Engineering & Management, Karjat, India

***Abstract*— During journey or travelling by any vehicle it is needed to carry water bottle. In such vehicle it is expected to have some arrangement for bottle holding. In some of vehicles are having certain arrangement to hold bottle but that arrangement have expressed some deficiencies like able to hold only fix size of bottle and broken after short use. Hence it is needed design robust and user friendly arrangement named as the Bottle Holder. Product designing techniques are implemented to attain robust design. Need identification can be done by Kano Model, QFD(Quality Function Deployment) approach will convert voice of customer into design parameters as well it gives competitive assessment so that drawback of existing models can be understood and rectified to have robust design. DFMA (Design for Manufacture and Assembly) can be useful to simplify manufacturing and assembly while design stage. After successful experimentation it is expected that customers will be satisfied.**

***IndexTerms*—DFMA, Engineering Analysis, Kano Model, Pugh Concept, QFD.**

I. INTRODUCTION

The need of implementation of Product designing technique is to achieve the improved Bottle Holder having capability to satisfy customer expectations as well as improve performance over its life. Hence it is needed to identify various customer requirements and preferences of their requirements. The QFD is used to establish qualitative customer requirements into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts. The Kano Model is a useful tool in understanding customer needs . The Kano model categorizes customer needs into three groups that are basic needs, performance needs, and excitement needs. Kano model is helpful for assessing the needs in order to set hierarchy of needs so that designer and developer can decide which of them are possible to satisfy with physical and economical feasibility. Basic needs are the needs that the customer must expect to satisfy as well as it leads to avoid mind diversion of the customer to another competitive product. Performance needs are having command on level of customer satisfaction, if performance needs are fulfilled with greater extent then the level of customer satisfaction is higher and vice versa. They are appealing for diverting customer minds from other competitive product to targeted product. Excitement needs are not focused and not expected by the customer but if they are fulfilled the customer satisfaction level will raise effectively. Similar to basic needs, excitement needs are not expected to be satisfied as well as not affecting the satisfaction level achieved by the basic needs. Customer expectations are identified as per their nature and designer takes decision which are economically and feasibly possible. While designing if manufacturing as well as assembly process is ignored then competency of design may be failed in the stage of manufacturing and assembly. DFMA criticizes design loop holes which may cause trouble and complexes in the production process along with assembly process. Product designer takes help of DFMA guidelines for selection of material, selection and scheduling of manufacturing processes those can give more effective and efficient use of available technologies with economical and feasible aspect. All the possible ways understood which of them more efficient and economical is determined as final. Finally customer and consumer approval is important which reflects through satisfaction level.

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II. PROBLEM DEFINITION

It is found that the available bottle holders in the market are having price above Rs.250, Hence if we calculated budget for 40 seat bus then it goes to Rs.10000 which is not affordable for the interior decorator. Hence there are bottle holders with lower cost found in Auto Rickshaw, bus and train. But it is observed that after couple of month bottle holder have been of no use.

While doing survey of consumers at various locations like at Auto Rickshaw Stand, ST bus depot and Railway Station shown in fig. 2.1 following observations are found.

Auto Rickshaws are having bottle holder provided by the vehicle manufacturer which gives good ability to hold bottles of fixed size of bottles but observed that it get failed either by enlarging size or get cracked at the corners shown in figures.

Trains for longer journey provides stretchable bottle holder but it is very hard to stretch for even putting bottle one liter and half liter bottle goes inside it and need to put hand inside to take it. Due to this inconvenience people avoid to use it.

ST buses are found within seat arrangement for resting bottle and for clamping purpose elastic strip is provided which can adjust with multiple size of bottle. But its elasticity fails and cannot clamp bottle properly.

Following drawbacks are there so that they are failing to satisfy consumer and customer requirements.

- Currently available bottle holder is not suitable for various size of bottles
- As well not having good life
- Lack of reliability
- Failing material
- Some good bottle holder are costly not affordable to the average customer.

Fig 1. Failure of Bottle Holder


At Railway Station


No one using,
Hard to stretch

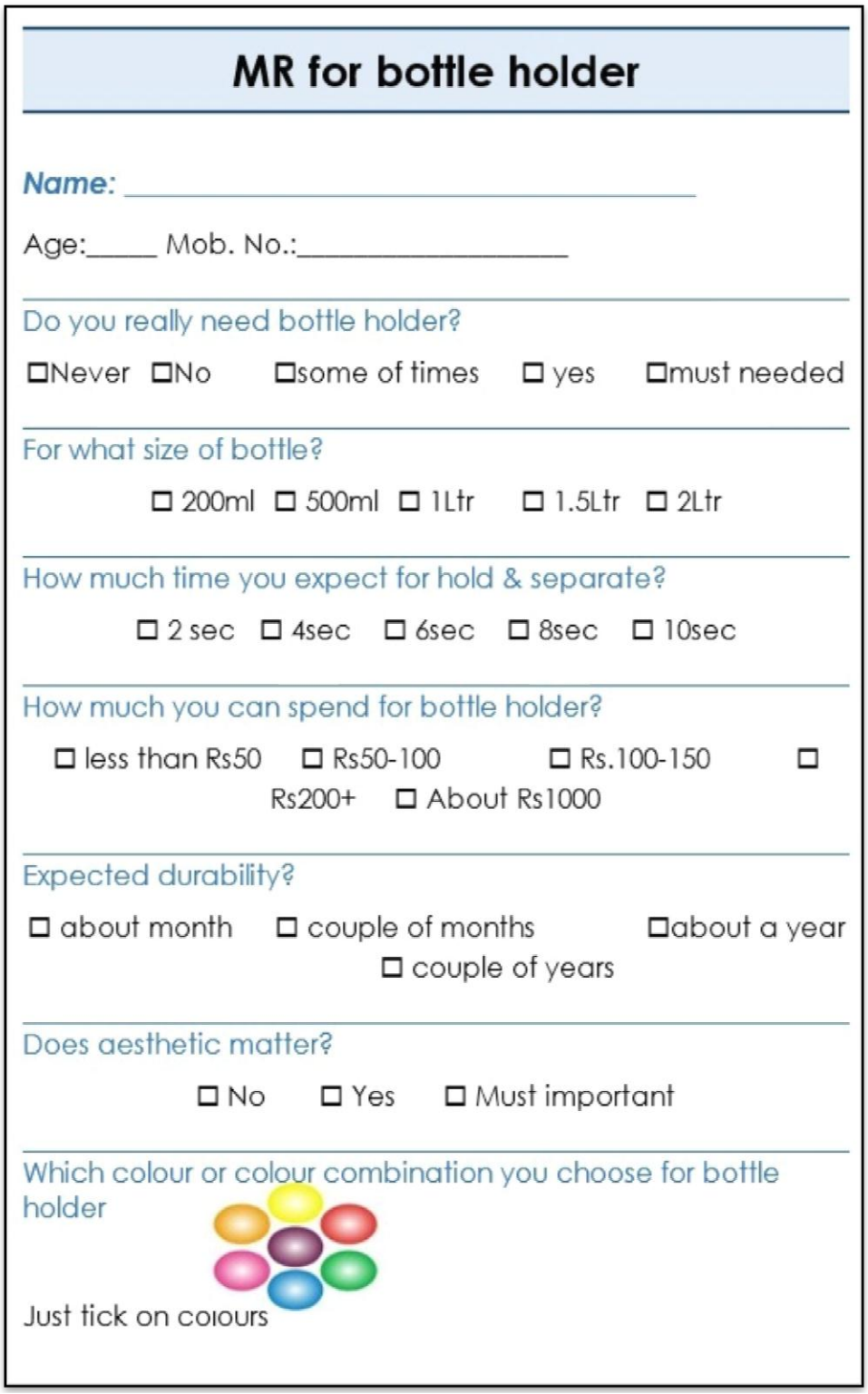
At ST bus depot

So now it is needed to develop Bottle Holder which should be durable and give robust performance along within budget of customer. For that required product development techniques can be implemented those are proven their ability to enhance effectiveness and performance of the product as well as different fields.

III. CUSTOMER NEED IDENTIFICATION

For understanding customer need it is important to know their experiences, reviews about the bottle holder. Hence set of questionnaire is prepared as shown in Fig.4.1.

Fig. 2 Set of Questionnaire



MR for bottle holder

Name: _____

Age:_____ Mob. No.:_____

Do you really need bottle holder?

☐Never ☐No ☐some of times ☐ yes ☐must needed

For what size of bottle?

☐ 200ml ☐ 500ml ☐ 1Ltr ☐ 1.5Ltr ☐ 2Ltr

How much time you expect for hold & separate?

☐ 2 sec ☐ 4sec ☐ 6sec ☐ 8sec ☐ 10sec

How much you can spend for bottle holder?

☐ less than Rs50 ☐ Rs50-100 ☐ Rs.100-150 ☐ Rs200+ ☐ About Rs1000

Expected durability?

☐ about month ☐ couple of months ☐about a year ☐ couple of years

Does aesthetic matter?

☐ No ☐ Yes ☐ Must important

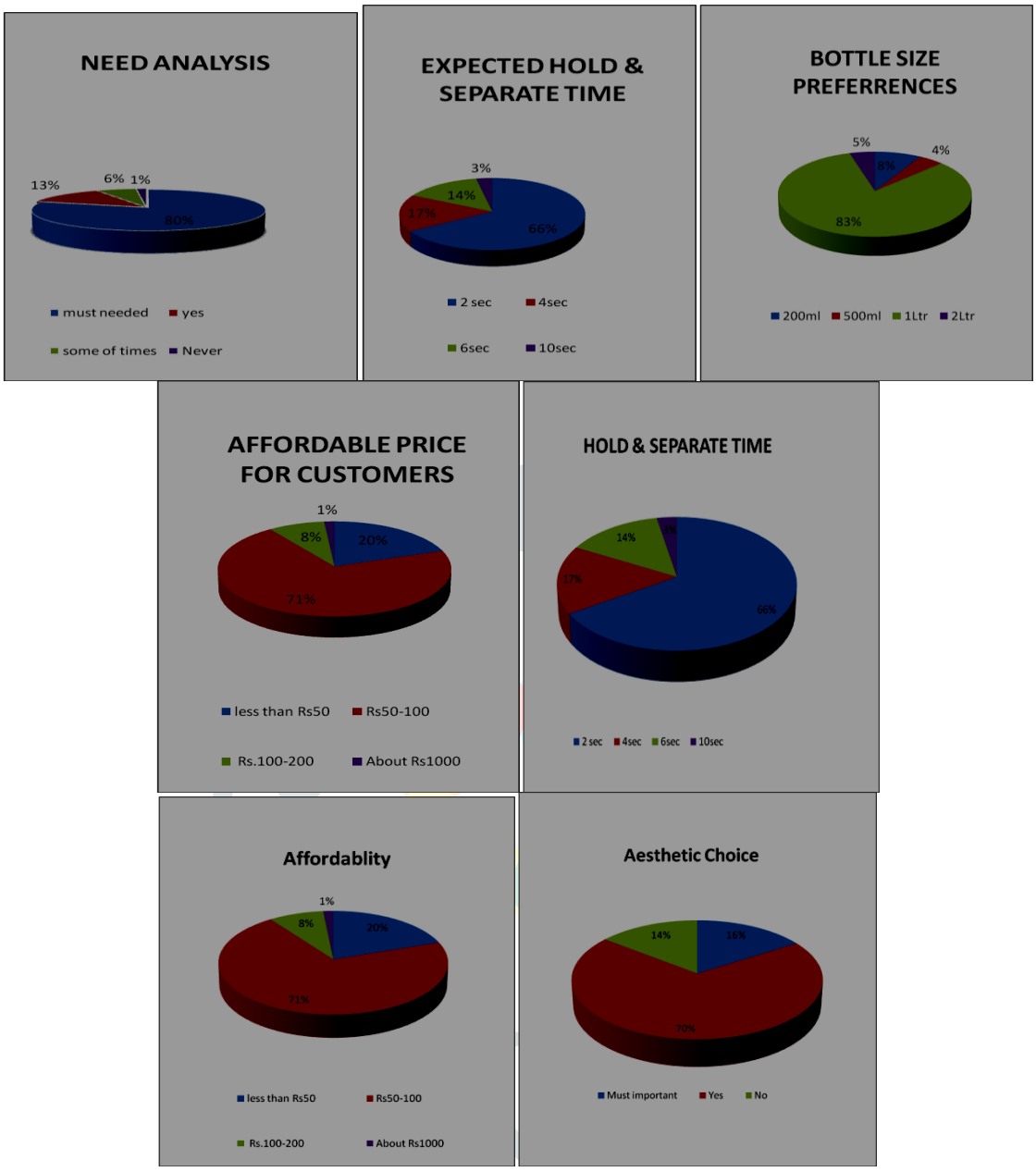
Which colour or colour combination you choose for bottle holder

Just tick on colours

After going through the survey activity at Railway station and Auto Rickshaw Stand at Thane analysis is done in MS-Excel Sheet and plotted Pie charts to understand customer choices.

Here the analysis is produced for customer preferences for 135 consumer who are Auto Rickshaw Drivers, Bus and Train passengers. From that we can conclude about 80% customers are needed the bottle holder in their journey. 92% customers carry bottles of sizes from 0.5Ltr to 1.5Ltr. About 90% customers are expected that bottle holder should have life of about one year. 91% customers are ready to pay Rs.50 to 100 for bottle holder. Aesthetic have got importance from 70% customers.

Fig. 3 Pie Charts for Customer



IV. KANO MODEL ANALYSIS

Kano model assesses different needs of customer and assist to decide which needs are Must be needs which are basic needs that customer expect to have adequate level of satisfaction, Performance needs which are related to effectiveness of functionality that rises level of satisfaction. Indifferent needs are those do not have any effect on satisfaction. Attribute needs are those have enormous effect on satisfaction level of the customer have surprised with that need. The kano model made for bottle holder is shown in table. Customers are asked his need through set of questionnaire. Along with that it is understood what customer would feel by present or absent feature.

Then kano model helps to identify needs by the evaluation table shown in table1, meaning of the customer statements are described in table2 and table3 is describing results found.

Table 1.Evaluation table

	Like	Expect It	Don't Care	Live With	Dislike			
							M	Must-Be
Like	Q	A	A	A	P		P	Performance
Expect It	R	I	I	I	M		A	Attractive
Don't Care	R	I	I	I	M		I	Indifferent
Live With	R	I	I	I	M		Q	Questionable (invalid)
Dislike	R	R	R	R	Q		R	Reversal (invalid)

Table 2. Meaning of the customer statements

Like	I would like it; enjoy it; it would be helpful to me.
Expect It	Must be that way; it is a basic need.
Don't Care	Neutral; wouldn't concern me; don't care.
Live With	Dislike it but can live with it; inconvenience.
Dislike	Extreme dislike; can't accept it; major issue.

Table 3. Results found with evaluations

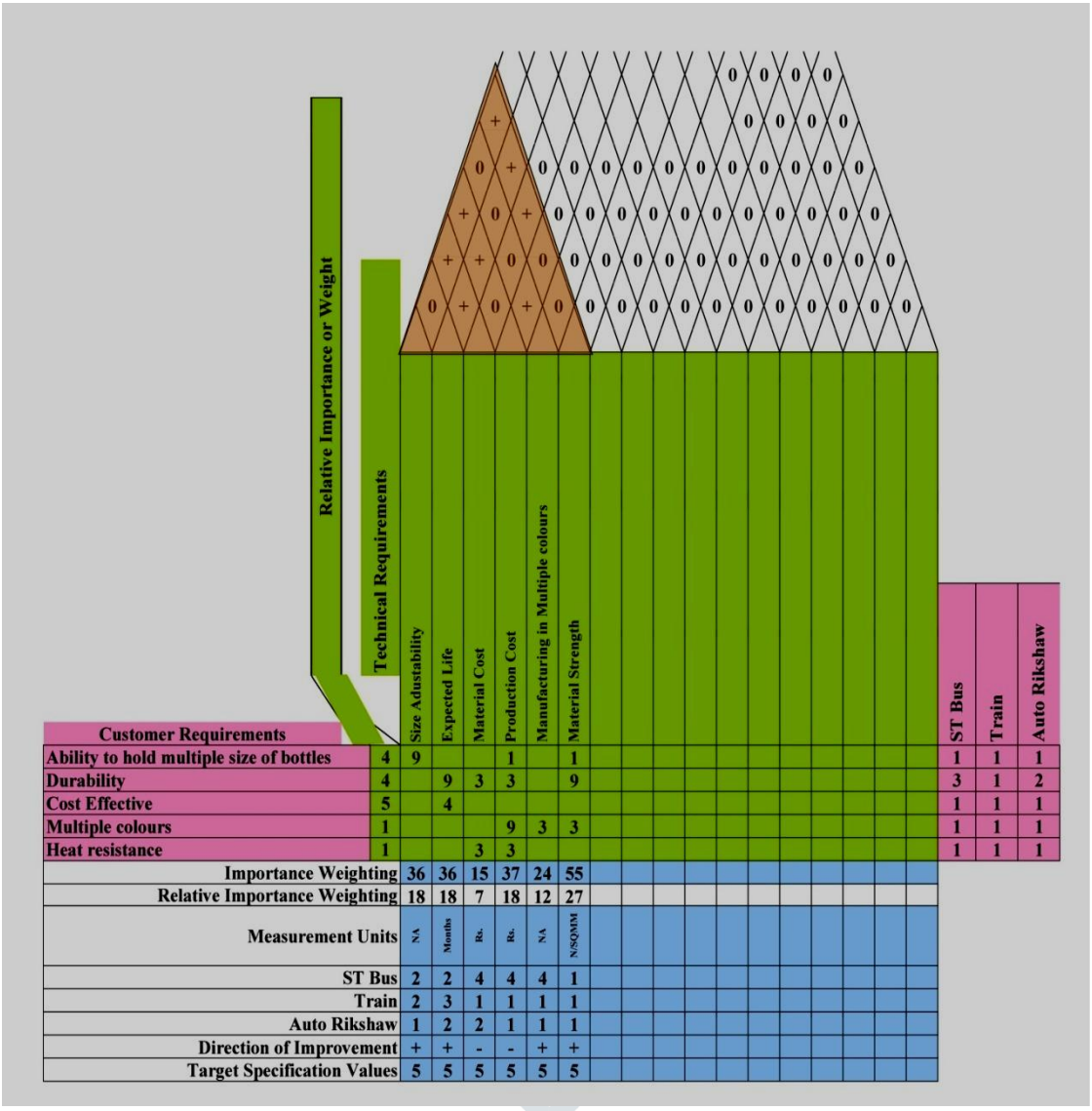
Title	Subtitle	How would you feel if this was present?	How would you feel if this was absent?	Priority
Bottle Holder	Availability	Expect It	Dislike	Must-Be
	Occupy multiple size of bottles	Expect It	Dislike	Must-Be
Life of Bottle Holder	Life about month	Dislike	Live With	Reversal (invalid)
	Life about couple of month	Expect It	Live With	Indifferent
	Life about year	Expect It	Dislike	Must-Be
Design	Robust Design	Like	Dislike	Performance
	Multiple colours	Expect It	Don't Care	Indifferent
	Good Aesthetic	Like	Live With	Attractive

It can be concluded with Kano model results that bottle holder is most needed in journey by bus or train for long time. It must occupy multiple size of bottles and must be last about year.
Availability in multiple colours is indifferent to customers, Robust design are the performance needs for customers. Good aesthetic will be the attractive need. Now results will be input to the QFD methodology.

V. QFD METHODOLOGY

Quality function deployment helps to identify important engineering characteristics which need to put emphasis for product development realising competitive impact also. It involves different rooms of House of Quality.
House of Quality: House of Quality having relationship matrix of engineering characteristics (EC) and customer requirements (CR) as well as correlation matrix of EC itself. Along with that its houses are indulged in direction of improvement, importance weighting and ranking of EC for giving weight to improve. Exact gap is found and target is set accounting competitive impact.

Fig. 4 QFD Methodology implementation for bottle holder.



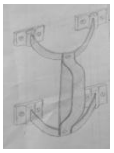
QFD Methodology results can be concluded that material strength and production cost is having greater weighting of 27 and 18 respectively. Hence they need to be given more importance for achievement fulfilled of CR. Then only CRs of durability, ability to hold multiple size and cost effective will be satisfied. Now the possible solutions are innovated or invented focusing on target ECs.

VI. PUGH MATRIX FOR SELECTING FINAL MODELS

For arrangements of resting options are within seat and external to seat and multiple solutions are there for arrangements of clamping. Customer satisfaction rank Designer rank In buses the bottle rest is assumed to be provided within seat and in train there is a need of external to seat arrangements for resting bottle.

Sometimes it may also provide within seat where seating chairs are there.
But arrangement for clamping are need to select appropriate options for final set of design For selecting that Pugh matrix is needed to implement.

Table 4 Pugh Matrix

Concept	Original In Bus and train	With Sufficient Flexibility	Fixed Size Strip	Elastic Strip	Adjustable Strips	Strips Hold With Spring Force	Torsion retractable fabric belt
							
Feasibility	 	S	S	S	S	S	S
Cost effectiveness		-2	S	S	S	S	S
Adjustability for different size of bottle		-1	-2	+1	+4	+4	+4
Ease of manufacturing		S	S	S	S	-1	-1
Manufacturing cost		S	S	S	S	-1	-1
Robustness		-1	-1	S	S	+3	+3
Durability		+1	-2	-2	+2	+3	+3
Material strength		+1	S	S	S	+1	+1
Aesthetic		+2	S	S	S	+3	+3
Ergonomic		+2	S	S	-1	+1	+2
S		3	7	8	7	2	2
+-		+2	-5	-1	+6	+13	+14
Rank & Remark		4 Rejected	6 Rejected	5 Rejected	3 Selected	2 Selected	1 Selected

Based on the Pugh's method [9], the decision-matrix is constructed to evaluate and rate the concepts, as shown in Table 4.1. Each of the chosen criterion of a possible alternative design concept is compared with the corresponding criterion of the currently used datum and the result is recorded in the decision-matrix as (+) if more favorable, (-) if less favorable, and (S) if the same.

For favorability 1 to 5 index are used. The decision on whether a concept is better than the datum is based on the analysis of the result of comparison, i.e. the total number of (-, +), and (S). New concepts with more favorable characteristics than drawbacks are selected as favorable candidates for substitution and used to redesign the bottle holder for detailed analysis.

VII. MODEL FINALIZATION AND DISCUSSION

Proposed model will be out of combinations of arrangements for resting and arrangements of holding. Possible combinations are to be identified and justified with Pugh matrix for decision making of final model. Again final model is to be put in actual use and as per customer reviews one of them will be finalized.

Bottle Holder for ST bus or Train (Second class)

- It is shown in Fig. 5.
- It is of strip of Velcro material that can be adjusted to any size of bottle.
- Good quality Velcro i.e. Hooks and Loops lock is having about 1.5 years of life.
- Both arrangements as within seat and external to seat are shown in Fig. 4.7.

Bottle Holder for Trains (AC class)

- It is shown in Fig. 6.
- Hinge loaded with torsion spring.
- It will be closed when no use and avoid disturbance in space.
- It is having good aesthetic.

Fig. 5 Bottle Holder for ST bus or Train (Second class).

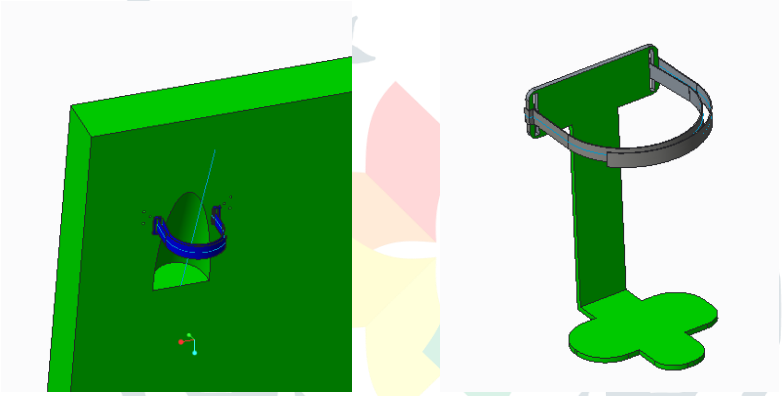


Fig. 6 Bottle Holder for Trains (AC class).

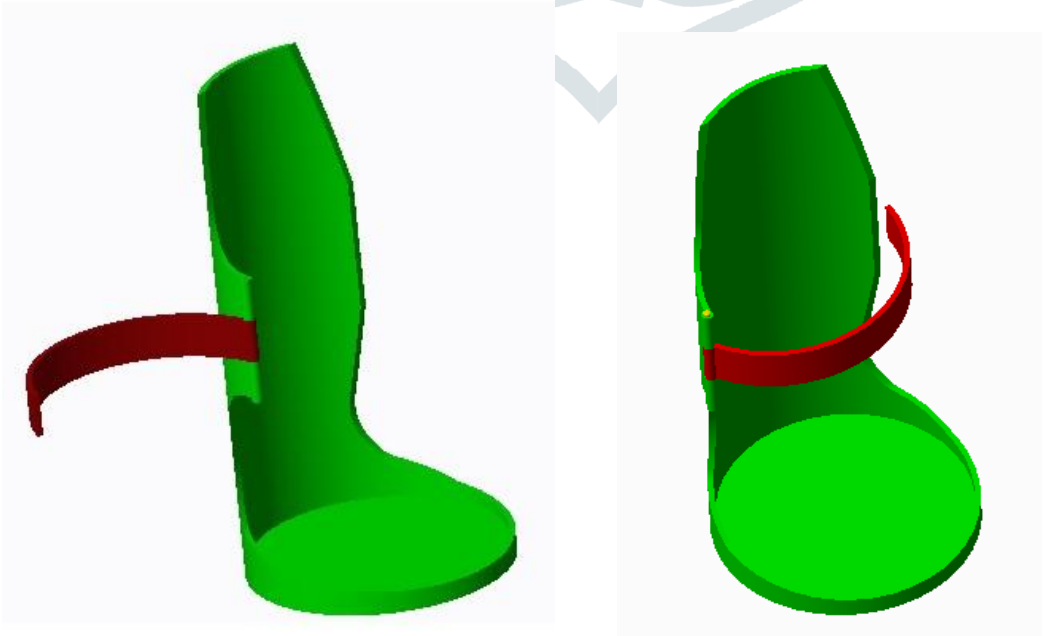
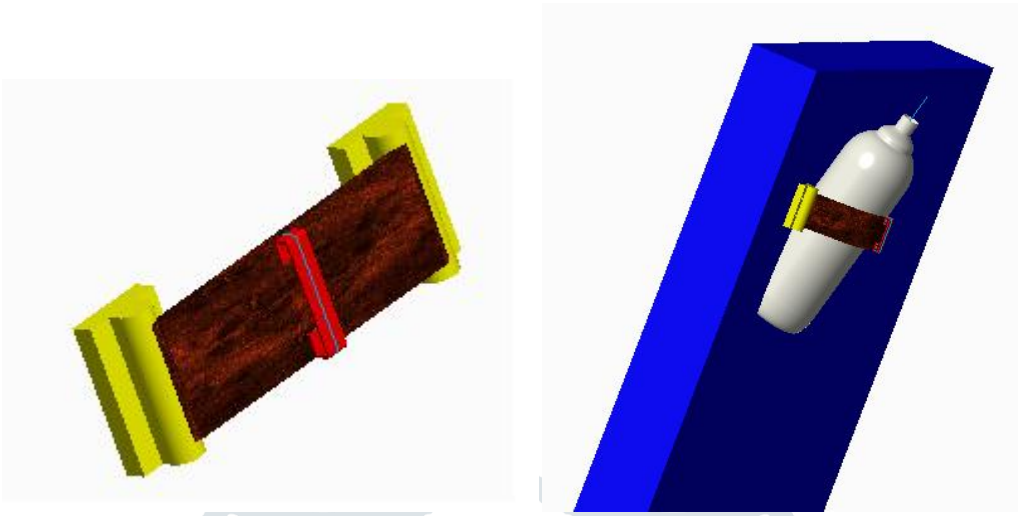


FIG. 7 BOTTLE HOLDER FOR AC BUSES AND TRAINS



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Bottle Holder for AC buses and trains.

- It is shown in Fig. 7
- It is having retractable strip that can be opened when bottle is to keep by pulling Red strip.

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