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Sustainable Computer Monitor Casing Design using Vault Structure

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***Abstract*—Sustainability is becoming inevitable in all manufacturing sectors because of consciousness on environmental issue to pass the earth with green and safe to the future generation. This paperreports on achieving sustainability by adopting vault structure concept. Computer monitor casing has been taken for the case study.The sustainability analysis has been carried out by CAD modelling and redesigned the computer monitor casing. Subsequently drop test and sustainability re analysis were carried out. It is observed from the results that, environmental impact has been reduced by 20% by incorporating vault structure.**

Keywords—computer monitor casing; sutainable manufacturing; sustainability; vault structures

I. INTRODUCTION

The interest in pollution prevention is continuously growing. This determines several industries, including manufacturingto develop and implement various environmentally-friendly strategies. Product design, selection of raw materials, manufacturing process, product delivery and reuse or recycling options for products' end of life have influences for the of environmental degradation level. There is an ongoing search for new and innovative ways by which industry can lessen its impact on the environment (Fratila 2013).

Environmental sustainability is about making products that serve useful market and societal functions with less environmental impact than currently available alternatives. Moreover, environmental sustainability necessarily implies a commitment to continuous improvement in environmental performance. This can be done by using processes which reduce energy and material consumption via clean manufacturing (Kyratsis et al. 2012). In this background the work is aimed to reduce environmental impact by using vault structure concept. The case study has been carried out for computer monitor casing.

II. LITERATURE SURVEY

Mirtsch et al. (2006) explained importance of vault structured products to achieve sustainability in manufacturing.Herrmann et al. (2008) this work intended to reduce environmental impact during machining by optimizing energy consumption and replacing the traditional coolants to some mineral based coolants. Vinodh and Rajanayagam (2010) had shown that by incorporating CAD and DFM principles leads to sustainability in product design. The case study begins with the CAD modelling of handle followed by sustainable analysis to determine the environmental impact in terms of Carbone foot print, energy consumption etc then the handle is redesign using DFM principles and environmental impact has been measured, after redesign the environmental impact is reduced.Borchardt et al. (2011)this paper focuses on ecodesign and its application in the footwear industry aiming to identify how the ecodesign can be applied to the redesign of a shoe component in order to minimize the environmental impact and simultaneously reduce costs of production and assembling. A longitudinal case study was developed in a company that produces shoe stiffeners. The process of ecodesign implementation and the practices of ecodesign considered during the product redesign were analyzed. A cost reduction of about 10% was observed (in relation to the use of natural fibers and polymers in its composition–31% of biomass and 69% of fossil material). Toxic materials were completely eliminated and a reduction of energy consumption was also noticed (during the injection process). The main contributions of this study are: ecodesign constructs to be further researched the conjoint analysis of technological ability and market potential in a redesign project, and the requirements to gain managerial support for a redesign project.Vinodh (2011) this paper reports a case study carried out in an Indian sprocket manufacturing organisation. The existing sprocket has been created using Computer Aided Design (CAD). Then, the sustainability analysis has been performed for determining the environmental impact. This is followed by the optimisation of sprocket design using Design Optimisation. The environmental impact has been measured in terms of carbon footprint, energy consumption and air/water impacts. It has been found that the optimised sprocket design possess minimal environmental impact. The results of the case study indicated that CAD and Design Optimisation could lead to the development of sustainable design with minimal impact to the environment. Kyratsis et al. (2012) this work is subjected to reduce the environmental impact by the product during the material selection. Here Eco-maniac Bin taken for case study, solidworks software package used for

selecting the less environmental impact material for the product.

The literature survey presented in this section indicates that researcher have applied various tools for achieving sustainability. In this background the scope of this paper is to achieve sustainability through incorporatingvault structure.

III. METHODOLOGY

The methodology used to carry out this work is as shown in fig. 1. The study begins with the literature review on sustainable manufacturing. Then selection of computer monitor casing has a candidate product for case study. The CAD modelling of computer monitor casing has been developed, then sustainability analysis has been carried out to identify the environmental impact. Later the computer monitor casing was redesigned using vault structure. Subsequently drop test analysis had been carried out.Once again reassessment of sustainability is done. Consequently results are obtained and discussion are made on the same and arrived for the final conclusion of the case study.

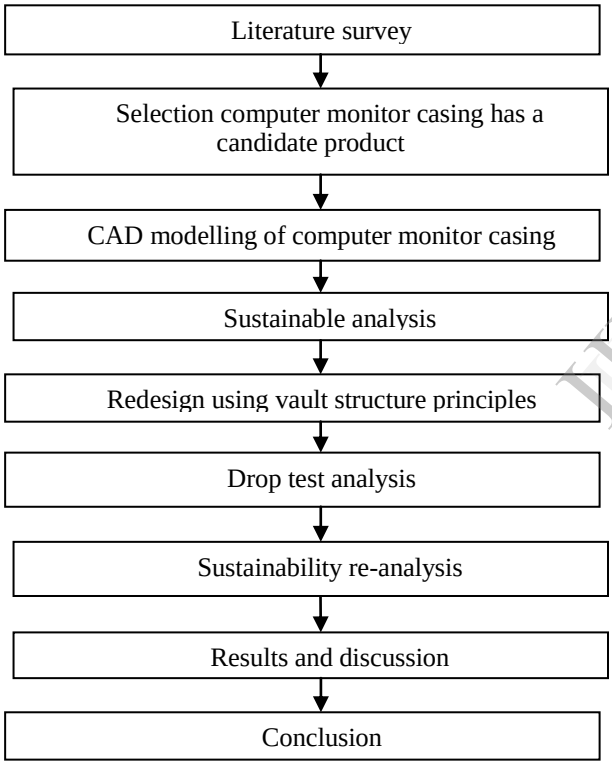

Fig. 1 Methodology

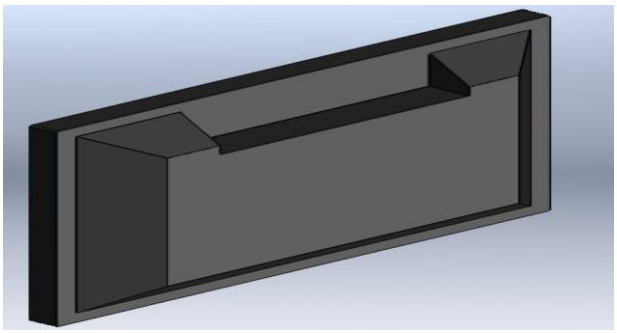

Fig. 2 CAD model of computer monitor casing

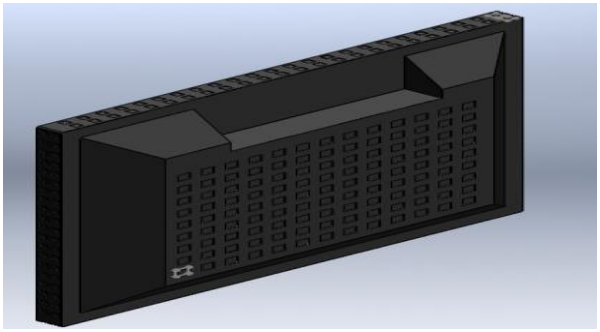

Fig.4 vault structured monitor casing

IV. CASE STUDY

The computer monitor casing has been taken for the case study. The following sections explain about CAD modeling, sustainability analysis, redesign characteristics and drop test analysis.

A. CAD modelling and Sustainability analysis

The computer monitor casing model has been developed using solidworks software (2012 version) fig. 2 shows the model of monitor casing. After completion ofmodelling sustainability analysis is carried out by using sustainability module in solidworks software. Fig. 3 shows the results of sustainability analysis obtained by giving input parameters like material used, type of manufacturing process, manufacturing and product use regions and electricity usage. Carbon footprint, air acidification, total energy consumed and water eutrophication are considered as indicators for life cycle analysis of monitor casing over different phases likematerial processing, transportation, manufacturing and end of life during its life cycle.

B. Redesign of computer monitor casing

The impact of the computer monitor casing on the environment can be lowered by minimizing the material consumption (i.e., by reducing the thickness of the monitor casing). This can be achieved by adopting the vault structure concept to the monitor casing. The vault structured monitor casing are stronger than the plain one. The fig. 4 shows the vault structured monitor casing.

C. *Drop test analysis*

Drop test study evaluates the effect of the impact of a part or an assembly with a rigid or flexible planar surface. The program calculates impact and gravity loads. The program solves a dynamic problem as a function of time. Drop test analysis of monitor casing has been carried out to authenticate whether vault structured monitor casing is gratifies the base design.

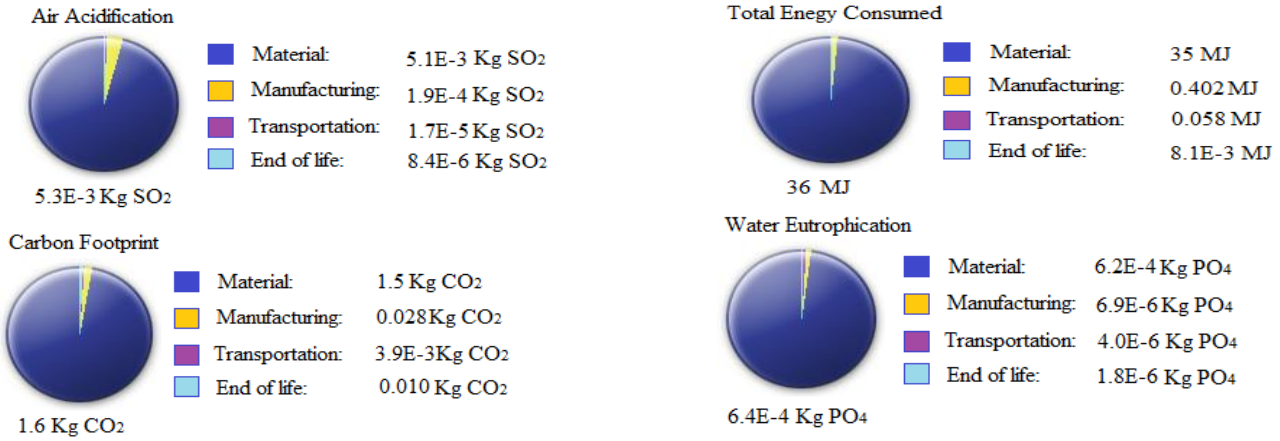

Fig.3 Result of sustainability analysis of existing computer monitor casing

V. RESULTS AND DISCUSSION

A. *Drop test analysis result*

Results of drop test analysis shows that design entities like stress, displacement and strain are complementarily same among the base line and new design. The result has been shown in fig. 5-8 and table 1.

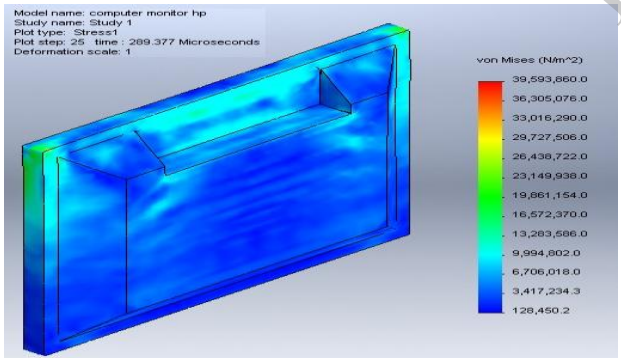

Fig.5 Distribution of stress in plain computer monitor casing

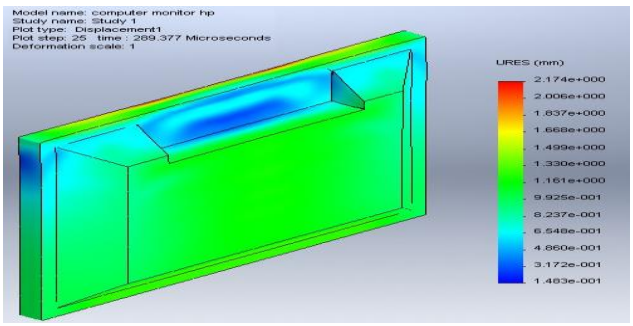

Fig.6 Displacement in plain computer monitor casing

From the result it found that, stress and displacement developed in the vault structured monitor is almost similar to the plain monitor casing.

TABLE 1COMPARISON OF THE DROP TEST RESULTS

Sl. No	Type of monitor	Material (plastics)	Weight (in Kg)	Stress (in N/m^2)	Stain	Displacement (in mm)
1	Plain monitor	**ABS**	0.3958	3.9593E+7	0.01386	2.17441
2	Vault structured monitor (reduce the thickness by 0.5mm)	**ABS**	0.29759	3.5799E+7	0.01503	1.44934

B. *Comparison results of sustainability analysis*

The comparison results of existing and re-designed monitor casing has been shown in fig 9-12. Comparisons are made among the indicators which are carbon footprint, air acidification; total energy consumed and water eutrophication over different phases like material processing, manufacturing, transportation and end of life of its life cycle. The environmental impact of the monitor casing has been reduced to 20% by incorporating valut structure. Hence it can be inferred that vault structure facilitates to achieve sustainability in products.

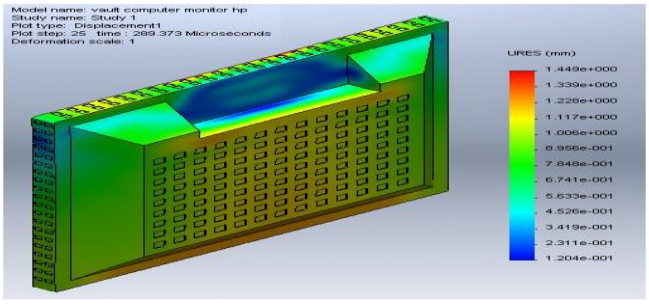

Fig.7 Distribution of stress in Vault structured computer monitor casing

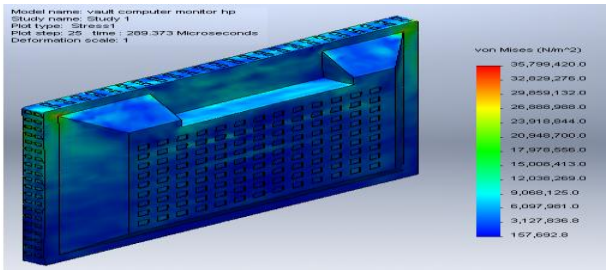

Fig.8 Displacement in Vault structured computer monitor casing

The environmental impact during material processing phase among all the indicators is comparatively lowered this were achieved by reducing the material consumption during the manufacturing. As a consequence in the manufacturing phase the environmentalimpact is minimized.

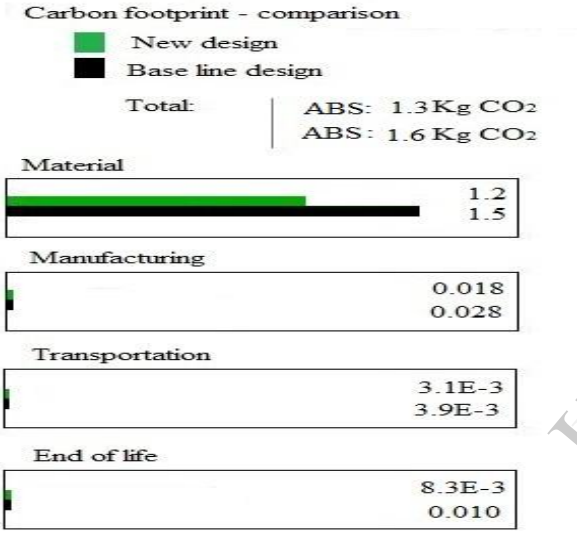

Fig.9 Comparison ofcarbon footprintamong the baseline and new design across the life cycle.

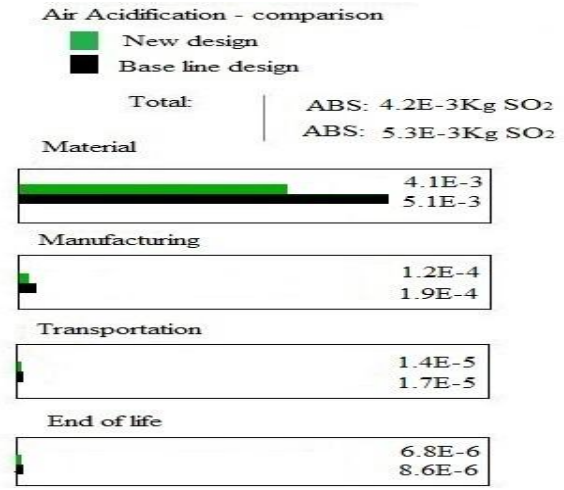

Figure 10 Comparison of air acidificationamong the baseline and new design across the life cycle.

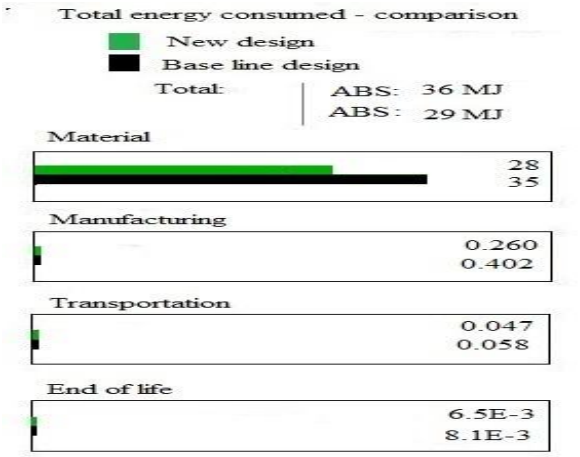

Fig.11Comparison of total energy consumed among the baseline and new design across the life cycle.

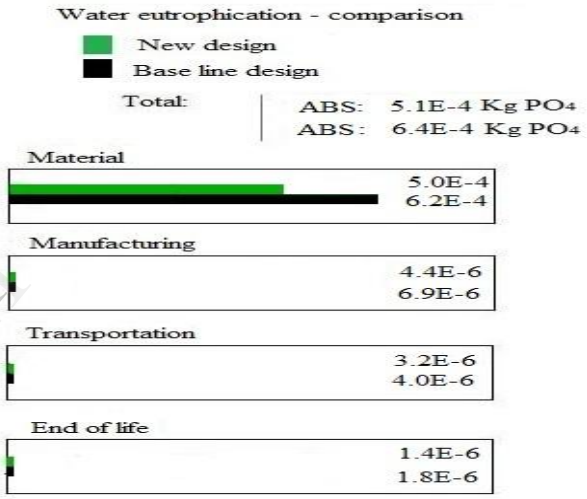

Figure 12 Comparison of water eutrophicationamong the baseline and new design across the life cycle.

VI. CONCLUSIONS

A. *Conclusions*

It is essential for manufactures to reduce environmental impact of their products to attain sustainability. This paper reports the achieving sustainability by incorporating vault structures. As from the results it can be concludes that, 20% reduction in environmental impact by the computer monitor casing among the indicators namely carbon footprint, air acidification, total energy consumed and water eutrophication shall be attained. It is also found that weight of the monitor casing has been reduced by 100 grams. One of the limitation of this paper is that, the modelling of the computer monitor casing is some degree of actual specifications.

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