Advances in Robotics & Mechanical Engineering

DOI: 10.32474/ARME.2021.03.000164

ISSN: 2643-6736

Short Communication

Ductility: Stress and Strain Theory

Paul T E Cusack*

versatile writer and researcher McGill University, Canada

***Corresponding author:** Paul T E Cusack, versatile writer and researcher McGill University, Canada

Received: November 17, 2021 **Published:** December 21, 2021

Abstract

Van Vlack claims that there is no mathematical relationship between the two measures of ductility viz elongation and reduction of area. In this paper, we prove that there is a relationship between the two measures that involves the golden mean parabola. Even is a subject as old as Mechanics, we can still make discoveries.

Keywords: Ductility; Stress; Strain; Golden Mean parabola; AT Math

Introduction

Ductility is a measure of a metal's ability to withstand tensile stress, which is a force pulling the two ends of an object away from each other. Ductility is a measure of a metal's ability to withstand tensile stress, which is a force pulling the two ends of an object away from each other (Source; Wikipedia). There are two methods to measure ductility. One is elongation (strain); the second is reduction of area $\left({}^{dA}\!/_{dt}\right)$. Van Vlack states that there is no mathematical relationship between the two measures of ductility. In this paper, we will unite the two mathematically. Assume a specimen that is circular in cross-section.

$A = \pi R^2$

$dA/d\varepsilon = 2\pi R = Circumference = 2\pi R$

$R = 2$

$dA/\varepsilon = -2\pi R = -2\pi(2) = -4\pi \approx -1.25 \Rightarrow GMP$

$t^2 - t - 1 = PE$

$t = 1/2 = 1/R$

$R = 1/t = E = -1.25$

$\int tdt = \int Rdt$

$t^2/2 = R^2/2 = 2^2/2 = 2$

$t = 2$

$2^2 - 2 - 1 = 1 = PE$

$dM/dt = 2 = t = R$

$F = Ma$

$dF/dt = dM/dt(a) = 2\left(1/\sqrt{2}\right) = \sqrt{2} = E_{max} = \sin 45^0 + \cos 45^0$

$= 1/\sqrt{2} + 1/\sqrt{2} = 2/\sqrt{2} = \sqrt{2}$

Now

$\sigma = y\varepsilon$

$F/A = y\varepsilon$

$F.1/A = y\varepsilon$

$dF/dt . d\varepsilon/dA = yd\varepsilon/dt$

$C.1/(4\pi) = Q\varepsilon$

$C.t = Q\varepsilon$

$C/Q = \varepsilon/t$

$0 = d\varepsilon/dt$

$dF/dt . d\varepsilon/dA = yd\varepsilon/dt$

$dF/dt . 1/(4\pi) = Y(0)$

$dF/dt .t = 0$

$dF/dt = 0$

$t = 0$

But

$dF/dt = \sqrt{2}$

$So, t = 0$

$t^2 - t - 1 = PE$

$0^2 - 0 - 1 = PE$

$PE = -1$

$PE = Mc^2$

$M = -1/c^2 = -1/9$

$KE = t = 1/2Mv^2 = 0$

$1/2\left(-1/c^2\right)v^2 = 0$

$-0.05555v^2 = -1/18v^2 = 0$

$v = 0$

$continuing,$

$\sigma = Y\varepsilon$

$$F/A = Y\varepsilon$$
$$[dF/dt]/[dA/d\varepsilon] = Yd\varepsilon/dt$$
$$\sqrt{2}.4\pi = Y\,d[\Delta L]/dL$$
$$1.777 = Work = 0.4233\left(d\varepsilon/dt\right)$$
$$d\varepsilon/dt = 42\%[=]none$$
$$\sigma = Y\varepsilon$$
$$F/A = Y(0.42)$$
$$F/ \quad dA/ \quad d\varepsilon = Y(0.42)$$
$$2.666/(A - \Delta A) = Y(0.42)$$
$$2.666/(A - 4\pi) = (0.4233)(0.42)$$
$$(A - 4\pi) = 2.666/[(0.4233)(0.42)] = 15.0$$
$$A = 15 - 4\pi = 2.427$$
$$2.666/2.427 = (0.4233)\varepsilon$$
$$\varepsilon = 2.5956 \approx 0.26 = \upsilon\, possion's\ Ratio$$
$$Finally,$$
$$0.42/0.25956 = 1.618GPM.$$

Conclusion

So, we provided a mathematical relationship between the two measures of ductility.

References

1. Van Vlack LH (1989) Elements of Materials Science and engineering. Addison Wessley.

DOI: 10.32474/ARME.2021.03.000164