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REVIEW

Convergence Proving of the Theoretical & True Elongation Inequalities by Derivation and Analogy

Run Xu*

Gyeongsang University, Metallurgical Engineering Dept, Gyeonnam, Chinju 52828, Korea

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$0<(1+\varepsilon)^{1/\varepsilon}<e$ and $0<\varepsilon^{1/\varepsilon}<1$

ABSTRACT

According to LNƐ, theoretical & true elongation of tensile, and by adopting the increasing function of formulas with the derivation and analogy methods, the elongation formula of $0<(1+\varepsilon)^{1/\varepsilon}<e$ & $0<\varepsilon^{1/\varepsilon}<1$& four convergences are deduced too when $\varepsilon >1$ and $0<\varepsilon<1$.The inequalities of $LN\varepsilon < \varepsilon$ and $LN(1+\varepsilon)<\varepsilon$ and $LN(1+\varepsilon)> LN\varepsilon$ are deduced if $\varepsilon>1$ and $0<\varepsilon<1$ in material dynamics. Finally the conclusions of $LN\varepsilon < \varepsilon$ and $LN\varepsilon<LN(1+\varepsilon)< \varepsilon$ are deduced together if $\varepsilon>1$ and $0<\varepsilon<1$.

1. Introduction

Under the condition of density invariance, the convergence of the real and theoretical elongation inequality in material mechanics is proved.When the elongation is greater than 0.15~0.2, there is no comparison between the true elongation and the theoretical elongation. [1~3] through the function analysis to judge their relationship of increasing function, so as to determine their comparison, in order to clarify their mathematical comparison.Because we want to know the true elongation of LN (1+ε) in the mechanics of materials.Although the phenomenon can be known from the experiment, it has not been proved from the mathematical relationship.Therefore, this paper abstracts the phenomenon and proves it mathematically, and finds that there is a certain relationship between them.That is, the true elongation is greater than the theoretical elongation, so that the experimental research becomes mathematical theory plasticity, which is a big proof of this paper. Prove "1 + 1 =?" like goldbach's

*Corresponding Author:
Run Xu,
Gyeongsang University, Metallurgical Engineering Dept, Gyeonnam, Chinju 52828, Korea;
Email: Xurun1206@163.com*

conjecture. In 1742, he wrote to Euler to talk about it. Its mean is what two prime numbers add? From the point of view of mathematics, finally "1 + 2" were proved by Chen Jingrun in a large chapter. It means that any bigger than two is presented by a prime number and multiplying two prime number. But it has some key points for elongation to prove successful, so from the increasing function and analogy is the key to this paper, prove that LN (1 + ε) < Ɛ is the core of this article, the last two induced mathematical inequality can also induce even dozens of inequality. Its proof process is not as long as Chen jingrun wrote so deep.The same is true for shrinkage rates, which can be traced back to Chinese database natural science full text 2020.1 (3).

We use these formulas to understand the internal relation problem, carry on the derivation and the analogy method.We prove that y = LN(1+ε) is an increasing function.Critical problems such as LNε<LN(1+ε)< ε when >0 are proved.

2. The Proof of 0< (1+ε) $^{1/ε}$< e & 0< ε$^{1/ε}$< 1

2.1 The Proof of y= LNε being Increasing Function

The discussion situation here is ε≥1.

If ε> 1 hasLNε> 0 (1)

Supposes y= LNx=LNε

has $\frac{dy}{dx}=\frac{d(LN\varepsilon)}{d\varepsilon}$ (2)

since $y=\frac{d(LN\varepsilon)}{d\varepsilon}=\frac{1}{\varepsilon}$

Due to $\frac{d(LN\varepsilon)}{d\varepsilon}>0$ (3)

& 0< 1/ε< 1 (4)

y= LNx is ncreasing function.

Its maximum is 1.

2.2 The Proof of Y = LN(1 +ε) being Increasing Function

If ε> 1 (5)

LNε> 0 (6)

Has too LN(1+ε) > LNε (7)

supposes y= LN(1+x)

so $\frac{dy}{dx}=\frac{d[LN(1+\varepsilon)]}{d\varepsilon}=\frac{1}{1+\varepsilon}$ (8)

since $\frac{dy}{dx}>0$ (9)

So that y=LN（1+x）is increasing function.

2.3 Proves LN(1+ε)< LNƐ

since LN(1+ε)/(1+ε)< LN（1+ε)/ε (10)

If ε>1 according to εt=LN(1+ε)> LNε (11)

has LN（1+ε）/LNε>LNε/LNε=1. (12)

because LN（1+ε）and LNε is increasing function. From above it has

from（11）it has

LN（1+ε）/LNε>1 (13)

So that LN（1+ε）> LNε (14)

That is the first result in this paper.

2.4 Proves LN(1+ε)< Ɛ

2.4.1 When Ɛ>1

From 1/ε<1 (15)

According to the above increasing function it has

LN(1+ε)/ε< ε/LNε (16)

This is the comparison among elongation and true stress when elongation ε ≧ 1, the above inequality(15) is gained upon inequalities comparison. The relationship may be seen in Figure 1, the biggest difference among LNε & LN（1+ε）is 25.

ε/LNε<ε/ε=1 (17)

According to equations (15) &(16) it has

1/εLN(1+ε)<1 (18)

ie. LN(1+ε)<Ɛ (19)

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This is the important inequality result in this paper among true tress and engineering one when $\varepsilon>1$.

2.4.2 When $0<\varepsilon\leq1$

$$\text{Since } \varepsilon t=LN(1+\varepsilon)>LN\varepsilon \tag{23}$$

$$\text{has } LN(1+\varepsilon)/LN\varepsilon>LN\varepsilon/LN\varepsilon=1 \tag{24}$$

$$\text{Has too } LN(1+\varepsilon)>LN\varepsilon \tag{25}$$

If $0<\varepsilon<1$because$1/\varepsilon>1$

$$\text{in equation(12) it is known that } 1/\varepsilon>\varepsilon \tag{26}$$

This is the relationship between true and engineering elongation when $\varepsilon>1$. The above inequality (26) and below (27) is obtained from this search for plasticity to compare which result the inequality (31). the relationships is in Figure 2, the biggest difference is 25.

According to equation, it has been known that when $0<\varepsilon<1$it has $LN\varepsilon<0$ ie.$1/\varepsilon>1$,

$$\text{hence} 1/\varepsilon LN\varepsilon<1 \tag{27}$$

$$\text{has } LN\varepsilon<\varepsilon \tag{28}$$

$$\text{According to } 1/\varepsilon LN(1+\varepsilon)< LN2<1 \tag{29}$$

$$\text{and } 1/\varepsilon>\varepsilon \text{ since} 1/\varepsilon>1>\varepsilon, LN(1+\varepsilon)>0$$

$$0=LN1<1/\varepsilon LN(1+\varepsilon)< 1/\varepsilon LN2<1 \tag{30}$$

$$LN(1+\varepsilon)>1/\varepsilon$$

$$\text{Hence } LN(1+\varepsilon)<\varepsilon \tag{31}$$

It is a important result deduced in this paper when $0<\varepsilon\leq1$.

From equation (25) &$LN\varepsilon<0$ it has been known

$$LN(1+\varepsilon)/\varepsilon<-LN(1+\varepsilon)/LN\varepsilon<\varepsilon/-LN\varepsilon<\varepsilon/\varepsilon=1 \tag{31}$$

$$-LN(1+\varepsilon)/LN\varepsilon<-\varepsilon/LN\varepsilon<\varepsilon/\varepsilon=1 \tag{32}$$

Hence according to (25) it has always

$$LN(1+\varepsilon)>LN\varepsilon \tag{33}$$

This is the results between $LN\varepsilon$ and $LN(1+\varepsilon)$ mathematics when$0<\varepsilon\leq1$.

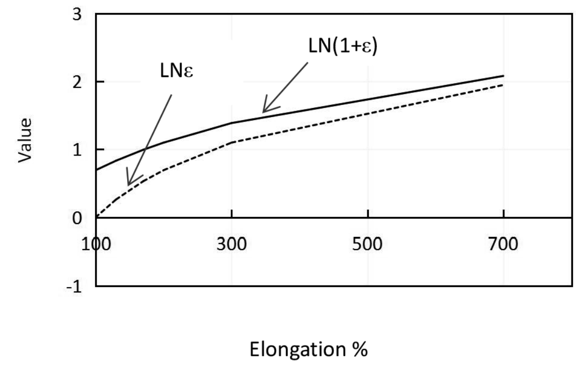

Figure 1. The relations of function of Ɛ, LNƐ & LN(1+Ɛ) if Ɛ>1

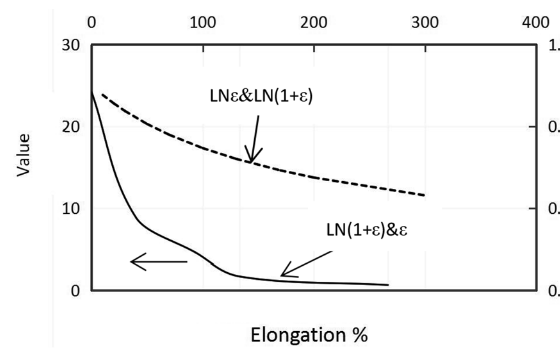

Figure 2. The relations of function of ratio with Ɛ, LNƐ & LN(1+Ɛ) If Ɛ>1

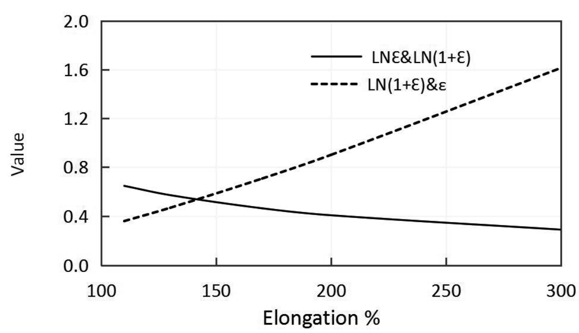

Figure 3. The relations of function of difference with Ɛ, LNƐ & LN(1+Ɛ) If Ɛ>1

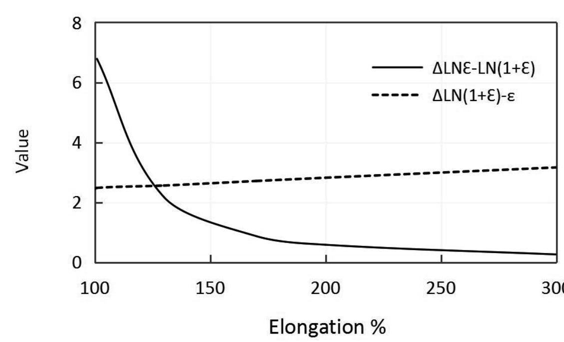

Figure 4. The relations of function of deviation with Ɛ, LNƐ & LN(1+Ɛ) If Ɛ>1

2.5 Prove $0< (1+\varepsilon)^{1/\varepsilon}< e$

Since $LN(1+\varepsilon)/|LN\varepsilon|>\varepsilon/|LN\varepsilon|$ (34)

From equation(13) it has

$1/|LN\varepsilon|>1/\varepsilon$ (35)

hence $|LN\varepsilon|>\varepsilon$ (36)

Ie $LN(1+\varepsilon)<-LN\varepsilon$ (37)

It has that $(1+\varepsilon)^{1/\varepsilon}<e$, when$1>\varepsilon>0$it has$LN\varepsilon<0$; when$\varepsilon>1$it has$LN\varepsilon>0$. This is dicsussed above.when $0<\varepsilon\leq 1$ it has in(12)and(13)

$(1+\varepsilon)^{1/\varepsilon}<1$ (38)

From equation(10)it has known that

$\varepsilon^{1/\varepsilon}<(1+\varepsilon)^{1/\varepsilon}<1$ (39)

When $0<\varepsilon<1$ it has known that $y'=\varepsilon^x LN\varepsilon>0$,so that $y=\varepsilon^x$ is increasing function.hence

$0<\varepsilon^x$ (40)

Hence it is been proven as below

$0<\varepsilon^{1/\varepsilon}<1$ (41)

From (12) it has know that
$LN(1+\varepsilon)^{1/\varepsilon}<1=LNe$ (42)
i.e.

$(1+\varepsilon)^{1/\varepsilon}<e$ (43)

In terms of the above proven $LN(1+\varepsilon)$ being increasing function it has

$LN(1+\varepsilon)/\varepsilon>LN1/\varepsilon=0$ (44)

Due to $LN1/\varepsilon=0$ (45)

It has $0<(1+\varepsilon)^{1/\varepsilon}<e$ (46)

This is a mathematical inequality in this paper, it expresses that below relationship $(1+\varepsilon)^{1/\varepsilon}<e$ and $0< (1+\varepsilon)^{1/\varepsilon}$.

It expresses that $(1+\varepsilon)^{1/\varepsilon}$ mathematical meaning in the scope of 0 & e=2.7.

$0<1/(1+\varepsilon)$ (47)

So that $LN(1+\varepsilon)<\varepsilon$ (48)

i.e.

$LN(1+\varepsilon)^{1/\varepsilon}<1=LNe$ (49)

i.e.

$(1+\varepsilon)^{1/\varepsilon}<e$ (50)

$LN(1+\varepsilon)/\varepsilon>LN1/\varepsilon=0$ (51)

So $0<(1+\varepsilon)^{1/\varepsilon}<e$ (52)

2.6 Prove $0< \varepsilon^{1/\varepsilon}< 1$

It is known above that $(1+\varepsilon)^{1/\varepsilon}<e$, if $1>\varepsilon>0$, $LN\varepsilon<0$; If $\varepsilon>1$, $LN\varepsilon>0$. from(12)and(10)it has

$(1+\varepsilon)^{1/\varepsilon}<1$ (53)

From(10)& (12) it has

$\varepsilon^{1/\varepsilon}< (1+\varepsilon)^{1/\varepsilon} < 1$ (54)

If $\varepsilon\geq 1$ $dy/dx= \varepsilon^x LN\varepsilon> 0$, so $y= \varepsilon^x$ is increaing function. hence
$0<\varepsilon^x$----- (55)

It proves the relationship of $0< \varepsilon^{1/\varepsilon}< 1$ (56)

3. Discussion

Figure 1~4 is the comparison of the true elongation and the elongation when the is not less than 1.The inequality (13) above and the inequality (14) below are the plastic relations obtained by comparing the inequality (17).Their sizes are shown in figure 1, and the comparison between the two is shown in figure 2.The maximum ratio between LNε and LN(1+ε) is over 25.According to figure 1, LN(1 +ε) is greater than LNε and the convergence trend is 700%.

The biggest difference is shown in Figure 3 for LN (1 + Ɛ) and Ɛ is 4 for LN Ɛ and LN (1 + Ɛ) is 2.As shown in figure 4 the maximum deviation for LN (1 + Ɛ) and Ɛ is 7 for LN Ɛ and LN (1 + Ɛ) is 1.Therefore, if the elongation is greater than 1, the value drops rapidly.When the elongation is greater than 130%, the trend is flat.

Figure 5~8 shows the comparison of the true elongation and the elongation when the is less than 1.The inequality (13) above and the inequality (14) below are the plastic relations obtained by comparing the inequality (17).Their sizes are shown in figure 5, and the comparison between the two is shown in figure 6.The maximum ratio for LNε and LN(ε) is 25.According to Figure 5, LN(1+ε) is greater than LNε.

The biggest difference is shown in Figure 7 for LN (1

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+ Ɛ) was 0.5 for LN(1+ε) and Ɛ&Ɛ and LN (1 + Ɛ) is 2.5.As shown in figure 8 the maximum deviation for LN (1 + Ɛ) and Ɛ is 7 for LN Ɛ and LN (1 + Ɛ) is 2.So if the elongation is less than 1, the value drops sharply.When the elongation is less than 70%, the trend is flat.

Because $dy/dx=1/\varepsilon x^{1/\varepsilon-1}>0$, when $\varepsilon>1$ $y=x^{1/\varepsilon}$ is increasing function. at the same time to prove the inequation (56).

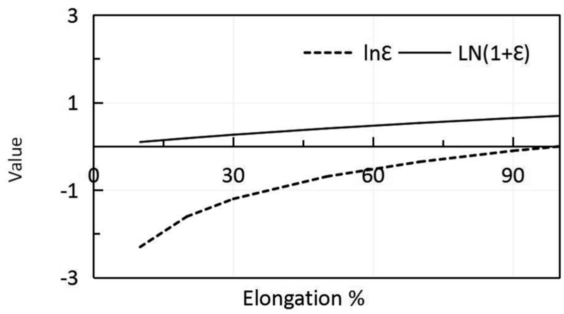

Figure 5. The relations of function of Ɛ, LNƐ & LN(1+Ɛ) if ε< 1

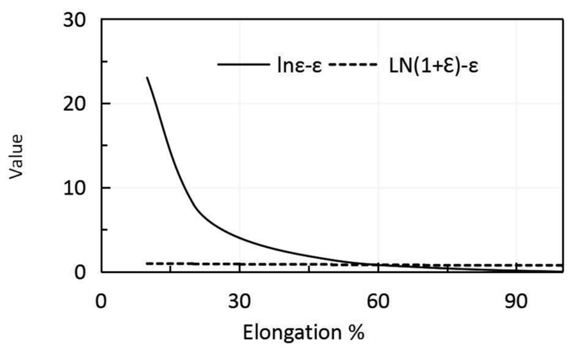

Figure 6. The relations of function of ratio with Ɛ, LNƐ & LN(1+Ɛ) if ε< 1

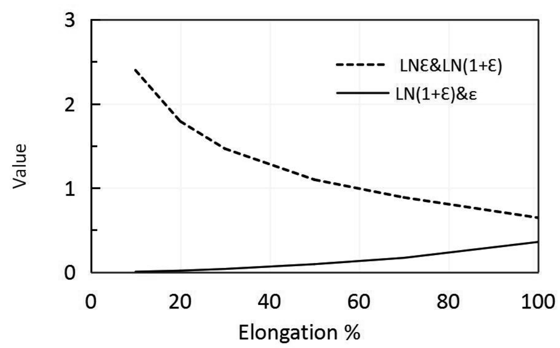

Figure 7. The relations of function of difference with Ɛ&LNƐ, LNƐ& LN(1+Ɛ) if ε< 1

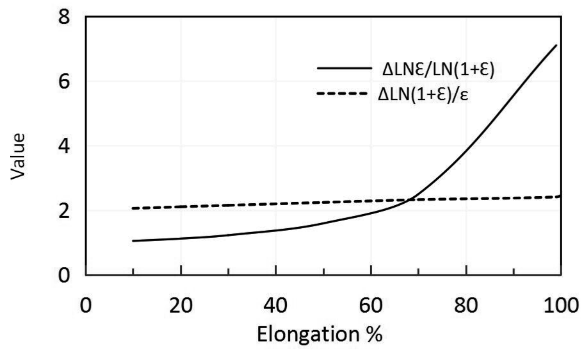

Figure 8. The relations of function of deviation with Ɛ& LNƐ, LNƐ&LN(1+Ɛ) if ε< 1

4. Conclusions

1. The inequality between true and theoretical elongation in material mechanics is proved.The inequality between LN(1+ε)> LNε and LN(1+ε)<ε is proved when 0<e.

2. The convergence of $0<(1+\varepsilon)^{1/\varepsilon}<e$ & $0<\varepsilon^{1/\varepsilon}<1$ is derived from $y=\varepsilon^x$ & $y=x^{1/\varepsilon}$ is an increasing function.In mechanics of materials prove LN (1 + ε) < LN ε, LN (1 + ε) < ε and LN (1 + ε)/(1 + ε) < LN (1 + ε)/ε 、LN (1 + ε)/ε < LN (1 + ε)/LN ε < ε/LN ε < ε/ε is established.

3. the greatest difference in LN(1+Ɛ) and Ɛ is 4 while LNƐ and LN(1+Ɛ) is 2. The greatest deviation in LN(1+Ɛ) and Ɛ is 7 while LNƐ and LN(1+Ɛ) is 1. The maximum ratio between LNε and LN(1+ε)is more than 25.

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