High-Performance Solid Tires

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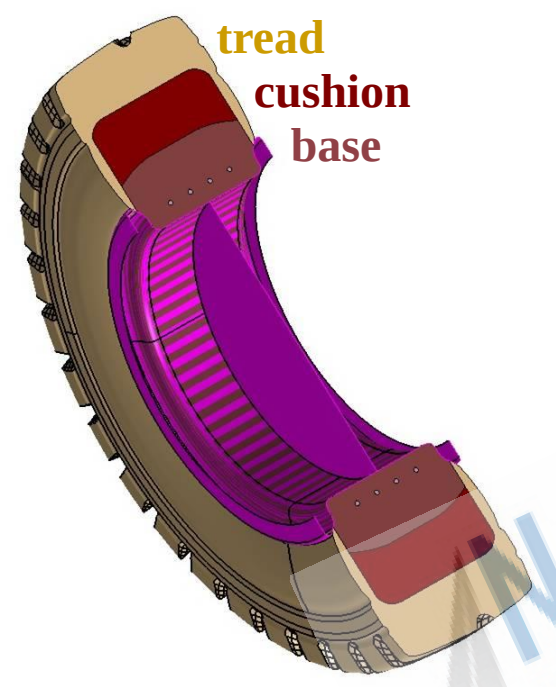
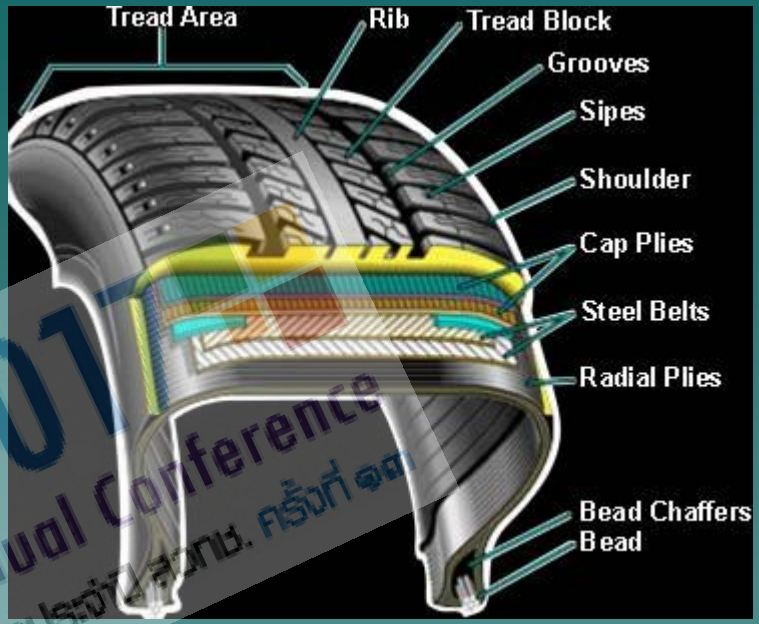
Structures of solid vs pneumatic tires

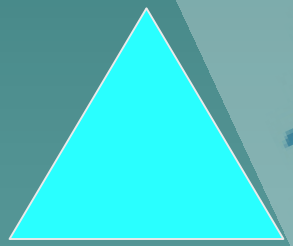


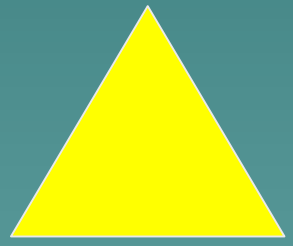


Different Philosophy

mechanical strength

wet grip





heat build-up

wear

rolling resistance

wear

Aging

Natural rubber (NR)

Styrene Butadiene Rubber (s-SBR)

Solid vs Pneumatic

Benefits

- no flat
save on labor and installation cost
no maintenance

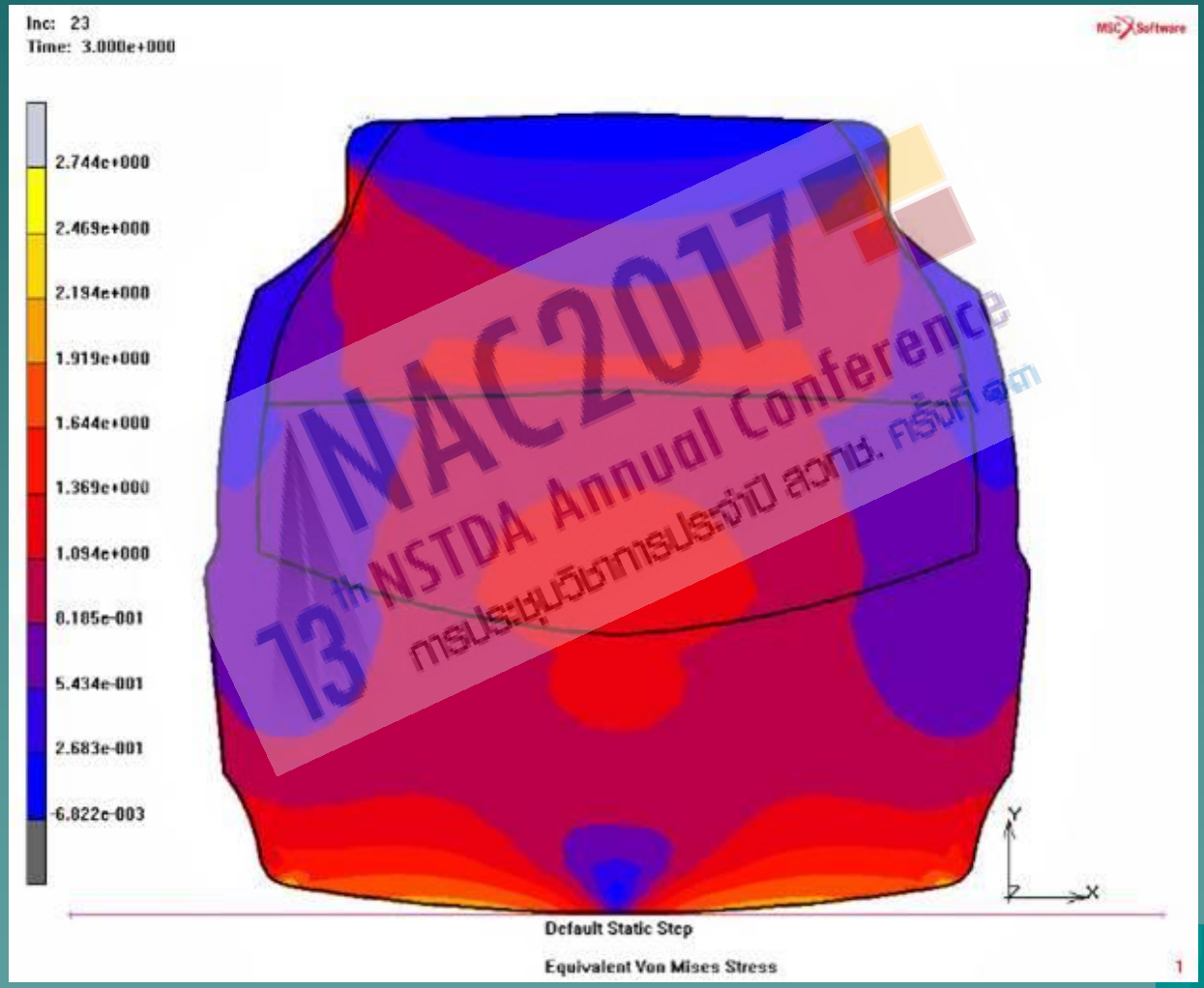
- longer tread life

Drawback

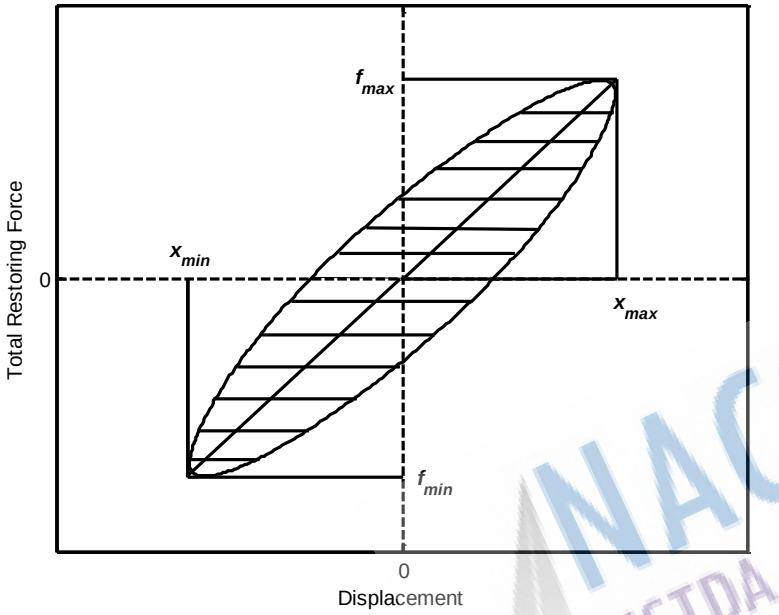
- less riding comfort

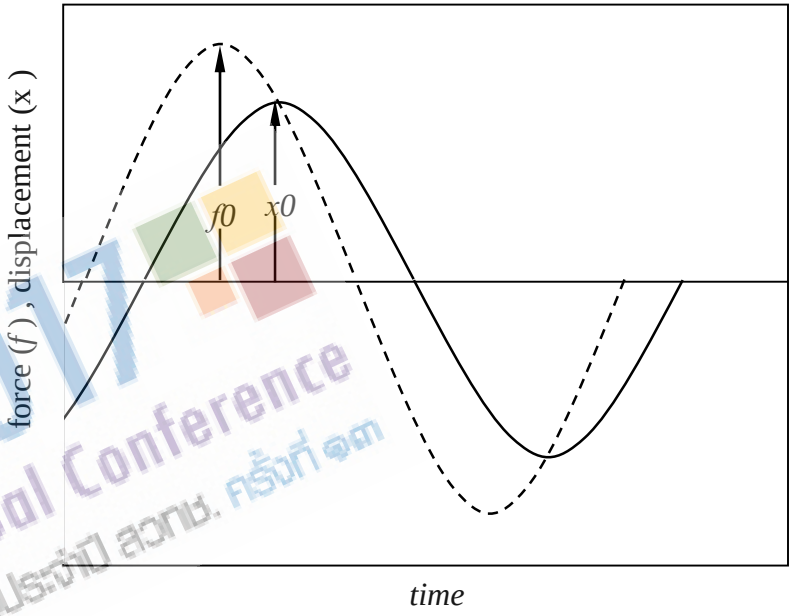
High-Performance Solid Tires ?

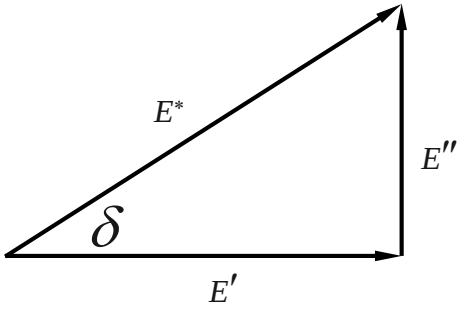
Finite Element Analysis (FEA)



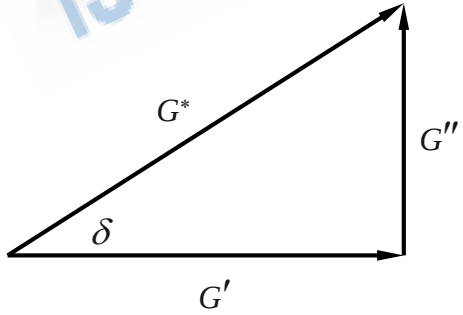
Dynamic Characterization







Tension-compression mode

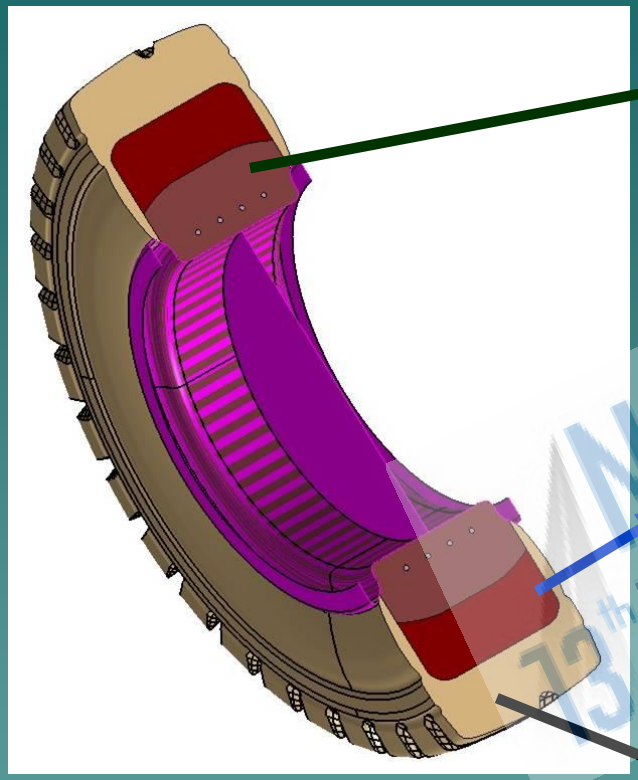


Shear mode

$$M^* = M' + iM''$$

loss factor or tan δ = M''/M'

Desired Properties



Base

- High Stiffness
- Low dynamic set
- Low energy dissipation

Cushion

- Decent mechanical strength
- Low energy dissipation

Tread

- decent mechanical strength
- proper abrasion resistance
- appropriate energy dissipation

Benchmarking of Solid Tires

8 tires : investigate

- endurance behavior

- structures

- properties and compositions

size 7.00-12
load 2.9 tons
speed 10 km/hr
amb temp. 38 ^{0}C

Failure in laboratory test

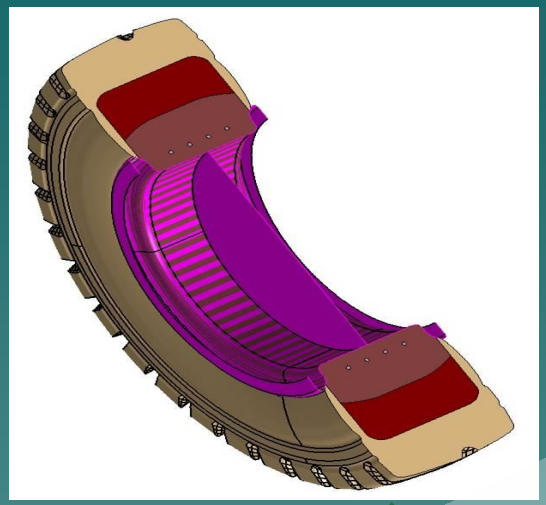
Failure in laboratory test

Endurance of solid tires in year 2012

Brand Name	Original	Endurance time [min]	Din loss abrasion
1.Continental	Germany	300	140
2.Trelleborg	Sweden	210	110
3.Solideal	Sri Lanka	160	160
4.Aichi	Japan	150	120
5.Thai Tire 1	Thailand	120	140
6.Thai Tire 2	Thailand	120	160
7.Thai Tire 3	Thailand	90	160
8.Thai Tire 4	Thailand	60	240

Target : Endurance and Abrasion

Development of High-Performance Solid Tire



2012-
> 50 prototypes

Bulging/Blowout resistance

Endurance of solid tires in year 2016

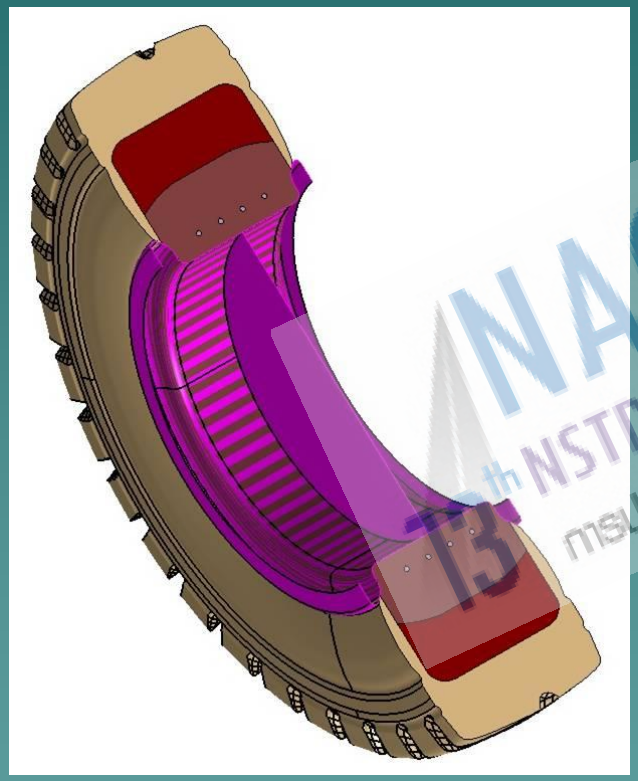
Brand Name	Endurance time [min]	Din loss abrasion
Thai Tire 3	> 360	90
1.Continental	300	140
2.Trelleborg	210	110
3.Solideal	160	160
4.Aichi	150	120
5.Thai Tire 1	120	140
6.Thai Tire 2	120	160
7.Thai Tire 3	90	160
8.Thai Tire 4	60	240

Energy Consumption Behavior of Solid Tires

Brand Name	Endurance time [min]	Rolling resistance Coefficient
Thai Tire 3	> 360	15
1.Continental	300	16
2.Trelleborg	210	17
3.Solideal	160	21
4.Aichi	150	n/a
5.Thai Tire 1	120	26
6.Thai Tire 2	120	23
7.Thai Tire 3	90	29
8.Thai Tire 4	60	31

Survival : Harsh and Severe Conditions

strong and durable basic-structure
+ different suitable caps (treads)



Other special problems

Other special problems

Other special problems

Future Plan

Field-tested Proof :

1. bulging and blowout resistance
2. general : long tread life
3. anti-aging, non-marking
4. oil resistance
5. high mechanical strength

etc.

Many thanks

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