

8th ICAP - Seattle, USA

ICAP '97

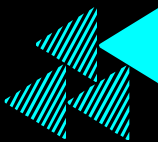
Session : Traffic/Loading Considerations

**DETERMINATION OF PNEUMATIC
TYRE/PAVEMENT INTERFACE
STRESSES UNDER MOVING LOADS
AND SOME EFFECTS ON PAVEMENTS
WITH THIN ASPHALT SURFACINGS**

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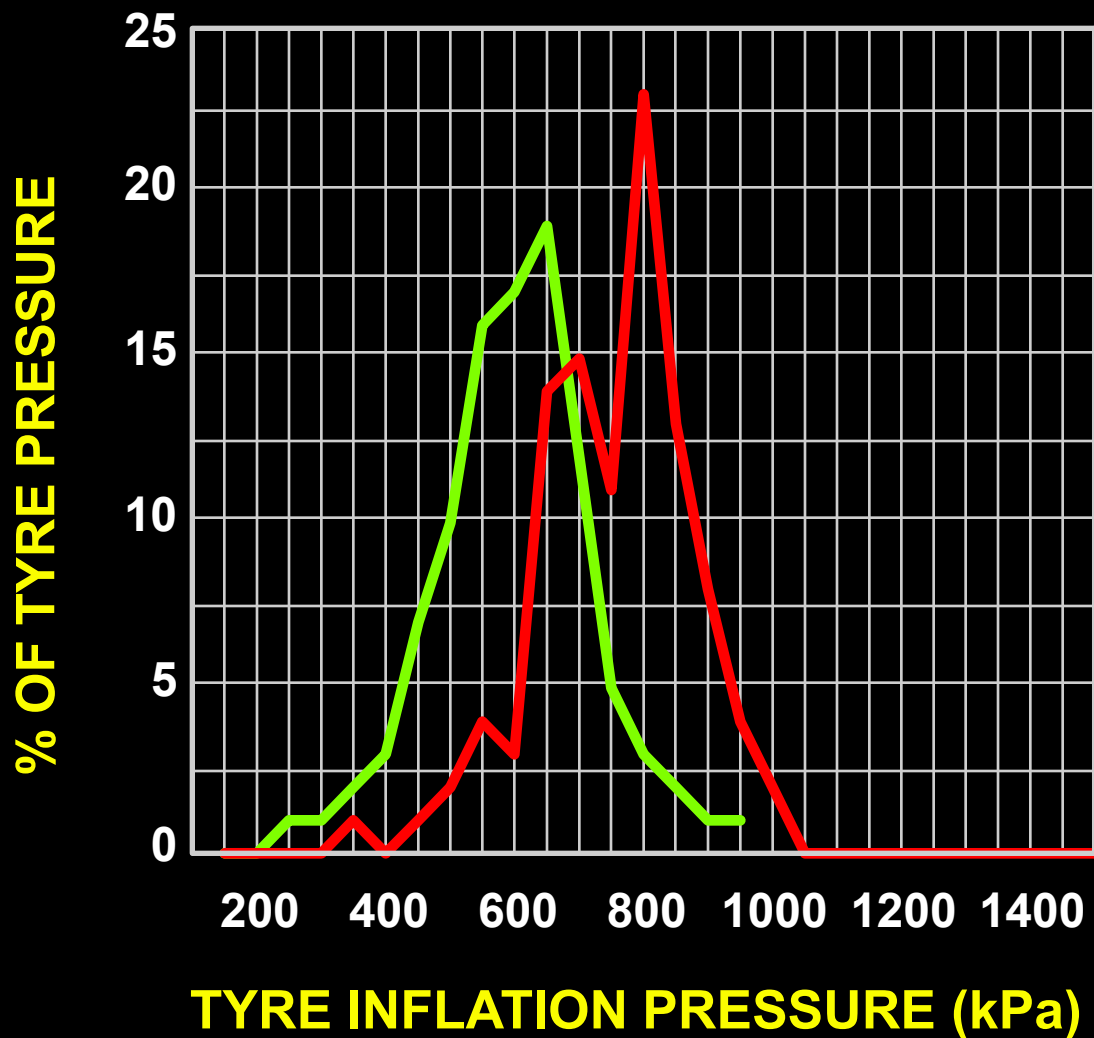


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COURSE PROGRAMME
FRIDAY, NOVEMBER 28, 1997

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APPENDIX H:
TYRE/PAVEMENT CONTACT
STRESSES BASED ON THE
Stress-In-Motion (SIM) systems
(Dr M De Beer)



Average: 620 kPa
(1974)

Average: 733 kPa
(1995)

TYRE INFLATION PRESSURE (kPa)

FIGURE 1a

Tyre inflation pressure distributions in South Africa (1974 - 1995)

Heavy vehicles: Axle Loads > 7 000 kg Survey: 1995

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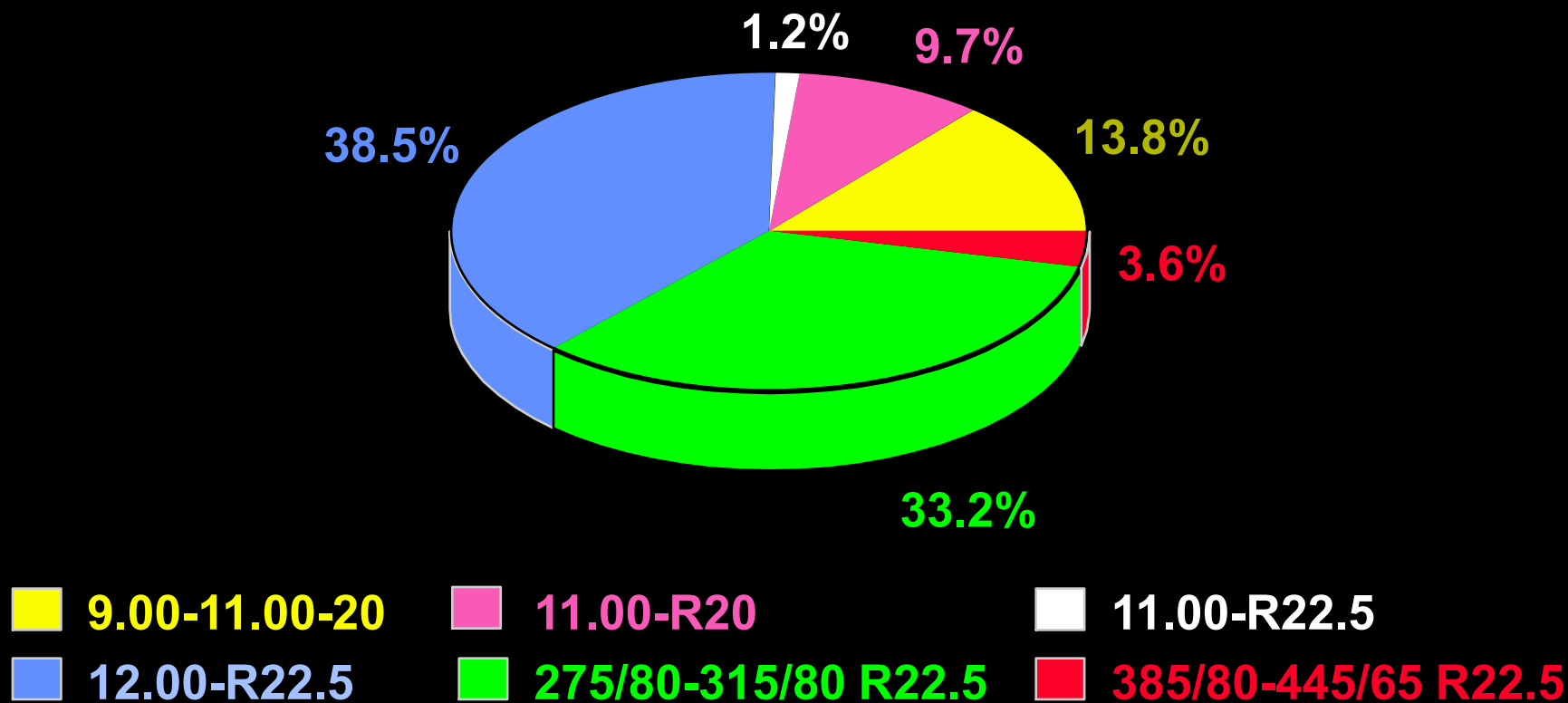


FIGURE 1b

Distribution of heavy truck tyre types in South Africa

VRSPATA

Direction of travel

TYRE ON HVS (or Vehicle)

Pavement Surface

Computer set-up

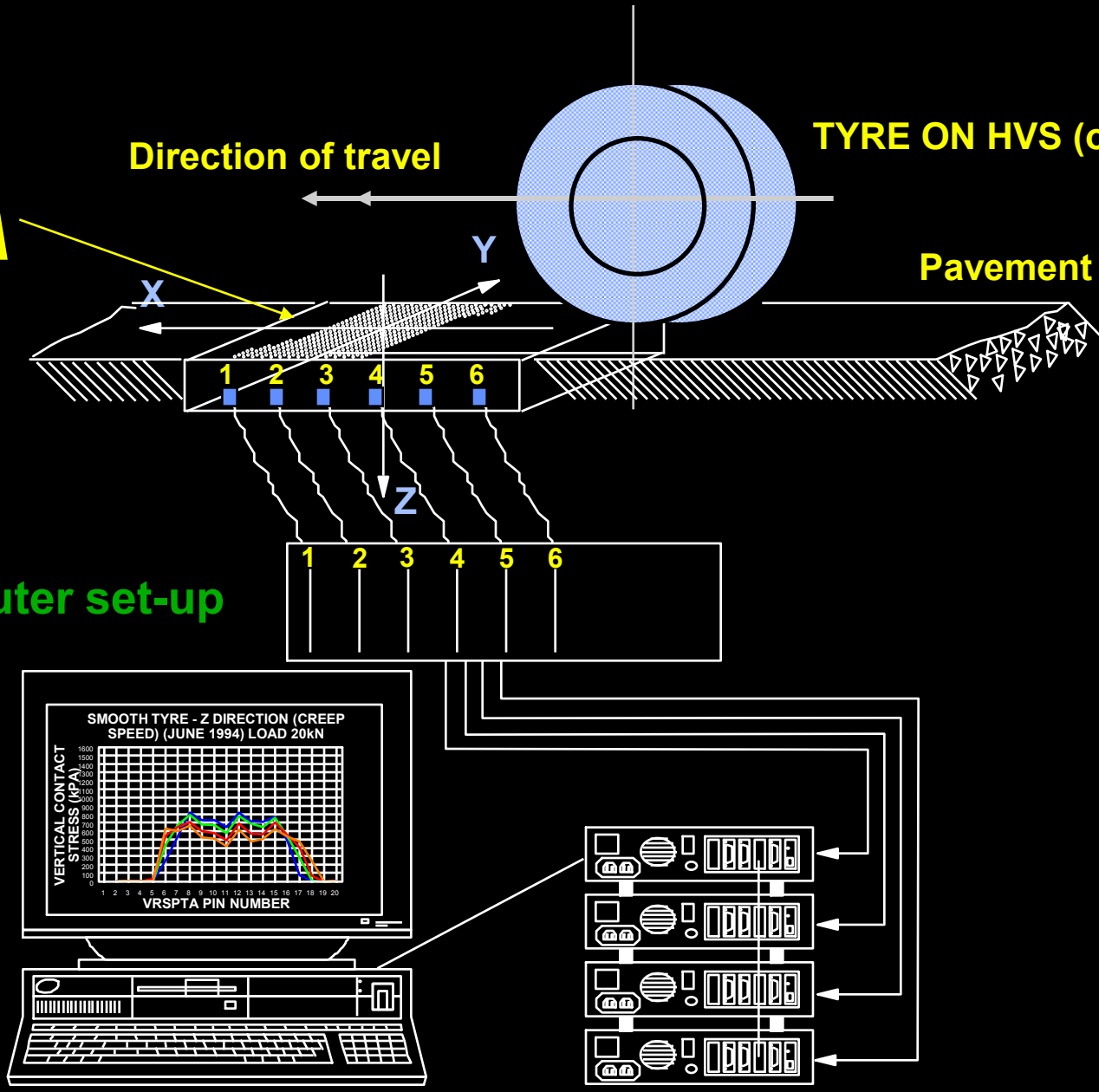


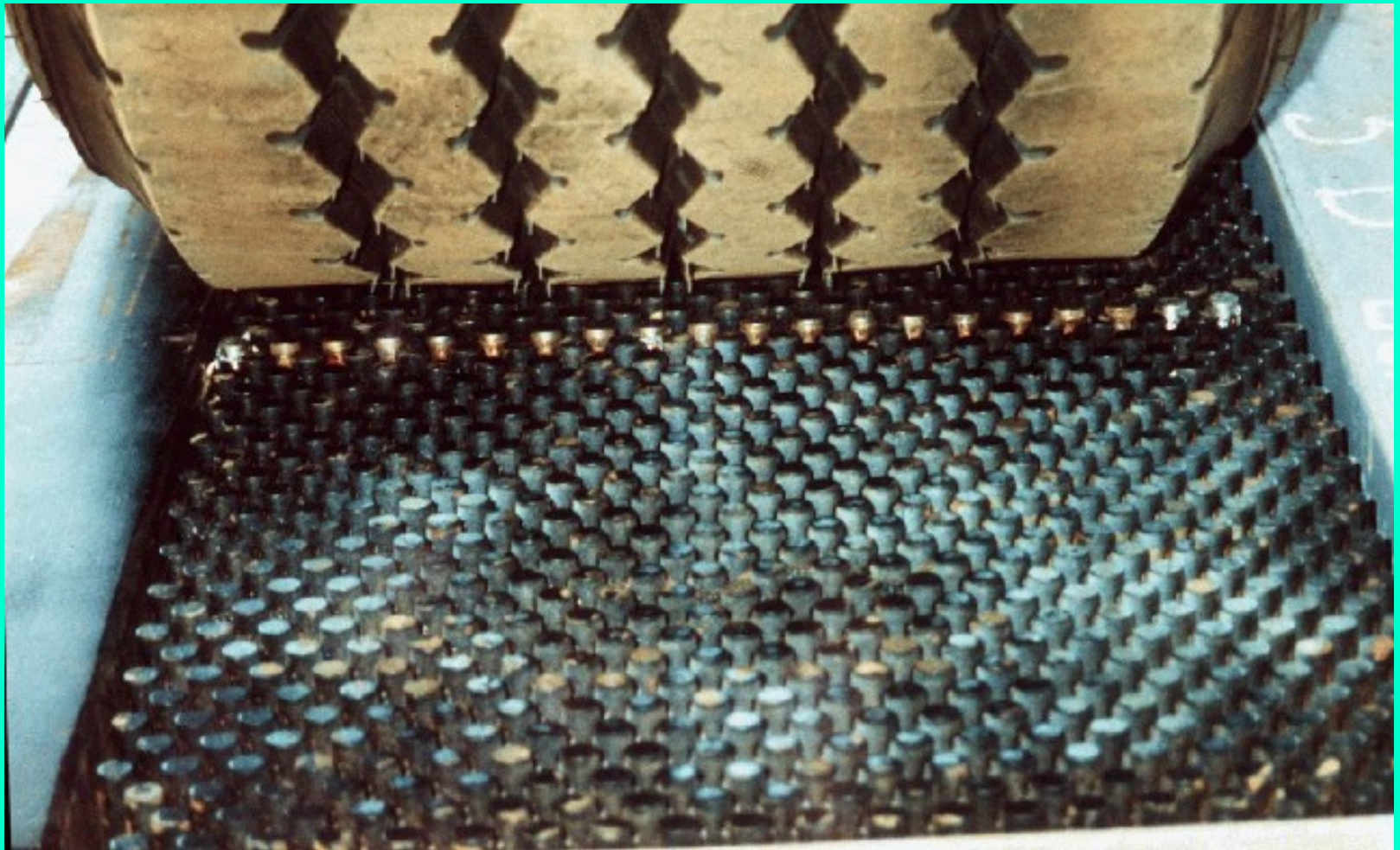
FIGURE 2
Schematic layout of VRSPATA system



VEHICLE-ROAD SURFACE PRESSURE TRANSDUCER ARRAY (VRSPTA)



315/80 R22.5 HVS TYRE ON VRSPTA



425 /65 R22.5 HVS TYRE ON VRSPTA

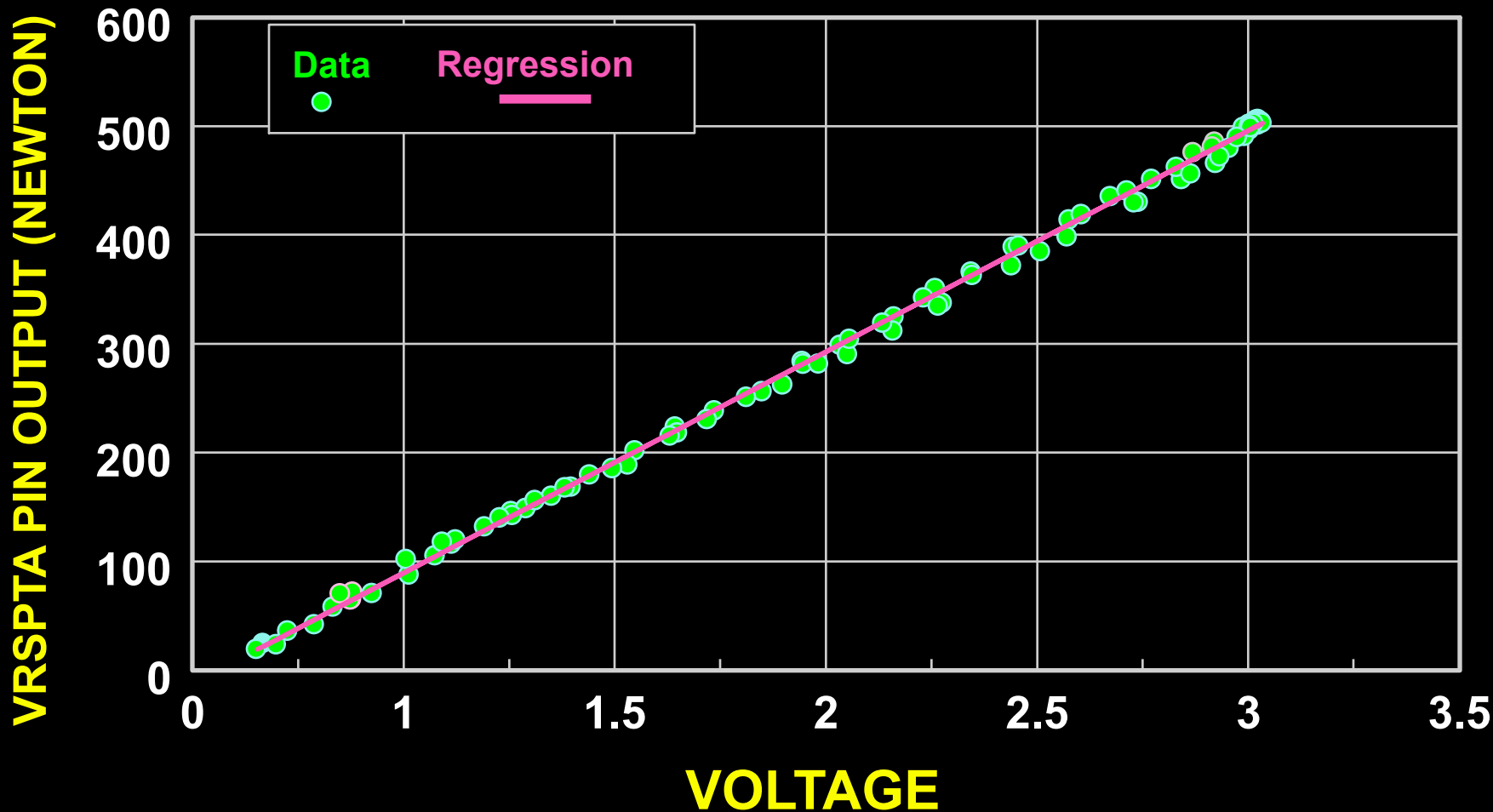


FIGURE 3

Laboratory calibration data of VRSPTA pins

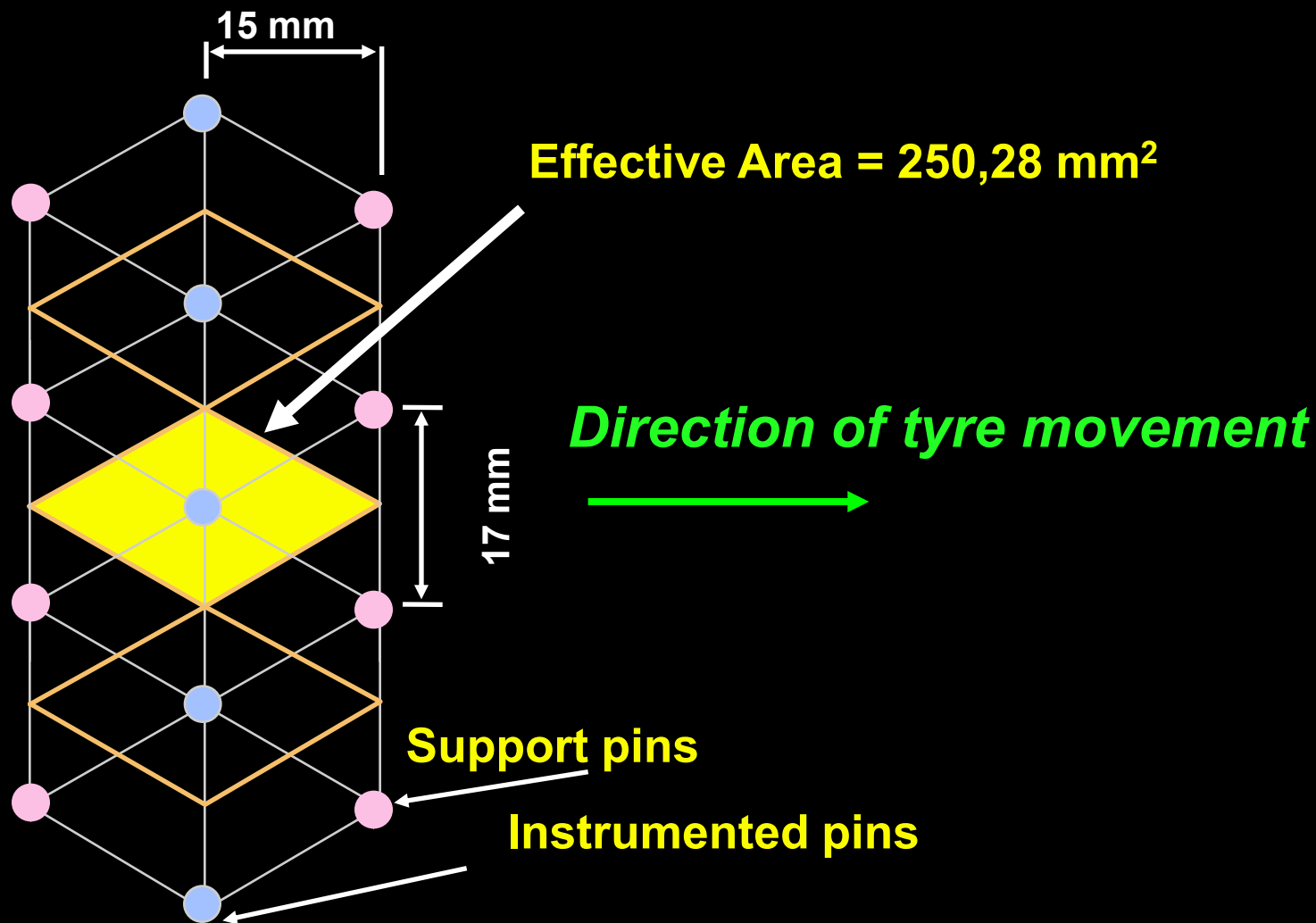


FIGURE 4

Effective Diamond Shaped Area used for the contact stress calculation in VRSPTA

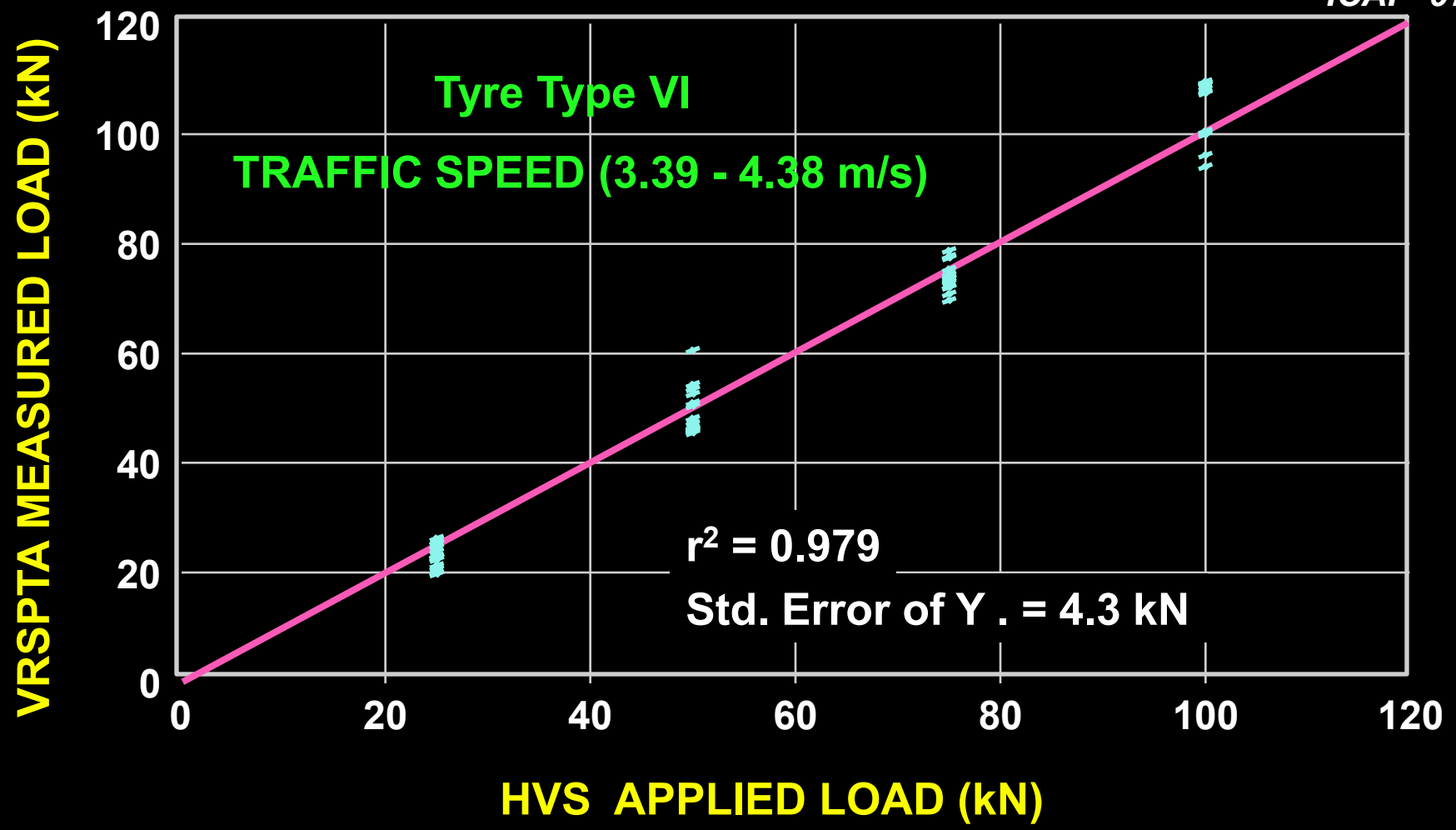


FIGURE 5

Accuracy of the VRSPTA relative to HVS applied load (random error)

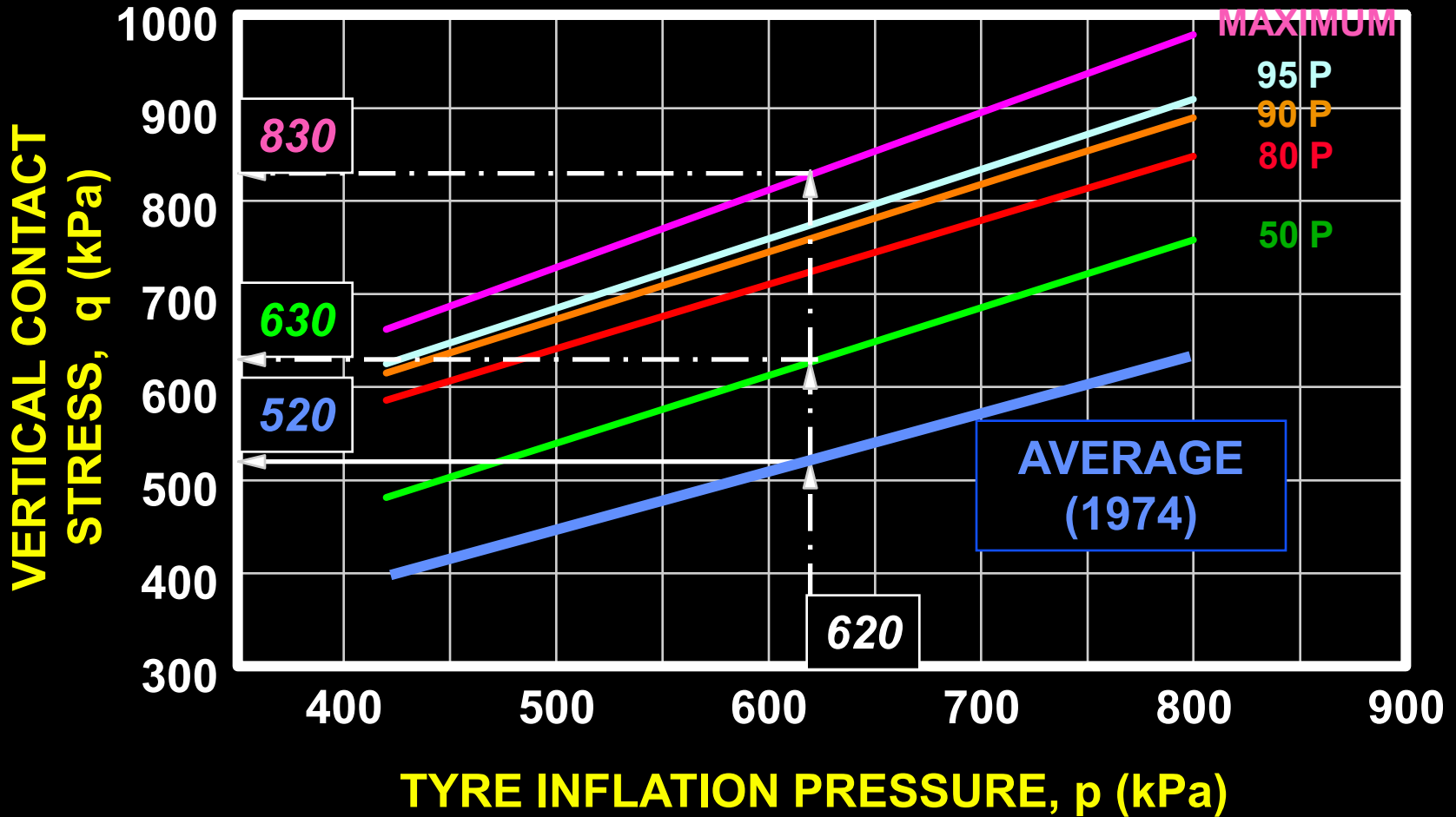


FIGURE 10
"Average" vertical contact stress vs inflation pressure

Tyre Load = 18 kN

CONTACT STRESS (kPa)

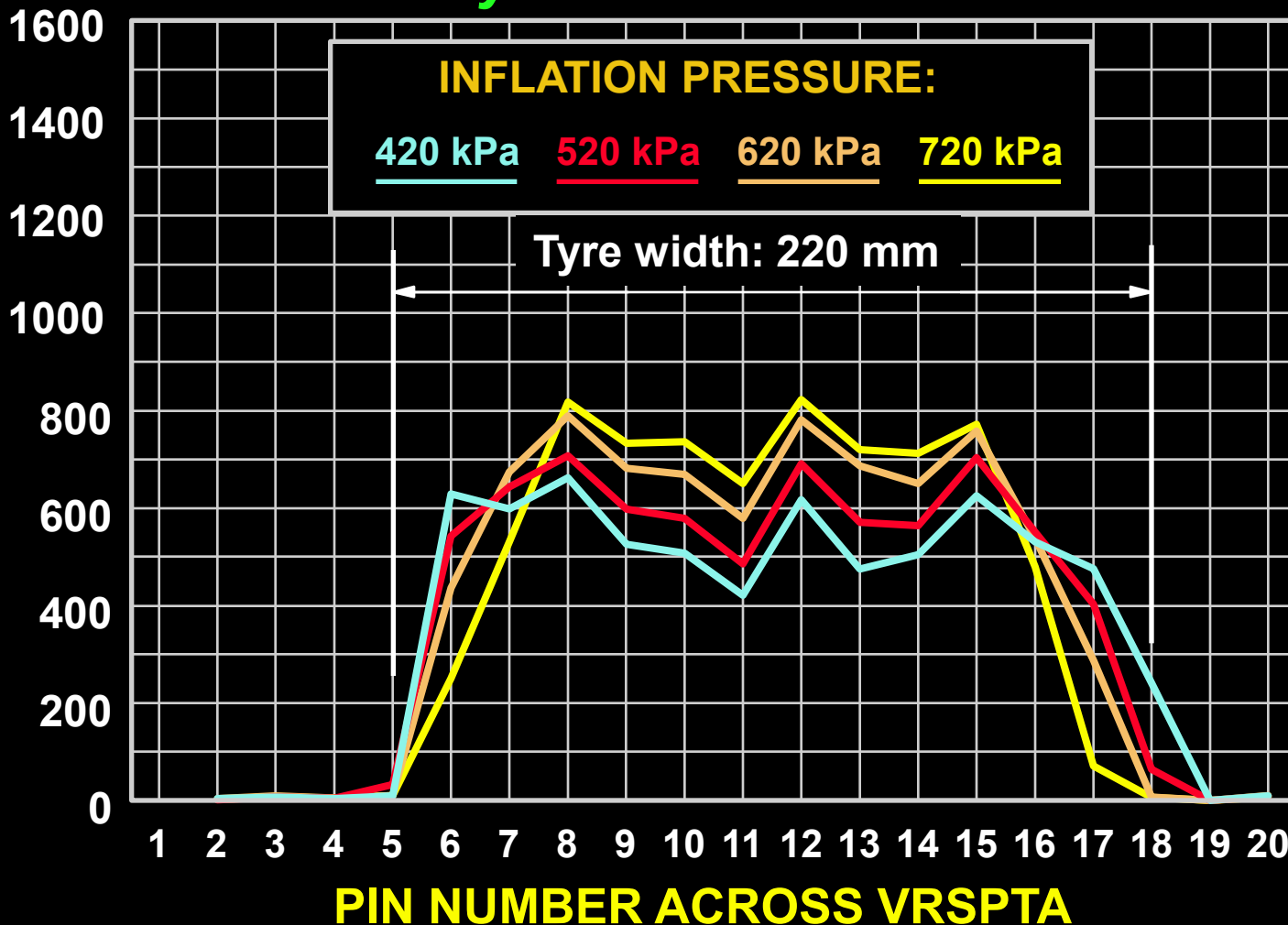
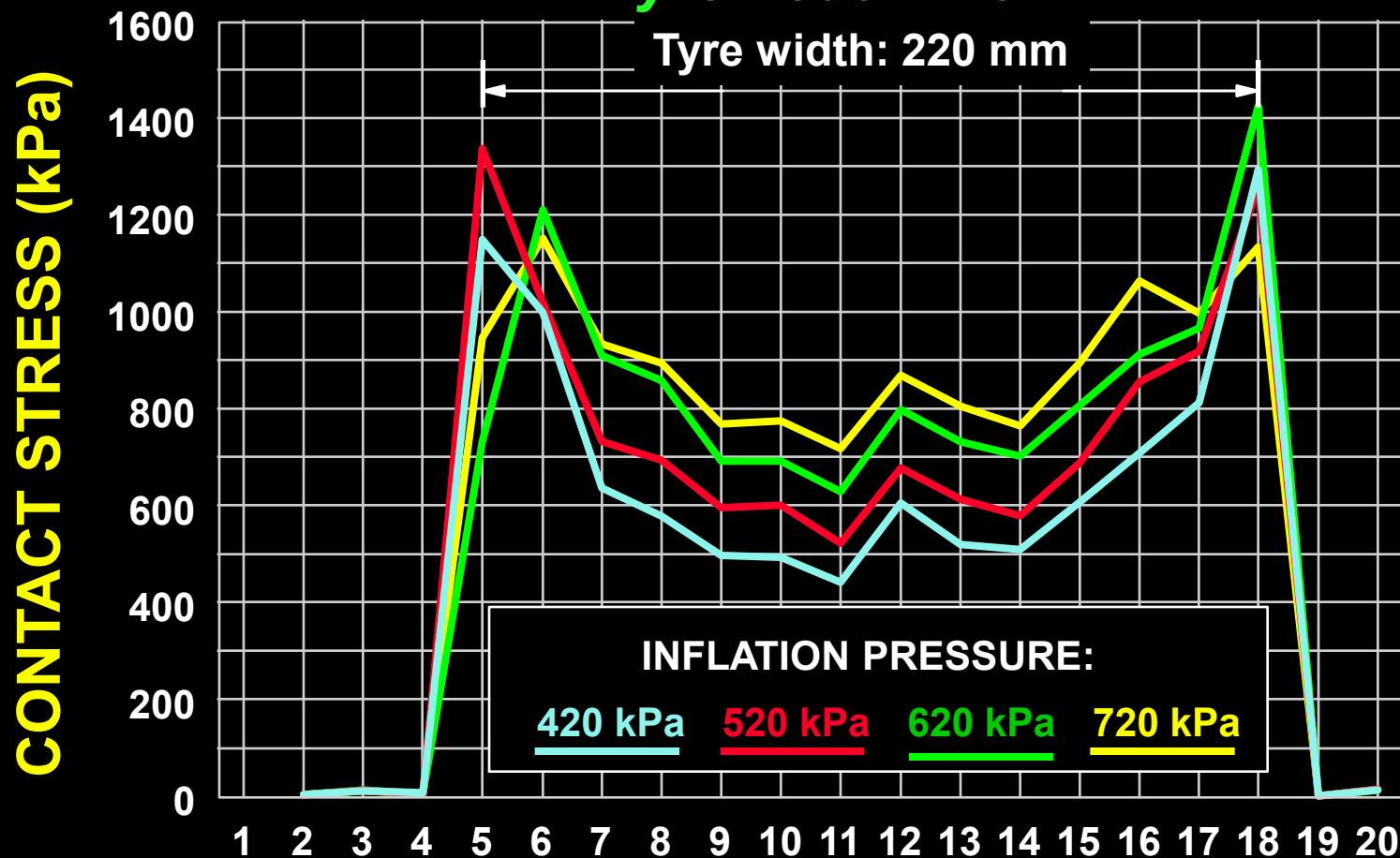


FIGURE 11

Maximum vertical stress at CONSTANT LOAD and various inflation pressures

Tyre Load = 49 kN

Tyre width: 220 mm



PIN NUMBER ACROSS VRSPTA

FIGURE 12

Maximum vertical stress at CONSTANT LOAD and various inflation pressures



INFLATION PRESSURE = 420 kPa

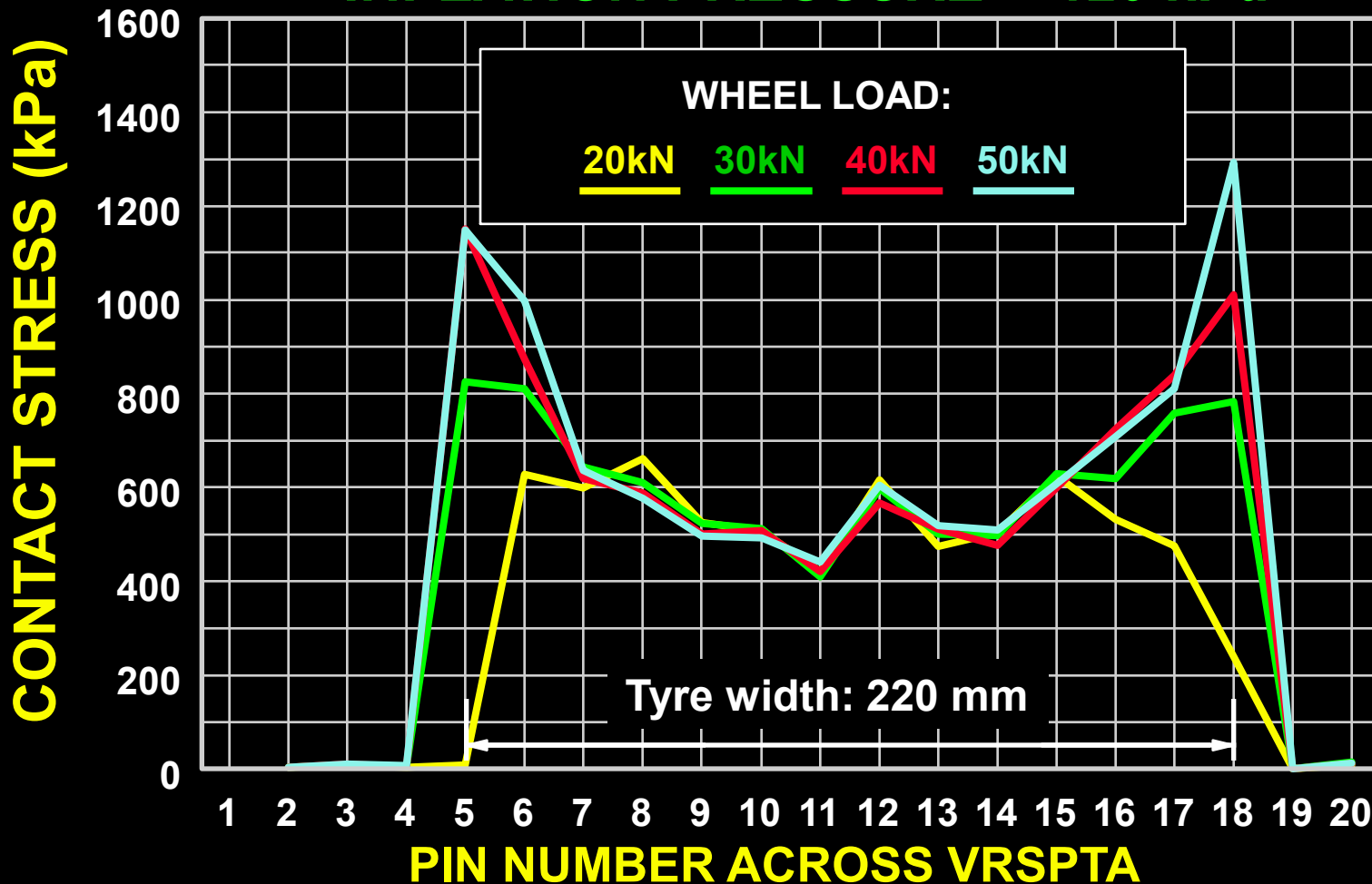
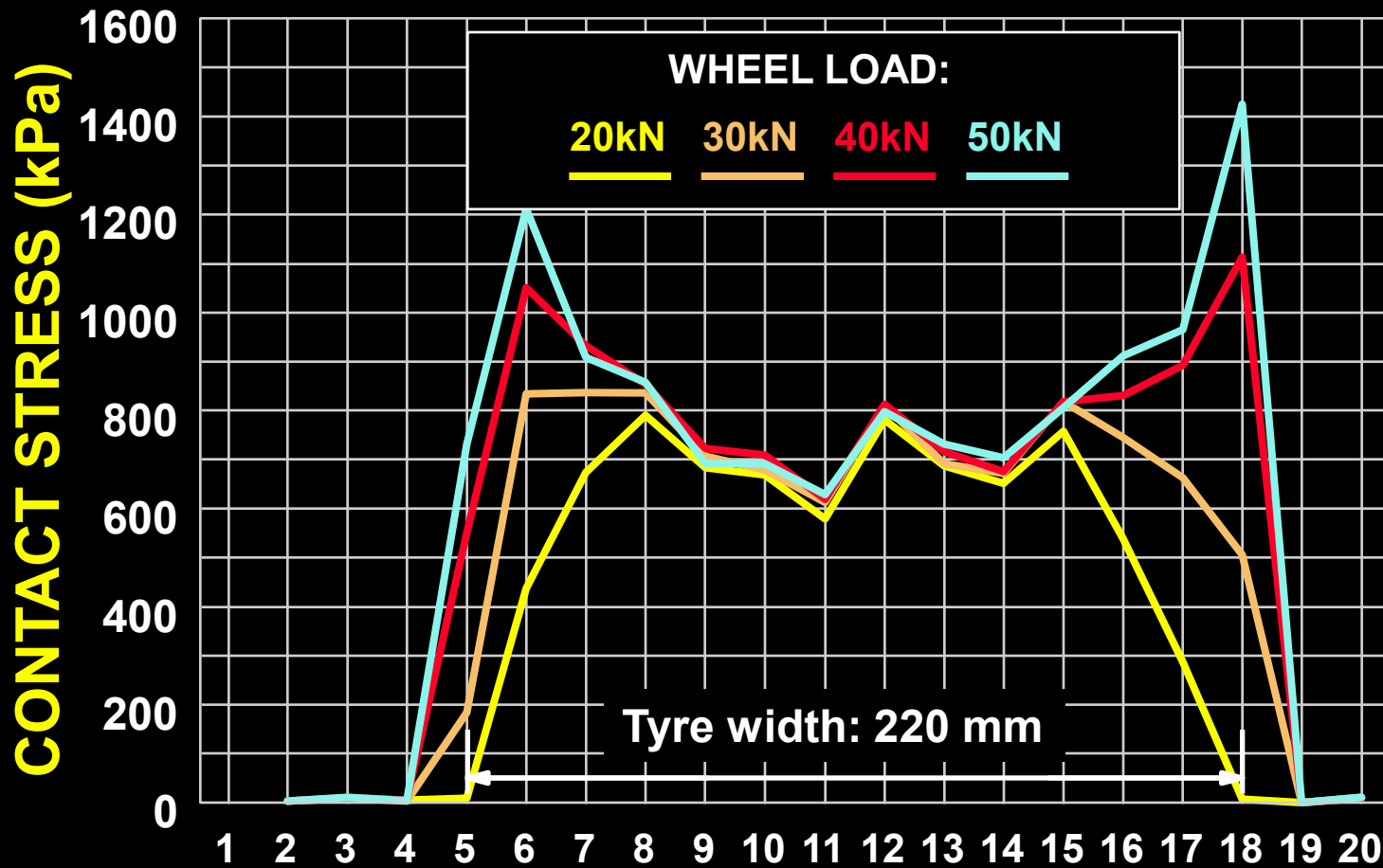


FIGURE 13

Maximum vertical stress at CONSTANT INFLATION PRESSURE at various loads

INFLATION PRESSURE = 620 kPa



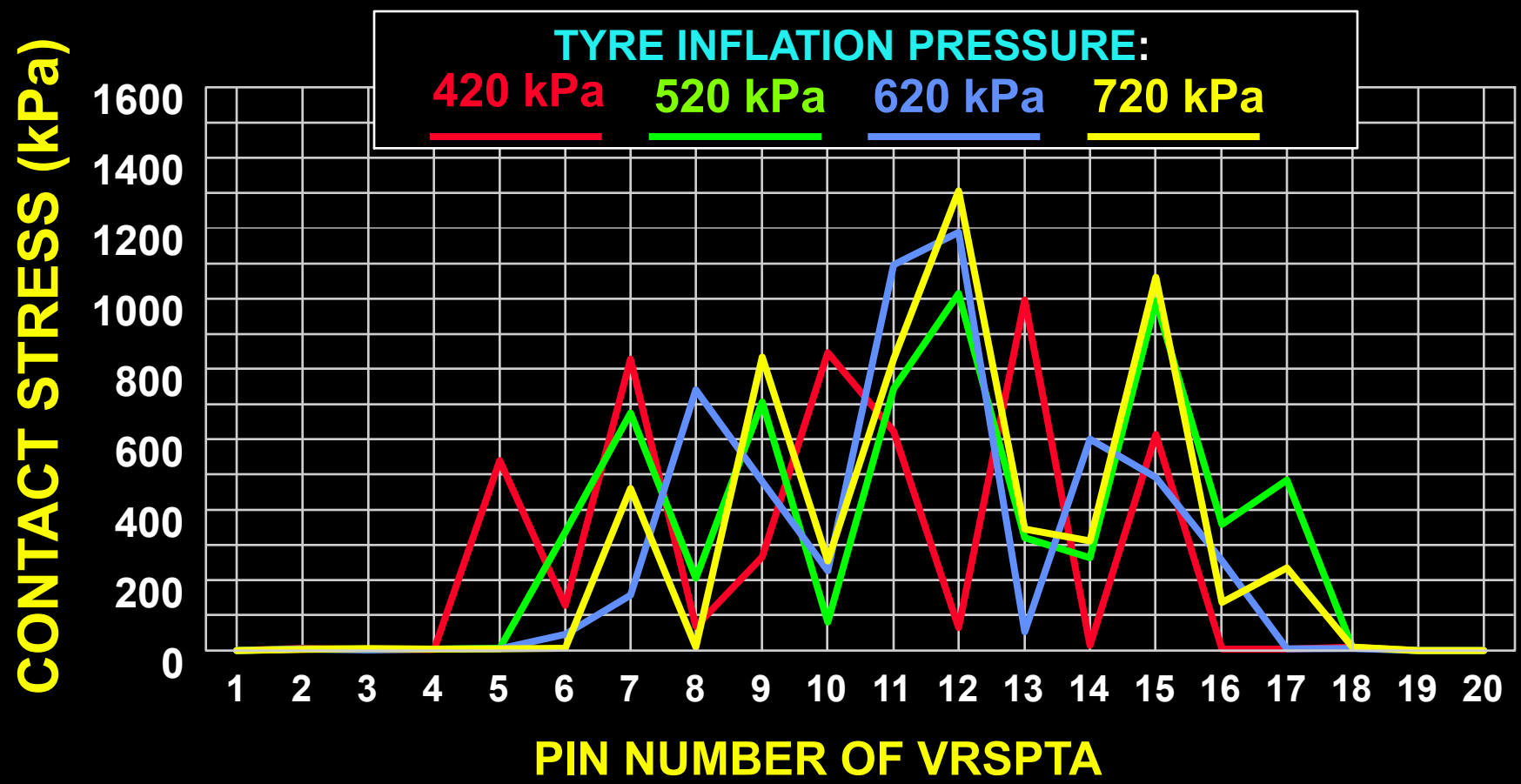
PIN NUMBER ACROSS VRSPTA

FIGURE 14

Maximum vertical stress at CONSTANT INFLATION PRESSURE and various loads



Tyre Load = 20 kN



FIGURE

Maximum vertical stress¹⁶ of tyre with tread grooves at CONSTANT LOAD and various inflation pressures

INFLATION PRESSURE = 520 kPa

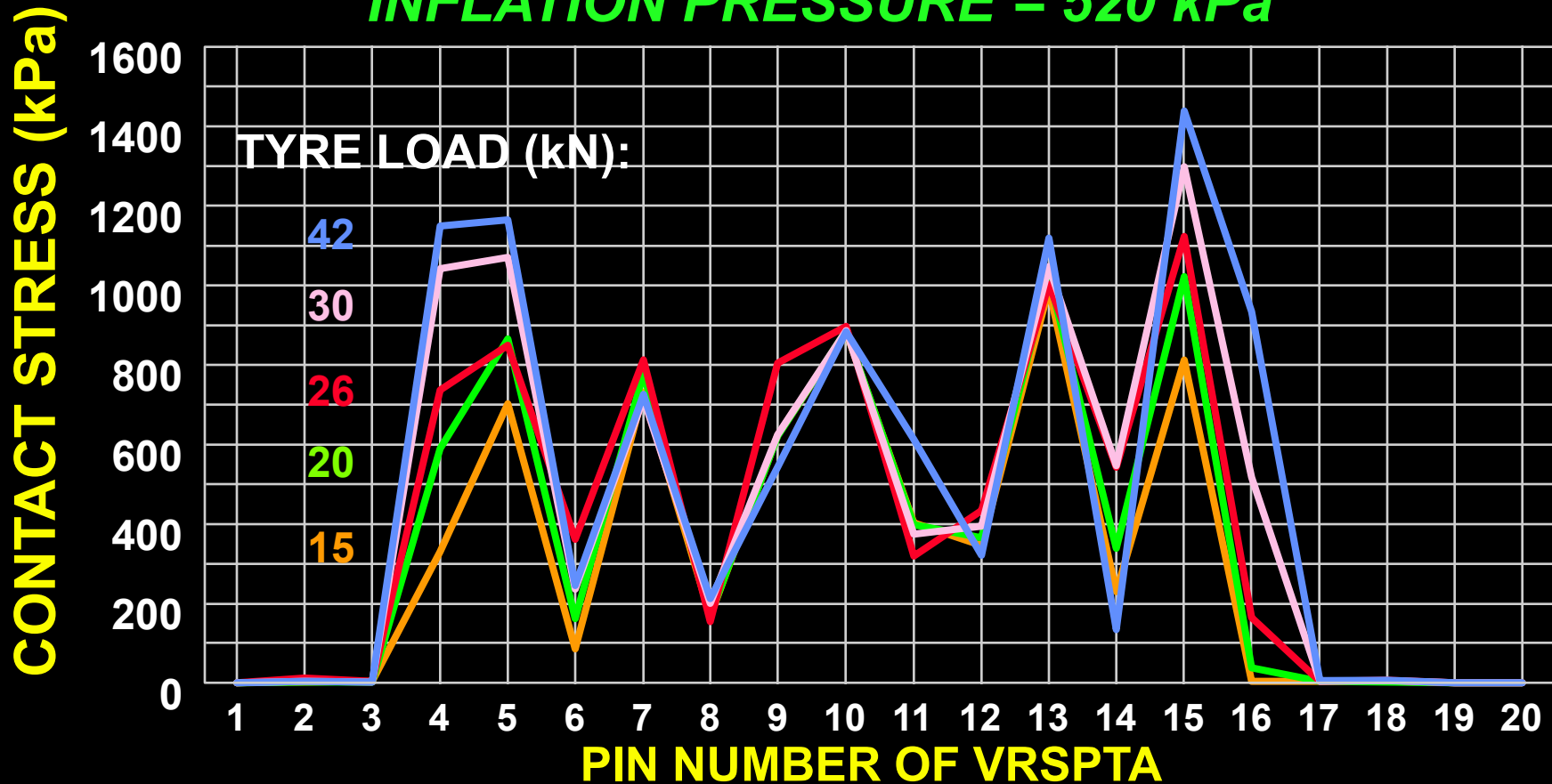


FIGURE 17

Vertical stress of tyre with tread grooves at CONSTANT INFLATION PRESSURE and various loads

10.00 X 20 14 PLY TYRE WITH TREAD

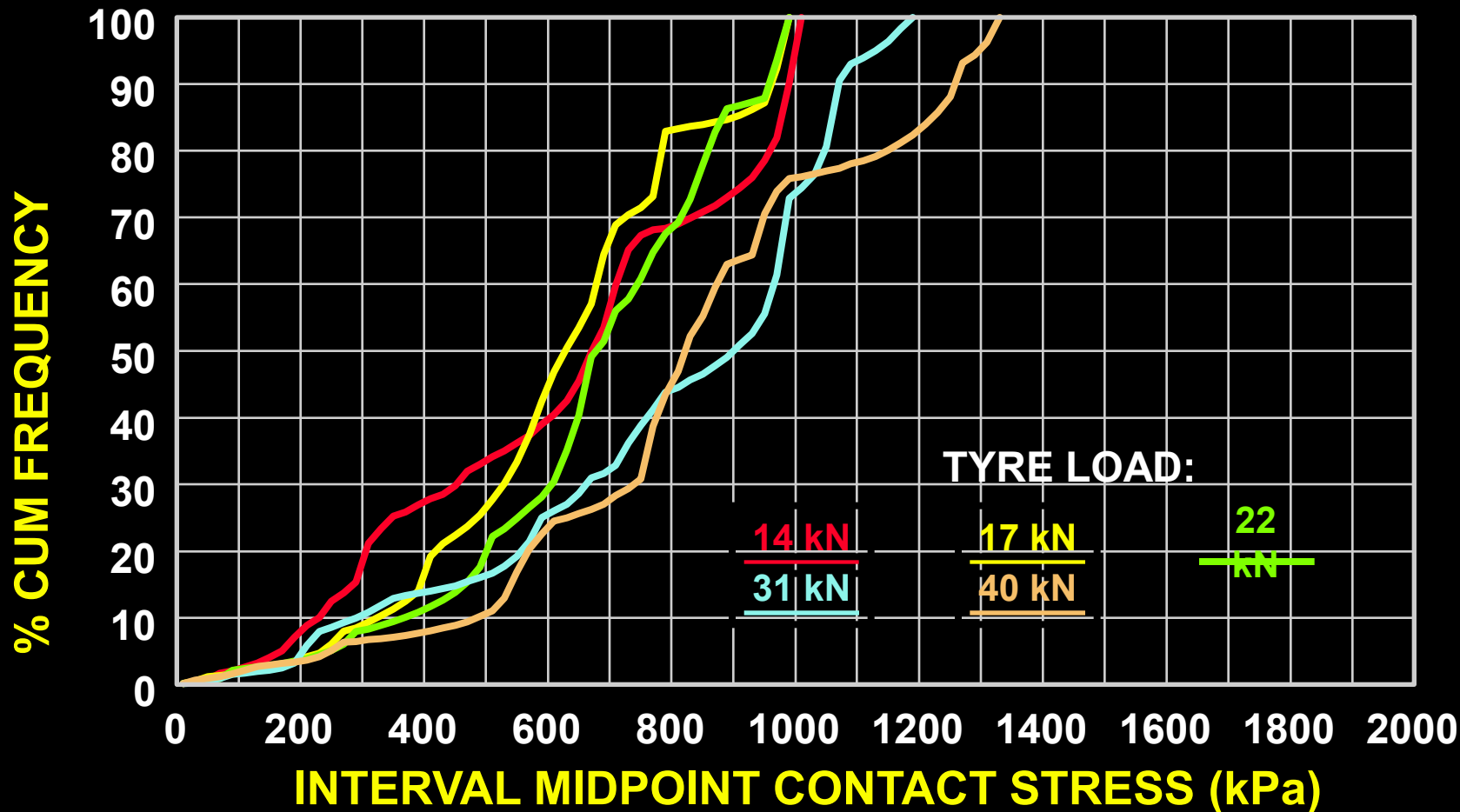
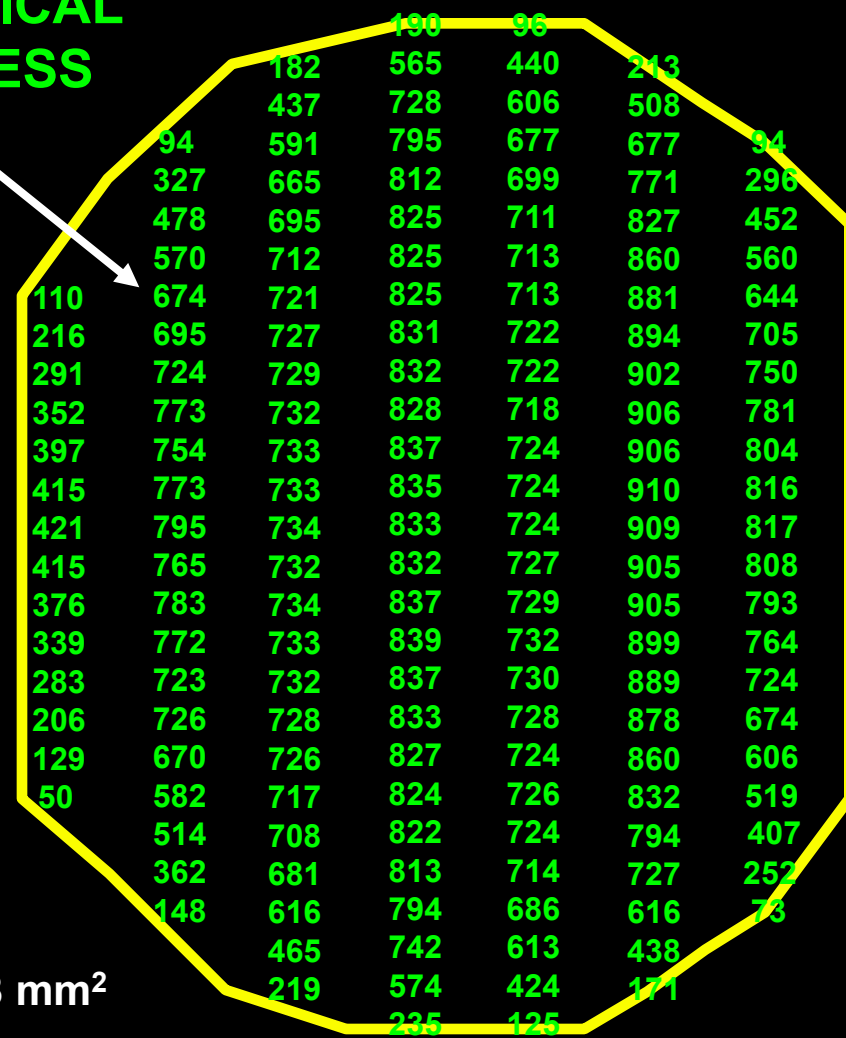


FIGURE 19

Cumulative frequency of maximum vertical stress



MEASURED VERTICAL
CONTACT STRESS
VALUES



DIRECTION OF TRAVEL

Patch area = 74 028 mm²

FIGURE 25d

Typical measured tyre contact patch

TYRE TYPE I (HVS SMOOTH) (11.00 X 20, 14 Ply)

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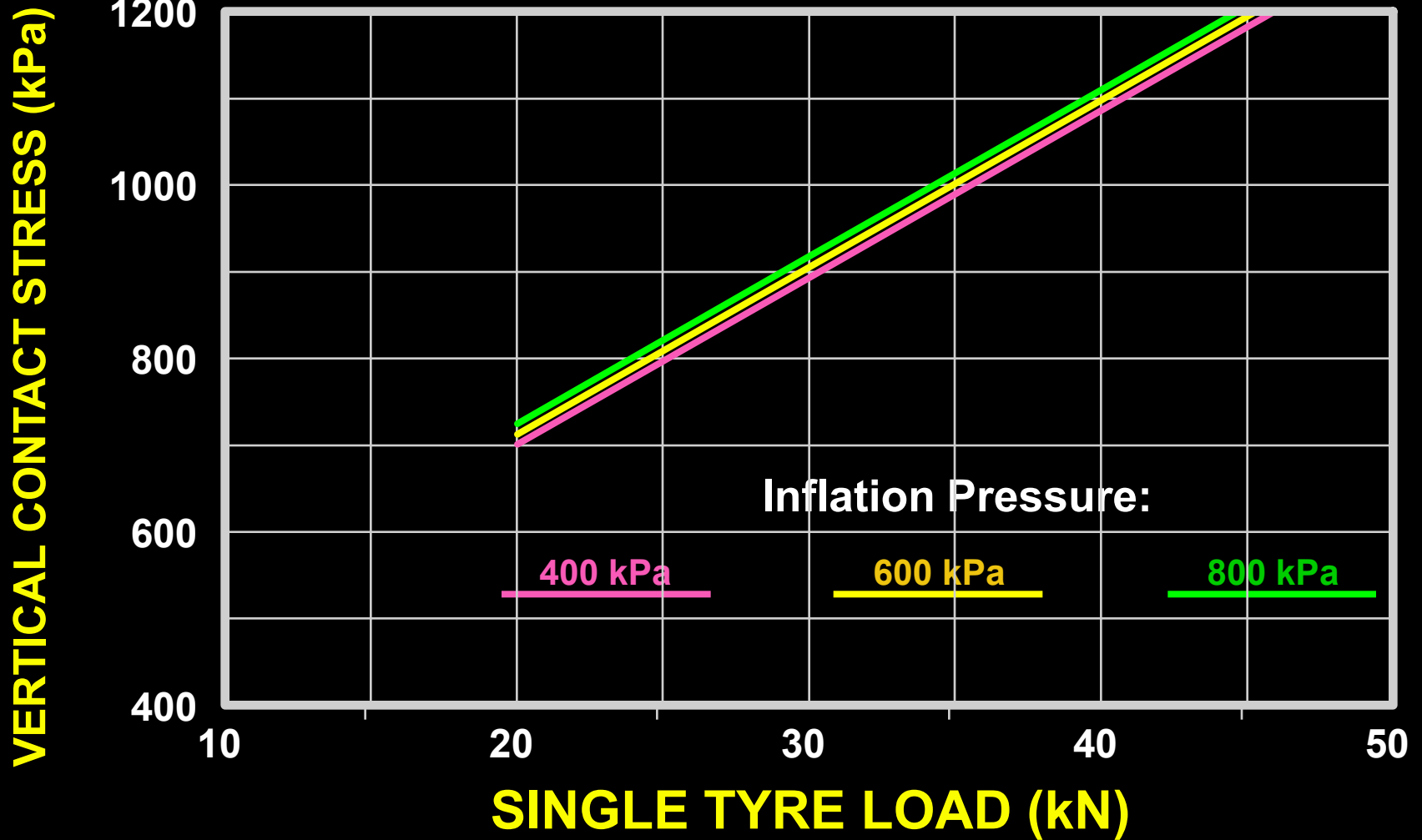


FIGURE 26a

Maximum vertical stress vs tyre load

TYRE TYPE II (HVS - WITH TREAD) (11.00 X 20, 14 Ply)

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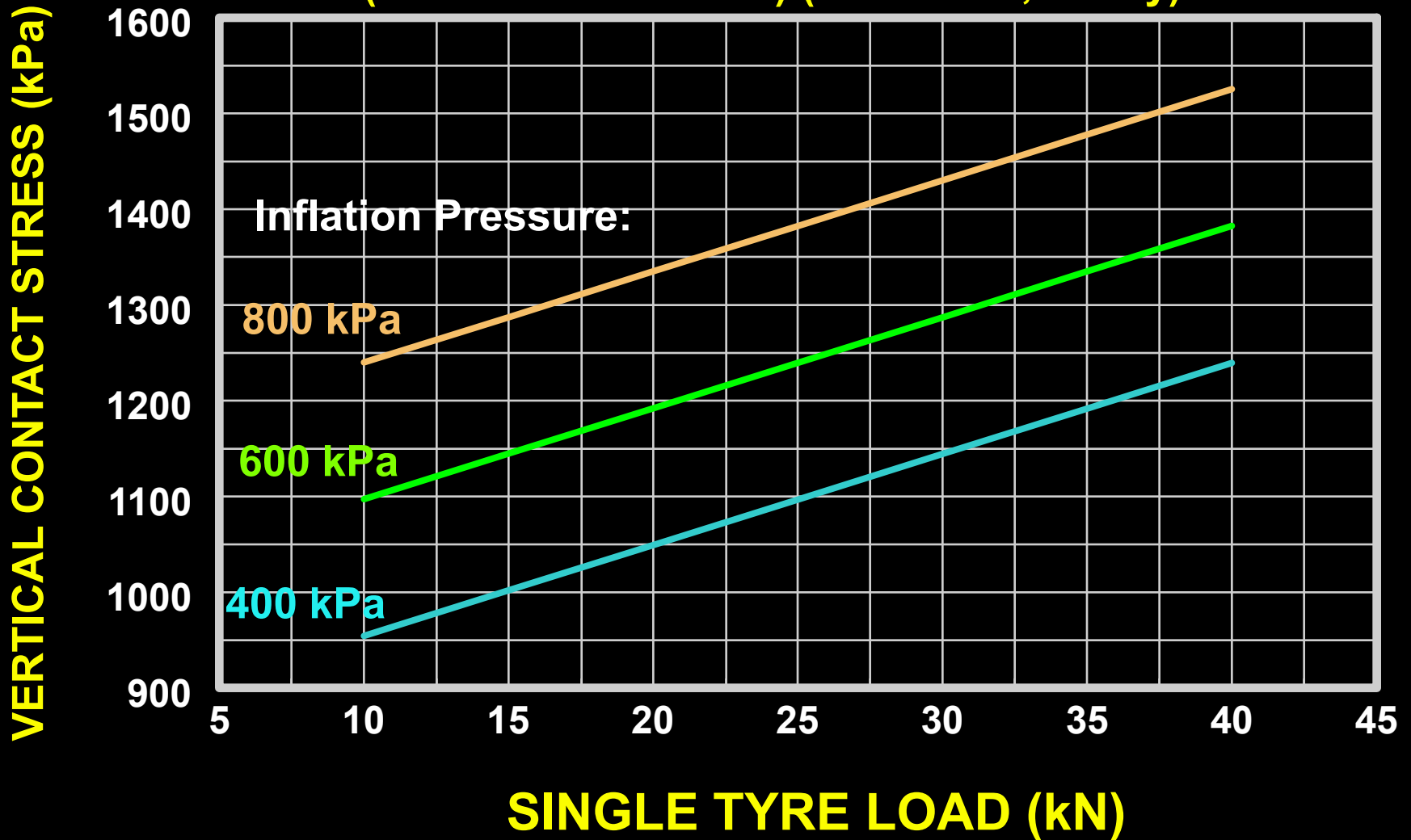


FIGURE 26b

Maximum vertical stress vs tyre load



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TYRE TYPE III (AIRCRAFT TYRE)

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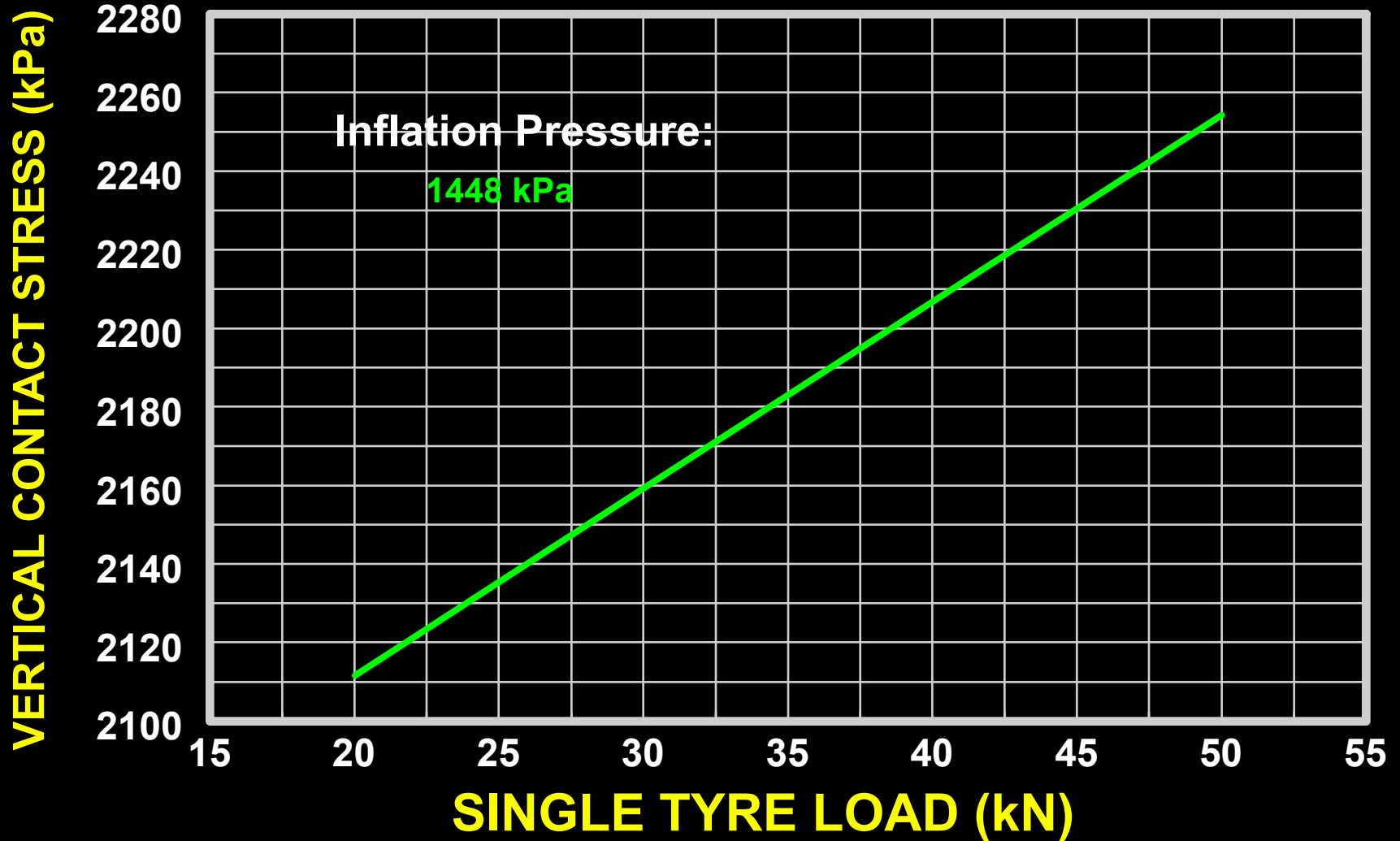


FIGURE 26c

Maximum vertical stress vs tyre load



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TYRE TYPE IV (315/80 R22.5)

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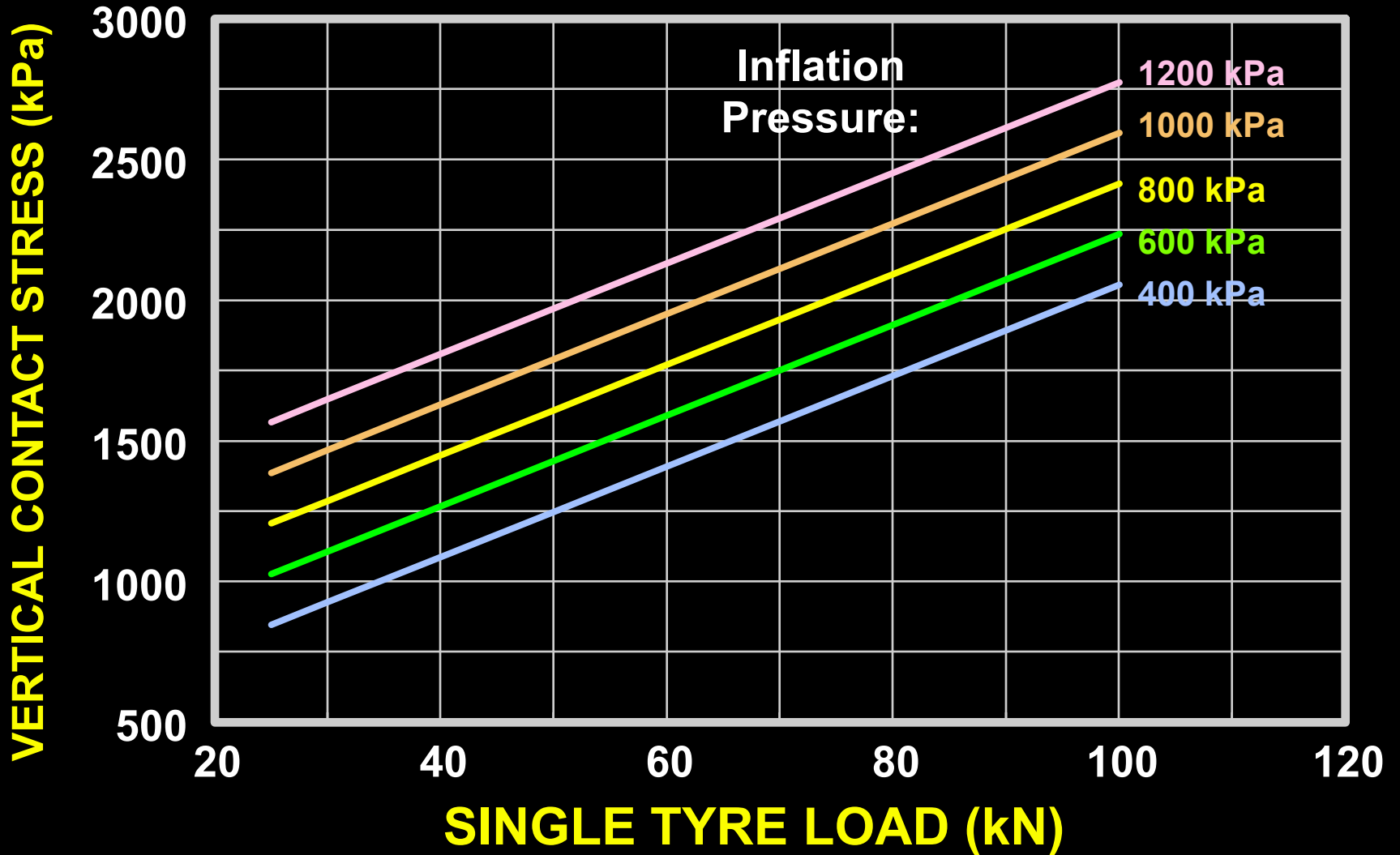


FIGURE 26d

Maximum vertical stress vs tyre load



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TYRE TYPE V (425/65 R22.5 - WIDE BASE)

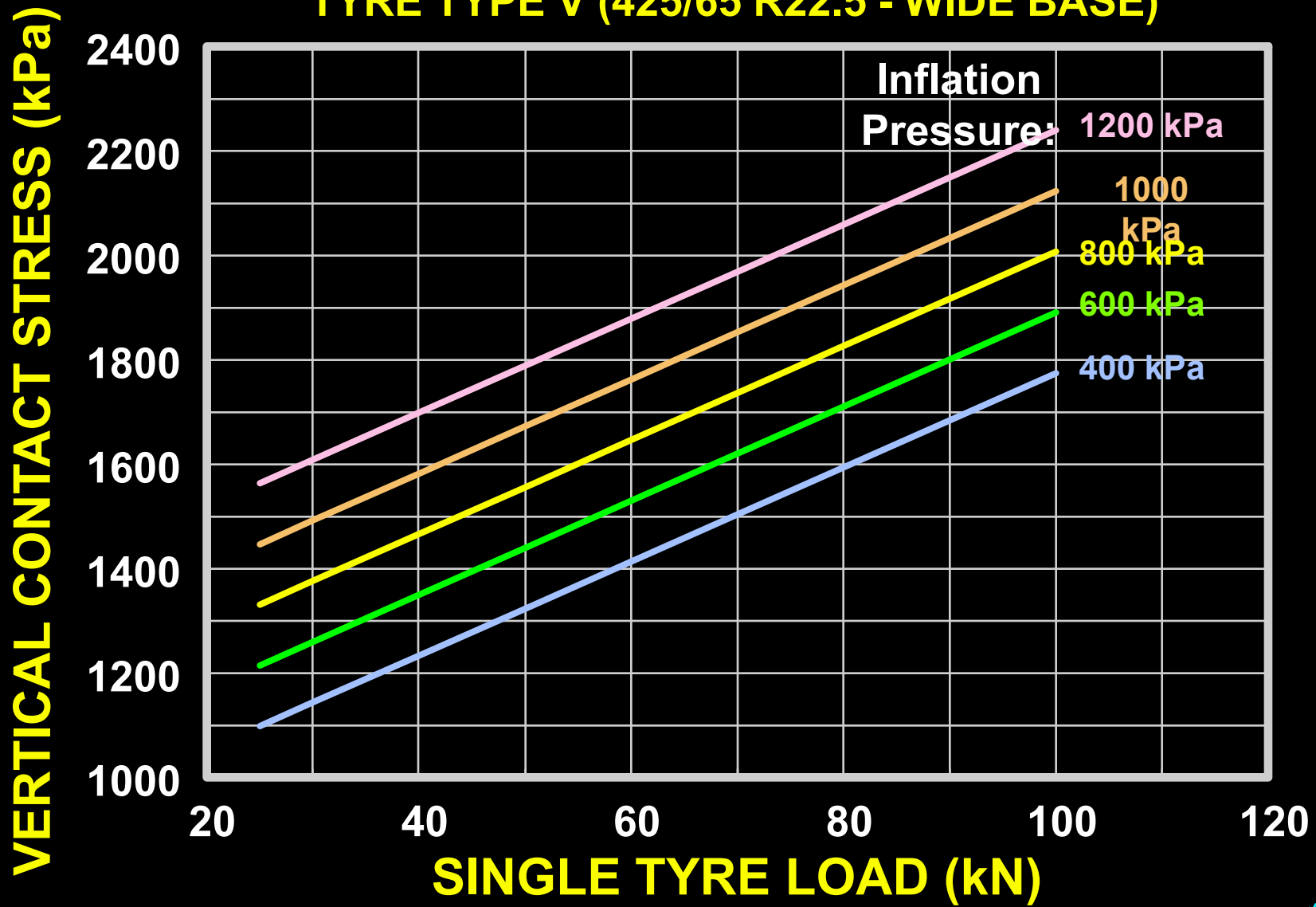


FIGURE 27a

Maximum vertical stress vs tyre load



TYRE TYPE VI (425/65 R22.5 - R160AZ WIDE BASE)



SINGLE TYRE LOAD (kN)

FIGURE 27b

Maximum vertical stress vs tyre load



TYRE TYPE VII (425/65 R22.5 - R160BZ - WIDE BASE)

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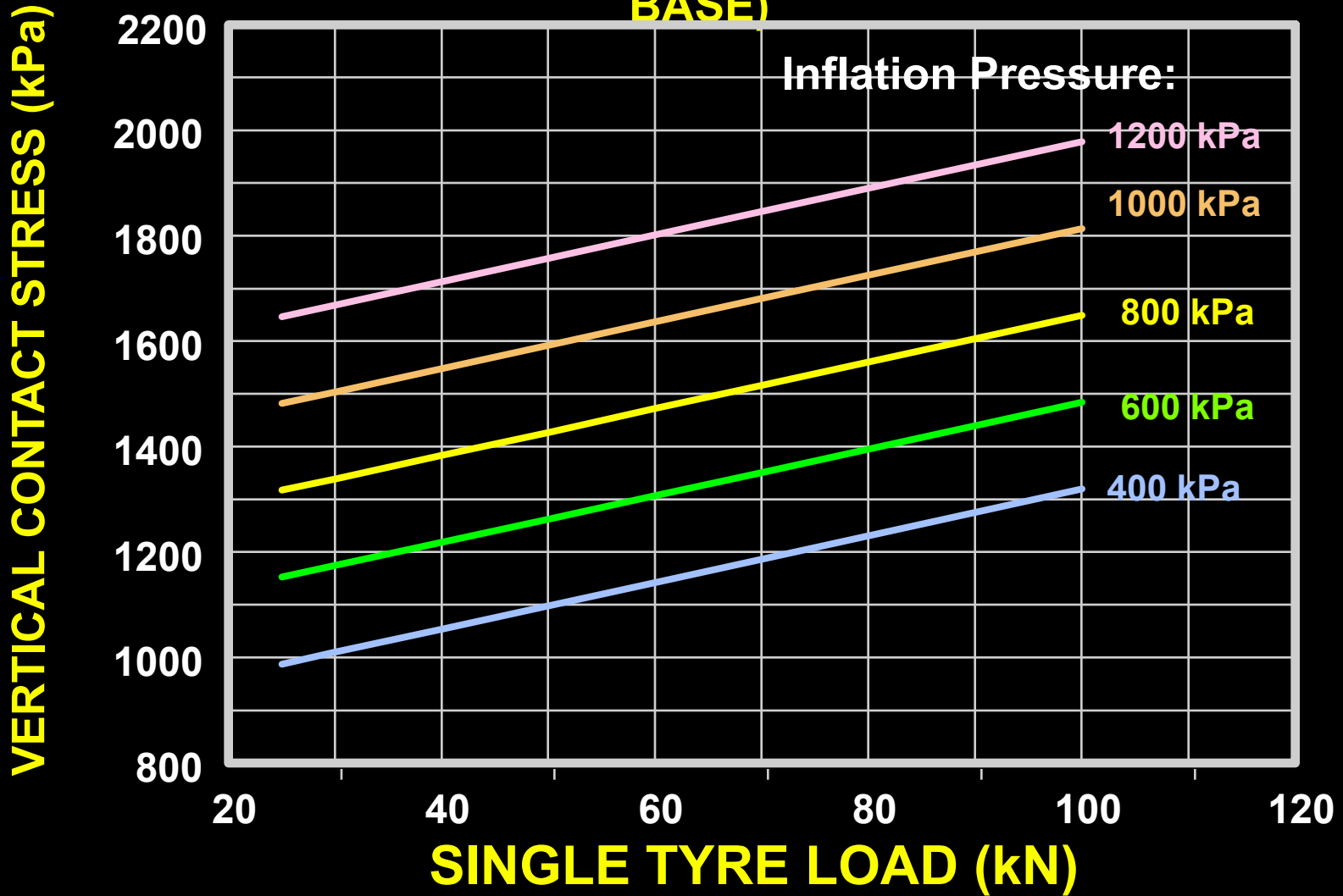


FIGURE 27c

Maximum vertical stress vs tyre load



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DEPTH (mm)

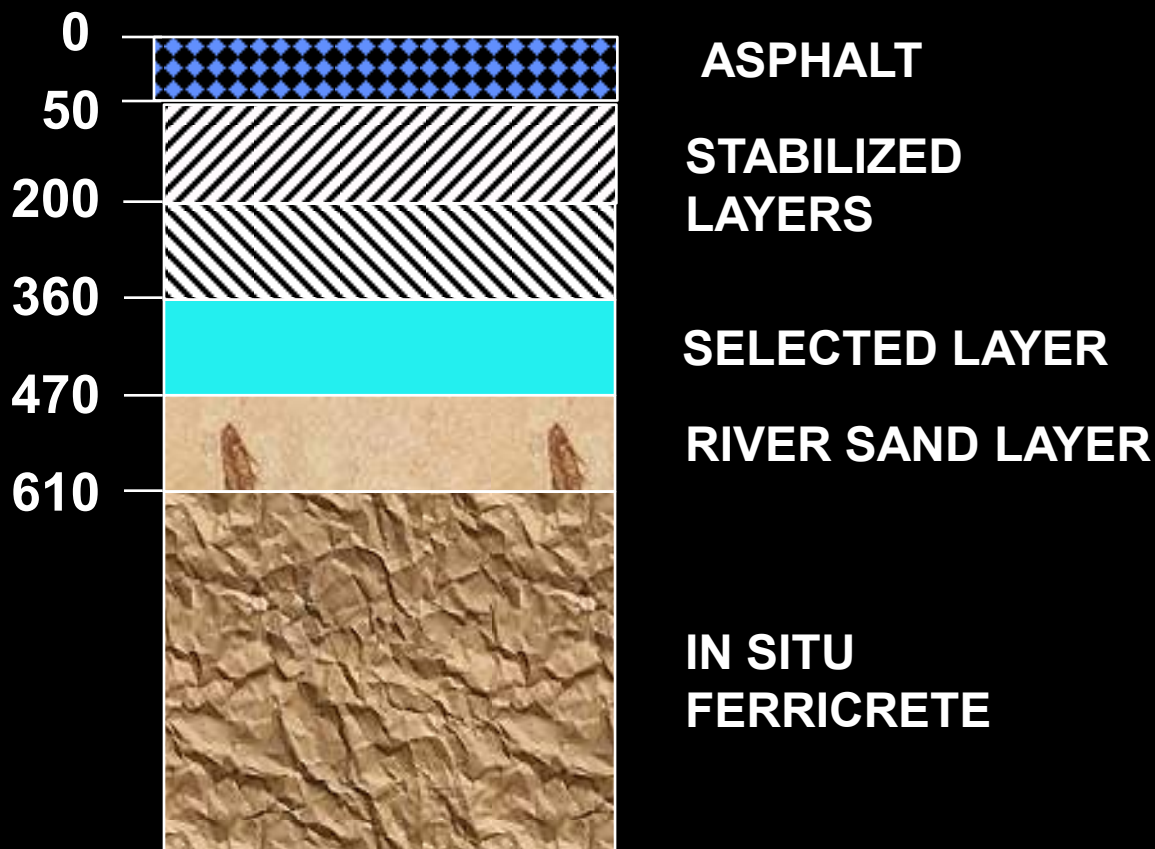


FIGURE: 28

Pavement structures evaluated with the HVS

Radial Distance (mm)

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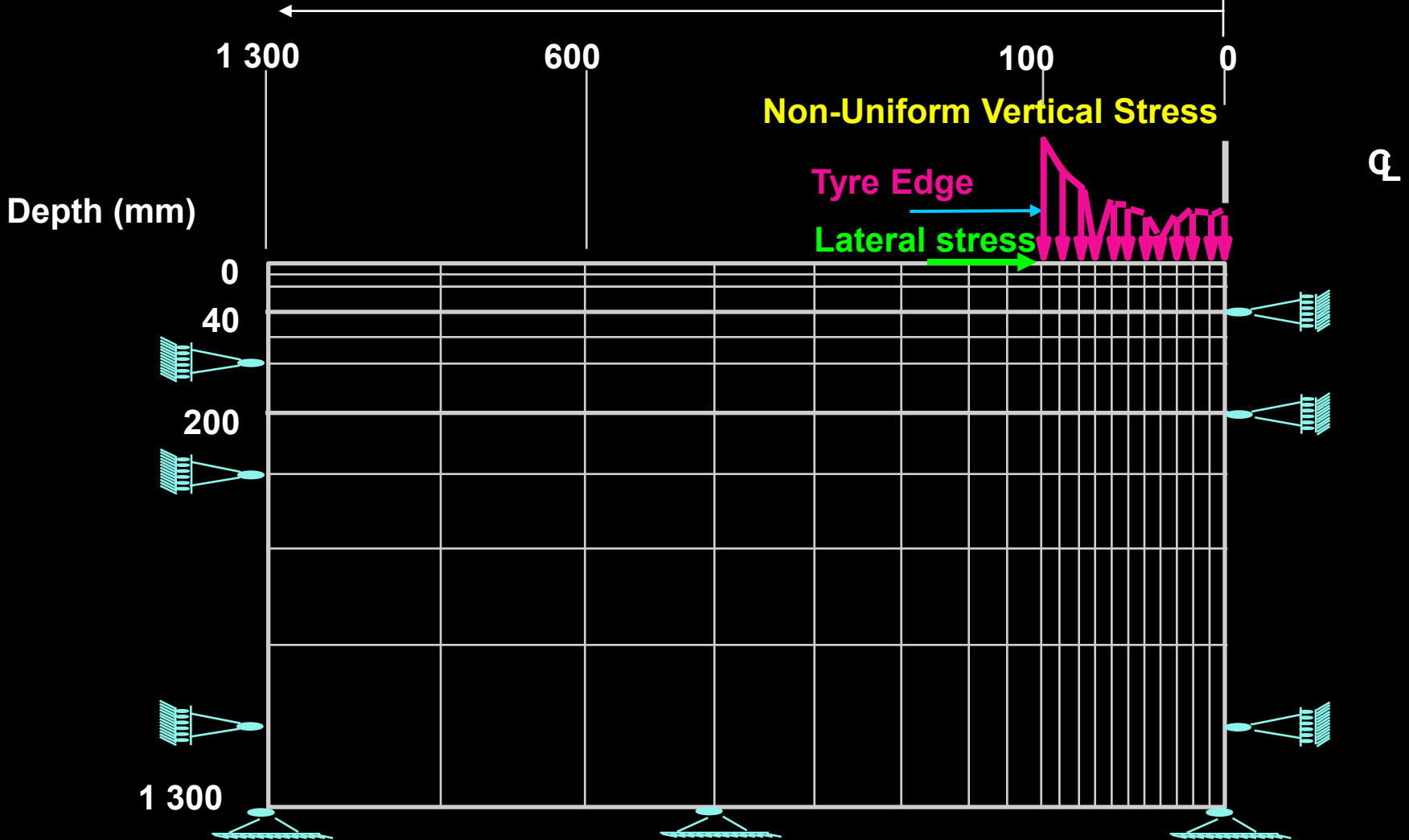


FIGURE: 29

**Axi-symmetrical Finite Element Model
used in this study**



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TYPE

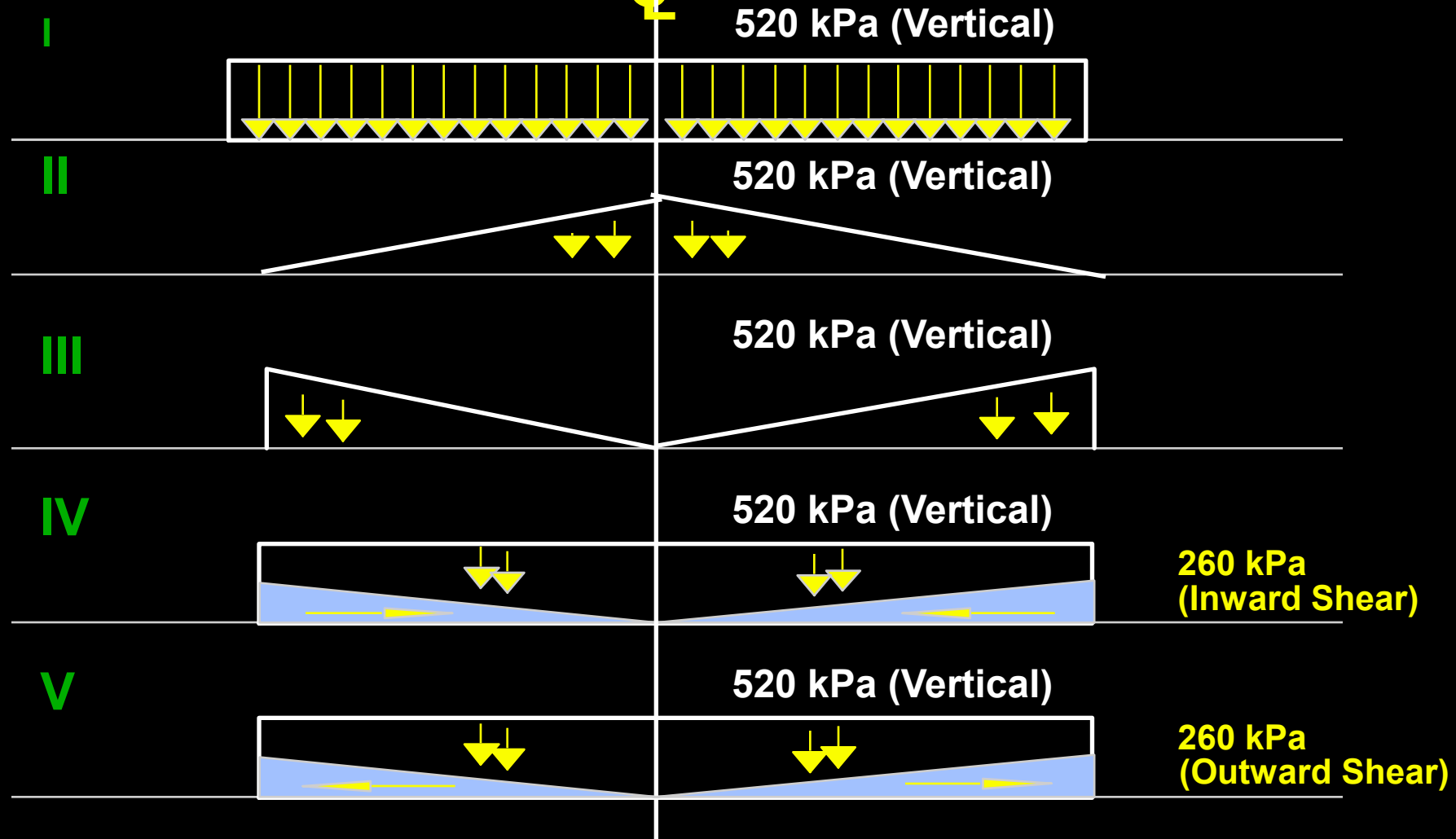
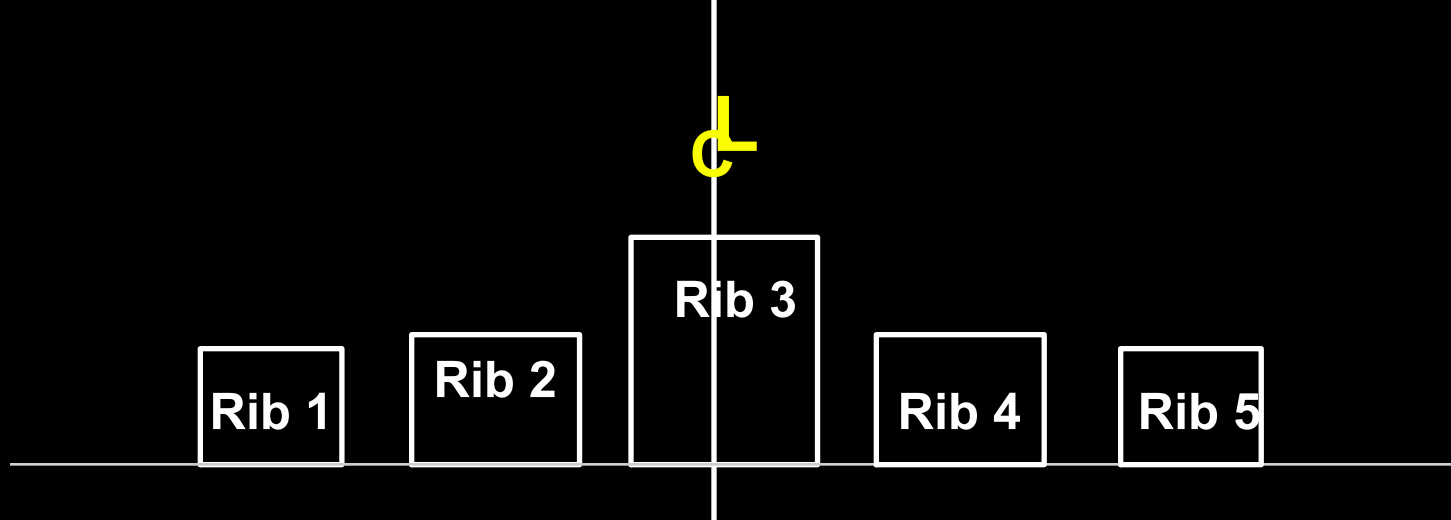
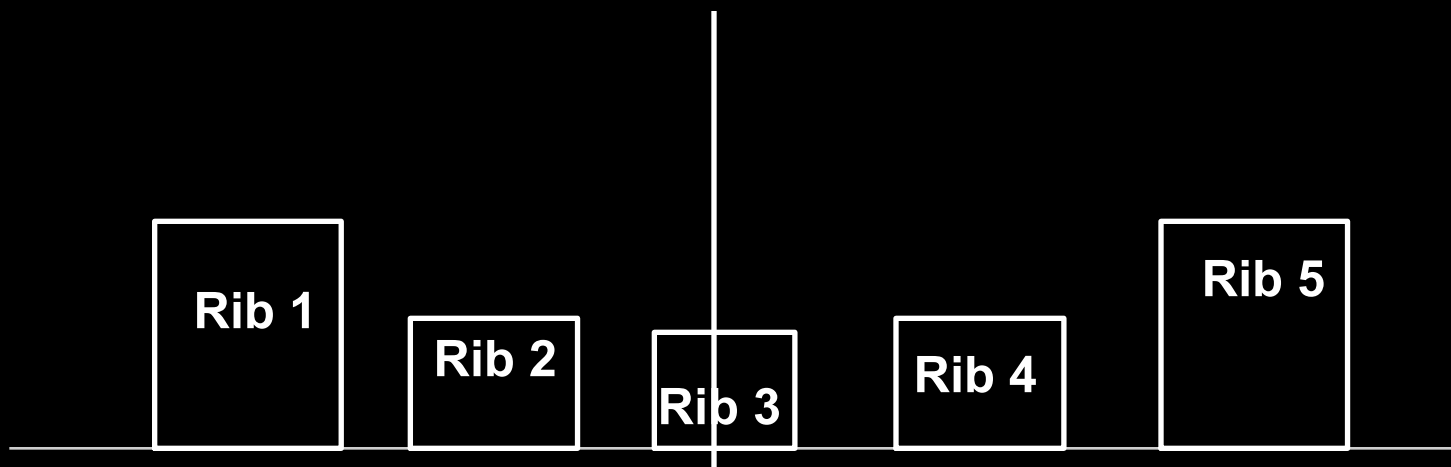


FIGURE: 30

Load/Contact Stress Idealizations used for the analysis in this study



TYPE VI - TYRE CENTRE
(Vertical and lateral)



TYPE VII - TYRE EDGE
(Vertical and lateral)



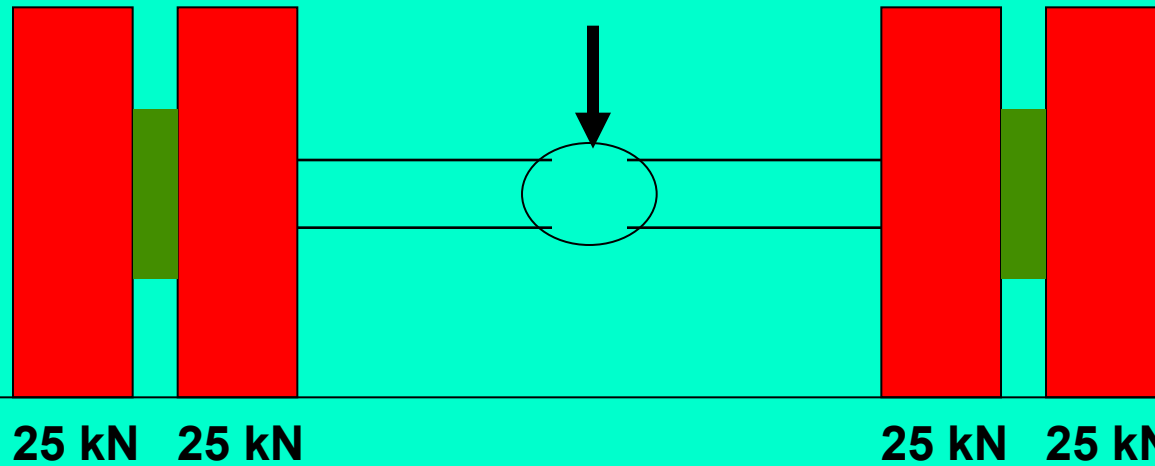
Maximum axle load legally allowed on South African Roads from 1996

Type of axle	No of tyres per axle	Axle Mass (kg)	Load per Axle (kN)*
Single axle (steering)	2 or 3	7 700 (7 700)	76
Single axle (non-steering)	2 or 3	8 000 (7 700)	78
Single axle	4 or more	9 000 (8 200)	88
Tandem axle	4 or more	18 000 (16 400)	88
Tridem axle	4 or more	24 000 (21 000)	78,3

() Previous legal load limits

* $g = 9,8 \text{ m/s}^2$

100 kN Axle



**WHEEL
LOAD**

25 kN 25 kN

25 kN 25 kN

TYRE CONTACT STRESSES

Road Category [TRH4 (1996)]	Percentile Values (%)	Contact Stress (kPa)	Load Radius (mm)
D	50	660	110
C	80	865	96
D	90	975	90
A	95	985	90

***Recommended new load/stress conditions
for mechanistic analysis (RR 93/296)***