8th ICAP - *Seattle, USA*

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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CSIR

COURSE PROGRAMME
FRIDAY, NOVEMBER 28, 1997

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

(Dr M De Beer)

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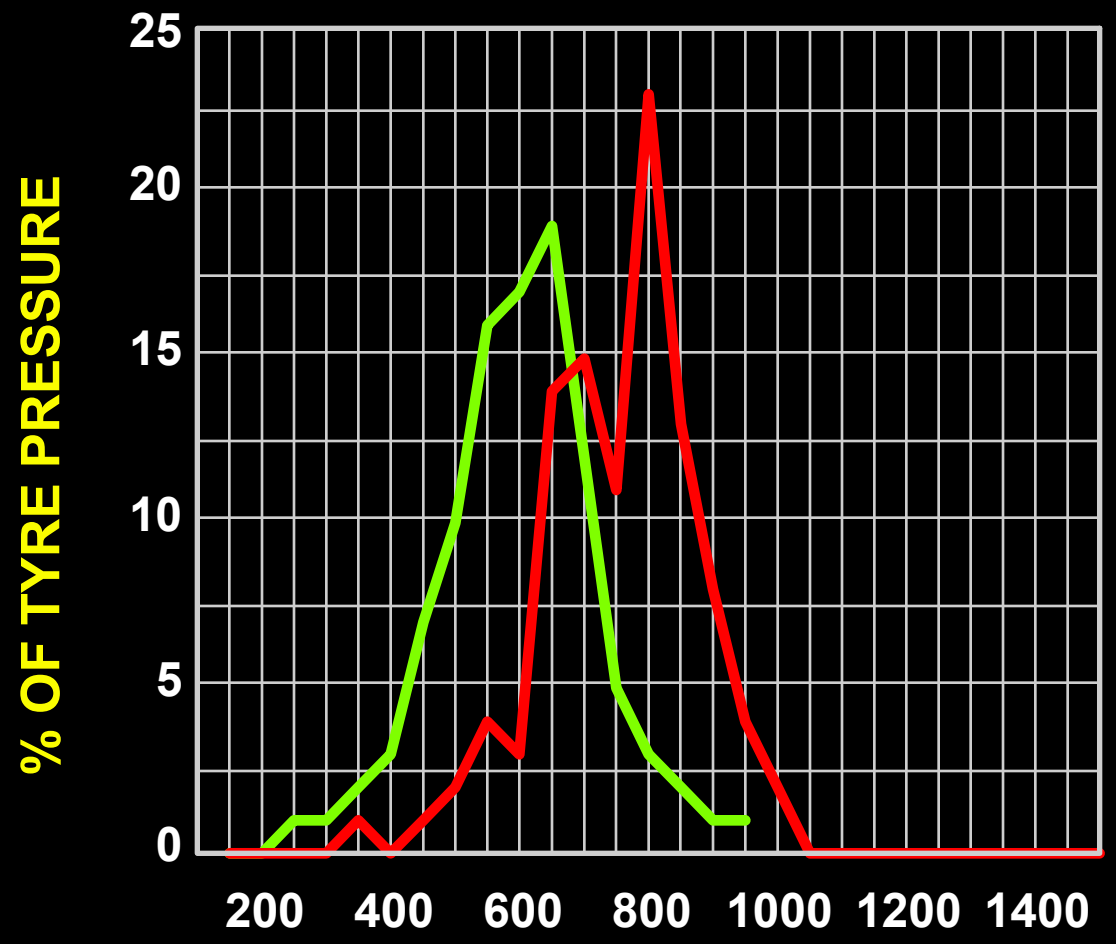

Average: 620 kPa (1974)

Average: 733 kPa (1995)

TYRE INFLATION PRESSURE (kPa)

FIGURE 1a

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

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

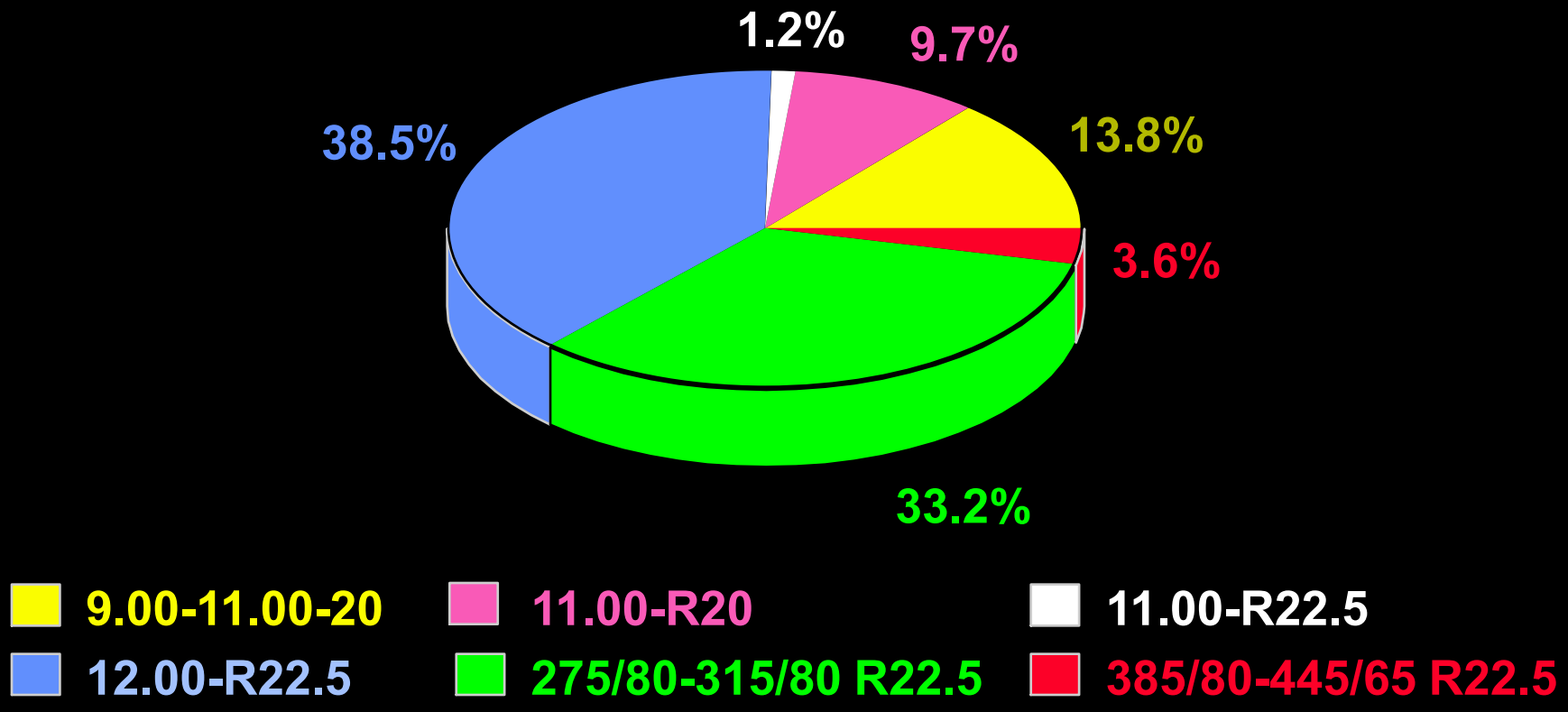

FIGURE 1b

Distribution of heavy truck tyre types in South Africa

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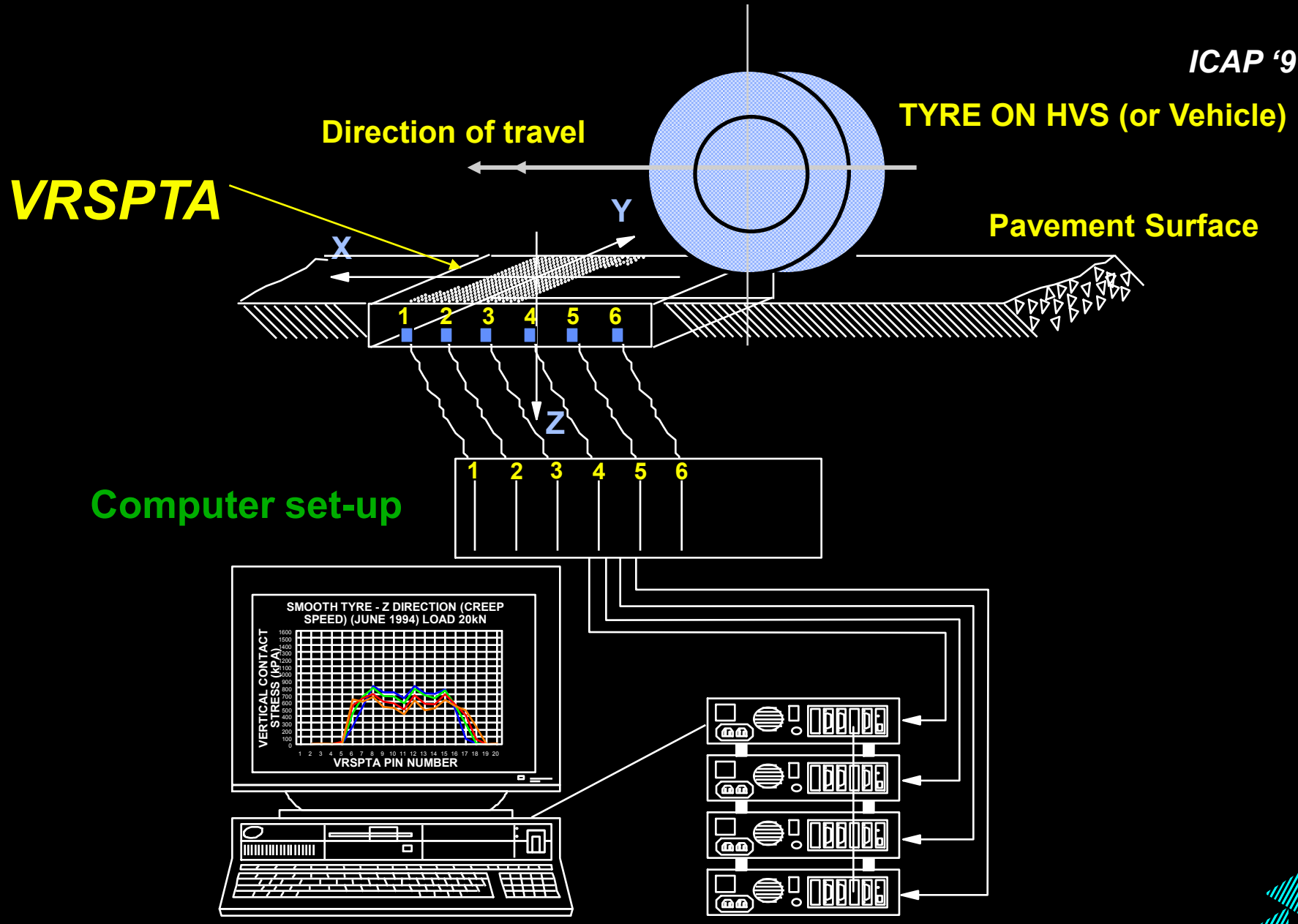

FIGURE 2

Schematic layout of VRSPTA system

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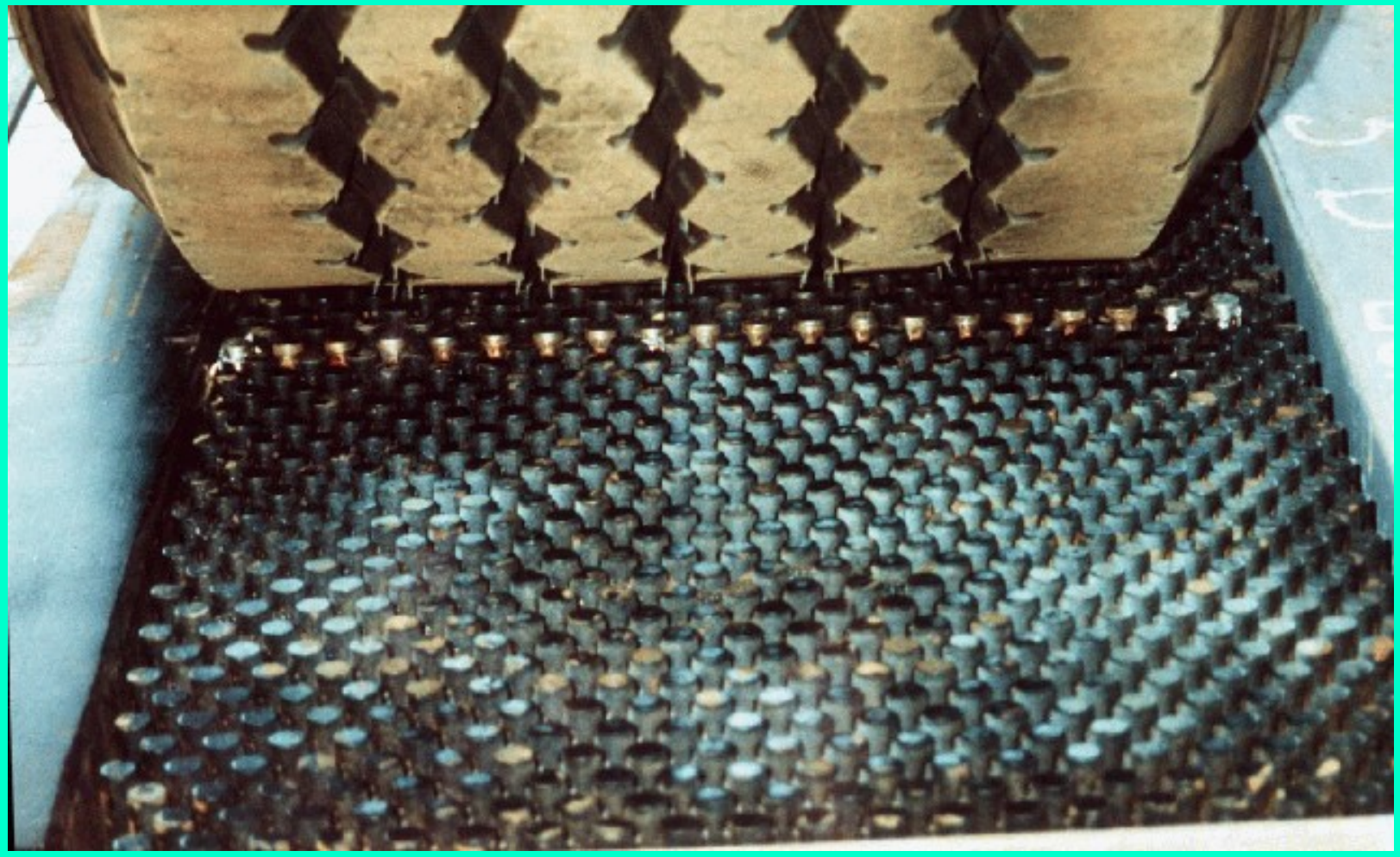
VEHICLE-ROAD SURFACE PRESSURE TRANSDUCER ARRAY (VRSPTA)

315/80 R22.5 HVS TYRE ON VRSPTA



425 /65 R22.5 HVS TYRE ON VRSPTA

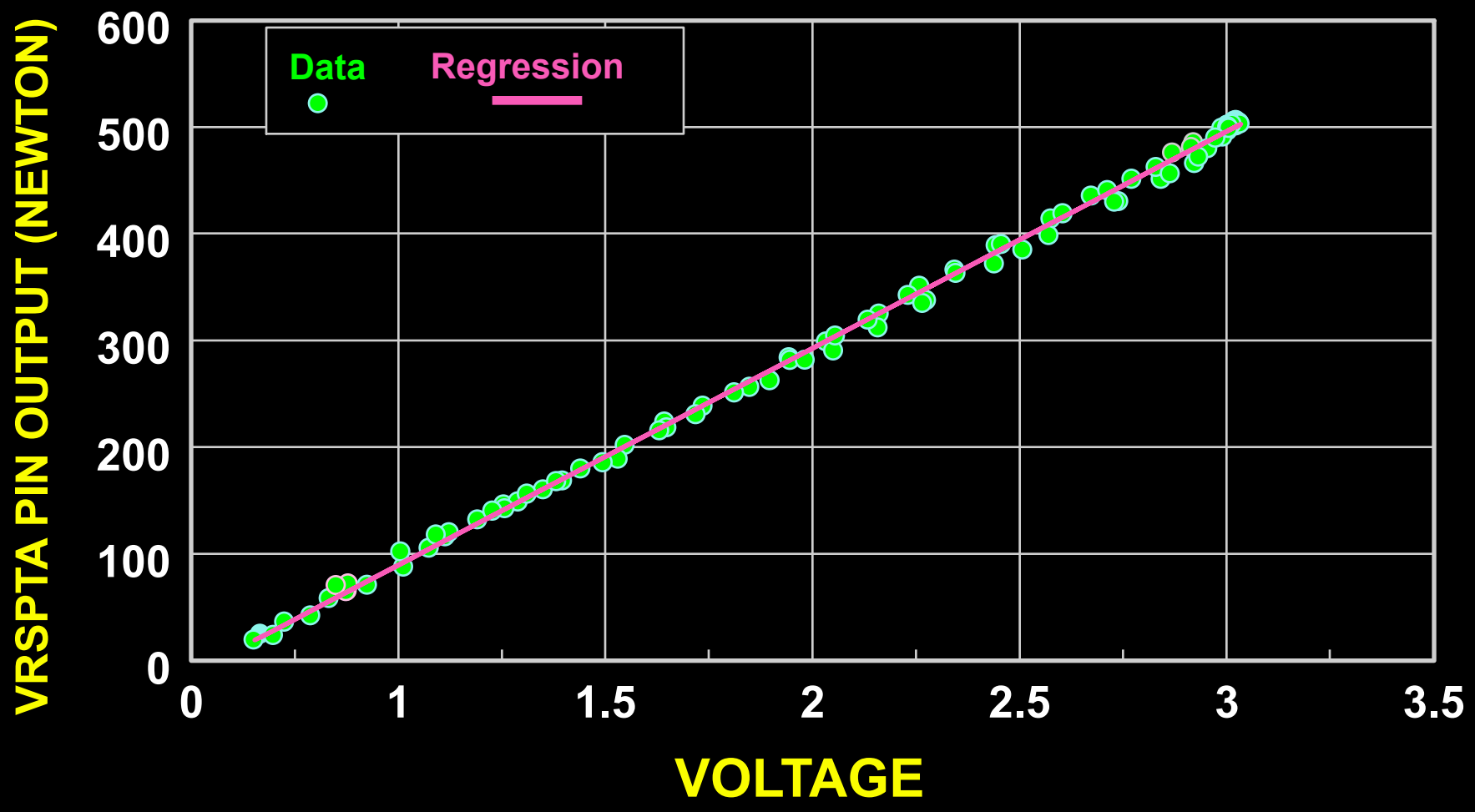


FIGURE 3

Laboratory calibration data of VRSPTA pins

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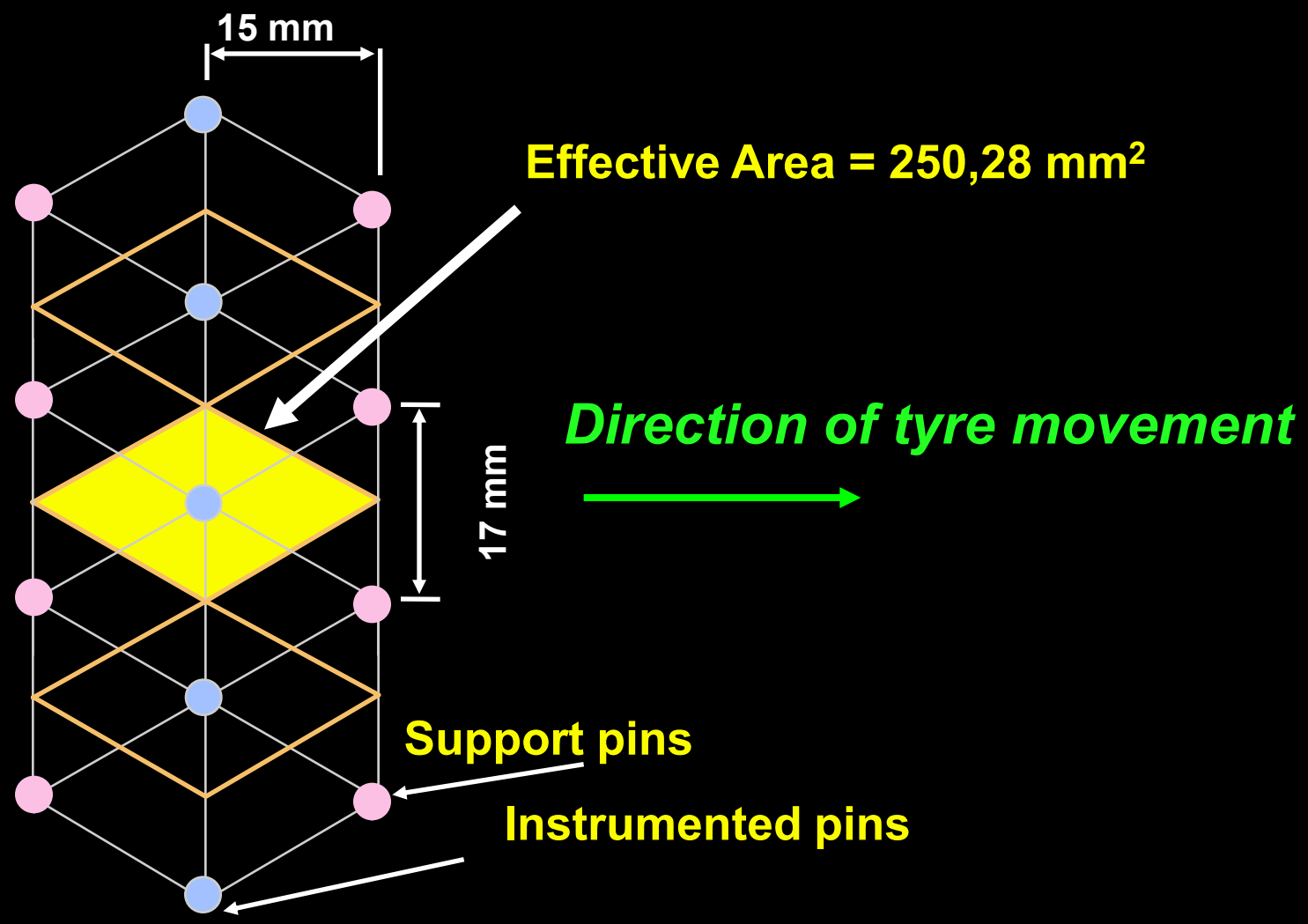

FIGURE 4

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

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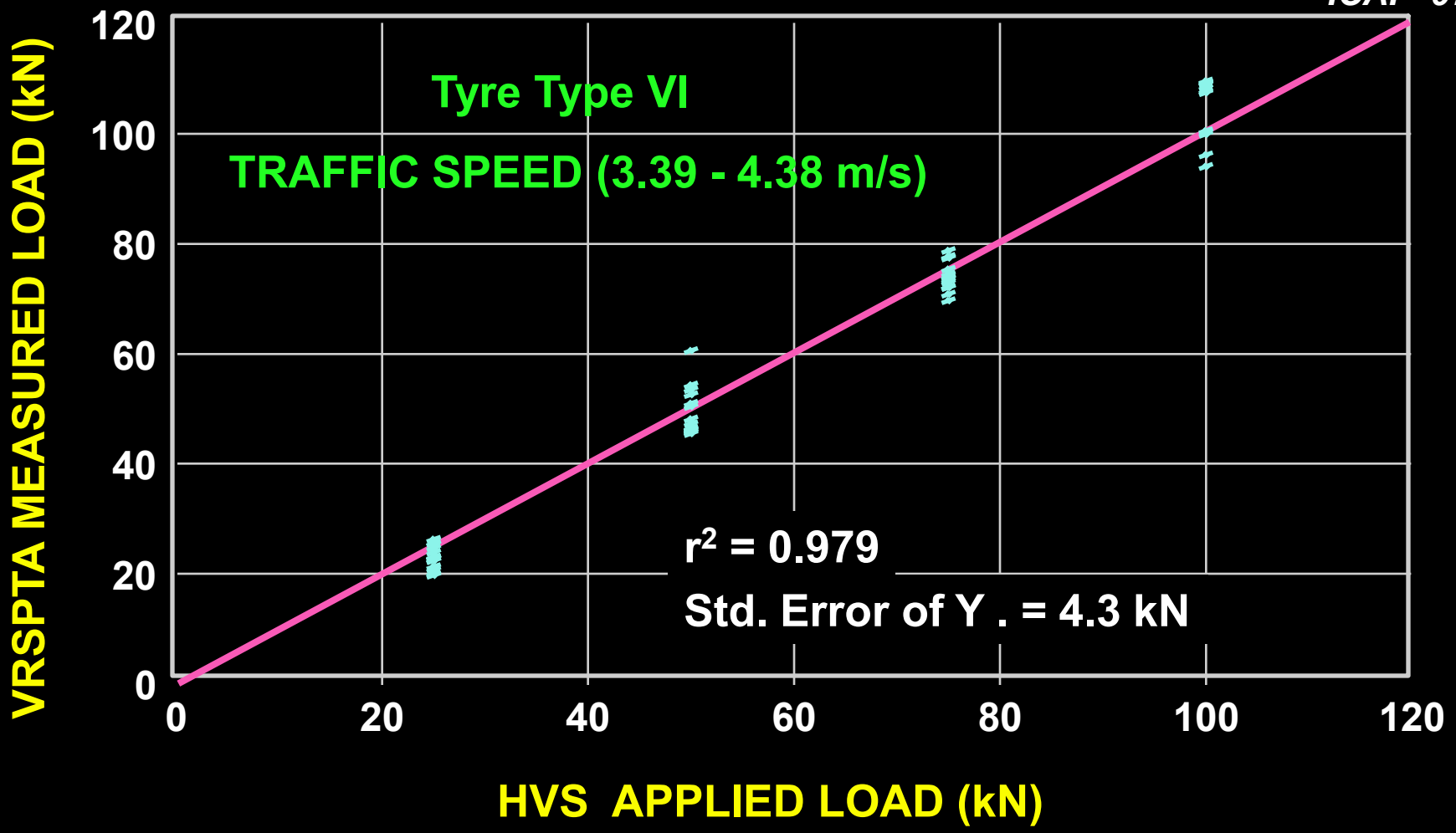

FIGURE 5

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

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11.00 x 20 14 ply smooth HVS Tyre

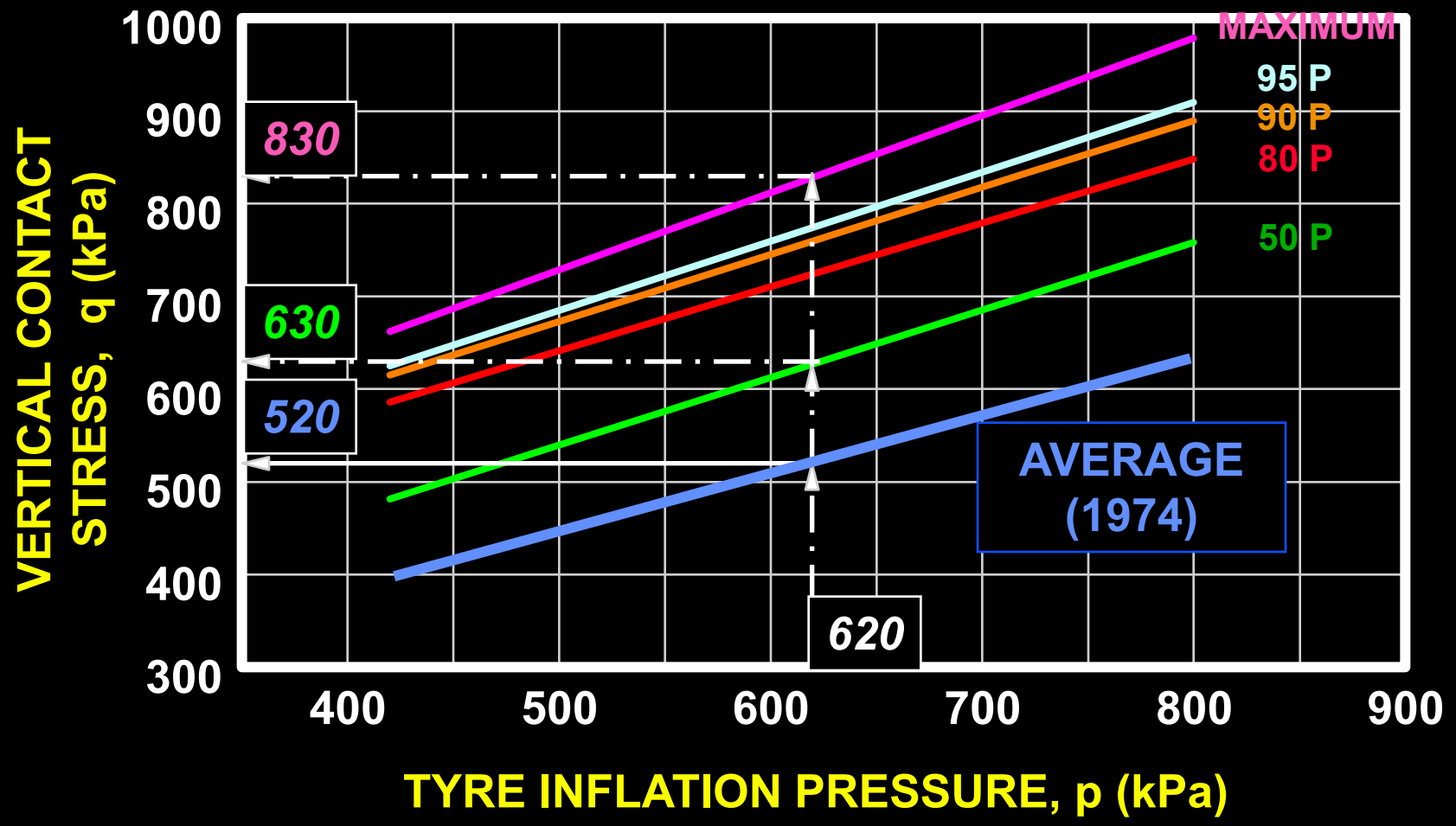

FIGURE 10

"Average" vertical contact stress vs inflation pressure

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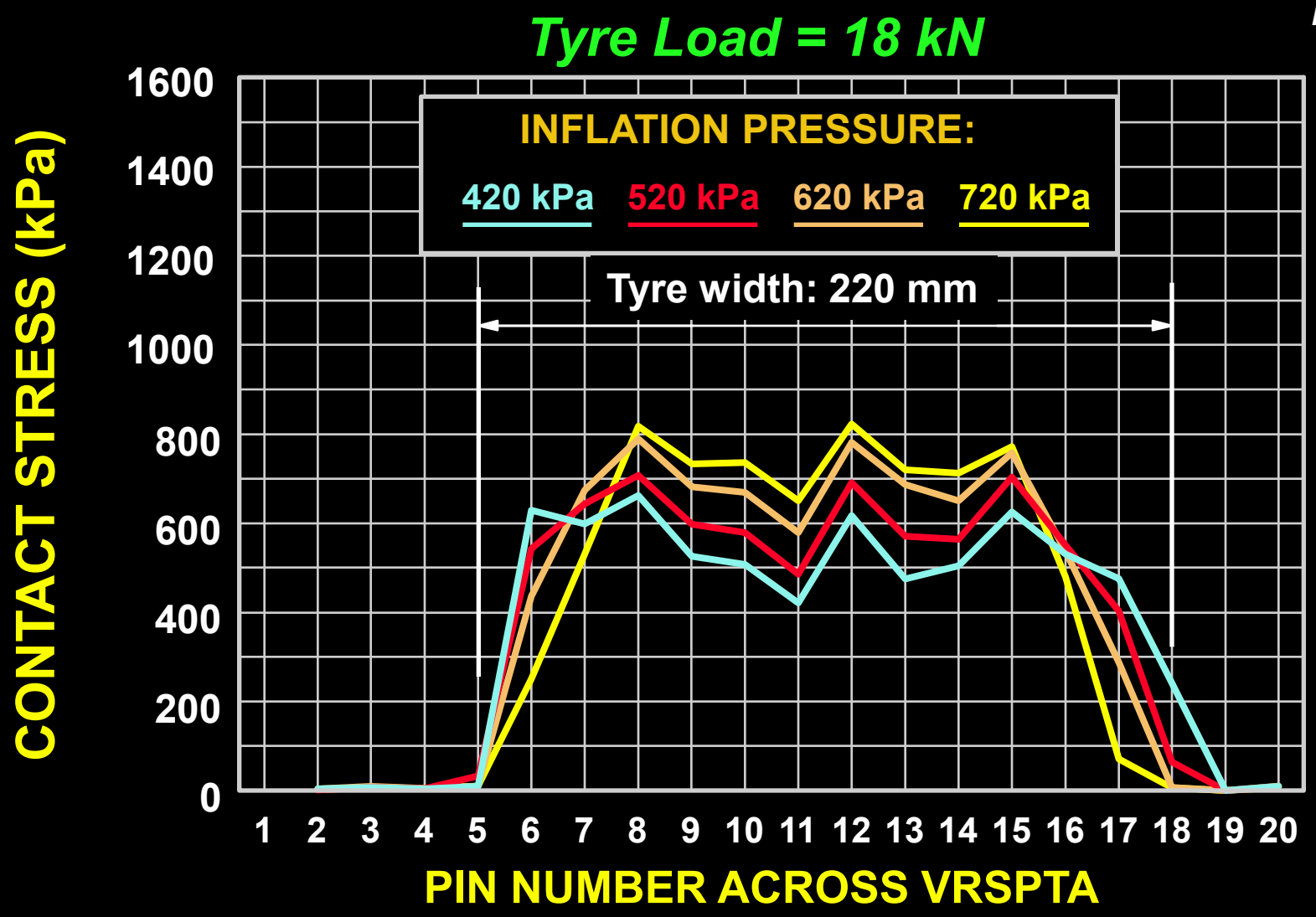

FIGURE 11

Maximum vertical stress at CONSTANT LOAD and various inflation pressures

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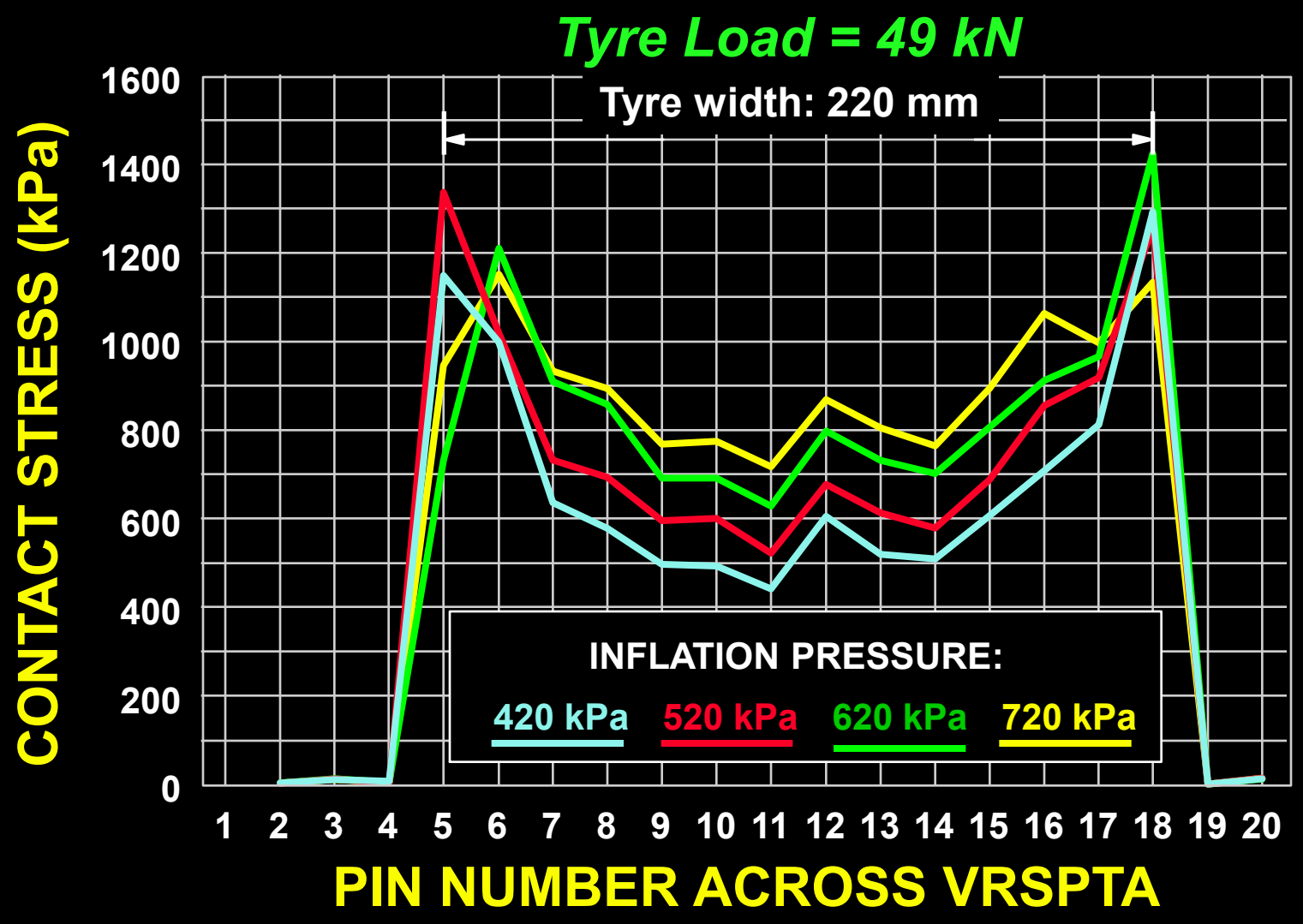

FIGURE 12

Maximum vertical stress at CONSTANT LOAD and various inflation pressures

CSIR

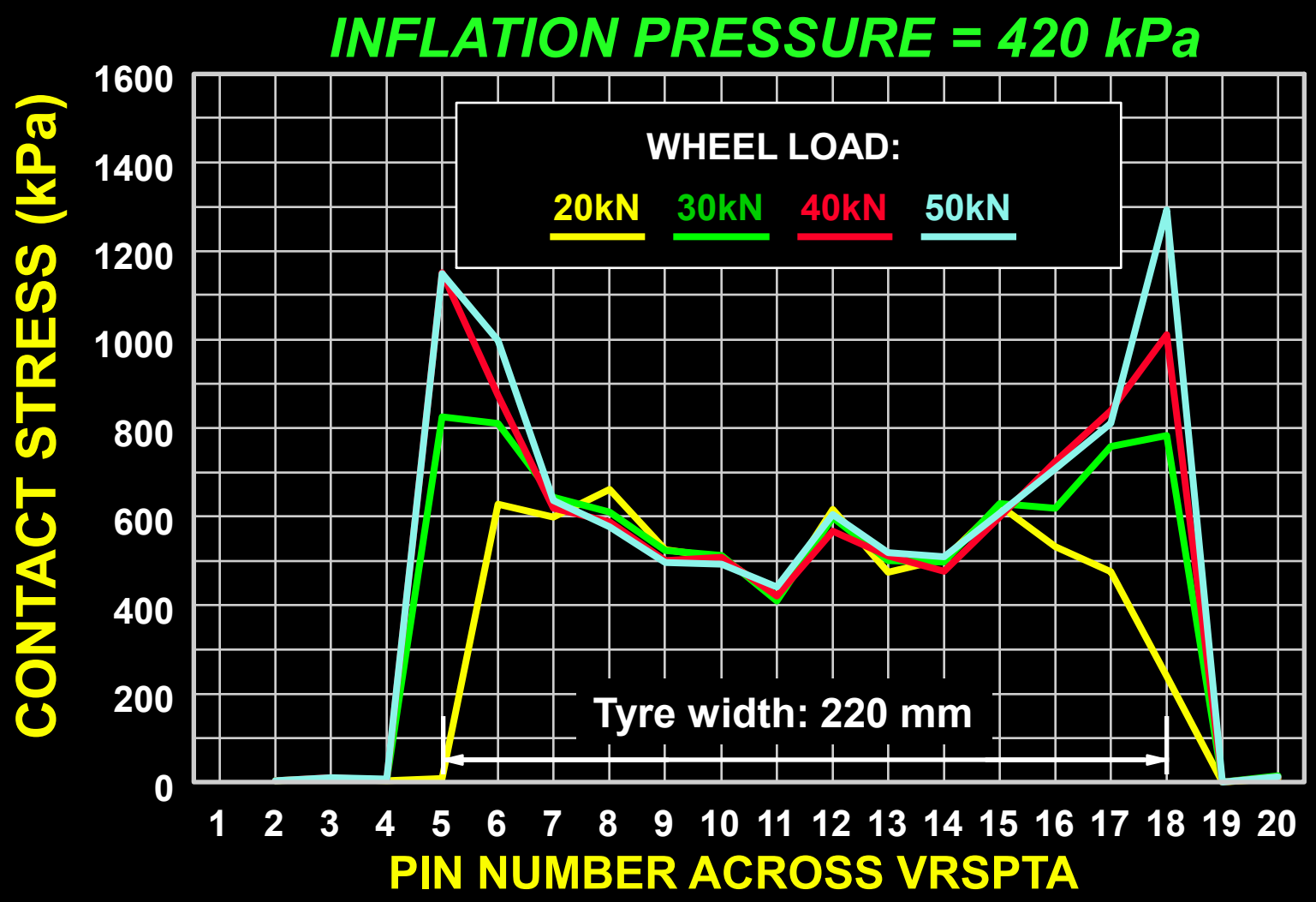

FIGURE 13

Maximum vertical stress at CONSTANT INFLATION PRESSURE at various loads

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INFLATION PRESSURE = 620 kPa

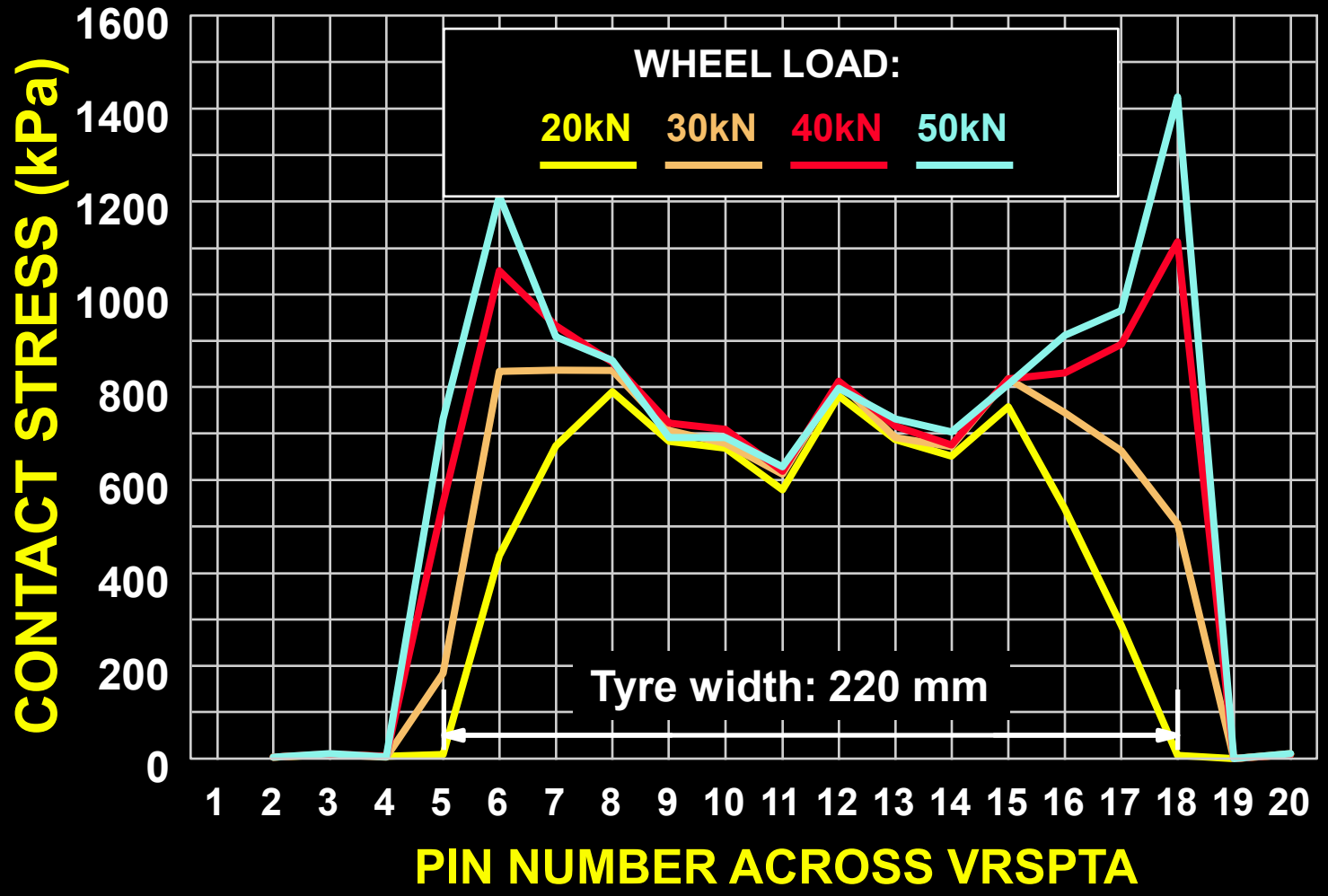

FIGURE 14

Maximum vertical stress at CONSTANT INFLATION PRESSURE and various loads

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Tyre Load = 20 kN

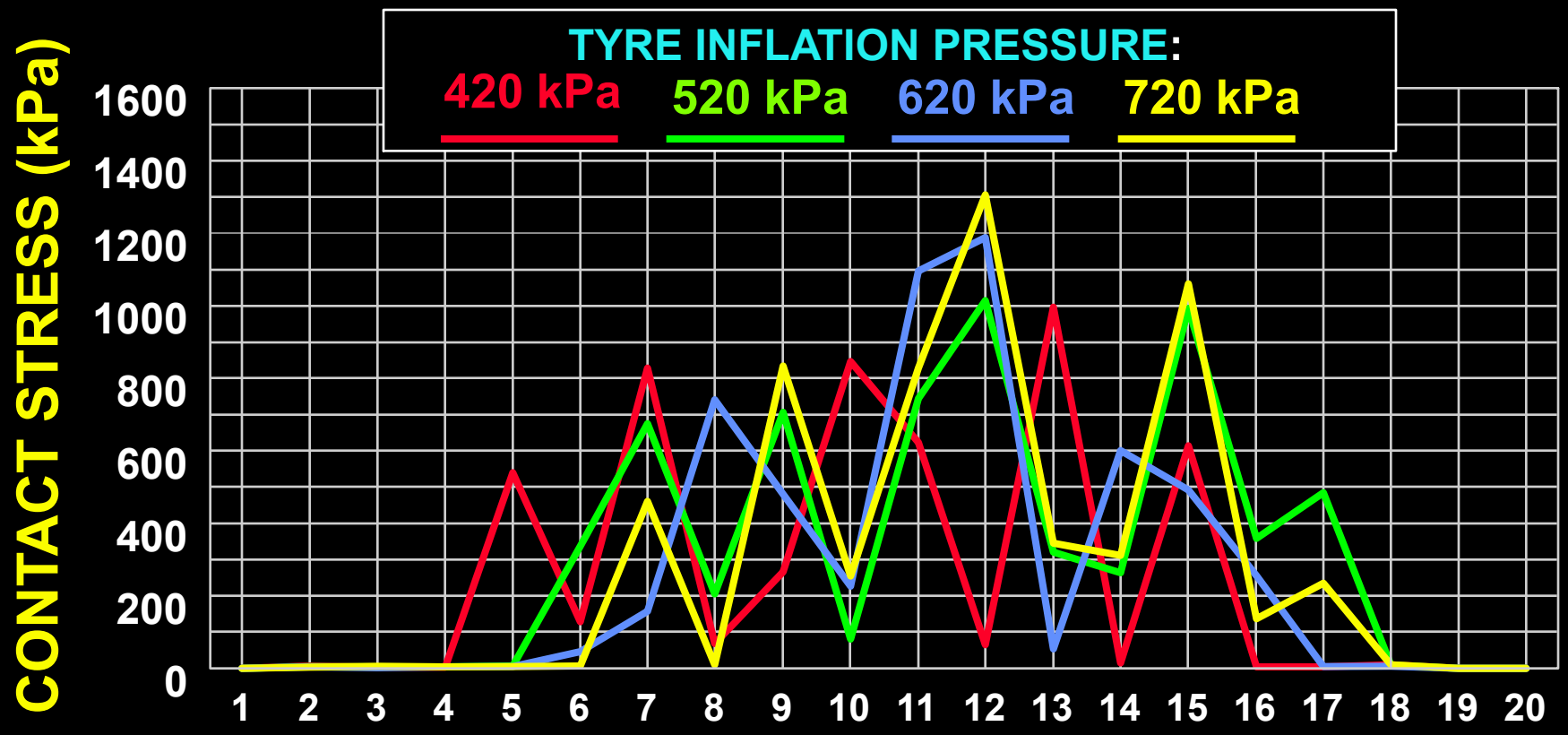

FIGURE 16

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

CSIR

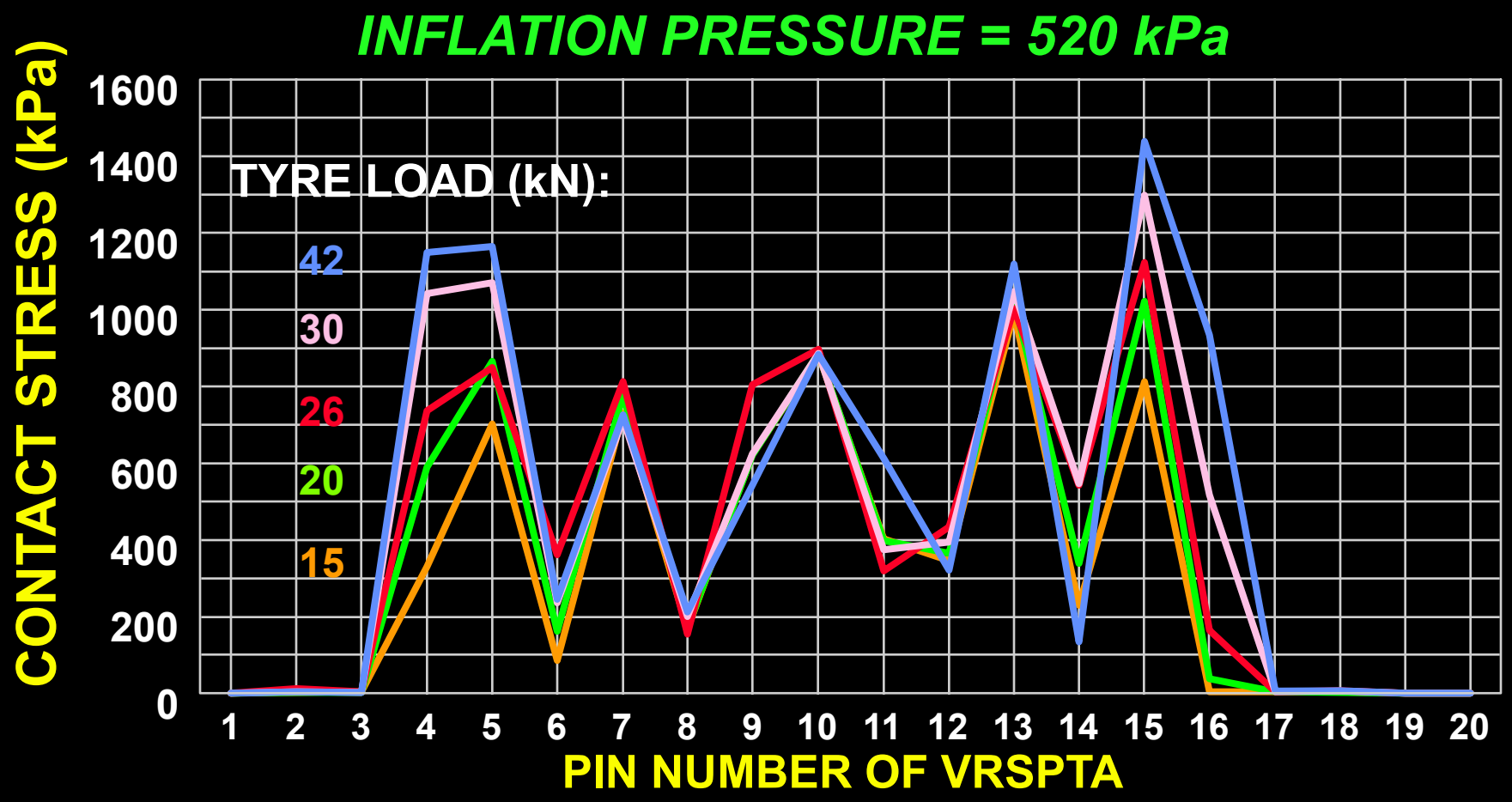

FIGURE 17

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

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10.00 X 20 14 PLY TYRE WITH TREAD

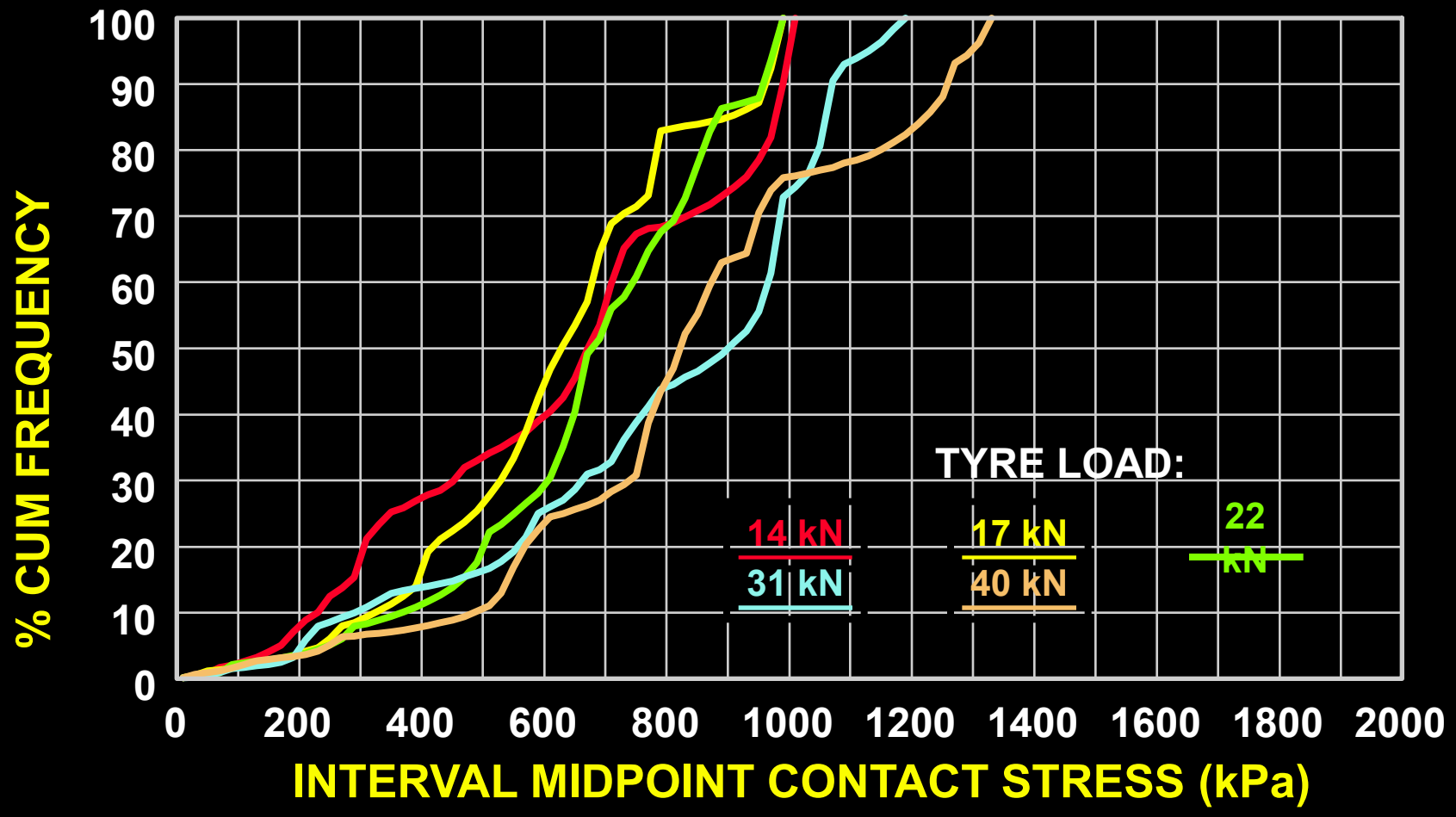

FIGURE 19

Cumulative frequency of maximum vertical stress

MEASURED VERTICAL CONTRACT STRESS VALUES

			190	96		
		182	565	440	213	
		437	728	606	508	
	94	591	795	677	677	94
	327	665	812	699	771	296
	478	695	825	711	827	452
	570	712	825	713	860	560
110	674	721	825	713	881	644
216	695	727	831	722	894	705
291	724	729	832	722	902	750
352	773	732	828	718	906	781
397	754	733	837	724	906	804
415	773	733	835	724	910	816
421	795	734	833	724	909	817
415	765	732	832	727	905	808
376	783	734	837	729	905	793
339	772	733	839	732	899	764
283	723	732	837	730	889	724
206	726	728	833	728	878	674
129	670	726	827	724	860	606
50	582	717	824	726	832	519
	514	708	822	724	794	407
	362	681	813	714	727	252
	148	616	794	686	616	73
		465	742	613	438	
		219	574	424	171	
			235	125		

DIRECTION OF TRAVEL

Patch area = 74 028 mm²

FIGURE 25d

Typical measured tyre contact patch

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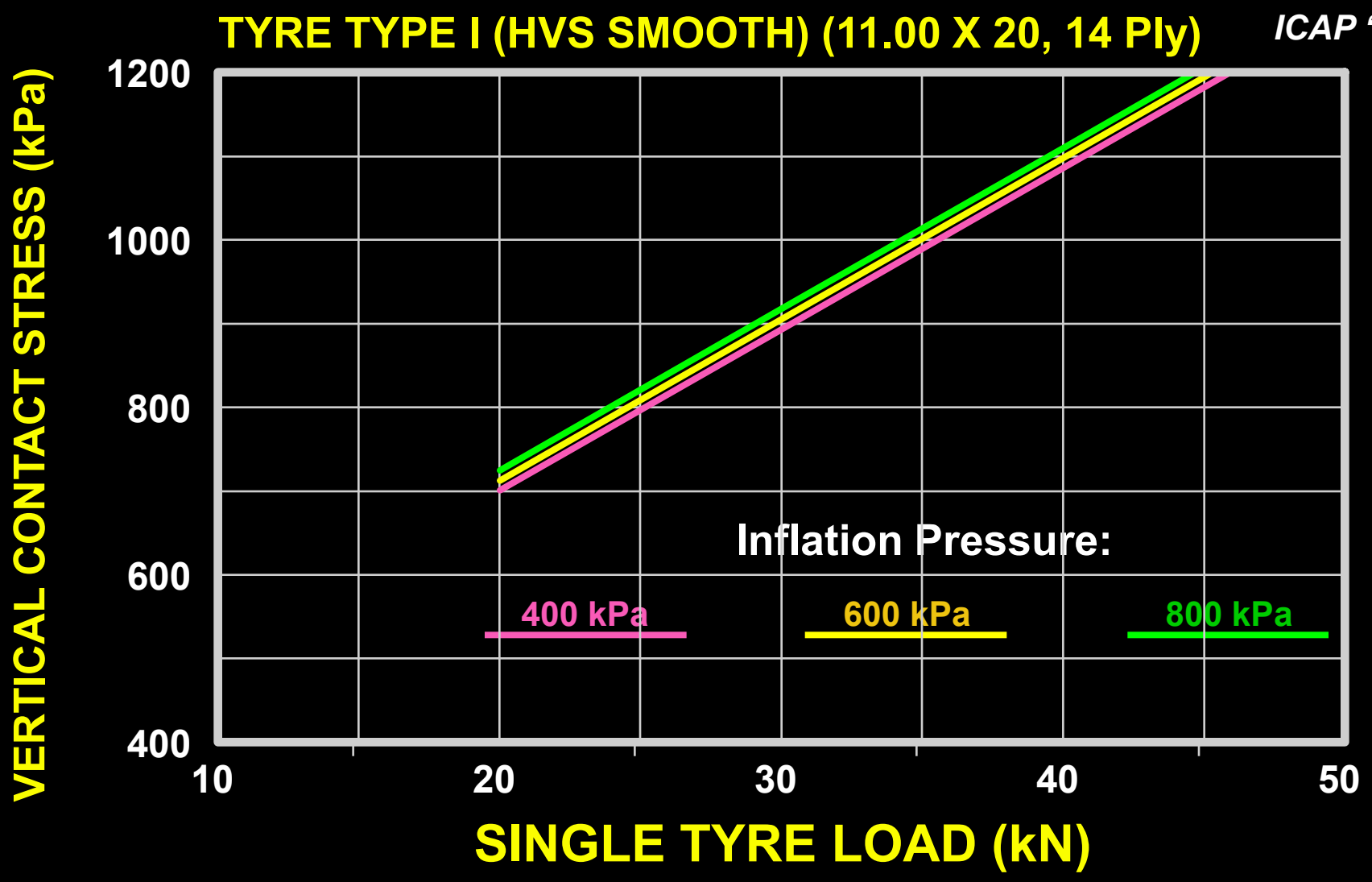

FIGURE 26a

Maximum vertical stress vs tyre load

CSIR

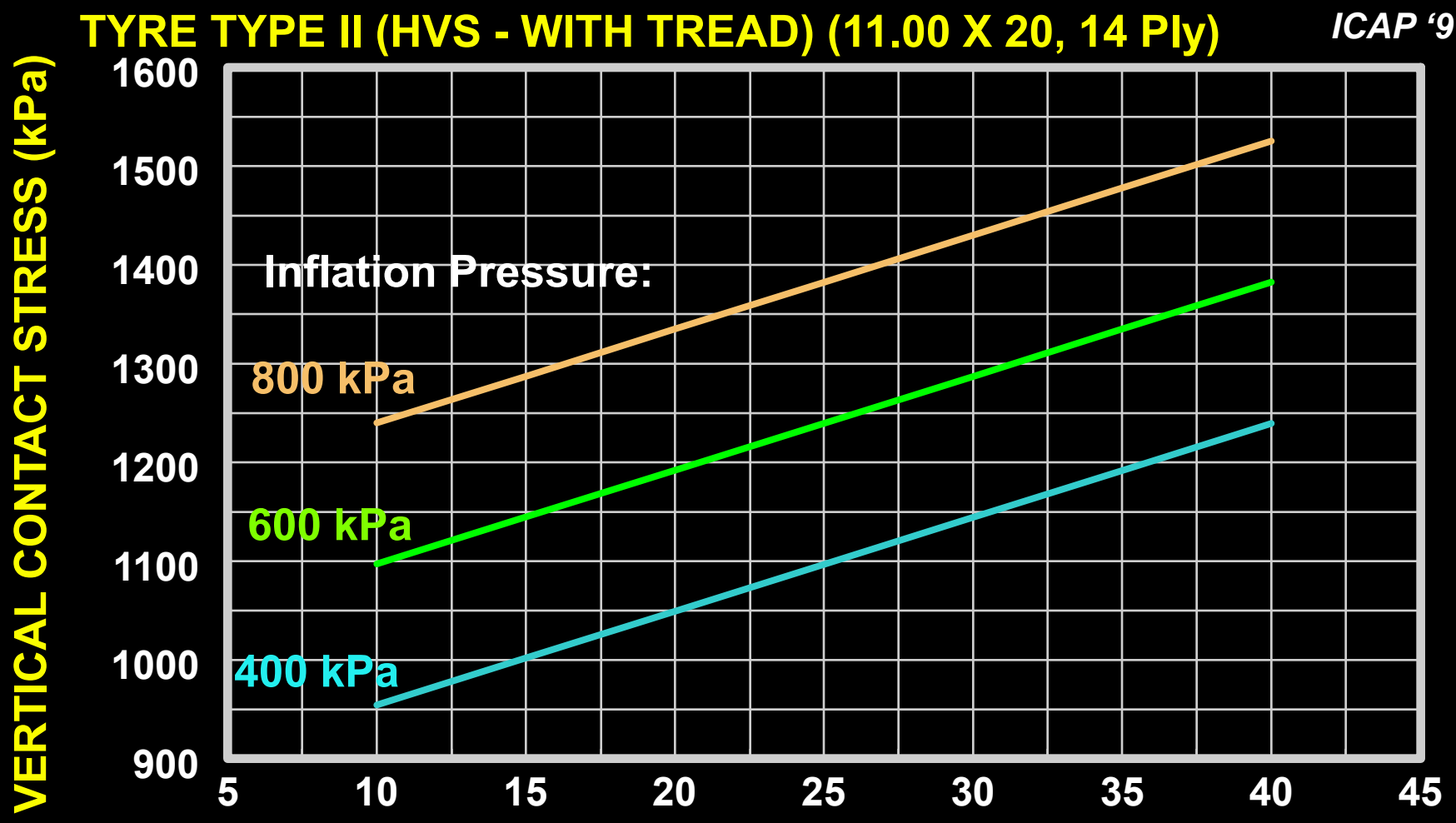

FIGURE 26b

Maximum vertical stress vs tyre load

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TYRE TYPE III (AIRCRAFT TYRE)

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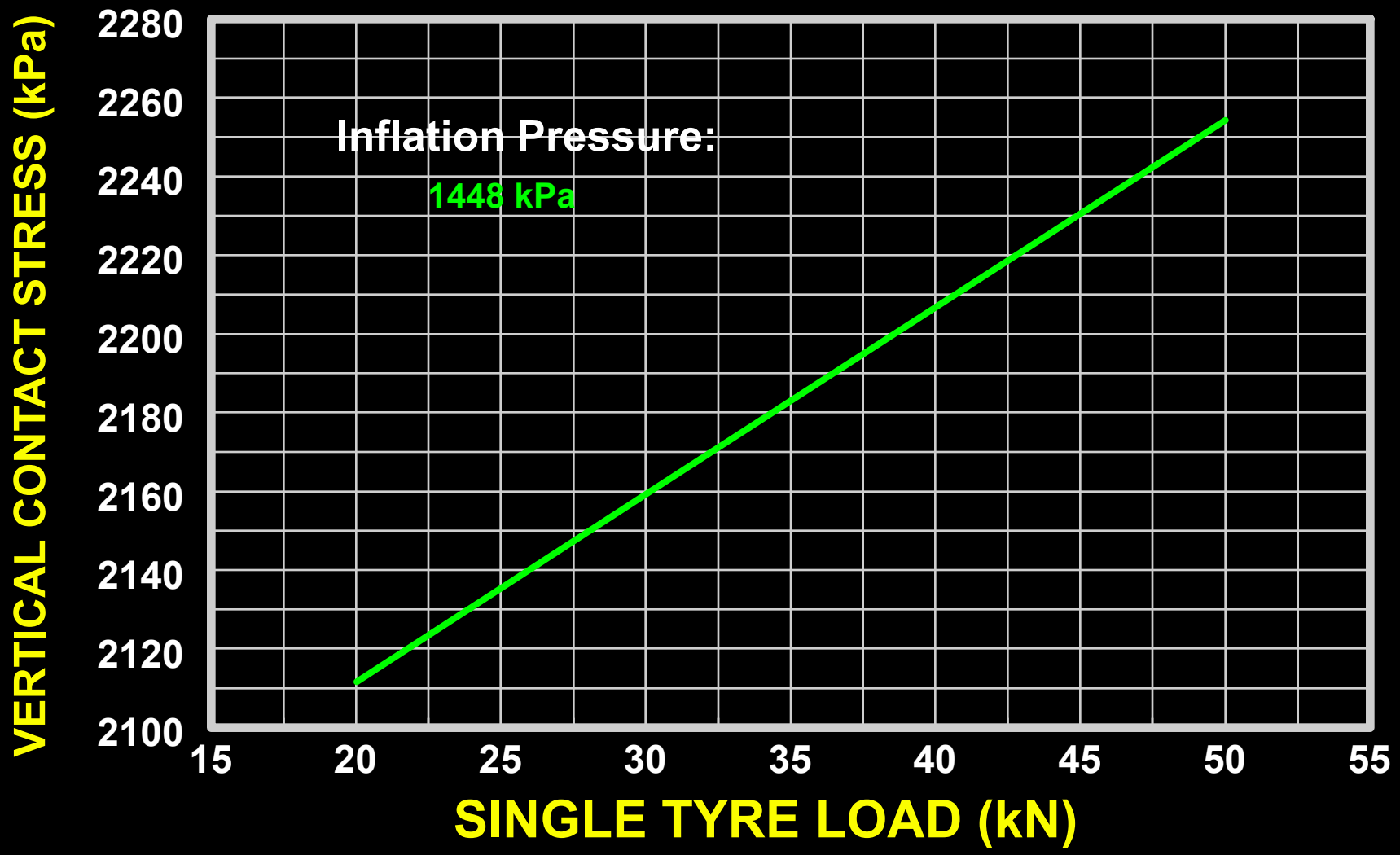

FIGURE 26c

Maximum vertical stress vs tyre load

CSIR

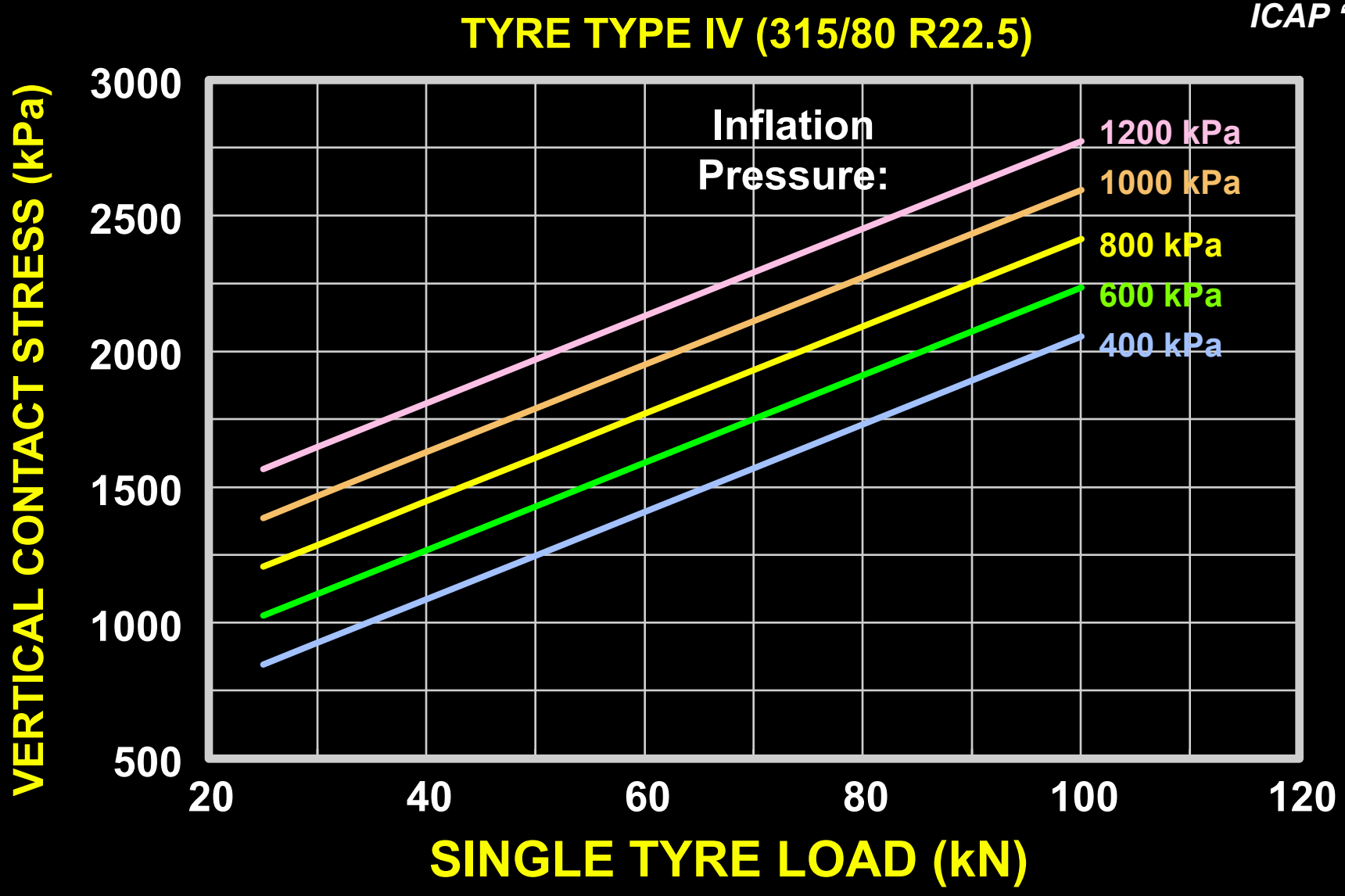

FIGURE 26d

Maximum vertical stress vs tyre load

CSIR

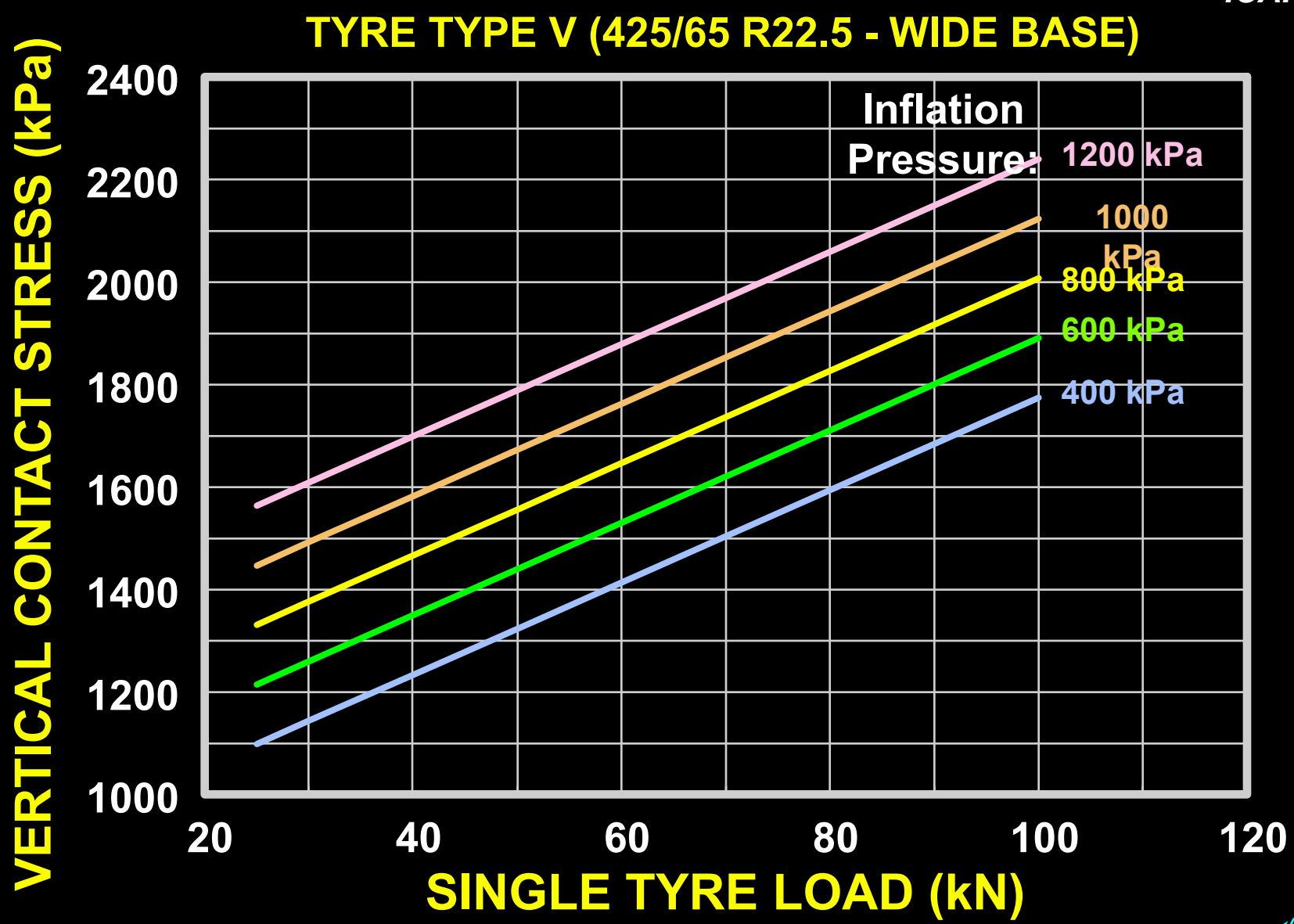

FIGURE 27a

Maximum vertical stress vs tyre load

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

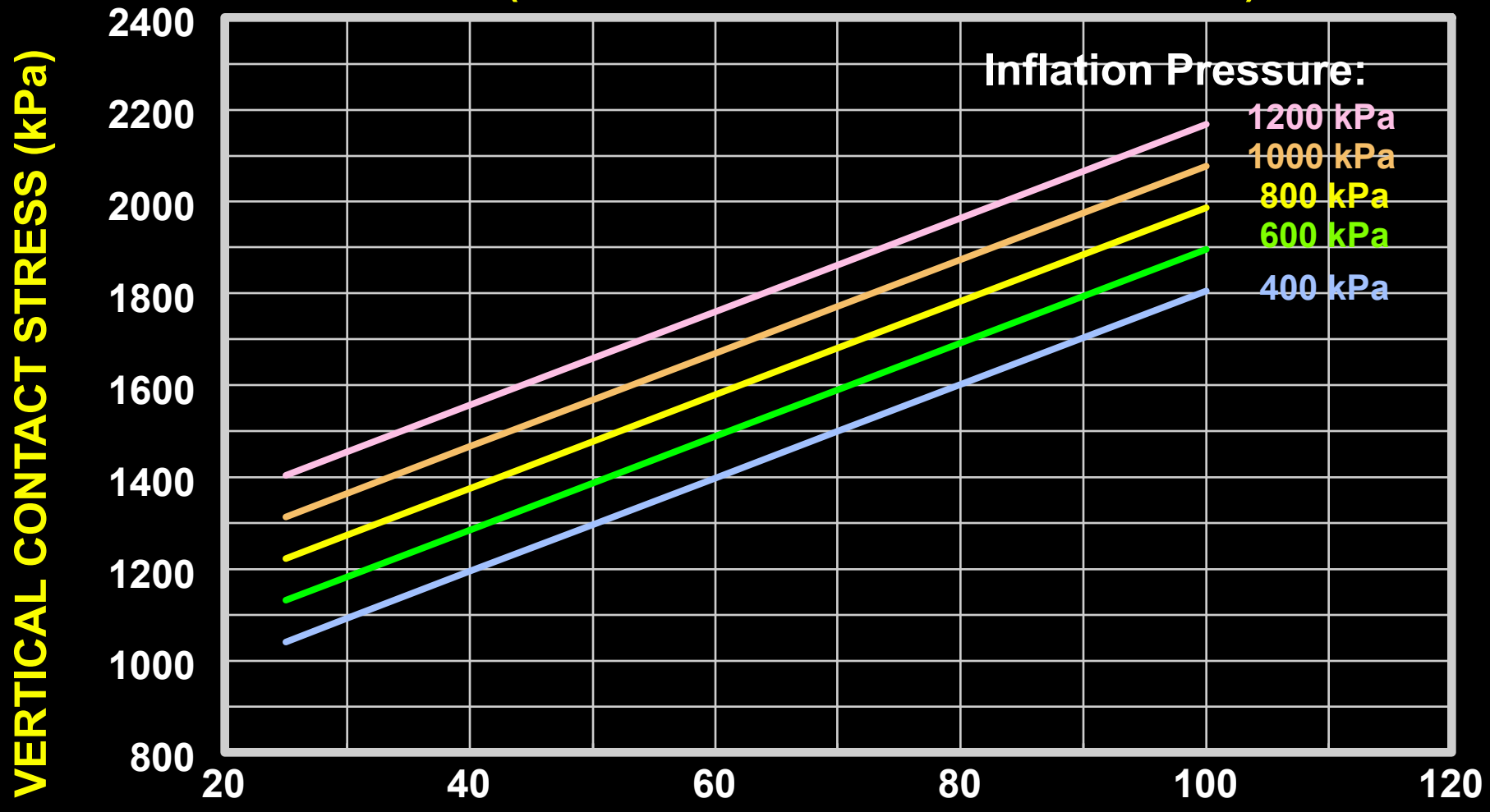


FIGURE 27b

Maximum vertical stress vs tyre load

CSIR

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

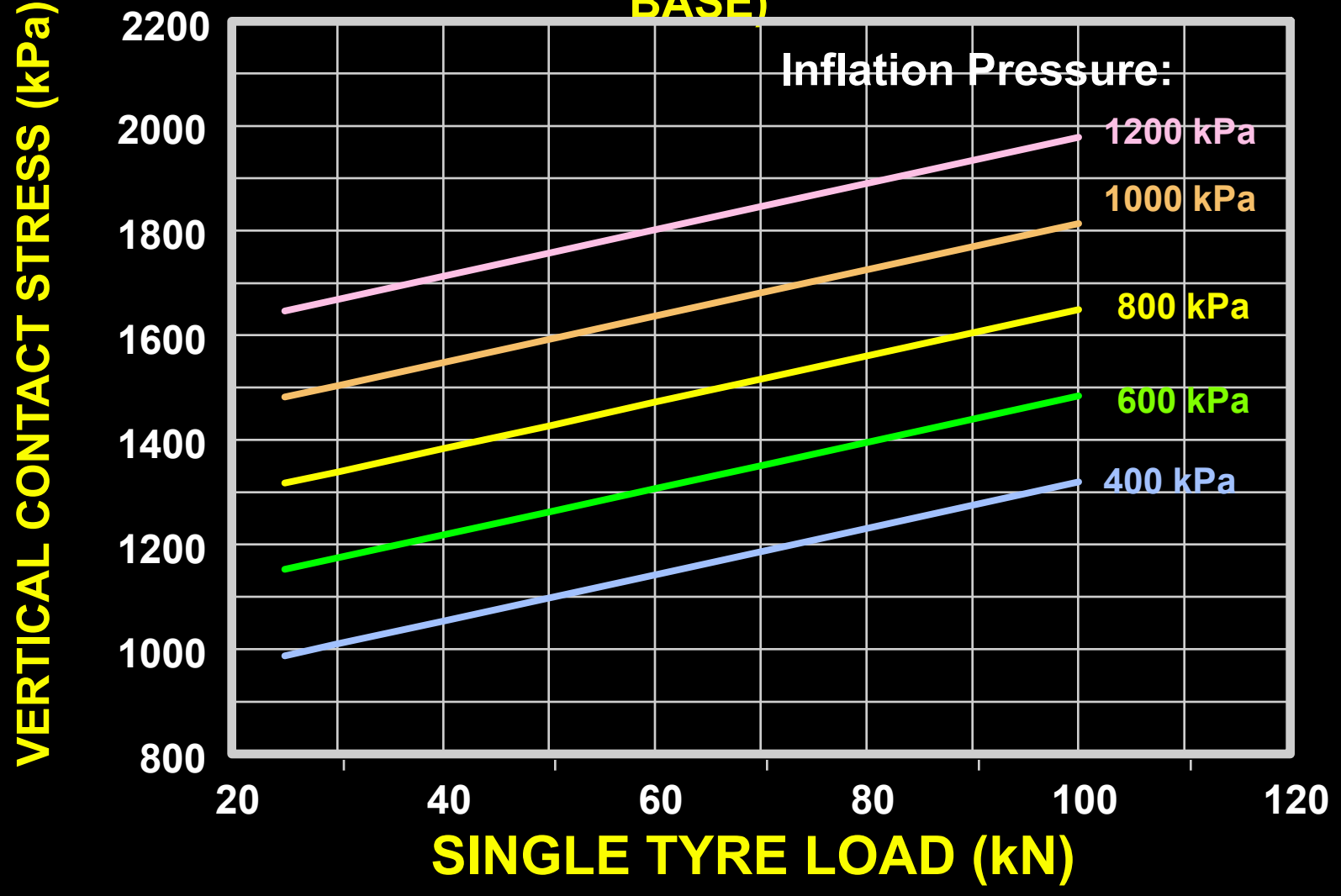


FIGURE 27c

Maximum vertical stress vs tyre load

CSIR

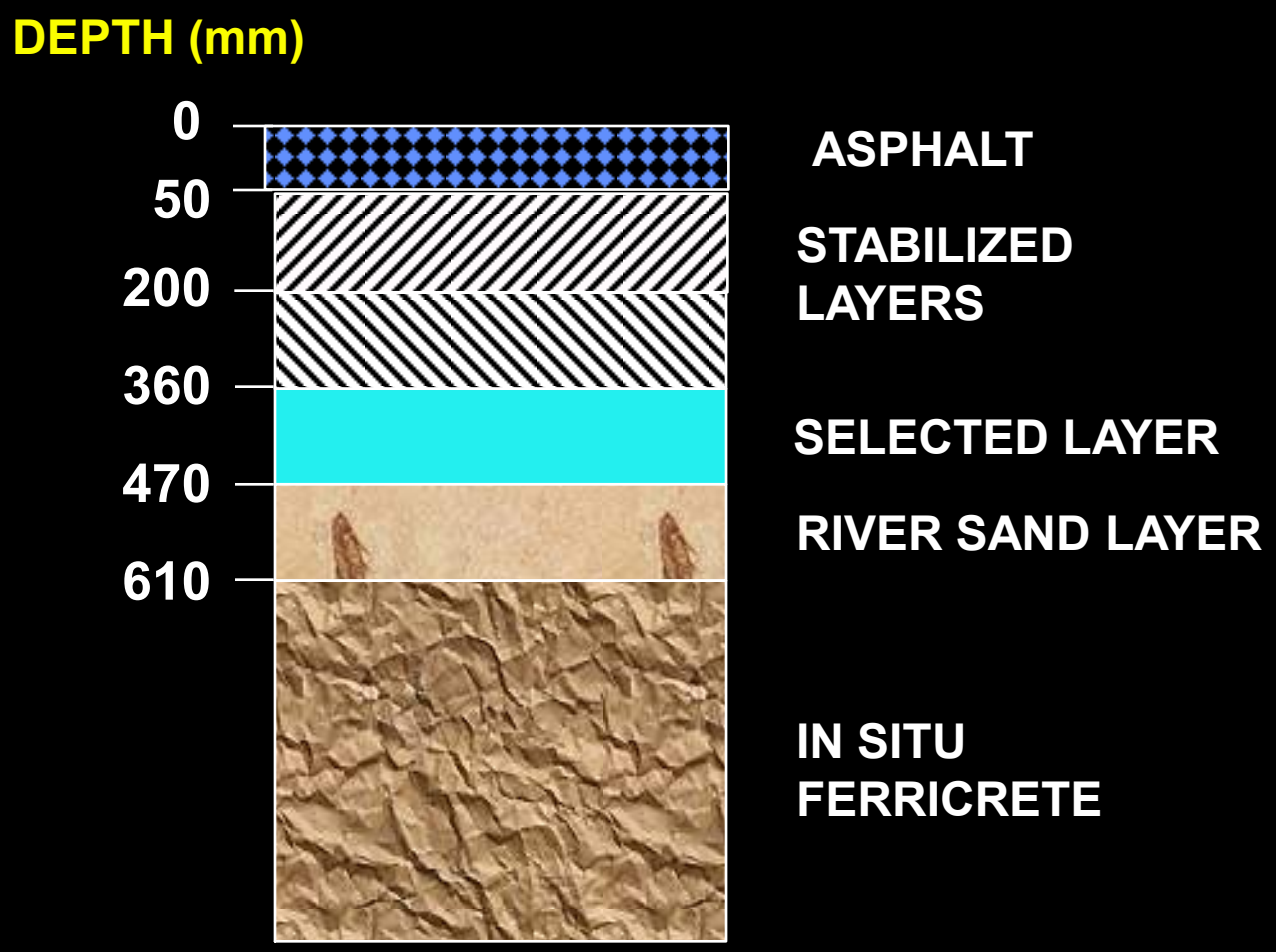


FIGURE: 28

Pavement structures evaluated with the HVS

CSIR

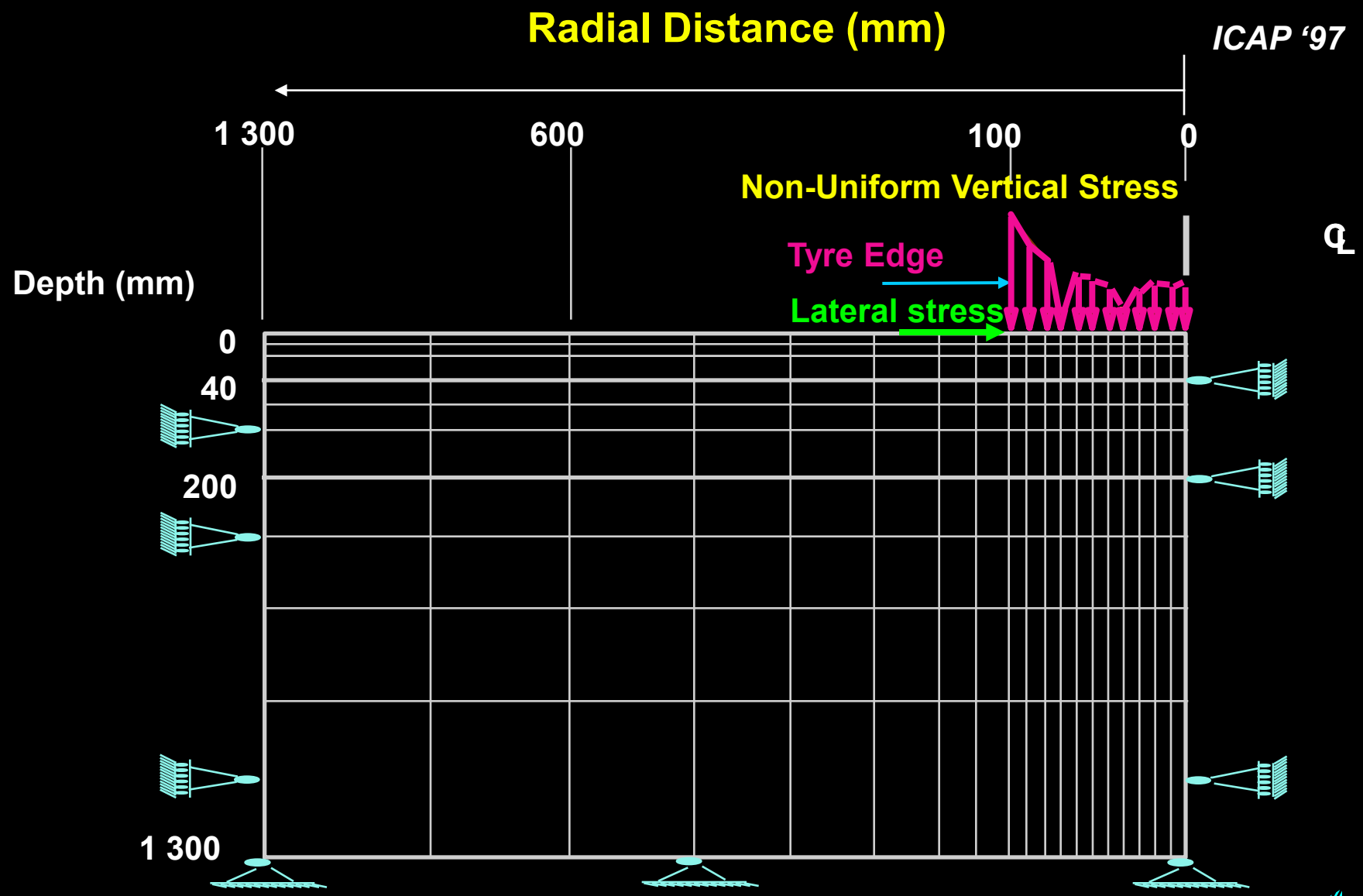


FIGURE: 29

Axi-symmetrical Finite Element Model used in this study

CSIR

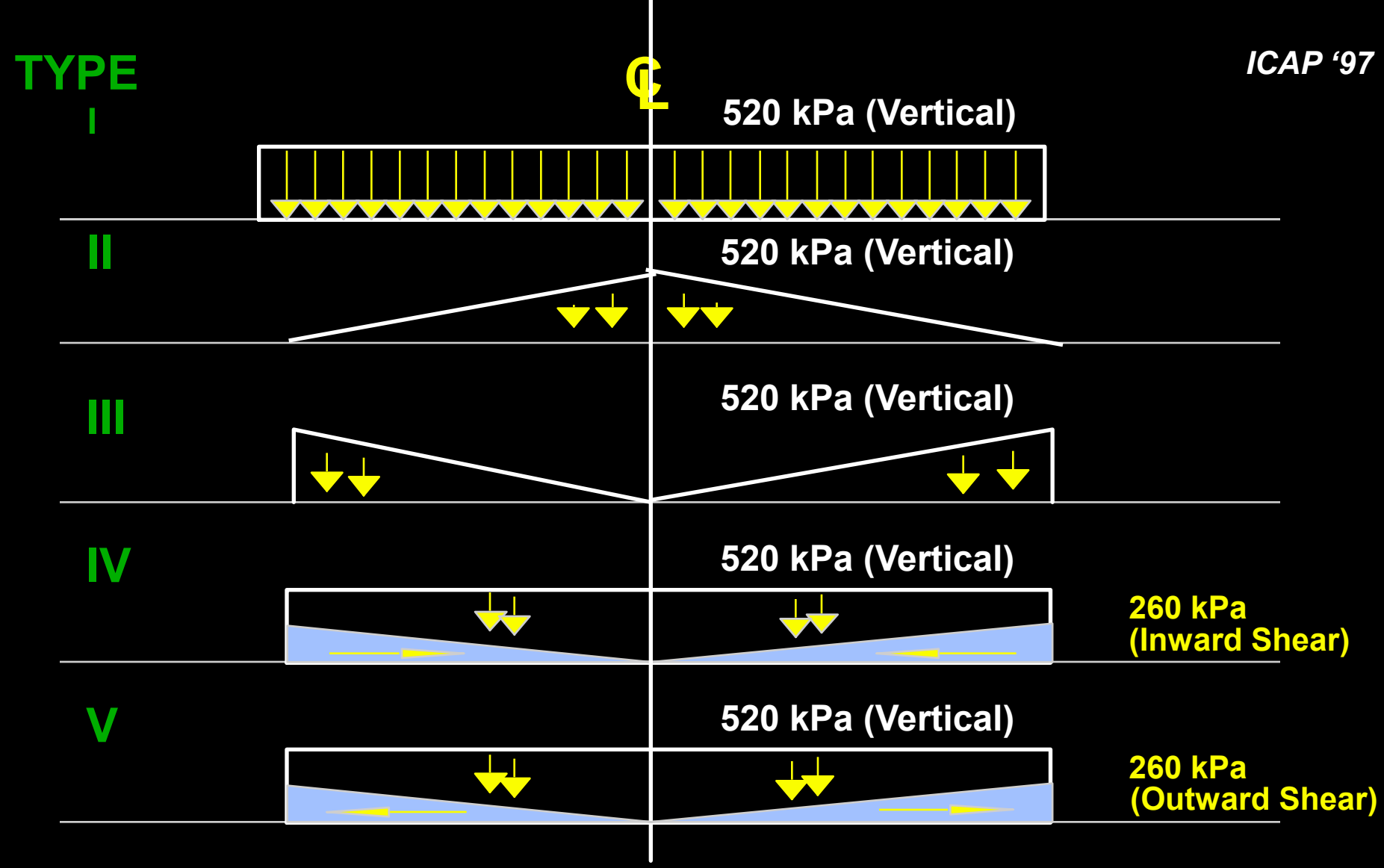
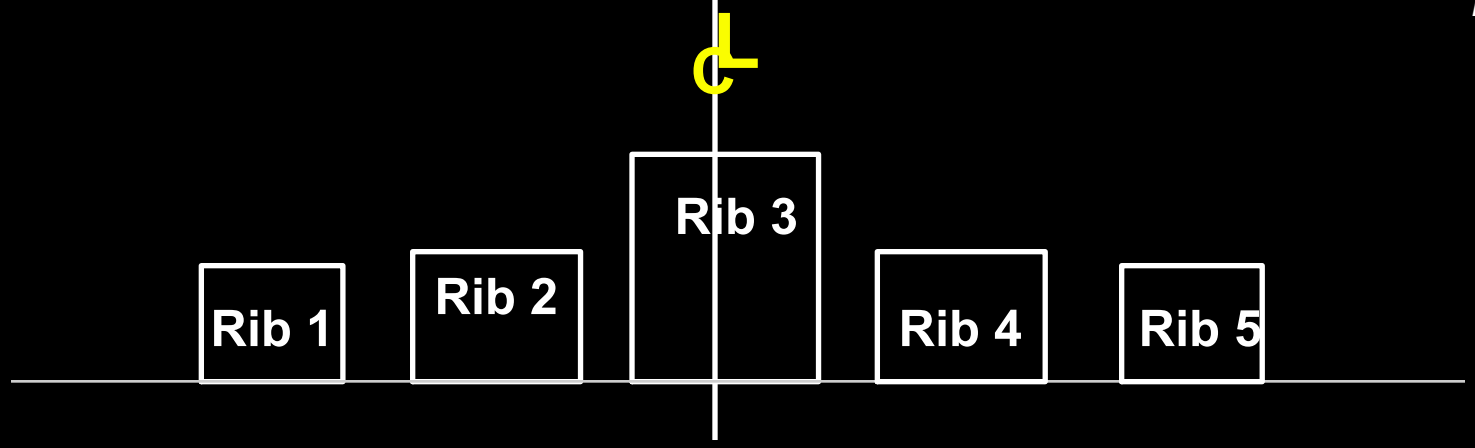


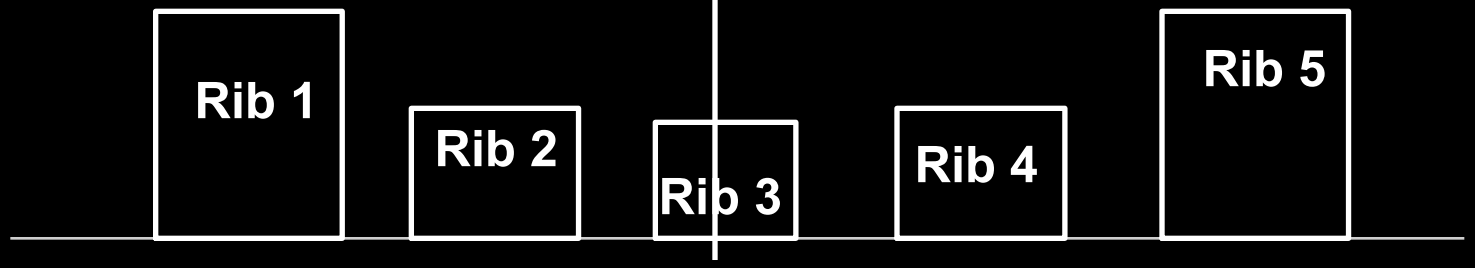
FIGURE: 30

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

CSIR



TYPE VI - TYRE CENTRE
(Vertical and lateral)



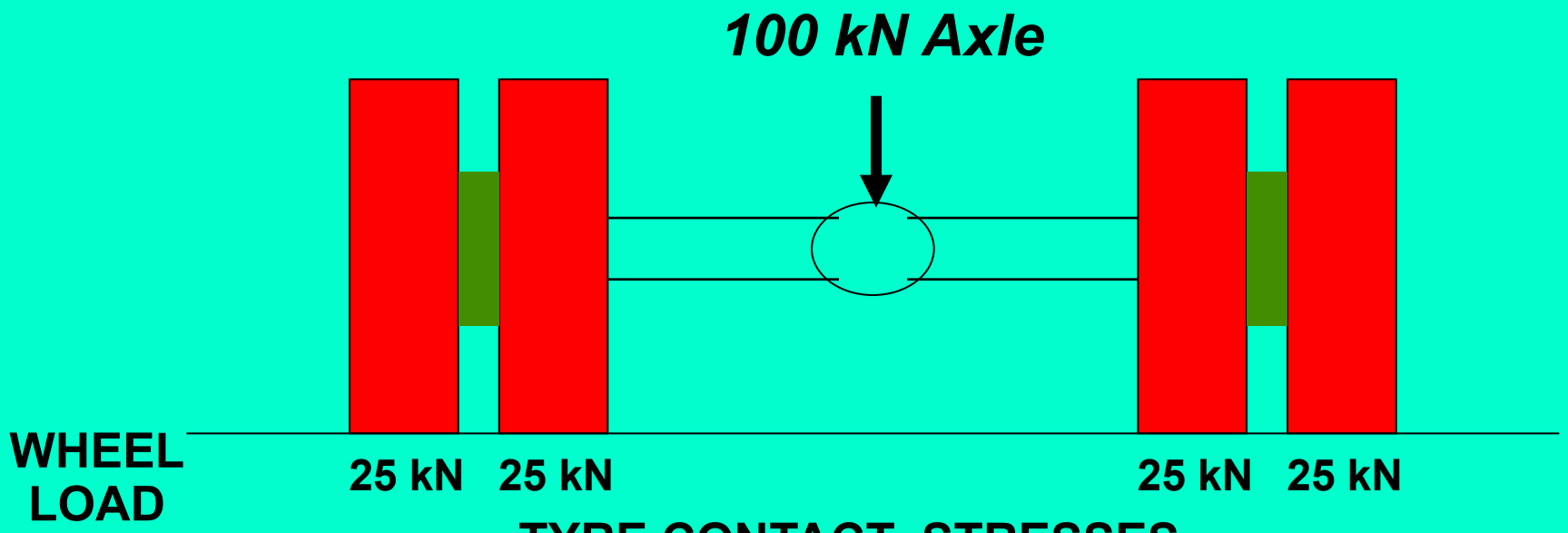
TYPE VII - TYRE EDGE
(Vertical and lateral

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

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



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)