Managing the Maintenance of the Runway at Baghdad International Airport

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Problem statement

- 1- The surface of the runway 33R-15L of Baghdad international airport is badly covered with aeroplanes tyre rubber.

- 2- Such accumulation of rubber could impart the safety of landing at various environment conditions.

- 3-The international flight companies had claimed that the rough surface of the runway caused damage to their aeroplanes tyres and ask for an assessment to evaluate and suggestion for remedy.

- **The new airside of Baghdad international airport had a runway of 4000 meters length and 45 meter width.**

- **It was constructed and came under service in 1982. Since 2010, the runway has seen increasing levels of commercial operations since it is supported with airfield lighting.**


Old Airside
New Airside

- **The runway consists of concrete pavement constructed in 12 panels of 5x4 meters size in the cross section direction, both contraction and expansion joints have been implemented.**

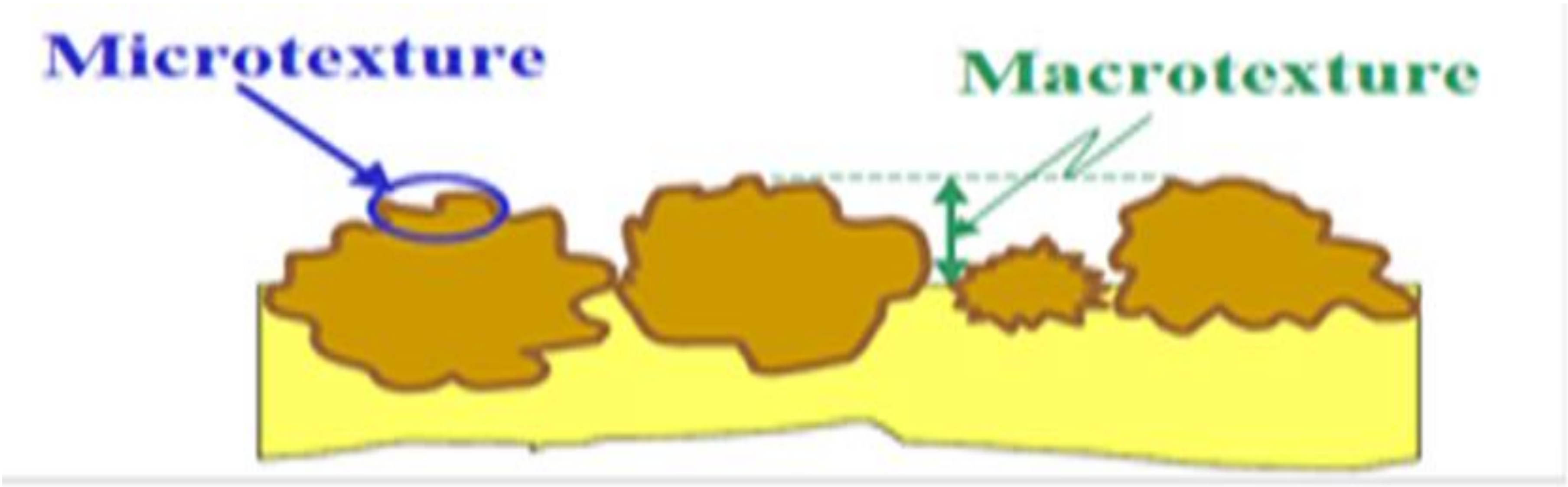
- **At the touchdown zone, the pavement surface was badly covered with rubber to a width of 8 panels in the cross sectional direction.**

- **The joints exhibit loss of sealant materials or need top up of the sealant.**

Skid resistance of pavement surfaces is largely depends on:

1- Surface microtexture (texture wavelength of <0.5 mm and amplitude of <0.2 mm)

2- Macrotexture (texture wavelength of 0.5 mm – 50 mm and amplitude of 0.1 mm – 20 mm)



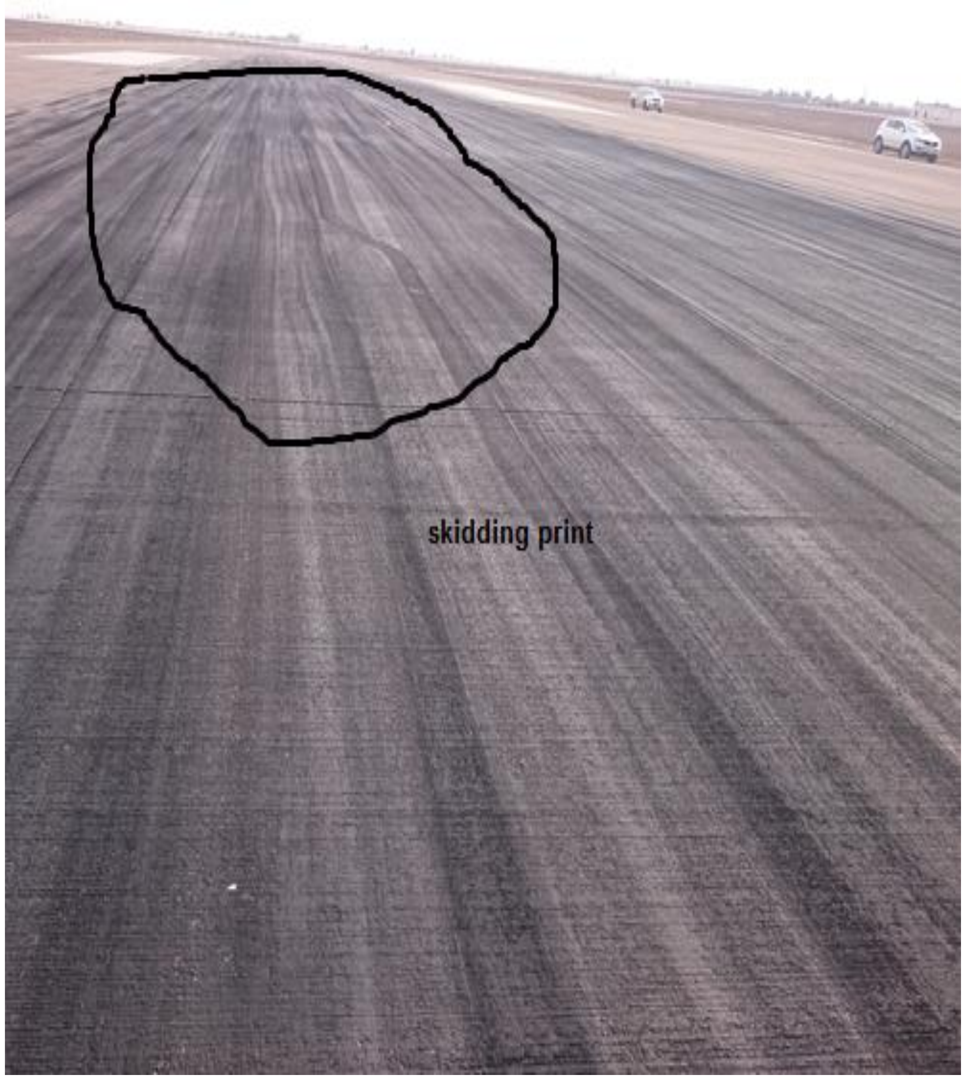
The microtexture and macrotexture available on pavement surfaces are mainly depend on aggregate mineralogy, aggregate size and gradation, surface voids, pavement types and surface finishing or texturization techniques.

- Microtexture penetrates the thin film of water on wet surface to maintain intimate tire–pavement contact and provide adhesion force.
- Macrotexture facilitates better drainage of water (prevents hydroplaning) and absorbs some kinetic energy with the deformation of airplane tires.
- Both together results in a friction force that facilitate controlled and safe operation.

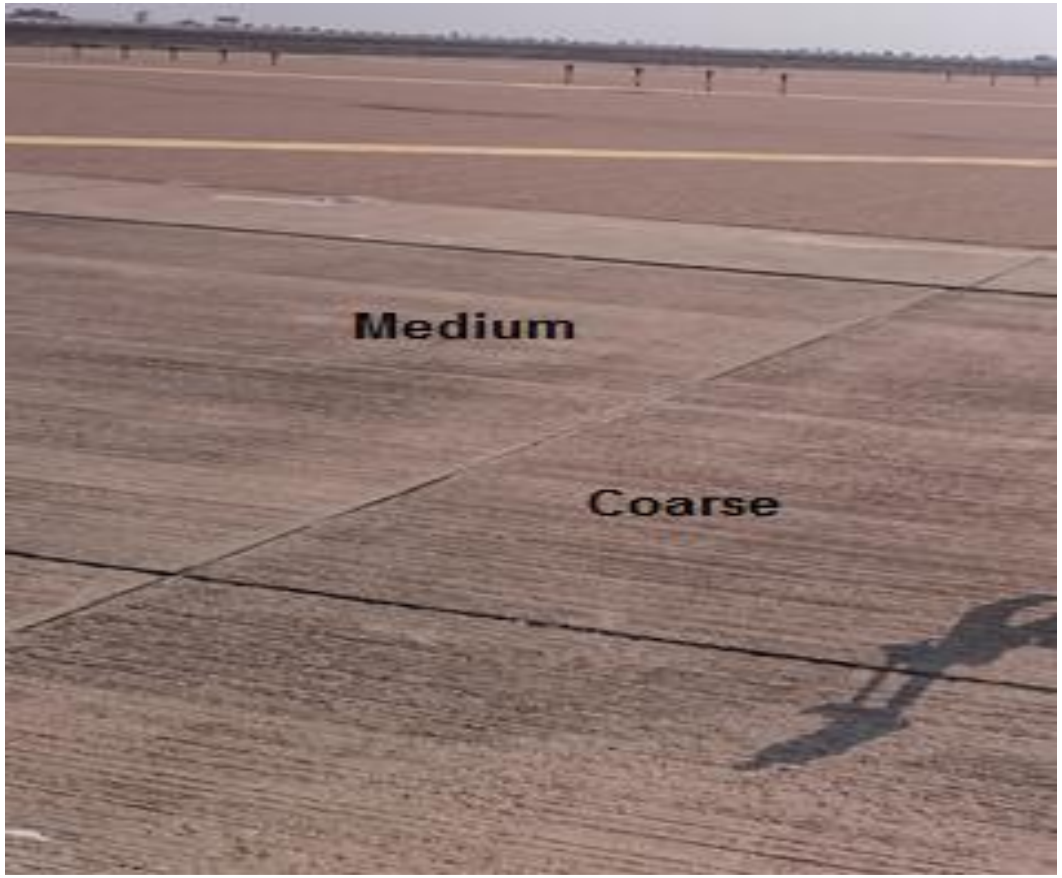
Management for Assessment

- **1- The airport site was visually investigated, the walk through technique was implemented starting from the threshold and along the touchdown zone to the centre of the runway from both directions (i.e. R and L).**

Skidding prints at the start of touchdown zone



Pavement texture quality varies from Coarse to medium



- **2- Staggered technique for the selection of testing location was implemented along each section so that for the adjacent panels one panel was tested while the second panel was left for that section, the next section will experience the testing of the panels opposite to those tested in the previous section.**

3- Macrotexture assessment using sand patch method as per ASTM procedure. A total of 200 sand patches have been implemented to cover the assessment requirements.

4- Microtexture assessment using British pendulum tester (BPN) according to ASTM. A total of 200 test locations have been carefully selected at the same pre tested locations for macrotexture representing different concrete surface texture condition.



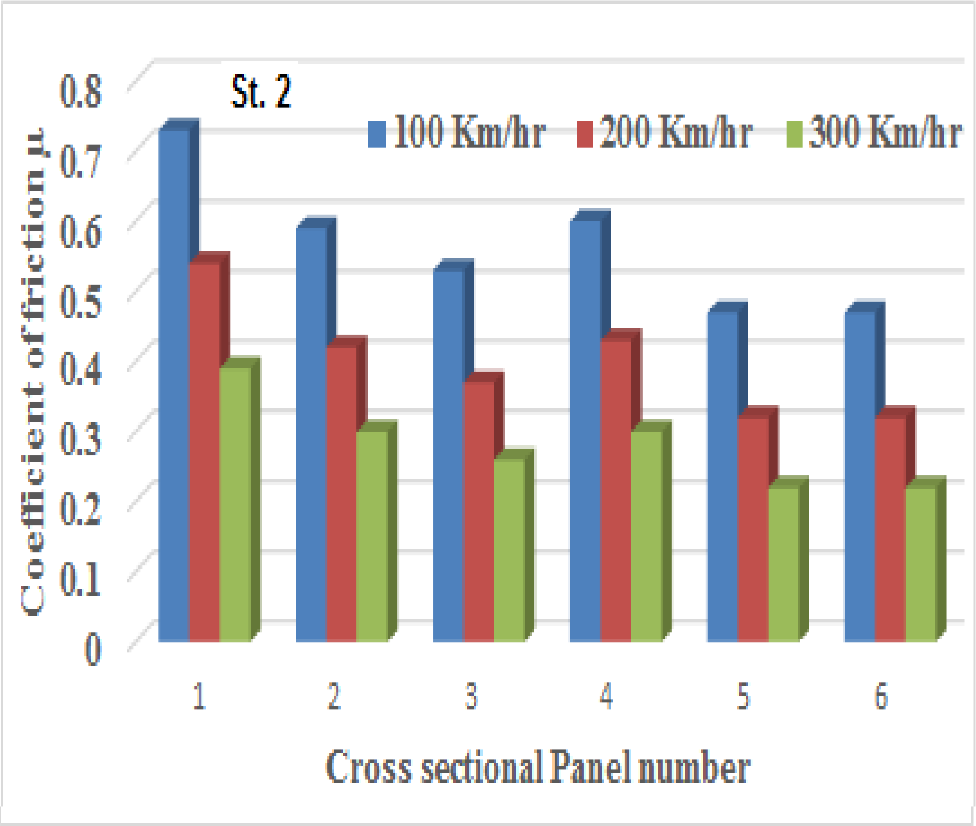
5- Determination of skid resistance and coefficient of friction (μ) at three cruising speeds.

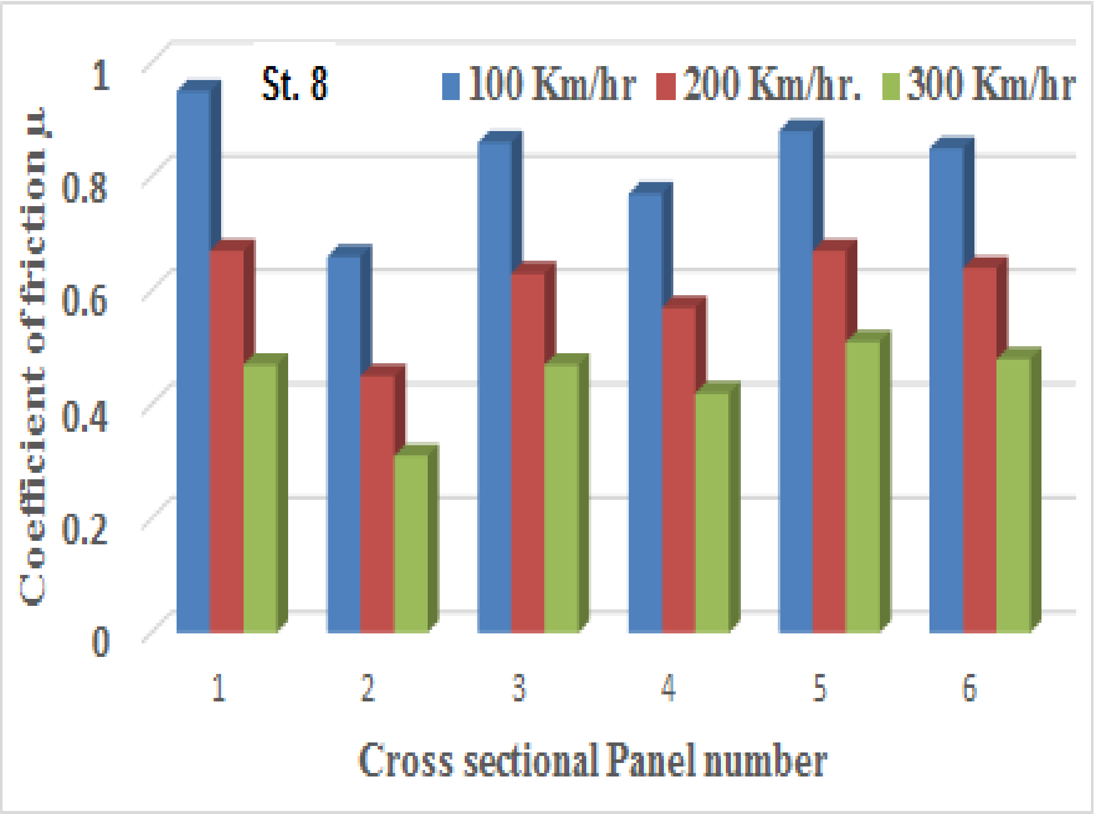
- MTD (cm) = Volume of sand / area of patch ………..(1)
- SN0 = 1.32 BPN – 34.9 ……………………...……………(2)
- PNG (%) = 0.157 (MTD) – 0.47 …………………………(3)
- SN = SN0 exp. – (PNG/100) V ....(4)
- μ = 100 SN ……………………………………………(5)

Range of assessed variables

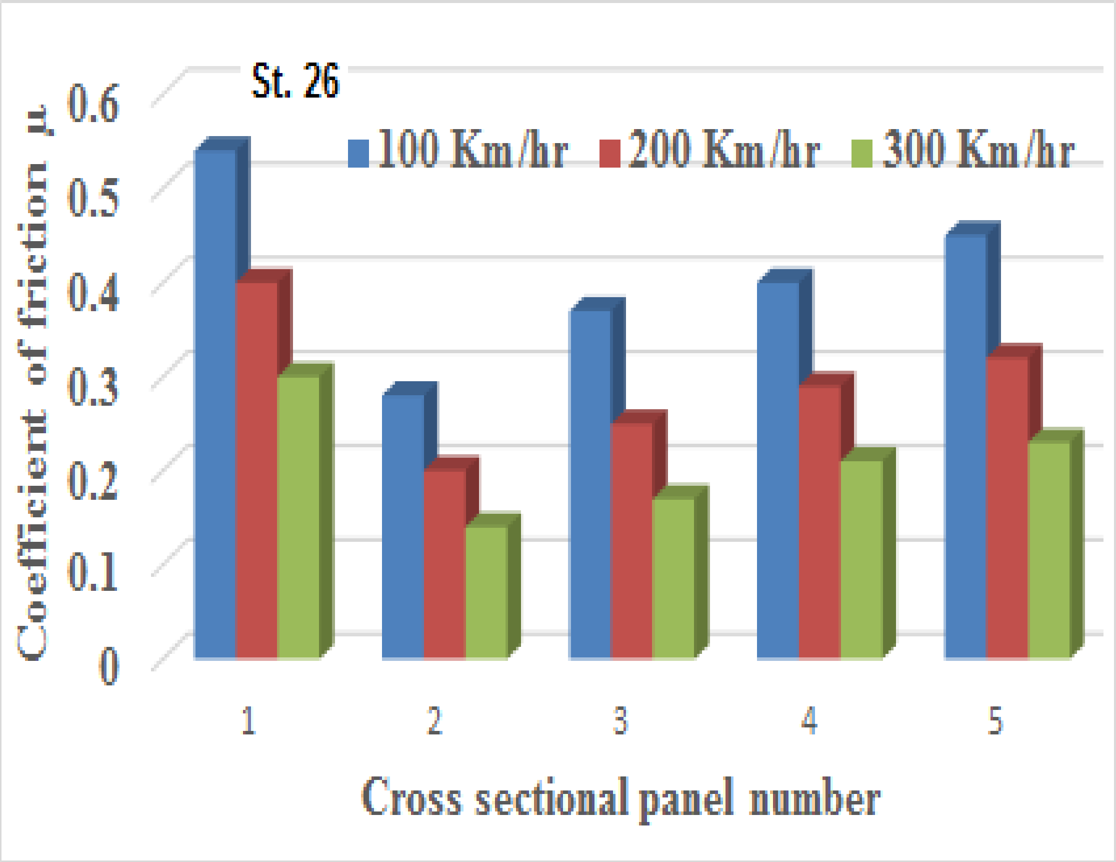
Variables	Maximum	Minimum	Mean
MTD mm	3.90	1.21	2.55
BPN %	129.5	32	80.7
SN_0	136	4.7	70.35
PNG %	0.649	0.379	0.514
SN@ 100Km/hr.	111.12	3.37	57.21
SN@ 200Km/hr.	77.6	2.42	40.01
SN@ 300Km/hr.	54.19	1.73	27.69
μ @ 100Km/hr.	1.11	0.03	0.57
μ @ 200Km/hr.	0.77	0.02	0.39
μ @ 300Km/hr.	0.54	0.01	0.27

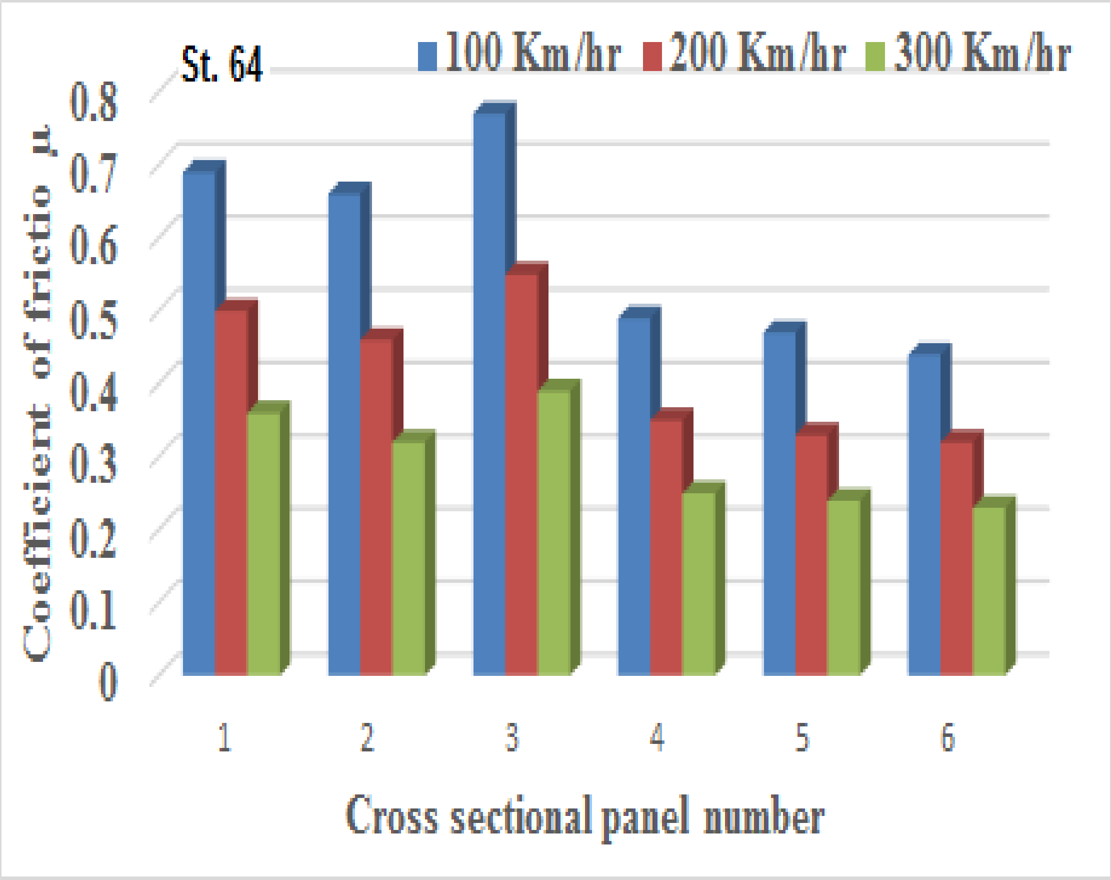
Typical Variations in the friction property at threshold zone.



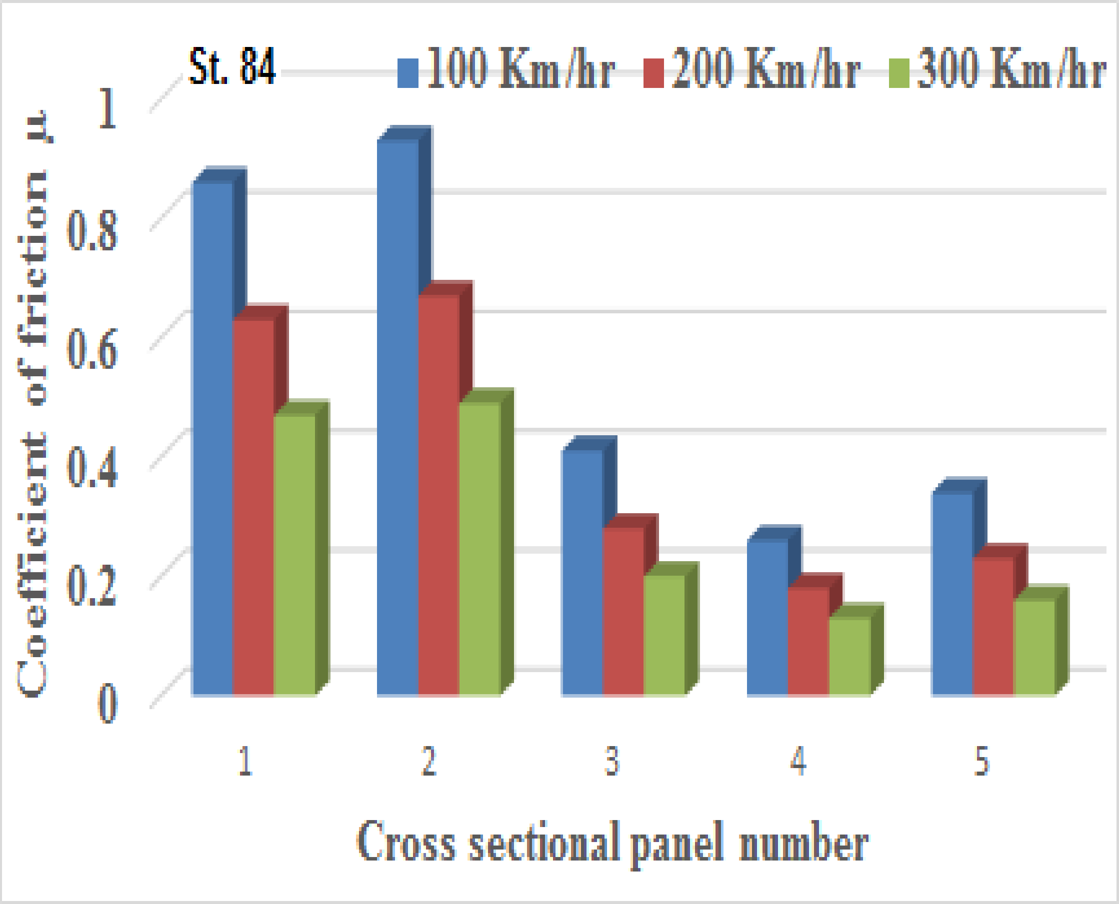


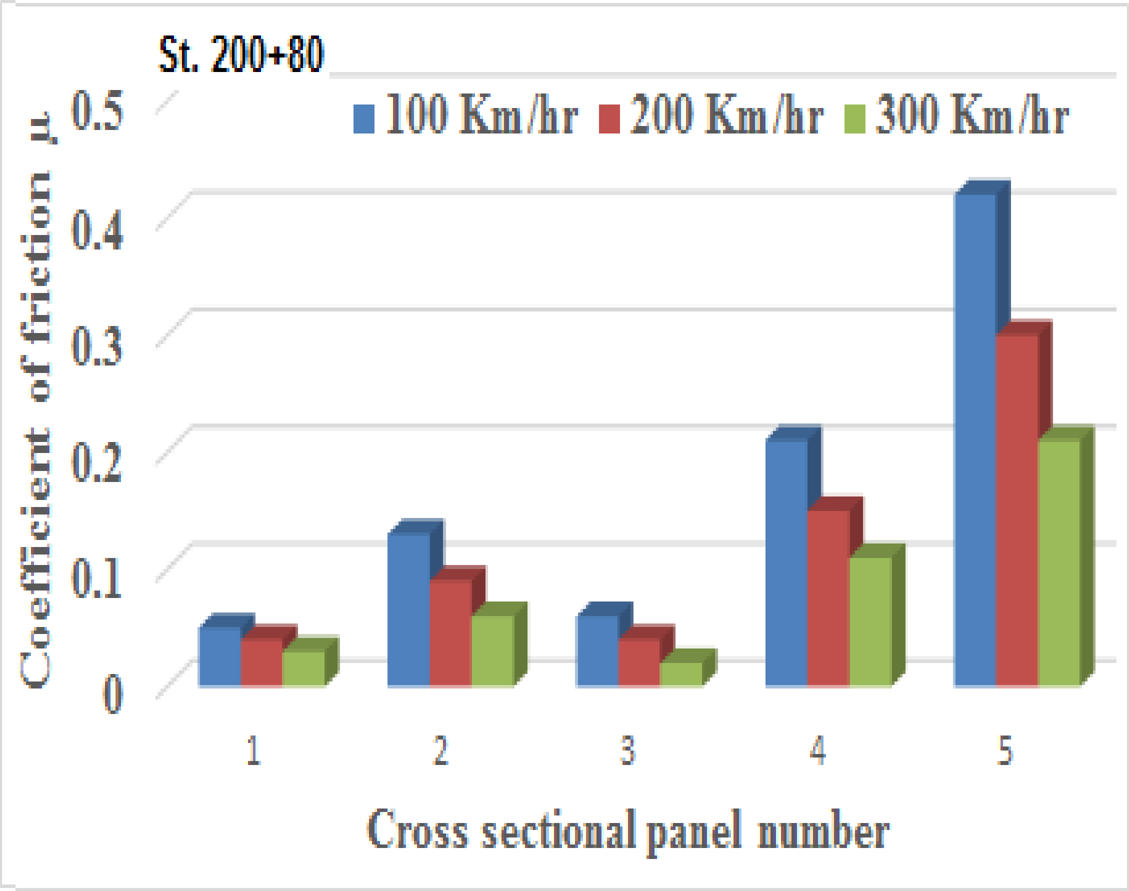
Typical Variations in the friction property at the start of the touchdown zone.





Typical Variations in the friction property at the middle portion of the touchdown zone.





- **6- The rubber accumulation at the touchdown zone could be considered as variable between (medium to dense) to (very dense) according to ICAO definition.**

- **As recommended by ICAO, the average surface texture depth should not be less than 1.0 mm.**

- **The minimum acceptable British Pendulum number (BPN) is 55%.**

- **No transportation agencies in Canada or the US set standards for minimum surface friction, different agencies have developed criteria for identifying low friction surface and initiating possible countermeasures.**

- **Improvements or general maintenance program is recommended if the skid number (SN) drops below 31.**

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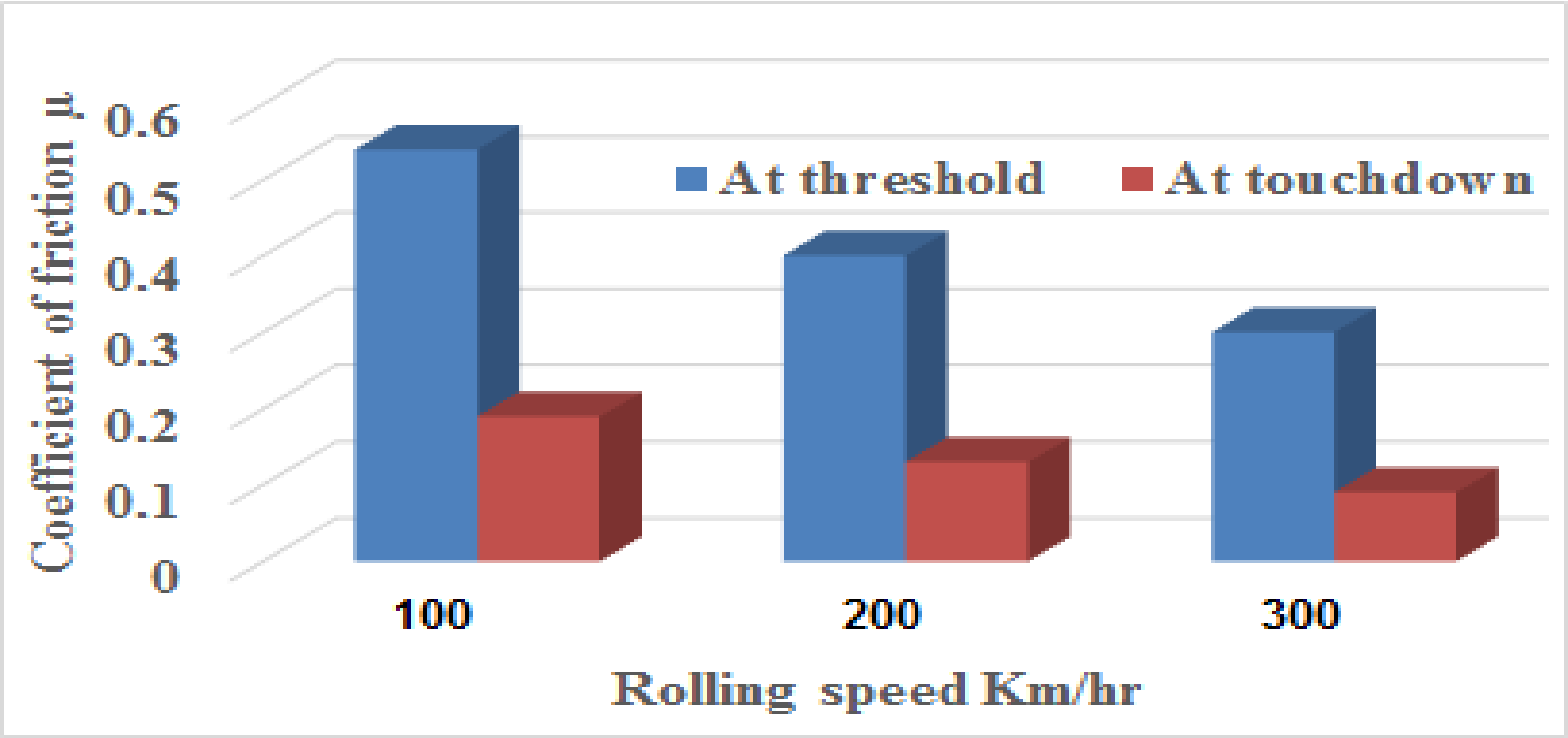
- **Corrective action, is recommended when SN remains between 31 and 40. No further action is needed if SN remains over 40.**

Visual estimation of rubber deposits on runway, ICAO

Rubber accumulation	% Area covered with rubber	Range of μ values
Very light	Less than 5%	0.65 or greater
Light	6-20%	0.55-0.64
Light to medium	21-40%	0.50-0.54
Medium	41-60%	0.40-0.49
Medium to dense	61-80%	0.30-0.39
Dense	81-95%	0.20-0.29
Very dense	96-100%	Less than 0.19

Variation of friction with rolling speed



Conclusions

- 1- Mean texture depth MTD for all of the tested sections exceeds the minimum requirement of 1 mm as recommended by ICAO.

- 2- Mean texture depth MTD should be maintained within a reasonable range of (1-2.5 mm), section with coarser texture should be subjected to grinding process so that the pavement exhibit a positive impact on tyre rubber wear.

- **3- The coefficient of friction μ at the touchdown zone for wet pavement is variable between (0.40-0.19) which is considered risky and needs to be reserved by rubber removal operation.**

- **4- The coefficient of friction decreases by 20% when the rolling speed is doubled.**

- **5- Rubber has negative impact on the friction of pavement surface, the value of μ decreases by (50-65) % when the pavement surface was covered by rubber as compared to the sections at the threshold or at the centre of the runway.**

- **6- Management of the required maintenance program could start only after such intensive assessment.**