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August 22, 2005

Matt Haney,
Precision Concrete Cutting
3191 N. Canyon Rd.
Provo, UT 84604

Dear Mr. Haney:

This will confirm my August17, 2005 service call to the city sidewalk of Yarmouth Avenue between Margate Street and Killion Street in the Encino area of Los Angeles for the purpose of evaluating the slip resistance of the Precision Concrete Cut surfaces of the municipal sidewalk.

I walked the entire block to find representative surfaces large enough to use the instruments. Precision is unique in using sawing to ramp uplifted sidewalk panels. The cutting results in a smooth and uniform surface.

As I awaited the arrival of Kevin Yocum, Precision's San Diego Branch Owner, I located two representative surfaces for testing and subjectively evaluated the other cuts I encountered in the Yarmouth block.

Saw cutting results in surfaces substantially smoother to finger touch and foot than the adjacent sand or broom finish sidewalk. Since slip resistance is dependent on angularity and sharpness of surface relief, I was expecting the saw cut surfaces to not perform as well as the adjacent concrete in preventing slip and fall incidents.

What I found from the testing was walking surfaces of unquestionably high slip resistance. There should be no slip and fall incidents on these surfaces dry or wet.

The instruments I used to evaluate the surfaces are the English XL Variable Incidence Tribometer (VIT) and a hand pulled version of the Horizontal Pull Slipmeter (HPS).

The Variable Incidence Tribometer (VIT) is an instrument to measure meaningful pedestrian slip resistance with a practical device of a convenient size. The variable incidence tribometer unit applies force to its sensor pad with gas pressure rather than gravity. It measures SR or Slip Resistance factor. This device is used in the evaluation of floors for slipperiness.

The VIT is an ASTM Standard device (ASTM F-1679 and D-5859). It is only its method and not the values which have been standardized by the ASTM. The VIT works wet or dry, can change sensor material, is small and relatively light, is simple to use, and does not use gravity as its driving force, so it can be used on inclines in any direction. The English XL, VIT, F-1679, D-5859 device is the only ASTM device which has a program for operator certification. I am certified with the device and its use.

I also tested the representative areas of the sidewalks and cut ramps with the hand-pulled version of the ASTM F-609, Horizontal Pull Slipmeter (HPS) device to get a baseline figure for dry static coefficient of friction on the surfaces. The testing with the HPS was done *across the* slope to eliminate directional bias. Testing was done in the manner of the C-1028 hand pulled slipmeter. I have been using the HPS since being instructed in its use by Liberty Mutual (the inventor, Irvine's, employer) since 1969.

Testing with the VIT was done in accord with the F-1679 protocol and the instruction manual for the English XL VIT. The sensor material was Neolite® for all tests. Testing was done down slope as this is the most likely direction of a slip. I tested wet only with the VIT, as wet testing is not within the capability of the HPS. Testing with the HPS used standard leather as the sensor material.

Both areas for testing were on the east side of Yarmouth Avenue in front of a large apartment building with the address of 5464. They were representative of the sawed ramps and concrete sidewalk surfaces in the entire area. The first area I designate as "North" was about 30 feet south of the apartment driveway. The area designated as "South" was nearly to the south property line of the 5464 building.

Both sample areas had sawed ramps that exposed the aggregate of the concrete. The North example had swirled broom marks for texture on the uncut original finish. The South sample had a troweled sand finish as original. The subjective impression of both surfaces was that they were smoother than the adjacent original finishes. The cutting was done about four months before my round of testing. I cannot determine the characteristics at the time of the original cutting. My experience has shown that cut concrete or stone surfaces can become more polished with wear over time, but this is usually over much longer time spans than months.

TESTING DATA

NORTH AREA

HPS

Coefficient of Friction

Static	Dynamic
.77	.70
.72	.68
.54	.48
.52	.48

SOUTH AREA

HPS

Coefficient of Friction

Static	Dynamic
.60	.40
.44	.40
.74	.45
.50	.45
.50	.48

NORTH AREA

VIT

Slip Resistance Factor (SRF)

Dry Sawed Ramp	Dry Adjacent	Wet Sawed Ramp	Wet Adjacent
.77	1.00	.92	.65
>1.00	.875	.91	.70
.90	.90	.91	.82
.96	.875	.90	.77

SOUTH AREA

VIT

Slip Resistance Factor (SRF)

Dry Sawed Ramp	Dry Adjacent	Wet Sawed Ramp	Wet Adjacent
.1.00	>1.00	.80	.94
.90	.87	.70	.87
.77	.82	.70	.87
.77	.86	.72	.80
.77	.85	.82	.81

The North Area was roughened with the secondary grinding to see how that would affect the results.

NORTH AREA (after roughening process)

HPS

Coefficient of Friction

Static	Dynamic
.60	.58
.60	.58
.62	.58
.66	.58

NORTH AREA (after roughening process)

VIT

Slip Resistance Factor (SRF)

Dry Roughened Ramp	Wet Roughened Ramp
1.00	.87
.85	.81
1.00	.87
1.00	1.00
1.00	1.00

CONCLUSION

The above data indicates a number of conclusions.

The North cut ramp when dry is marginally less slippery than the adjacent concrete sidewalk surfaces, and the values are well above the range considered slip resistant and reasonably safe.

The South cut ramp when dry is about the same slipperiness (values above and below the adjacent) than the adjacent concrete sidewalk surfaces. The values are well above the range considered slip resistant and reasonably safe.

The north sawed ramp when wet was more uniform and higher in slip resistance than the broom finished concrete sidewalk. Again, the values were well above the values generally considered as reasonably safe.

The south sawed ramp when wet was marginally more slippery than the sand finished concrete sidewalk. Again, the values were well above the values generally considered as reasonably safe.

Roughening of the ramp surface tends to make the surface more uniform, and it appears to marginally improve the slip resistance factor for the sawed ramp both wet and dry. Again the values are well above the values generally recognized as reasonably safe.

It should be pointed out that the ADA requirements for a numerical slip resistance factor are not in force and they have been withdrawn. The ADA regulation writers did not specify an instrument, a sensor material, or a testing protocol. The value of .65 as a coefficient of friction has no scientific basis because it was lifted from a European study of human ambulation using force plates and the researchers measured .65 and named the result "required friction," which is a term of art relating solely to that study. After the writers of ADA regulations were forced to withdraw this value, another writer threw in a safety factor and came up with a value of .80 which has even less scientific validity than the .65 figure. This, too has been discredited and withdrawn from the regulations.

The overwhelming consensus of a substantial majority of tribometrists (those who measure friction) is that wet or dry a Slip Resistance Factor (SRF) of .50 when measured with the ASTM F-1679 Standard Variable Incidence Tribometer provides adequate slip resistance for a walking surface and is reasonably safe for even those with difficulties walking.

Right now the only codified standard in wide use for slip resistance is that found in the International Building Code for ramps. It does not call out a number. It requires that ramp surfaces be roughened or treated to make them non slip. It is clear from my testing that the Precision Process meets this requirement without the supplemental roughening. The additional or optional roughening does marginally improve the slip resistance of the surface.

You may want to recommend to your branch operations that they obtain their own VIT instruments and become certified in their use. That way there will be an additional verification of the slip resistance of every surface sawn.

Should you require additional information or further explanation of the results, please feel free to contact me.

Yours,

Jay W. Preston, PE, CSP, CXLT

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