that the surface water will flow diagonally from one corner to the other of a stretch of wall 28.8 feet long. Pursuing this a little further we find that this diagonal is on an incline of 10.21 per cent., as against the prescribed 10 per cent. longitudinal gradient. The combined effect of transverse slope and longitudinal gradient is to increase the prescribed incline of the walk, and to lead the surface water on and along the walk instead of across it, both of which results add to the hazard and discomfort of the public using the walk.

It would therefore seem reasonable to require that surface drainage should be confined to the shortest path across the walk, wherever possible, and that a limiting angle should be fixed beyond which it should not be permitted to go. Assuming that the path of drainage be confined between the limits of ninety degrees and forty-five degrees with the direction of the walk, substituting the value of any required transverse slope, making the base equal to the altitude, and solving for % grade in the formula given, we find that in each case the limiting grade is equal to the transverse slope. This relationship may be best shown by the following table

Transverse Slope Inches per Foot.	% of Transverse Slope Also limiting grade.	Inclination of 45 degree diagonal.
1/8	1.042%	1.47%
1/6	1.389%	1.96%
1/5	1.667%	2.36%
1/4	2.083%	2.94%
1/3	2.778%	3.93%

It will be observed that the inclination of the forty-five degrees diagonal is in all cases approximately 40 per cent. greater than the corresponding transverse slope.

This table gives us working limits for any assumed slope. Thus, assuming that ¼ inch per foot is the minimum permissible slope for satisfactory drainage, and ½ inch per foot is the maximum permissible slope, we find that ¼ inch per foot may be used on grades from 0.0 per cent. up to 2.08 per cent.; that 1/5 inch per foot may be used on grades from 1.48 per cent. (interpolated) to 1.67 per cent.; that 1/3 inch per foot may be used on all grades less than 2.78 per cent.; that ½ inch per foot may be used on level grade only, and so on for any of the other slopes, if the cross drainage is to be confined to the shortest reasonable paths across the walk.

If the surface drainage could be confined to the amount of water falling on the area of the walk alone, if it was uniformly distributed, or if the walk is of short length, the issue here raised would be without point, but this is rarely the case. Property owners will spend considerable sums of money in levelling their premises so as to drain away from the dwellings and toward the street. Private walks and driveways are often water collectors discharging upon the public walks with no regularity of interval and in such manner as to often make the walks unduly hazardous during the cold and wet season. This drainage also has a tendency to wear fixed water courses along and in the walk. For these reasons all effort should be made to rid the walks of water as quickly as possible, and the method here offered will apply to grades up to four per cent.

Again, the principles enunciated are sufficiently obvious to most of us to be axiomatic, but it is not unusual in formal sidewalk specifications to find requirements for transverse slope without regard to grade. The average contractor engaged in this class of work will blindly follow a "rule of thumb" with acquiescence on the part of the average inspector allotted to the engineer, unless explicit instructions to the contrary are issued.

How should walks laid on grades in excess of 4 per cent. be treated?

At first glance it might appear desirable to give the walk a crown similar to that prescribed for pavements, in order that the middle of the walk, which is also the path of the greatest number of pedestrians, may rapidly shed snow, ice and water. It might also appear less objectionable to have a gradually increasing and curved incline on either side of the center than to have all of the incline in one direction across the walk. As the principles already stated for transverse slope apply with the same force to a crowned surface, and for the further reason that this form of construction would have to be built with greater care than is usually accorded this class of work, and at a greater expense, this idea may be dismissed without further comment.

The answer to this question appears to lie in restricting the amount of surface drainage to the area of the walk by either providing suitable depression in the earth surface on either side of the walk, or laying artificial drains to serve the same purpose; the walk should then be laid without transverse slope as the longitudinal incline is sufficient for purposes of drainage.

In connection with the subject of slope in the parking brief mention may be made of the admissibility of steps in sidewalk construction. As a general proposition the writer is of the opinion that they should be avoided wherever it is possible to do so. They are from 400 to 500 per cent. more costly than walk of the same area, exclusive of proper guard rails; they add to the expense of maintaining the parking by creating excessive slopes; they subject the public to needless hazard in sleeting weather; they are dangerous to persons afflicted with bodily infirmities; they add to the lighting bill of the city. These objections apply only to all ordinary conditions. Situations undoubtedly exist where steps afford the only possible convenient means of ingress or egress for the public from one street to another, or from one section of a city to another. On residential streets of short extent, where the lot lines may lie parallel with terraces, and where the street walk may be placed at a considerable distance from the curb, steps may be used with good effect. Cement walks with a float finish, brick walks laid of unglazed brick, and cinder walks, on grades as high as 12 per cent., and possibly higher, may be used by the public with no apparent discomfort at all times except when the walks are covered with ice, and the insertion of steps for the purpose of reducing the grades would appear to be of doubtful economy. Limestone flags and walks constructed of glazed tile in vogue in some sections of this country are slippery in wet weather on relatively low grades.

There is one feature of the prescribed slope for parking that deserves consideration in communities of rapid growth where certain streets in the residential districts are so located as to invite invasion by business houses. In such localities the slope in the parking should be held down to the minimum commensurate with satisfactory drainage in order that the walk may be extended out to the curb without creating an excessive inclination or needlessly requiring building up over the top of the curb.

Given two walks A and B located parallel with corresponding curbs a and b.

Let Aa = Distance between curb and walk A.
Bb = Distance between curb and walk B.
Wa = Width of walk A.

(Continued on Page 724.)