

NRC Publications Archive Archives des publications du CNRC

Water-shedding details improve masonry performance

Maurenbrecher, A. H. P.

For the publisher's version, please access the DOI link below. / Pour consulter la version de l'éditeur, utilisez le lien DOI ci-dessous.

Publisher's version / Version de l'éditeur:

<https://doi.org/10.4224/40002846>

Construction Technology Update; no. 23, 1998-12-01

NRC Publications Archive Record / Notice des Archives des publications du CNRC :

<https://nrc-publications.canada.ca/eng/view/object/?id=972efc54-a60b-413a-877e-862f6fb55499>

<https://publications-cnrc.canada.ca/fra/voir/objet/?id=972efc54-a60b-413a-877e-862f6fb55499>

Access and use of this website and the material on it are subject to the Terms and Conditions set forth at

<https://nrc-publications.canada.ca/eng/copyright>

READ THESE TERMS AND CONDITIONS CAREFULLY BEFORE USING THIS WEBSITE.

L'accès à ce site Web et l'utilisation de son contenu sont assujettis aux conditions présentées dans le site

<https://publications-cnrc.canada.ca/fra/droits>

LISEZ CES CONDITIONS ATTENTIVEMENT AVANT D'UTILISER CE SITE WEB.

Questions? Contact the NRC Publications Archive team at

PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca. If you wish to email the authors directly, please see the first page of the publication for their contact information.

Vous avez des questions? Nous pouvons vous aider. Pour communiquer directement avec un auteur, consultez la première page de la revue dans laquelle son article a été publié afin de trouver ses coordonnées. Si vous n'arrivez pas à les repérer, communiquez avec nous à PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca.

Water-Shedding Details Improve Masonry Performance

by **A.H.P. Maurenbrecher**

This Update shows how the lack of effective water-shedding details can affect the appearance and performance of the exterior surface of masonry walls. Practical recommendations for avoiding problems are presented.

Masonry is known for its long-term durability and low maintenance. But in order for these strengths to be realized, building facades must be designed to prevent concentrated sources of water from reaching the wall. The most important exterior design details are projections and drips — roof overhangs, copings, window sills and gutters — which protect vertical surfaces.

Water can cause problems that may be primarily aesthetic such as staining, efflorescence and biological growth, or that may lead to material damage such as spalling of masonry units caused by freezing and corrosion of metal components in the wall. The potential for problems depends on the properties of the materials in the wall and on the amount of water reaching the wall. The latter depends on the climate, the location of the wall on the building, design, workmanship and maintenance. Precipitation wets walls either directly or indirectly. Direct wetting is most severe on horizontal surfaces (most of the rain, and melting ice and snow) and least on vertical surfaces (wind-driven rain, with higher parts of the building and the corners wetted most). Indirect wetting results from run-off from higher locations on the building and its extent depends on

surface texture, water-absorption characteristics of the surface material, and design features that collect and divert water flow.

Effect of Building Details on Masonry Walls

Good design lessons can be learned by closely observing the exterior surfaces of buildings, in particular, looking at building details to see how they affect the flow of water on the surface and how water can influence surface appearance and deterioration. The design objective should be to avoid concentrated flows of water and reduce the time of wetness. Concentrated flows can cause staining and saturation of the masonry. The longer an area remains wet the greater the chance of biological growth, corrosion of metal components and increased saturation. The areas wetted most are horizontal and sloping surfaces, and vertical surfaces that receive run-off from low-absorption surfaces such as metal, glass and vinyl (e.g., windows and siding). These areas should be protected with waterproof caps and flashings, which divert water from the masonry.

Copings

Overhanging copings (caps) at the top of walls, parapets and chimneys can effectively reduce the potential for water damage. In regions with freezing temperatures, damage can be serious: high moisture content together with freeze-thaw cycles can lead to spalling. The staircase wall shown in Figure 1 has a concrete coping but



Figure 1. Frost damage (coping allows water to drain onto the wall)



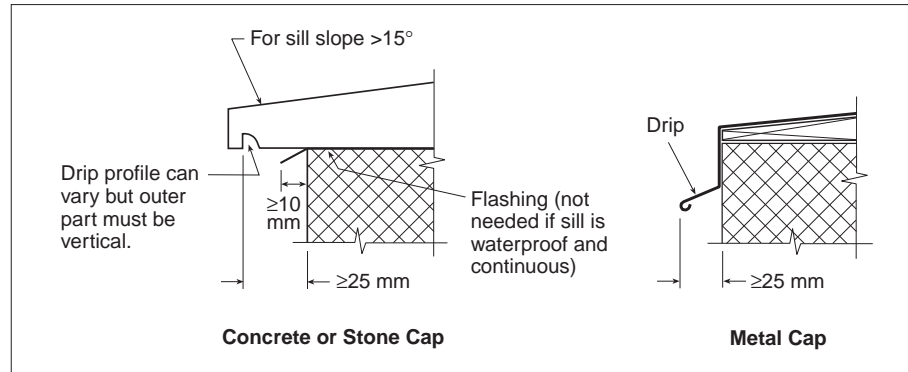
Figure 2. Efflorescence (coping allows water to drain onto the wall)



Figure 3. Efflorescence (water migrates through brick sill)



Figure 4. Staining and icing below garage vents (sills flush with the wall)



because it was built flush with the face of the wall, water can still run onto the masonry below. The problem is most severe when snow on the coping melts during the day and the water freezes at night; this cycle may be repeated over several days. Another problem with this wall is that the bricks go all the way down to ground level (not recommended practice). At ground level, rain and melting snow have also caused frost damage (de-icing salts used on the walkway make matters worse). The same brick on the more sheltered wall of the apartment building has suffered no damage.

Figure 2 shows a building with a stepped back parapet. The lower section has a concrete coping with a metal cap which slopes towards the front of the wall and allows water to drain straight onto the wall (insufficient overhang). One small section of parapet without a setback on the left of the photograph does not have this problem; the top of the metal coping slopes towards the roof and at the face of the wall the bottom end projects outward to shed water. At the balconies, a concrete

coping overhangs the brick but water can still run back underneath the coping (no drip groove) and through junctions in the coping. Extensive efflorescence during the colder months of the year is the result.

Damage can be avoided by using copings that extend beyond the face of the wall, by using a projecting metal flashing between the coping and the wall, or by using masonry with a known high frost resistance (but then staining may still occur). Field observations indicate that drips that project at least 25 mm beyond the face of the wall are effective. Concrete or stone copings must have a drip groove to stop water from running back under the overhang, while metal copings must be shaped to form a drip (see diagram). Junctions in copings should be carefully designed to avoid water getting through, or alternatively there should be a projecting flashing underneath to intercept the water. Staining below junctions is a common defect observed in practice.

Window Sills

Brick window sills are generally not recommended unless care is taken to choose durable brick and mortar (especially in areas where freezing occurs). They may be acceptable in drier parts of the country and in low-rise housing with a protective roof overhang. If a brick sill is used, a continuous waterproof flashing material must be bedded immediately under it. The flashing should also project beyond the face of the wall; this will intercept water coming through the sill, usually through fine cracks at the brick/mortar interface. Figure 3 shows a brick sill that allows water to drain through, causing efflorescence below. Figure 4 shows ventilation vents in a parking garage with a brick sill flush with the face of the wall, resulting in staining and ice formation. A projecting metal flashing on the sill would have avoided this problem.



Figure 5. Staining below window (no sill projecting beyond wall)



Figure 6. Staining below windows (no end barriers on sills)



Figure 7. Staining beneath junction in a window sill

Large window areas and sloping sections increase the water run-off considerably (Figure 5). The lack of a projecting sill beneath the window has resulted in severe staining, all the more obvious with the light-coloured masonry. With large areas of sloped glazing, the minimum projection for the sill may need to be increased to 50 mm; alternatively a gutter could be installed to collect the water. Each end of a sill should have a barrier to stop water from running off the ends onto the wall (often a raised section to deflect the water forward). Figure 6 shows the typical staining pattern when barriers are not provided. Where possible, sills should be made in one piece to avoid junctions (Figure 7). When

junctions are unavoidable, they should be detailed to ensure water will not get through, or a projecting flashing should be bedded underneath to divert any water. Mortar and sealants in junctions may be adequate in the short term but not the long term.

Roof Details

Water run-off from pitched roofs is substantial and therefore must be shed well away from the wall or be collected by gutters. With complicated roof forms this may not always be successful. The house shown in Figure 8 has some of its roof run-off being funnelled to one location that does not effectively shed water. Additional water coming from the flat roof (beyond the ridge) exacerbates the problem. The water is wetting the brick near the top of the wall and at ground level, the latter mainly by splashing. It is important to correct such problems promptly. The best solution in this case would be to install a gutter and downspout.

Other Details

Concrete and aluminum or vinyl siding above masonry must have a flashing at the intersection to shed water away from the masonry. Figure 9 shows an apartment building with aluminum siding. The siding has drips at every storey to break the flow of water down the wall. But above the ground storey masonry the flashing does not project beyond the masonry. Here much of the water runs along the flashing until it hits a junction and then drains down, leading to staining.

Water running off fittings and decorative items (e.g., lights, signs and flagpole supports) projecting beyond the surface of the wall must also be diverted to avoid staining. Staining may be caused by dirt, lime from concrete or limestone products, or corrosion products from iron or copper. The staining



Figure 8. Wetting of wall from roof run-off



Figure 9. Staining below junction in flashing set back from the wall



Figure 10. Staining below light fixture (water run-off)



Figure 11. Frost on wall at a laundry exhaust vent

shown in Figure 10 can be avoided by placing a flashing between the lamp fixture and the wall with a projection beneath, or a gap between the fixture and the wall.

Kitchen and laundry exhaust vents should be designed to direct the air away from the wall, including adjacent walls (Figure 11).

Maintenance

The prompt repair of water-shedding elements is important especially in the case of gutters and downspouts (gutters should be regularly cleared of debris such as leaves from overhanging trees). Figure 12 shows what can happen if repairs are postponed. The brick in this building has good frost resistance and only suffered minor damage. The damage to the concrete window sill is caused by corroding reinforcement (not directly related to the downspout break).

Summary

One of the best ways to improve the long-term durability of masonry is to pay particular attention to building details that reduce the amount of water reaching exterior walls, especially concentrated water flows. Follow the path of the water all the way from the top of the building to ground level. Where possible, water coming off water-shedding elements must not unintentionally wet lower parts of the building.

Figure 12. Severe icing below break in downspout



Further Reading

1. Wind-driven Rain and Buildings. G. Robinson and M.C. Baker. National Research Council, Division of Building Research, Technical Paper 445, 1975.
2. The Interaction of Design and Weathering on Masonry Constructions. T.L. Knight and M. Hammett. Masonry International, Vol. 7, No. 1. 1993, pp. 9-13.
3. Performance of Materials in Buildings. L. Addleson and C. Rice. Butterworth-Heinemann, 1991, 588 p.
4. Brick Masonry Details. Brick Industry Association (U.S.), Technical Notes 36 and 36A, 1988.

Dr. A.H.P. Maurenbrecher is a research officer in the Building Envelope and Structure Program of the National Research Council's Institute for Research in Construction.

© 1998
National Research Council of Canada
December 1998
ISSN 1206-1220