Engineering Structures xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Engineering Structures

journal homepage: www.elsevier.com/locate/engstruct

Corrigendum

Corrigendum to "Modeling of asphalt roof shingle-sealant structures for prediction of local delamination under high wind loads" [Eng. Struct. 96 (2015) 100–110] ☆

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ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Asphalt shingles
Digital image correlation
Energy release rate
High wind-induced uplift pressure loading
Numerical simulations
Roof structures
Structural analysis

ABSTRACT

The authors regret that they have identified a miscalculation in the original article that required the authors to provide corrective additions that are listed below. Specifically the authors determined that the shingle uplift pressure, p_1 = 12.5 Pa, used in the original article (Croom et al., 2015) is associated with a 40 km/h (25 mph) wind velocity instead of 145 km/h (90 mph). A miscalculation of pressure values due to inaccurate unit conversion was the source of the misstatement. The corrected interior uplift pressure is p_1 = 183 Pa for a 145 km/h (90 mph) wind velocity and p_1 = 507 Pa for a 241 km/h (150 mph) wind velocity. Additional simulation results have been performed for the corrected pressures and the results are reported in this Corrigendum.

Even though all of the equations and technical developments are correct in the original paper, the authors regret that they have identified a miscalculation in the original article that required the authors to provide corrective additions that are listed below. Specifically the authors determined that the shingle uplift pressure, p_1 = 12.5 Pa, used in the original article [1] is associated with a 40 km/h (25 mph) wind velocity instead of 145 km/h (90 mph). A miscalculation of pressure values due to inaccurate unit conversion for the pressure was the source of the misstatement. The corrected interior uplift pressure is p_1 = 183 Pa for a 145 km/h (90 mph) wind velocity and p_1 = 507 Pa for a 241 km/h (150 mph) wind velocity. Additional simulation results have been performed for the corrected pressures and the results are reported in this Corrigendum. The results reported below indicate that: (a) the trends identified in the original paper are essentially unaltered; (b) the predicted energy release rates at the inner and outer edge of the sealant strip have increased by ~227 and ~1740 times (inner edge) and by ~185 and ~1425 times (outer edge) for a 145 km/h (90 mph) wind and a 241 km/h (150 mph) wind, respectively, relative to the original article [1]; and (c) the range of predicted energy release rates for 241 km/h (150 mph) winds are the same order of magnitude as the published critical energy release rate values using ASTM standard methods [2]. Item (c) is in very good agreement with visual evidence of actual shingle delamination events observed by the authors during field testing of several shingle systems subjected to 150 mph winds [3].

1. Introduction for Corrigendum

Fig. 1 presents a schematic of the model used in both the original article [1] and the enclosed simulations. Using results from Peterka et al. [4], while assuming an average roof height of 4.57 m (15 ft), a wind height of 9.14 m (30 ft), a 3-s time factor [5] and a mean uplift differential pressure coefficient of −0.4, the predicted shingle uplift pressures p_1 (inside of sealant) and p_3 (outside of sealant, or leading edge) for 145 km/h (90 mph) and 241 km/h (150 mph) wind velocities were determined. Table 1 shows how three specific wind velocities, namely 40, 145 and 241 km/h (25, 90 and 150 mph) are related to shingle uplift pressures for a nominal (typical) shingle configuration (sealant thickness, t = 0.0028 m; shingle length between nail line and inner edge of sealant strip, l_1 = 0.105 m; sealant length, l_2 = 0.0127 m;

DOI of original article: http://dx.doi.org/10.1016/j.engstruct.2015.03.063

☆ Note: After extensive consultation with the original authors and the code developer, Mr. Croom, Mr. Aleshin performed all of the updated simulations and hence is added to the author list.

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http://dx.doi.org/10.1016/j.engstruct.2015.10.051
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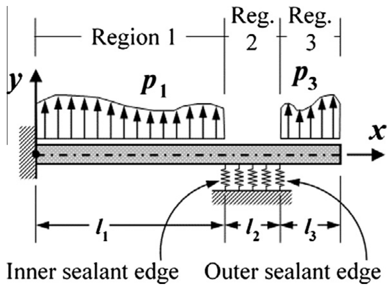

Fig. 1. Roof asphalt shingle structural model to predict uplift behavior. Note that *z*-axis is perpendicular to *x* and *y*. All notation is consistent with original article [1].

Table 1
Shingle uplift pressures and applied energy release rate values at sealant strip edges as function of wind velocity for nominal shingle configuration.

Wind velocity	Uplift pressures (Pa)		Applied energy release rate (J/m^2)	
(km/h (mph))	p_1	p_3	G (inner edge)	G (outer edge)
40 (25)	12.5*	50*	~0.0003*	~0.0002*
145 (90)	182	730	~0.068	~0.037
241 (150)	507	2028	~0.522	~0.285

* Values presented in original article [1].

length of the leading edge of the shingle, $l_3 = 0.0154$ m; flexural stiffness of the shingle, $EI = 0.234$ N m^2; and sealant stiffness parameter, $S = 4.53$ GPa/m [1]).

To provide the readership with predicted energy release rate, *G*, at the higher and more realistic uplift pressures shown in Table 1 for 145 km/h (90 mph) and 241 km/h (150 mph) winds, additional simulations were performed using the beam on elastic foundation (BOEF) model presented in Fig. 1. To make it easier to compare with the findings from the original article [1], the graphs presented herein have a similar format. Results for energy release rate, *G*, from a few of the new simulations using the higher pressures shown in Table 1 are presented below, along with a brief discussion of the findings for each set of simulations.

2. Effect of sealant location on applied G at inner and outer sealant strip edges

The applied *G* at the inner and outer edge of the sealant was determined for wind speeds of 145 km/h (90 mph) and 241 km/h (150 mph) and the results are shown graphically in Figs. 2 and 3, respectively. In these simulations, the location of the sealant strip as shown in Fig. 1 was varied from the nail line to the leading edge of the shingle (i.e., in the range $0 \leqslant l_1 \leqslant 0.1204$ m). For each position, *G* was calculated at the inner and outer edges of the sealant strip in the same manner as described in the original article [1]. The results in Fig. 2 for a 145 km/h (90 mph) wind were obtained using a constant internal pressure, $p_1 = 182.5$ Pa, and leading edge pressures, $p_3 = 182.5$ Pa, 365 Pa, 547.5 Pa and 730 Pa. The results in Fig. 3 for a 241 km/h (150 mph) wind were obtained using a constant internal pressure, $p_1 = 507$ Pa, and leading edge pressures, $p_3 = 507$ Pa, 1014 Pa, 1521 Pa and 2028 Pa. For the specific case where $p_3/p_1 = 4$ and the sealant strip is located at the nominal position, the right-hand column in Table 1 compares the *G* values at the inner and outer edge of the sealant strip for wind velocities of 40, 145 and 241 km/h (25, 90 and 150 mph).

First, as shown in Table 1, the computed values of *G* at the nominal position for 145 km/h (90 mph) and 241 km/h (150 mph) winds are approximately 227 and 1740 times larger, respectively, at the inner edge of the sealant strip, and approximately 185 and 1425 times larger at the outer edge of the sealant strip,

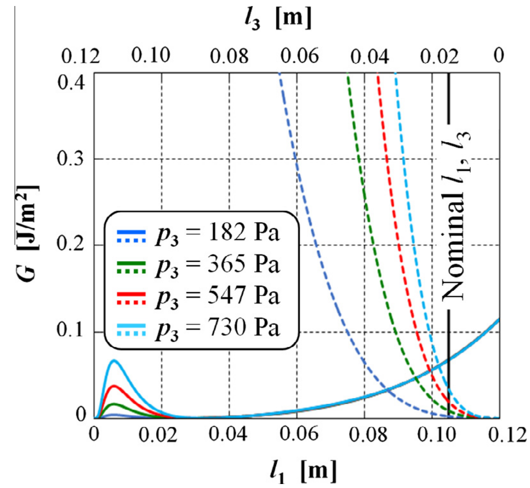

Fig. 2. Applied *G* at inner edge (solid lines) and outer edge (dashed lines) of sealant in structural model shown in Fig. 1 as function of sealant location and p_3, assuming constant $p_1 = 182$ Pa, $l_1 + l_3 = 0.1204$ m, $l_2 = 0.0127$ m, $S = 4.535$ GPa/m, and $EI = 0.234$ N m^2.

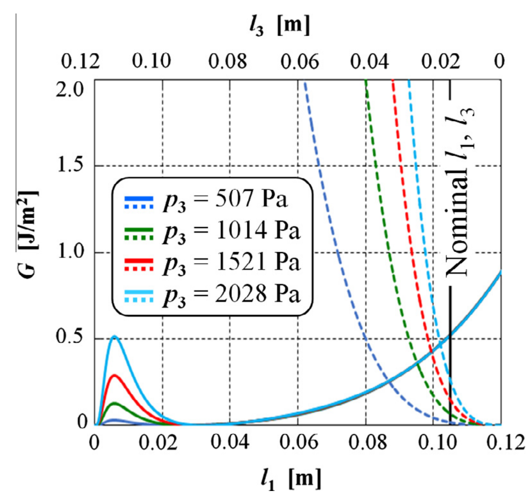

Fig. 3. Applied *G* at inner edge (solid line) and outer edge (dashed line) of sealant in structural model shown in Fig. 1 as function of sealant location and p_3, assuming constant $p_1 = 507$ Pa, $l_1 + l_3 = 0.1204$ m, $l_2 = 0.0127$ m, $S = 4.535$ GPa/m, and $EI = 0.234$ N m^2.

respectively, than those presented in the original paper [1] for 40 km/h (25 mph) winds. Salient observations are given as follows, with overall trends for the higher pressure simulations generally consistent with those highlighted in the original article [1] at much lower pressures.

- Figs. 2 and 3 clearly show that the value of *G* at the outer edge of the sealant strip (i.e., at $x = l_1 + l_2$) increases rapidly as the sealant strip moves inward from the leading edge.
- When the sealant strip is near the nominal position (i.e., $l_1 = 0.105$ m as in typical roof shingle systems, with $l_3 = 0.0154$ m), the applied *G* at the inner edge typically exceeds the value at the outer edge of the sealant strip. In such cases, delamination would be expected to initiate at the inner edge and propagate towards the outer edge.
- Figs. 2 and 3 clearly show that there are extremely high gradients in the applied *G* at the outer edge as the length of the leading edge, l_3, increases. Thus, relatively small changes in the sealant position could result in larger changes in applied *G* at the outer edge, making it difficult to optimize sealant

Please cite this article in press as: Croom BP et al. Corrigendum to "Modeling of asphalt roof shingle-sealant structures for prediction of local delamination under high wind loads" [Eng. Struct. 96 (2015) 100–110]. Eng Struct (2015), http://dx.doi.org/10.1016/j.engstruct.2015.10.051