



Discussion

Reply to the discussion of “Deteriorated pavements due to the alkali–silica reaction: A petrographic study of three cases in Argentina”S.A. Marfil^{*,1}, P.J. Maiza²*Geology Department, Universidad Nacional del Sur, San Juan 670, 8000 Bahía Blanca, Argentina*

Received 2 January 2002

As a response to the points brought up for discussion by Bryant Mather, please note the following. (1) We used the term vulcanite since engineers in Argentina frequently use it, but we think volcanic rocks would be more suitable. For Concrete C, where there is a glassy component, glassy volcanic rocks should be used. (2) In the case of glassy volcanic rocks, it is stated in the article that they are clays of the montmorillonite group, which, although they do not develop ASR, are in themselves expansive and lead to an increase in cracking. (3) In Argentina, it is very difficult to know what type of cement was used in works built in the past. However, cements from the city of Córdoba typically have a high alkali content supplied mainly by K_2O (Concrete A). Cements from the province of Buenos Aires are of high quality. The content of sodium equivalent is below 0.6%. However, 15–20 years ago, cement was imported from neighbor countries and from the area of Córdoba, where it has a high alkali content (greater than 1% Na_2O equivalent). (4) The petrographic study was conducted as mandated in ASTM C-859; only the material

extracted from the site was available. Therefore, lithology, texture and the development of reaction products were analyzed. ASTM C-295 could not be applied since natural aggregates were not available. (5) It is clear that ettringite is not an ASR product. In the article, it is mentioned as reaction material. It is never said that it is an ASR product, but that it occurs together with aluminosilicates from the ASR. (6) We agree with you that Na and K do not cause the “alkali” reaction, although their presence is essential for the reaction product (Na and/or K) to cause expansion. Undoubtedly, the concrete pH is close to 13. Under these conditions, the labile silica is soluble and is incorporated as such to the gel. If alkaline elements (Na, K) are present, even with a low Al content, they will crystallize expansive products. Crystallization force is, in our opinion, responsible for the deterioration. (7) We agree that ettringite in the analyzed samples can be classed as innocuous. Its presence is attributed to its subsequent circulation through cracks developed as a result of ASR, precipitating the sulfate dissolved in water.

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