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Interference Effect of V, U & Square Notches of Variation of Parameters on Elastic Stress & Strain Concentration of Periodic Notches on The bars

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Abstract- Geometrical features such as notches and corners give rise to stress concentrations. In industrial components these features are often designed with a constant radius, width, depth & Centre distance; however it is already known that a more complex shape, having a variable r, w, d, cd can have a much lower stress concentration factor. In this paper we describe new approaches for obtaining useful variable-r, w, d, Cd of notches. In the presence of sharp V-notches, U- notches, Square- Notches the stress distributions are singular and the intensity of the stress fields is given in terms of the notch stress intensity factors which are largely used in the literature for fatigue strength assessments of bars. The FEM is employed to study the effect of notch depth on a new strain-concentration factor (SNCF) for circular bars with a multiple-notch under axial, pure bending, torsion condition. In the presence of notches with different radius, width and depth & CD, the equations obtained are compared with finite element results, showing a very good agreement.
Keywords- stress concentration, FEA, notch parameters

I. INTRODUCTION

Geometrical irregularities, in the following referred to as notches, are of prime importance in the life assessment of machine elements, since they act as local stress and strain raisers. The presence of notches in machine element forms an interruption of the load path; it will, therefore, bring about stress and strain concentrations at the notch root. The knowledge of stress and strain distributions on the net section is valuable for practical design and application of various engineering elements.
In addition to the stress and strain concentrations introduced by the notch, there is also a change in the stress state even if the stress state is uniaxial throughout the remainder of the gage length. That is, the stress state becomes triaxial stress state in the immediate vicinity of the notch root. Very few attempt are done to investigate interference effect and elastic stress concentration due to notch parameters of double circumferential notched bar. A considerable amount of work has been completed with regard to the determination of static stress concentration factors for common discontinuities. Results of these studies have been presented in graphical representation of experimental results, empirical formulae. The stress developed in a member at a discontinuity due to dynamic loading is generally estimated from experimental results, finite element (FE) simulations, or by introducing a safety factor to the static stress concentration factor (Kt). The understanding and documentation of stress concentration factors (Kt) is important to many areas of design, high-speed impact, and transportation of hazardous materials.

Theoretical stress concentration factor is

$$Kt=\sigma_{max}/\sigma_{nominal}.$$

EFFECT OF NOTCH PARAMETERS FOR AXIAL LOAD

The effect of notch parameters such as notch depth, notch width, and centre distance between circumferential notches U shaped, Plain root shaped notches& V Shaped Notches for axial loading is performed and investigation of interference effect by FEA (ANSYS 14.5).

FEA Results give complete idea of the interference effect of stress concentration and strain concentration. FEA gives Equivalent Stress. We can understand the concept of the stress concentration at the notch root. Also stress interference is occurred at the notched length of multiple notches in the bar. FEA gives Equivalent Strain which elaborates the concept of strain concentration at notch root and strain interference at notch length.The effect of notch depth on interference effect. As notch depth is increasing the net diameter is decreasing. Due to decrease in net diameter it is expected stress induced is also increases.

2.1 Effect on Square Notch the Variation on the Depth, Width & C.D.

Axial load 25 KN-Tensile Force, Effect of Variation of Centre Distance on Square Notch

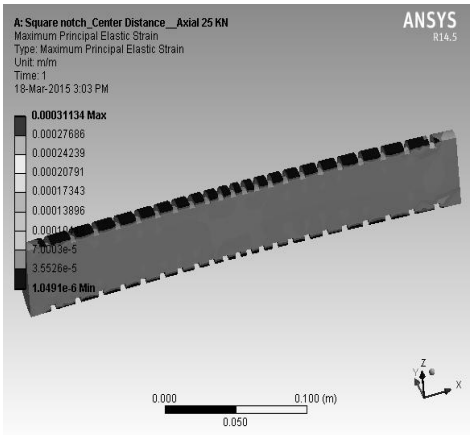

Fig. 1 Maximum Principal Elastic Strain

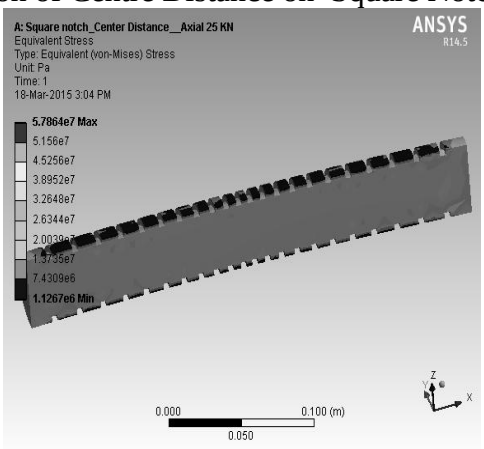

Fig. 2 Equivalent Von-Misses Stress

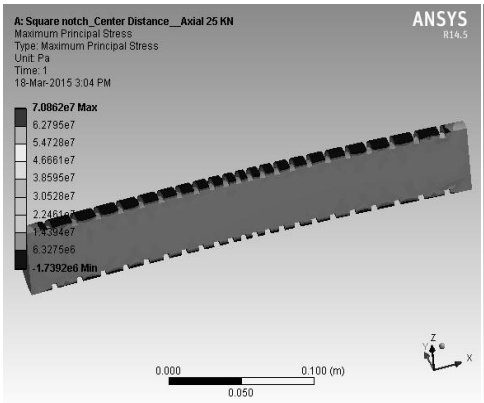

Fig. 3 Maximum Principal Stresses

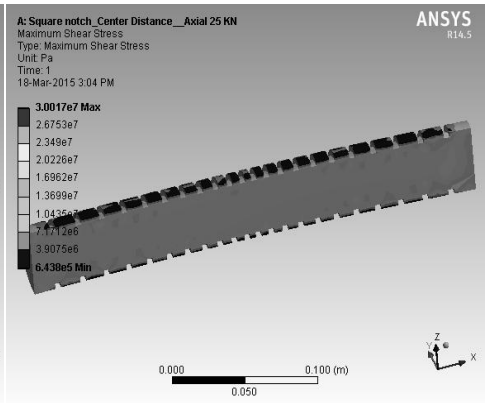

Fig. 4 Maximum Shear Stresses

The effect of the Square notch Centre Distance variation on the stress-concentration factor is studied for circumferentially notched cylindrical bars under static tension. In this study the notch Centre Distance is varied from 4 mm to 15 mm in step of 1mm.From above investigation one thing is cleared that interference is occurring in the specimen for applied load 25000N. Also the maximum Von misses stress is occurs at the minimum centre distance of the notch and that value is higher than maximum stress developed for same net area of 4 to 7 mm of CD of bar. It is cleared that stress interference is occurs for minimum Centre Distance of notch. From the investigation of effect of

notch Centre Distance variation, it is observed that notch Centre Distance has the less significant effect on stress distribution and stress concentration. But the stress pattern is different for the minimum distance of notches. As notch Centre Distance increases Von misses stress is developed in the notch length which gives the less significant interference effect. For lesser notch Centre distance the interference is occurring in notched length and stress concentration is also occurs. It is increasing with lesser notch Centre Distance.

Effect of Variation of Depth on Square Notch

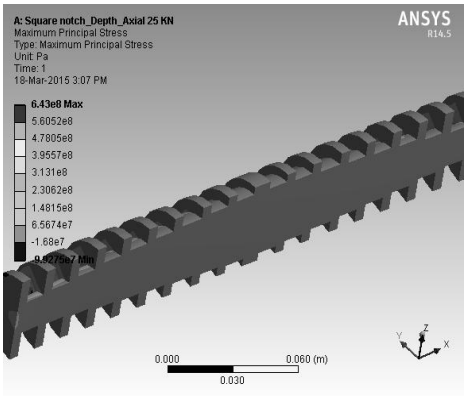

Fig. 6 Maximum Principal Stresses

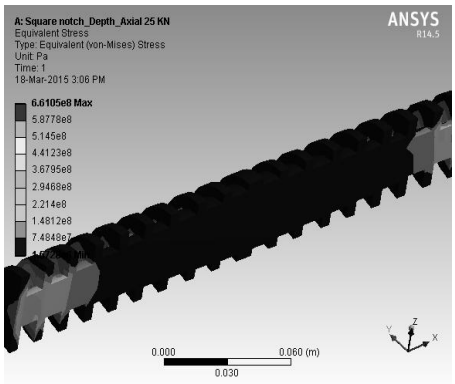

Fig.7 Equivalent Von-Misses Stress

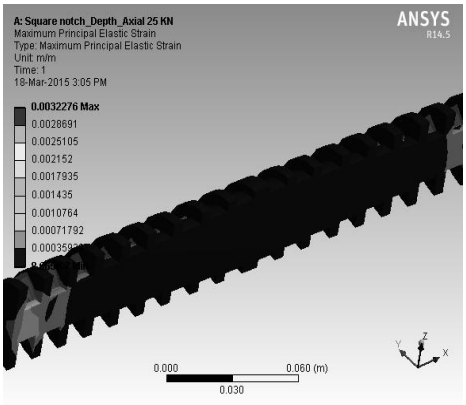

Fig. 8 Maximum Principal Elastic Strain

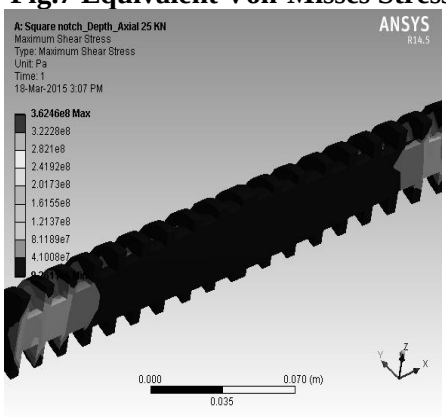

Fig. 9 Maximum Shear Stresses

The effect of the Square notch Depth variation on the stress-concentration factor is studied for circumferentially notched cylindrical bars under static tension. In this study the notch Depth is varied from 4 mm to 13 mm in step of 1 mm From above investigation one thing is cleared that interference is occurring in the specimen for applied load 25000N. Also the maximum Von misses stress is occurs at the maximum Depth of the notch and that value is higher than maximum stress developed for same net area of 8 to 13 mm Depth of Notch of bar. It is cleared that stress interference is occurs for maximum Depth of notch because of the diameter of bar decreases with maximum Depth of notch. From the investigation of effect of notch Depth variation, it is observed that notch Depth has the more significant effect on stress distribution and stress concentration. But the stress pattern is different for the maximum Depth of notches. As notch depth increases Von misses stress is developed in the notch length which gives the more significant interference effect. It is increasing with maximum notch Depth.

1.2 Effect of Variation of Width on Square Notch

The effect of the Square notch Width variation on the stress-concentration factor is studied for circumferentially notched cylindrical bars under static tension. In this study the notch Depth is varied from 8 mm to 11.5 mm in step of 0.5 mm From above investigation one thing is cleared that interference is occurring

in the specimen for applied load 25000N. Also the maximum Von misses stress is occurs at the root of the notch and that value is much more higher than maximum stress developed for same net area of 8 mm to 10 mm of notch width of bar. It is cleared that stress interference is occurs for maximum Width of notch. From the investigation of effect of notch width, it is observed that notch width has the less significant effect on stress distribution and stress concentration. But the stress pattern is different for the higher notch width. As notch width increases Von misses stress is developed in the notch length which gives the significant interference effect. For higher notch width the interference is occurring in notched length and stress concentration is also occurs at un-notched length at vicinity of notch and it is increasing with notch width.

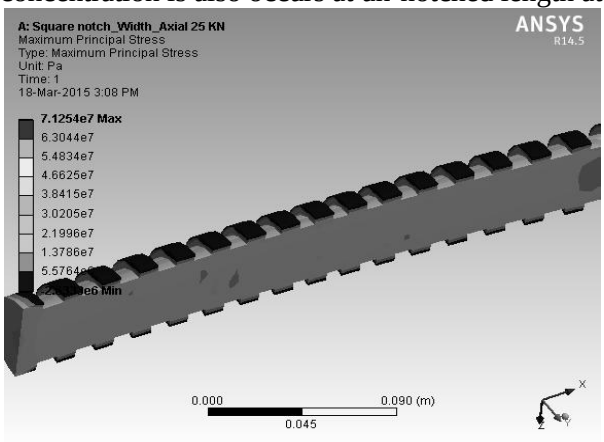

Fig. 12Maximum Principal Stresses

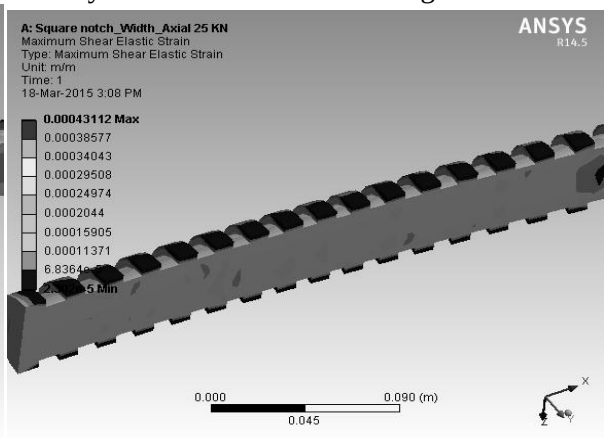

Fig. 13 Maximum Shear Elastic Stain

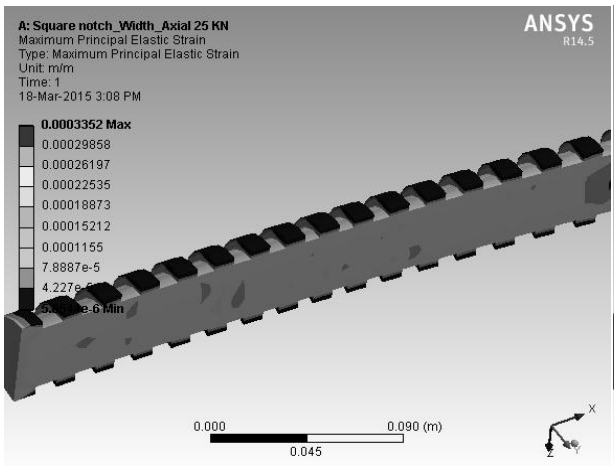

Fig. 14Maximum Principal Elastic Strain

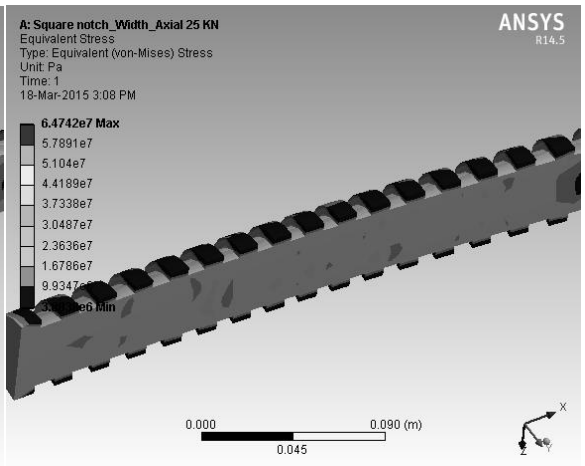

Fig. 15 Equivalent Von-Misses Stress

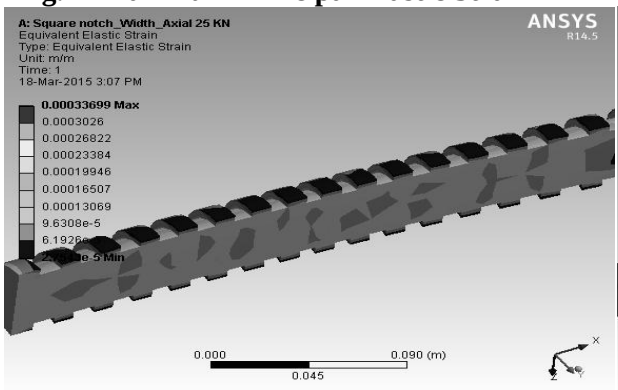

Fig. 16Equivalent Elastic Strain

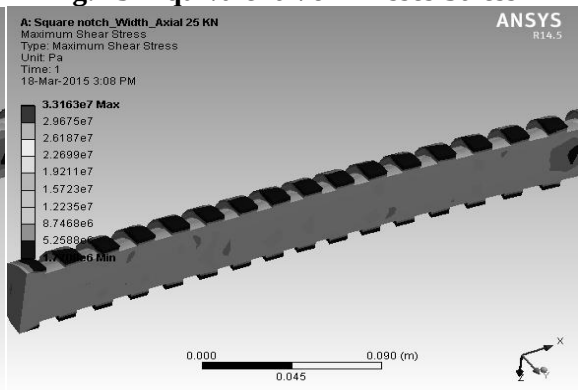

Fig. 17Maximum Shear Stresses

4.0 Effect on U Notch the Variation of the Depth, Width & C.D.

Axial load 25 KN-Tensile Force

4.1 Effect of Variation of Depth on U-Notch

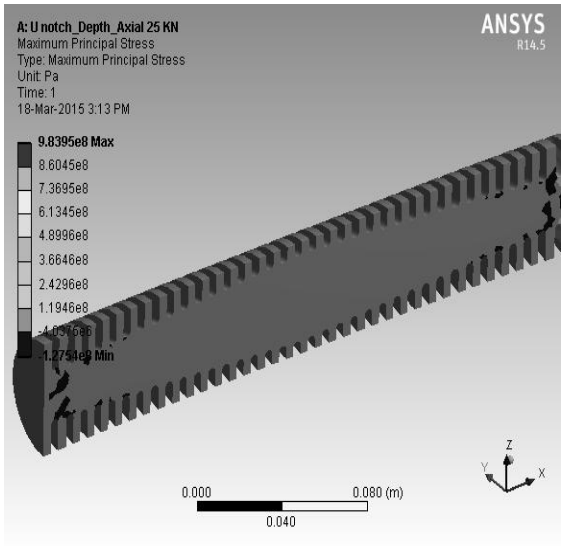

Fig. 18Maximum Principal Stresses

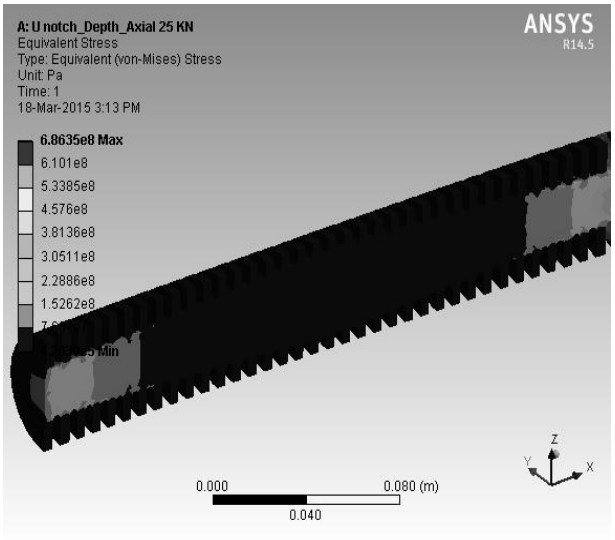

Fig. 19 Equivalent Von-Misses Stress

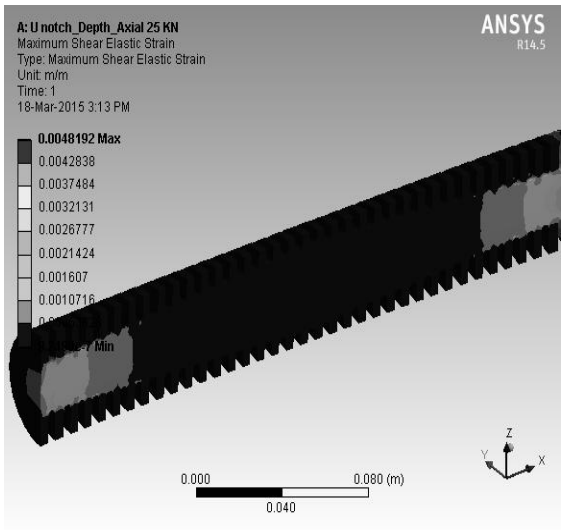

Fig. 20Maximum Shear Elastic Stain

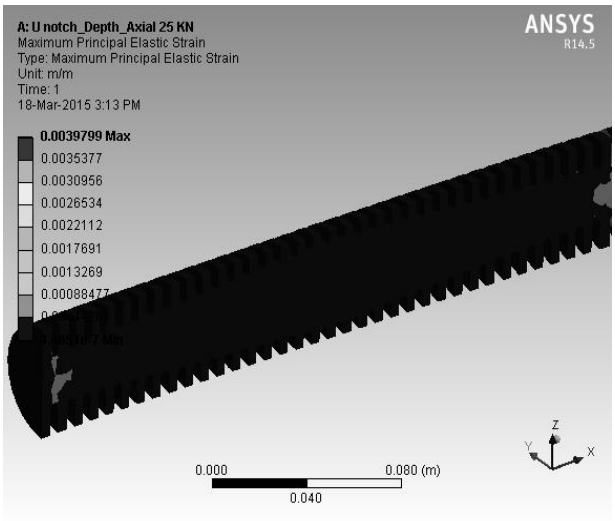

Fig. 21Maximum Principal Elastic Strain

The effect of the U notch Depth variation on the stress-concentration factor is studied for circumferentially notched cylindrical bars under static tension. In this study the notch Depth is varied from 4 mm to 12.5 mm in step of 0.5 mm. From above investigation one thing is cleared that interference is occurring in the specimen for applied load 25000N. Also the maximum Von misses stress is occurs at the maximum Depth of the notch and that value is higher than maximum stress developed for same net area of 4 to 8 mm Depth of notch in bar. It is cleared that stress interference is occurs for maximum Depth of notch because of the diameter of bar decreases with maximum Depth of notch. From the investigation of effect of notch Depth variation, it is observed that notch Depth has the more significant effect on stress distribution and stress concentration. But the stress pattern is different for the maximum Depth of notches. As notch depth increases Von misses stress is developed in the notch length which gives the more significant interference effect. It is increasing with maximum notch Depth.

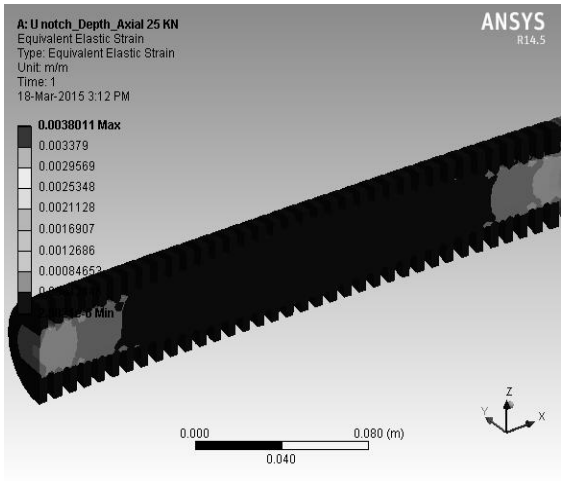

Fig22Equivalent Elastic Strain

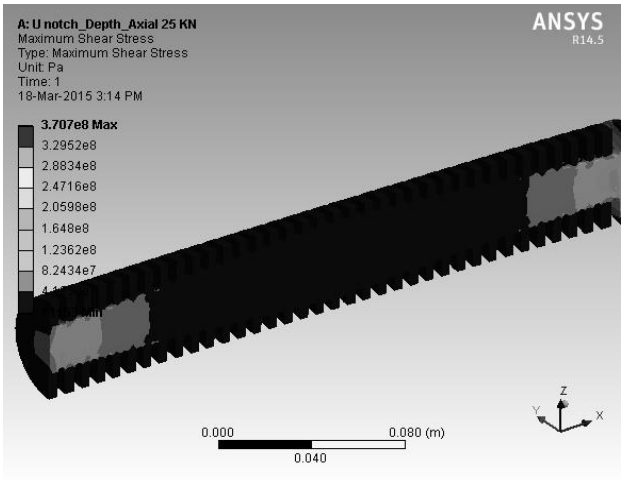

Fig23Maximum Shear Stresses

II. CONCLUSION

From the investigation of effect of Square, U & V notches width variation, it is observed that notch width has significant effect in terms of governing the Stress behaviour of the specimen but has the less significant effect on stress distribution and stress concentration. The max Stresses of specimen goes on increasing with increase in notch width significantly.

From the investigation of effect of Square, U & V notches Depth variation; it is observed that it has more significant effect in terms of stress distribution and stress concentration in the specimen. As the notch Depth goes on increasing the stress values also increases gradually. Because depth is maximum then the diameter of shaft less.

From the investigation of effect of Square, U & V notches Centre Distance variationit is observed that the minimum centre distance of the notch and that value of maximum stress developed.

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