



## SURFACE CONDITION OF STEEL REINFORCEMENT

*The bond and anchorage properties of bars and mesh are not detrimentally affected by a light coating of rust which has formed on the steel surface after normal exposure to the atmosphere<sup>[1][2]</sup>.*



### NORMAL CONDITIONS

Hot-rolled bars, as delivered from the mill, have a layer of tightly adhering mill-scale on the surface. If stored under cover this mill-scale will help to preserve the steel. However, with handling and storage of the rods and bars, the mill-scale can be loosened and, if stored in the weather, rusting can occur and the mill-scale can become detached and "loose". Research has shown that the sorting and normal handling and placing of bars removes the loose scale and the remaining rust and bonded scale is not detrimental to the bar bond.

Under some climatic conditions, where the atmosphere is hot and humid, "black" rust may form on bundled bars. When unbundled and exposed to dry conditions, the corrosion products will dry and convert to red rust which is powdery and will tend to readily fall off the bar.

### POTENTIAL PROBLEMS

The major potential problem with rust on reinforcement is caused by rain washing particles onto the formwork and this can subsequently cause staining of the concrete surface on floor soffits and external facades. This problem can be avoided by ensuring that all loose and extraneous material is removed from the formwork prior to placing concrete. In some critical situations, galvanised reinforcement could be used to eliminate potential staining problems.

Where reinforcing steel is exposed to salt water, more significant problems may occur. Corrosion of reinforcement in concrete is promoted by the presence of chloride ions which are present in salt water<sup>[3]</sup>. Reinforcing steel which has been subjected to salt water exposure and has been severely rusted should not be placed in concrete without some prior treatment such as high-pressure washing to remove the

loose corrosion and salt<sup>[4]</sup>. Severely corroded and pitted steel should not be used unless the material has been checked for strength and cross-sectional area limitations.

### AS 3600, CLAUSE 19.2.4 SURFACE CONDITION

AS 3600, Clause 19.2.4 states: *"At the time concrete is placed, the surface condition of reinforcement shall be such as not to impair its bond to the concrete or its performance in the member. The presence of millscale or surface rust shall not be cause for rejection of reinforcement under this Clause."*

AS 3600 Commentary on Clause 19.2.4 states: *"Rust and millscale has little effect on bond<sup>[1],[2]</sup>. Moderate rusting has been shown to improve bond<sup>[5]</sup>."*



## REFERENCES

- [1] Kemp, E. L. et al, *"Effect of Rust and Scale on the Bond Characteristics of Deformed Reinforcing Bars"*, ACI Journal, Proceedings, Vol. 65, No. 9, Sept 1968.
- [2] Rejab, H. M. et al, *"Effect of Rust on Bond of Welded Wire Fabric"*, Technical Bulletin No. 265, American Road Builders Association, 1986.
- [3] Campbell-Allen, D. and Roper, H., *"Selection of Materials to Improve Performance of Materials in Service"*, Handbook of Structural Concrete, Kong F. K. et al, 1983.
- [4] Pollock, D. J. and Kay, E. A., *"Concrete Construction in Hot Climates"*, Handbook of Structural Concrete, Kong F. K. et al, 1983.
- [5] *"The Effect of Initial Rusting on the Bond Performance of Reinforcement"* CIRIA Report No. 71, ISSN 0305-408X



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