# Hot Dip Galvanized Case Study No. 17
# White rust and Wet storage stains

## The Application

There are two possible forms of white rust.
Firstly, and less problematic form, is when newly hot dip galvanized steel is exposed to atmospheric moisture, the surface zinc reacts rapidly to form a white deposit of zinc oxide (ZnO) and zinc hydroxide $Zn(OH)_2$, both of which constitutes **White Rust**..

In order to combat this form of white rust, hot dip galvanizers provides limited protection by a passivation process immediately after the material exits the molten zinc. The passivation solution gives the hot dip galvanized surface a yellowish tinge that does not affect corrosion control of the coated steel.

The more serious development of white rust, ($Zn(OH)_2$) results when zinc coated steel is stored with moisture trapped between closely packed components. White rust, now referred to as wet storage stain will continue unabated as long as the micro-climate created between the stacked materials is allowed to exist and until such time as such zinc coated surfaces are separated. This is the more insidious form of white rust, referred to as **Wet Storage Stain.**

## Environmental Conditions

**Closely packed hot dip galvanized strips stored with water trapped within the bundles**

**The development of wet storage stains will continue unabated as long as the condition is allowed to exist**

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**Removing the top strap from the stacked bundles of re-enforcing straps, the extent of the wet storage stain becomes evident**

**It is important to understand that the longer the trapped moisture is allowed to remain the more the zinc will be consumed**

## The Site (Wet storage stains)

In December 2011 the Association was requested to attend a site meeting due to a quality complaint relating to severe white rust. The following photograph clearly illustrates the client's concern.

**December 2011**

**An example of wet storage stains**

**Note the absence of white rust on certain plates, three with fittings that were not part of the packed materials and one plate from the top of a bundle**

***The plates were white rusted before assembly due to wet storage stains***

## Findings

The photograph also shows four tank plates on the assembly structure where no white rust is evident. From this evidence if can be concluded that the white rust is a result of the plates being stored with moisture trapped between causing wet storage stains. Three plates without white rust all have attached fittings and would not be stored as part of a bundle. In the case of one plate, again without any sign of white rust, came from the top of a bundle.

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Using this project as a case study, routine visits were undertaken to monitor how the white rusted surfaces have weathered.

White rust is very unstable and will, given time, wash off revealing a matt grey surface colour.

**May 2015**

**The same tank after 29 months in service**

**The surface colour is becoming more and more uniform as the zinc is allowed to weather and develop its protective barrier of zinc carbonates that provide corrosion control**

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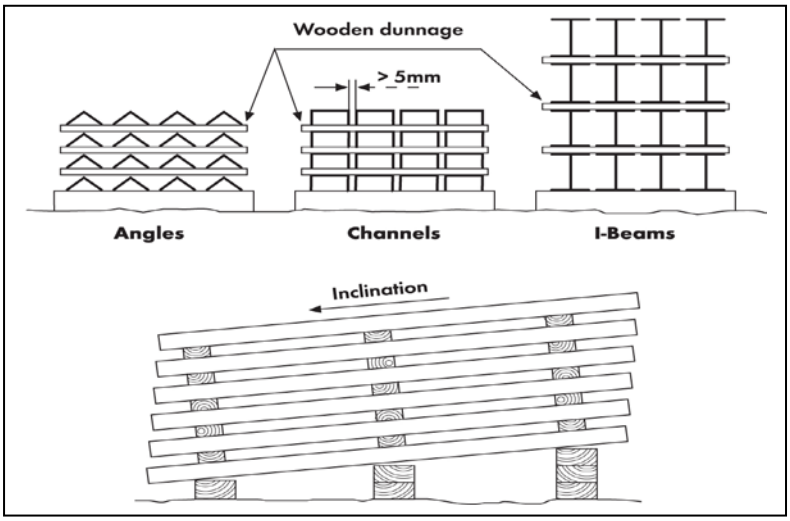
## Conclusion

Hot dip galvanized material must be stored under cover (dry) or in a situation so as to allow full air circulation to all zinc surfaces. The following examples of how wet storage stains can be prevented.


**Hot dip galvanized air cooled condensers, stored on site, exposed to wet and dry atmospheres, for upwards of 12 months**

**Fully ventilated as well as protected for ground moisture**




**Sketch representation of recommended site storage in order to prevent wet storage stains**

**Allows for drainage as well as limited zinc on zinc contact**

**Refer to Information sheet Np. 2 “White rust also referred to as Wet storage stains”**

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