Does Galvanizing Affect Steel Strength?

Introduction

Over the past 10 years steel makers worldwide have developed new structural grade steels with higher yield and tensile strengths. These developments have enabled manufacturers to design their steel products using lighter section steels which in turn reduces the production, transport and erection costs of the finished product. Prior to these developments, the steel fabrications which were most commonly galvanized were manufactured from Grade 250 MPa hot rolled structural steels.

Since the early 1970's, the results from research and testing centres around the world have shown that the hot dip galvanizing process does not affect the tensile and proof (yield) strengths of the Grade 250 MPa structural steels. But does the hot dip galvanizing process affect the yield and tensile strengths of the newer high-tensile grades of structural steels?

Galvanizers have been asked these questions on a number of occasions following claims made by others that galvanizing of these steels affected their tensile strength and performance. To ensure that factual information was available, a testing program of galvanizing these steels was initiated, to establish the effect of hot dip galvanizing on their structural performance.

Objective

The aim of this test program was to establish if the hot dip galvanizing process of dipping steel in molten zinc adversely affects the strength properties of a typical high tensile steel using standard hot dip galvanizing practices. These practices include duplicating the immersion time of the steel in the molten zinc (this does not exceed 15 minutes under normal conditions) at a temperature of 455 degrees Celcius.

Test 1 Product: HA70T-P hot rolled, with black finish manufactured by BHP Steel.

HA70T-P hot rolled steel has a guaranteed minimum yield strength of 450 MPa and a minimum hardness of 70 HRB. The typical yield strength is between 520 to 610 MPa. The typical tensile strength is between 530 to 620 MPa. This steel is normally used in shelving, automotive parts and more recently for purlins.

Procedure

The test procedure involved cutting eleven pieces from a of 3.0mm thick black HA70T-P steel coil. Six of the pieces were hot dip galvanized in accordance with AS 4680-1999.

Test 2 Product: GALVASPAN G450 zinc coated, structural grade manufactured by BHP Steel.

GALVSPAN G450 has a guaranteed minimum yield strength of 450 MPa and is an in-line hot dip zinc coated structural grade steel. The typical yield strength is between 470 to 550 MPa. The typical tensile strength is between 510 to 600 MPa. This steel is normally roll formed into products such as purlins, girts and light structural profiles.

Procedure

The test procedure involved cutting six pieces from a single length of a roll-formed Z25024 purlin, which had been roll formed by BHP Building Products.

Section	Finish	Thickness Nominal (mm)	Thickness Actual (mm)	Hardness (Brinnel)	Yield Strength (Mpa)	Tensile Strength
1.	Black	3.000	2.982	82	471	482
2.	Black	3.000	2.996	83	450	465
3.	Black	3.000	2.986	83	451	466
4.	Black	3.000	2.984	83	453	466
5.	Black	3.000	2.982	83	448	466
6.	HDG	3.000	2.966	83	445	482
7.	HDG	3.000	2.969	84	465	499
8.	HDG	3.000	2.977	84	473	501
9.	HDG	3.000	2.972	84	443	480
10.	HDG	3.000	2.966	83	443	481
11.	HDG	3.009	2.968	84	442	482

The steel thickness was 2.4 mm. Three of the pieces were acid pickled (to completely remove the Z350 mill applied zinc coating) and hot dip galvanized in accordance with AS 4680-1999.The remaining pieces were left in the mill applied Z350 Zinc coating (as rolled) finish.

All sections were then delivered to the BHP Port Kembla Technical Services for testing.

TABLE 2

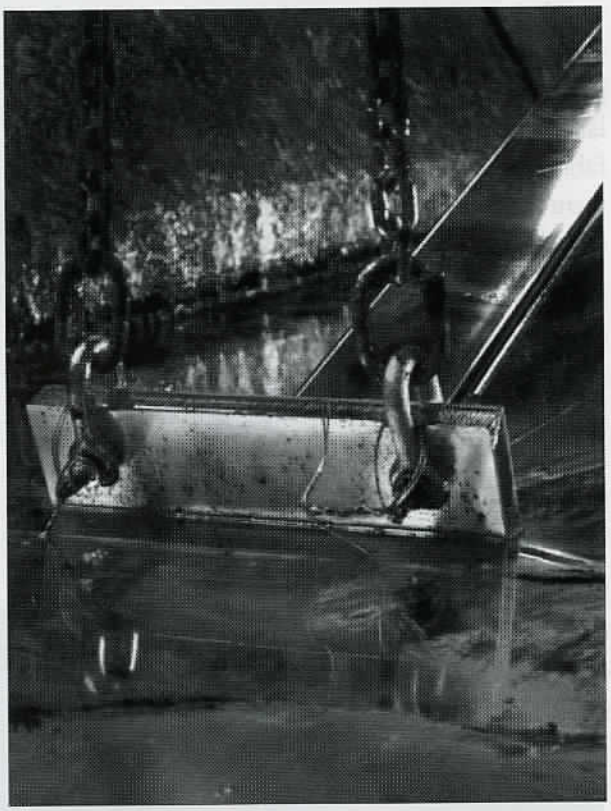
Section	Finish	Thickness Nominal (mm)	Thickness Actual (mm)	Hardness (Brinnel)	Yield Strength (Mpa)	Tensile Strength (Mpa)
1.	Zinc coated	2.400	2.400	91	537	573
2.	Zinc coated	2.400	2.374	91	531	564
3.	Zinc coated	2.400	2.372	92	535	569
4.	HDG	2.400	2.372	91	532	566
5.	HDG	2.400	2.383	91	529	563
6.	HDG	2.400	2.383	92	536	569

RESULTS

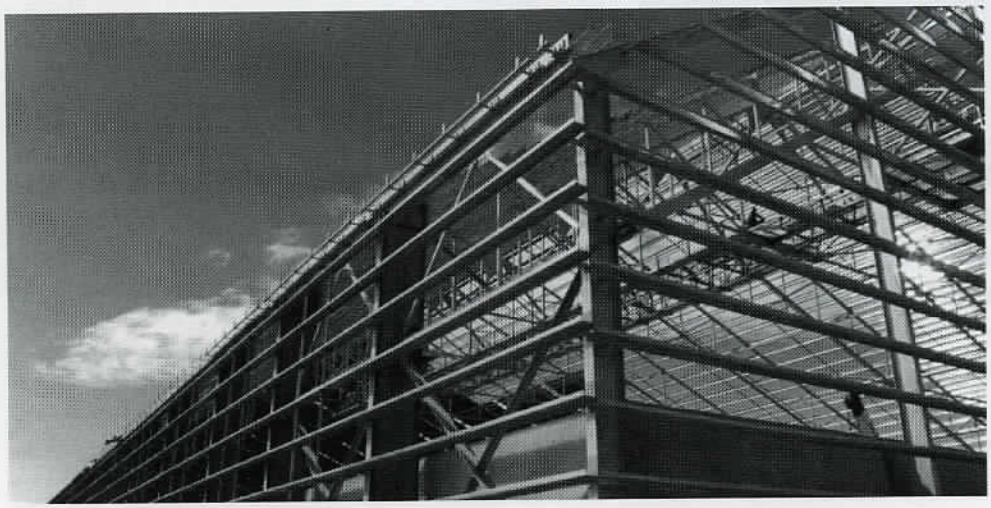
Tables 1 and 2 show the results of the testing. If the results of the yield strengths of the uncoated sections and the results for the galvanized sections of the HA70T-P are averaged, the difference is 0.4%. As this variation is less than 1% it is considered to be within the accuracy tolerance of the testing procedure.

If the results of the yield strengths of the uncoated sections and the results for the galvanized sections of the Galvaspan G450 are averaged, the difference is 0.6%. As this variation is less than 1% it is considered to be within the accuracy tolerance of the testing procedure.

Both these tests have verified that hot dip galvanizing of either uncoated high strength steel or the hot dip galvanizing of pre-galvanized high strength steel after acid stripping of the original coating has no effect on the structural strength of the steels involved. ❑



Standard structural grade of steel remain unaffected by galvanizing, although yield strength is reduced by 50% at galvanizing temperature, so items must be properly supported during the galvanizing process.



Cold formed sections of purlin were tested to evaluate the effect of hot dip galvanizing on higher strength steel. There were no detrimental effects caused by galvanizing this type of steel.

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Editor.

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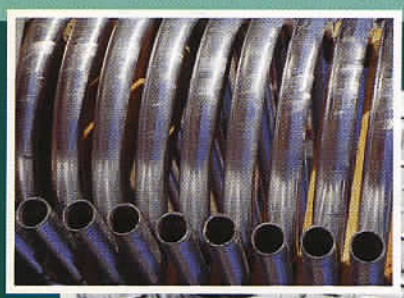

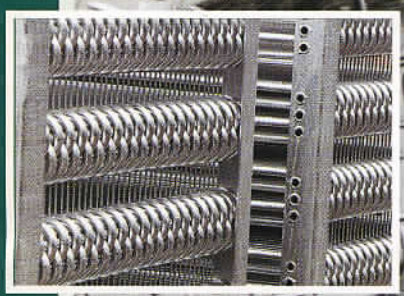

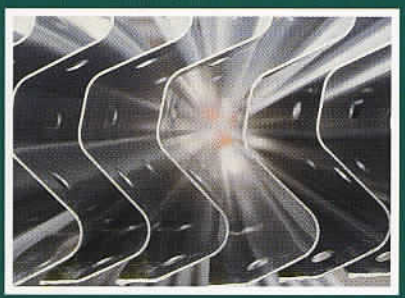

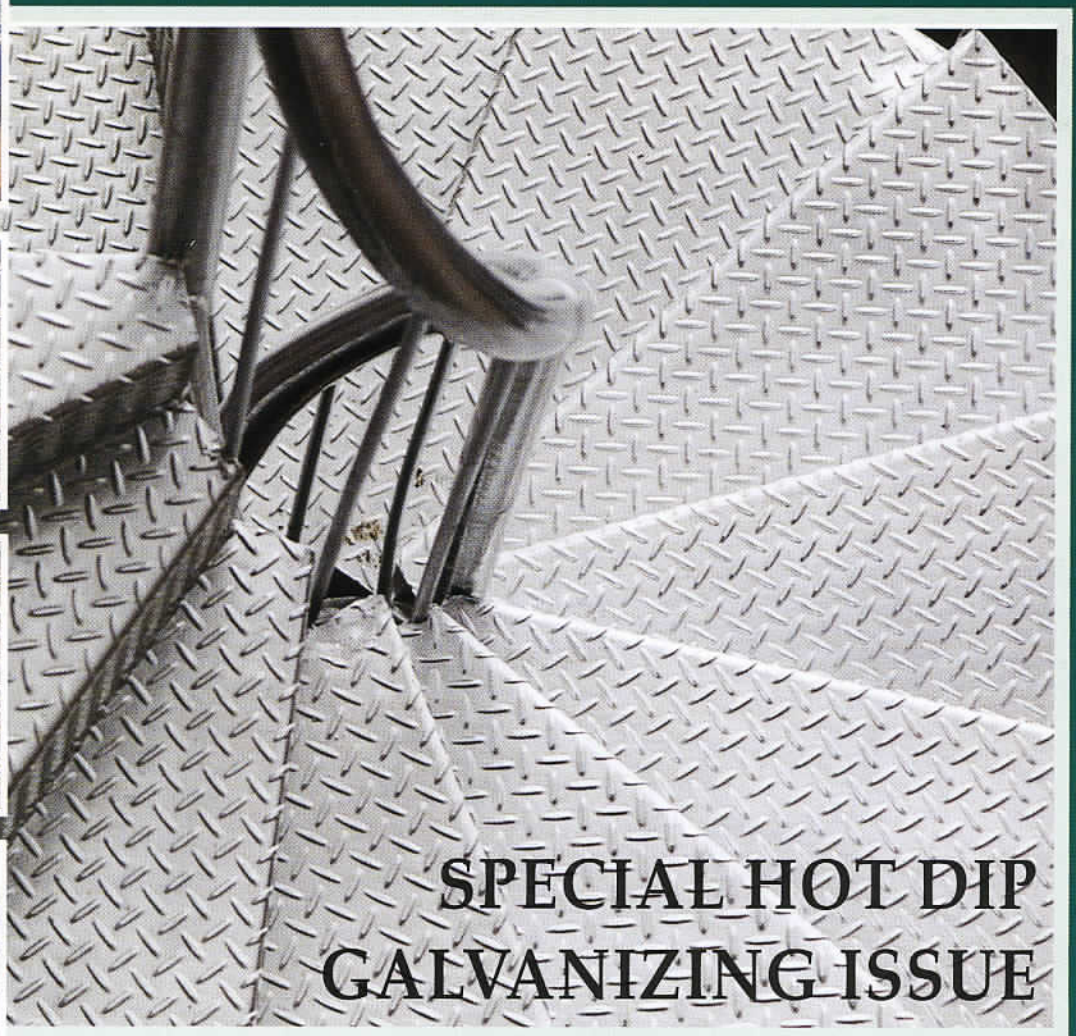

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