EUROPEAN COMMISSION

RFCS Sponsored Research Project

CONFIDENTIAL

Title of Research Project:	**Structural Application of Ferritic Stainless Steels**
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Workpackage 3 – Task 3.1

Task 3.1: Production feasibility for composite decking

The aim of this task was to assess whether ferritic stainless steel could be processed in the same way that galvanised steel to produce steel decking or if some adaptations to the process parameters are needed.

A.1 Material & decking geometry

The decking type chosen for the work-package is Cofraplus 60 which is a 58mm-high decking produced in galvanised steel by ArcelorMittal (Figure A-1). Two configurations were tested with different ferritic stainless steel grades, although only one of them was used for structural testing (see Table A-1). In both case surface aspect was shiny even if 2R (cold rolled, bright-annealed) finish is brighter than 2B one (cold rolled, skin-passed). However, to reduce the amount of test on composite decking, it was decided to supply only 1.4003 decking for the structural assessment of the composite decking.

Material	Finish	Thickness mm	Width mm	Profile	Embossment	Structural tests
1.4003	2B	0.8	1500	Cofraplus 60 – 5 waves	Yes	Yes
1.4621	2R	0.8	1220	Cofraplus 60 – 4 waves	Yes	No

Table A-1 : Processed stainless steel coils for decking trial

To determine the mechanical properties of the material, tensile tests were carried out according to EN 10 002-1 procedure on 1.4003 specimens from the same coil used for decking trials. The tensile properties are reported in Table A-2. The comparison to S350GD galvanised steel properties (Table A-3) shows actually similar tensile strength but slightly lower elongation and significantly higher yield strength for galvanised steel than for 1.4003 grade.

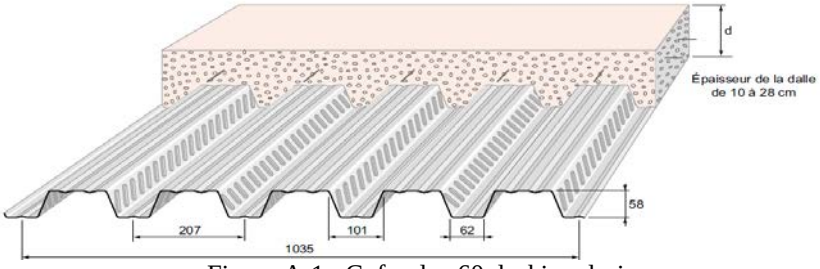

Figure A-1 : Cofraplus 60 decking design

Specimen orientation	Specimen #	Rp0,2% MPa	Rp1% MPa	Rm MPa	A %	Ag %
Transverse direction	1	323	349	504	27,2	17,6
	2	324	351	503	27,6	17,5
Rolling direction	1	305	335	492	28,8	18,1
	2	305	334	491	28,7	18,1

Table A-2 : Tensile test of 1.4003 samples from processed coil

Specimen orientation	Nominal thickness galvanized/bare steel mm	Rp0,2 MPa	Rm MPa	A %
Rolling direction	0,75 / 0,71	408 ±6	486 ±7	26,4 ±1,5
Rolling direction	1 / 0,96	388 ±7	475 ±5	26,3 ±1,6

Table A-3 : Tensile test of S350GD-Z275 (mean out of 10 measurements each)

A.2 Decking trial

A.2.1 First trial

Two profiling trials have been carried out in ArcelorMittal Strasbourg plant: the first one in March 2011, the second one in May 2012. Two coils of 5 tonnes each were processed (partially), one of each grade.

These roll-forming trials were carried out using the same industrial parameters as for galvanized steel processing. The decking was obtained after successive deformation through various roll-forming stands. The first step of the roll forming produced embossment on the flat strip while following steps lead to the bending of the strip into various “omega” waves.

After profiling and cutting samples, geometrical checks were carried out. Global geometrical parameters (wave height and width) were found to be within tolerances. Superficial defects on some ribs were noticed and could be explained by the presence of zinc traces in some parts of the rolls. These defects can be removed if a specific roll cleaning is performed before processing stainless steel (4 hours maintenance operation). The main issue of the first trial was that the embossment height appeared to be lower than the tolerance value. A second profiling trial has therefore been performed in 2012 after taking corrective actions as explained in the following paragraph. The shiny aspect of the sheets was preserved thanks to protective films on both sides of the strip.

Figure A-2 : Roll-forming trials of Cofraplus 60 decking

A.2.2 Second trial : embossment improvement

Measurements carried out by UPC on 1.4003 decking after first trial confirmed the low value of embossment height. This remark was not specific to stainless steel since similar drifting toward lower embossment height was also noticed in the same time on galvanized steel, although at a lower level. The target height for embossment was recently decreased to $2.6\ \mathbf{mm}^{+0.4}_{-0.3}$.

Table A-4 presents a summary of these measurements carried out on a representative area of the decking (full width, length corresponding to a roll perimeter). It was noticed that this low embossment height observation was more pronounced on 2 marking rolls. Since the final application was composite decking and since the embossment geometry plays a significant role in the load transfer at the concrete/decking interface, a second profiling trial was planned in May 2012 to increase embossment height.

A maintenance operation was performed on the embossment rolls before this second trial to clean it. The process parameters were also adjusted. However it should be noticed that some discrepancy in the embossment height was due to the facility set up and could not be avoided : the embossment height was lower in the centre of the decking than on the edges due to the

slight bending of the rolls during profiling. Further measurements after this second trial have shown an improvement of the height of more than 0.3mm, as shown in Table A-4. Decking samples from this second trial was therefore used for composite decking tests.

	Stainless steel decking (1.4003)		**Galvanized steel decking**
	Trial 1	Trial 2	
Mean value	2,40	2,78	2,76
Standard deviation	0,23	0,21	0,16

Table A-4 : Embossment height measurements (mm)

A.3 Sampling

About 1.7 tons of 1.4003 decking were sent to SCI and UPC for WP3 testing. Some galvanised steel profiles with similar thickness (0.75mm) were provided to UPC for comparison together with some test reports on galvanised steel decking structural performance.
Two batches of stainless steel profiles were sent: the first batch (from first trial) was used for construction stage tests while the second batch (from second trial with improved embossment) was used for composite decking tests.