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TEST REPORT

| | |
|---|---|
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| **Subject** | Comparative Testing of Roofing Materials |

## 1 SCOPE

Two sections of SS-tile, pressed steel roofing was submitted for testing. It was requested that the steel roofing be tested comparatively with standard concrete roof tiles typically used in high density accommodation units.

## 2 SAMPLE DESCRIPTION

Two pre-coated pressed steel roofing sections (SS-tiles) of approximately 1.5m in length and 900 mm wide were submitted (Figure 1). The steel sections were longitudinally profiled with transverse ribs pressed into the profile at regular intervals, creating the appearance of overlapping tiles. Samples of *Double-Roman* style concrete roof tiles were obtained for comparative testing. The concrete roof tiles were from two different manufacturers (Marley and Coverland), one representing a typical economy product (Marley) and one a premium product (Coverland), both displaying the SABS mark.

## 3 TESTS

The general guidelines of SANS 542:2004, *Concrete roof tiles* were used in the comparative assessment. The different roofing materials were weighed and measured in order to determine the typical coverage and weight per unit area installed. In addition, the transverse strength of each type was assessed. In light of the fact that SANS 542:2004 is aimed at concrete tiles, slight deviation of the prescribed test procedures of SANS 542:2004 was incorporated in order to comparatively test the steel and concrete products as well as to provide a closer match with regards to actual installed conditions.

# 4 RESULTS

## 4.1 Measurements

The average cover width of the concrete tiles was determined from three interlocking tiles, in accordance with the procedure prescribed in SANS 542:2004. The average cover width for the steel sheets was determined by overlapping the opposing edges of the two samples and measuring the exposed width of the bottom sheet. The hanging length of the concrete tiles was determined in accordance with SANS 542:2004. Since the steel sheets can be manufactured in purpose fit-lengths (no overlapping required), with the only restriction the transportability to site, the hanging length of the steel roofing is variable. The weight per unit area covered for the concrete tiles was obtained from the manufacturers recommended installation procedure and associated coverage. The weight per unit area for the steel sheet was determined based on the cover width and a unit length of material, considering purpose-made sheet lengths. The dimensional attributes of the roofing materials are presented in Table 1.

**Table 1: Dimensions and weights of the various roofing materials.**

| Roofing Material | Pre-coated Pressed Steel | Double-Roman Concrete Tiles | |
|---|---|---|---|
| | | Economy | Premium |
| Cover Width | 770 mm | 305 mm | 302 mm |
| Hanging Length | Variable | 393 mm | 395 mm |
| Weight/tile | 3.7kg/m | 4.17 kg/tile | 4.79 kg/tile |
| Weight/unit area | 4.8 kg/mm$^2$ | 40.3 kg/mm$^2$ | 46.1 kg/mm$^2$ |

## 4.2 Transverse Strength

Two section of the pressed steel roofing material was removed for bend testing in order to determine the transverse strength. Both sections were sized to include two repetitions of the longitudinal profile pattern (similarly to the double-roman style concrete tiles). However, the one sample excluded the anticipated longitudinal overlap of adjacent roof sheets resulting in a narrower sample, while the second sample incorporated such an overlap (wider sample). Both samples included a two transverse, pressed, ribs to ensure inclusion of the additional stiffening provided by these profiles (refer to Figure 2).

The transverse strength of the roofing materials was determined by means of three point bend testing according to the procedure outlined in SANS 542:2004. During testing the roofing materials were supported on 36 mm square wooden battens to simulate actual installed conditions. For all the tests the batten spacing was in accordance with SANS 542:2004, based on the average hanging length of the concrete tiles tested. Similar batten spacing was used for testing the steel roofing in order to obtain comparative strength results. The loads were applied centrally between the support battens, using purpose-made, profiled, pressed-wood, packing blocks. During testing the load-displacement behaviour of the materials was continuously monitored. The load-displacement curves for the individual tests

are presented in Figure 4, and the tested samples are presented in Figure 2 and Figure 3 for the steel and concrete materials respectively. Figure 5 shows the load displacement values normalized for sample width. The average transverse strength, representing the normalized load at failure for the concrete tiles and that at denting for the steel sheeting is presented in Table 2.

**Table 2: Transverse strength of roofing materials**

| Roofing Material | | Maximum Load | Transverse Strength |
|---|---|---|---|
| Pre-coated Pressed Steel | | 5.10 kN | 11.6 N/mm |
| Double-Roman Concrete Tile | Economy | 3.85 kN | 12.7 N/mm |
| | Premium | 2.8 kN | 9.4 N/mm |

## 5 DISCUSSION AND CONCLUSIONS

Evaluation of the geometry and unit weights of the various roofing materials indicated that the concrete roof tiles is almost 10 time heavier than the pressed steel per unit area coverage. The transverse strength tests indicated that pressed steel roofing could support significantly higher loads, using the same supporting substructure, compared to concrete roof tiles. The combination of higher loads and wider coverage of the steel roofing translates to transverse strength per unit width as per SANS 542:2004 at the same level as that of concrete roofing. It should however be borne in mind that the concrete tiles fractured at the maximum stress valued attained, resulting in a compromise in structural integrity and environmental protection provided by the concrete roof. In contrast, the steel roofing displayed localized, permanent plastic strain only, with no evidence of fracture of the material, therefore, maintaining the environmental protection of the roofing system although the aesthetic appearance had been compromised.

Practical experience has shown concrete roof tiles to frequently fracture longitudinally at loads well below the rated transverse strength, when a person walks on the roof, due to uneven loading resulting from improper seating of the tiles on the battens. Although denting and bending of steel roofing are periodically encountered, fracture of steel roofing is highly improbable as a result of a person walking on the sheets during or subsequent to the installation. The combination of strength and light weight of pressed steel roofing enables the use of increased spacing between supporting trusses and battens.

For and on behalf of MegChem Engineering
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## 6 FIGURES

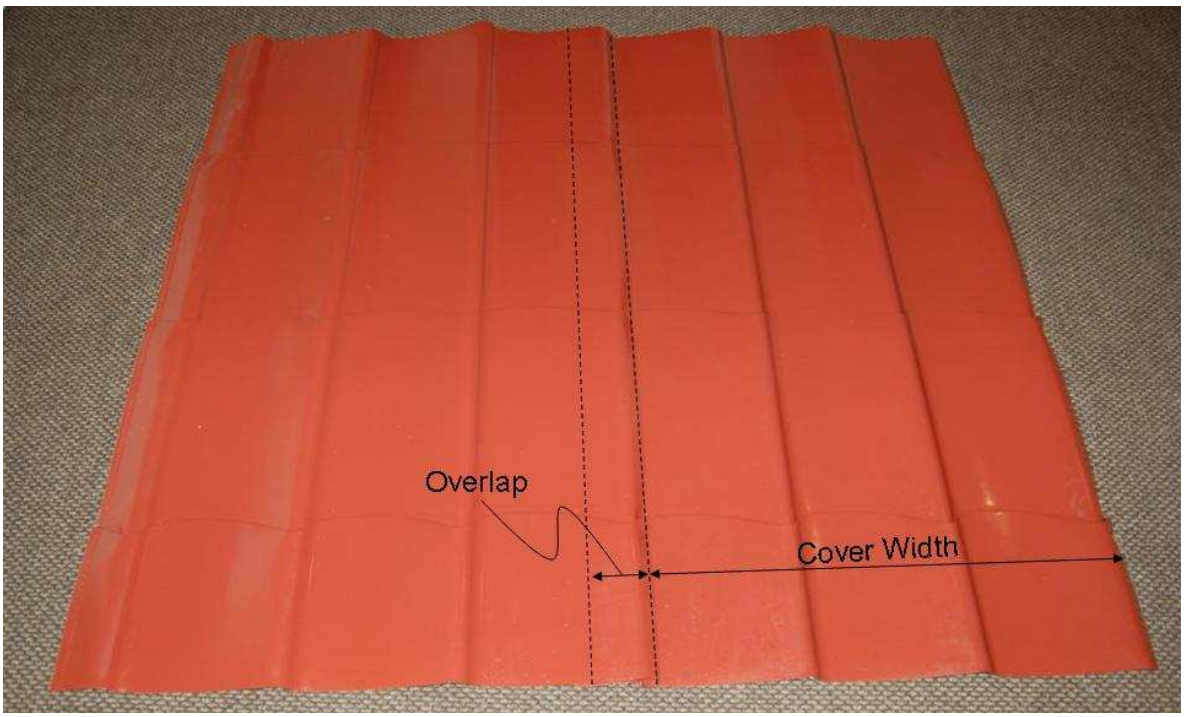


**Figure 1: Typical appearance of the submitted pressed steel roofing material. Note the overlapped are not included in the cover width.**


**Figure 2: Samples removed from sheeting, shown after testing. Note the localized plastic deformation, and absence of any visible fracture..**

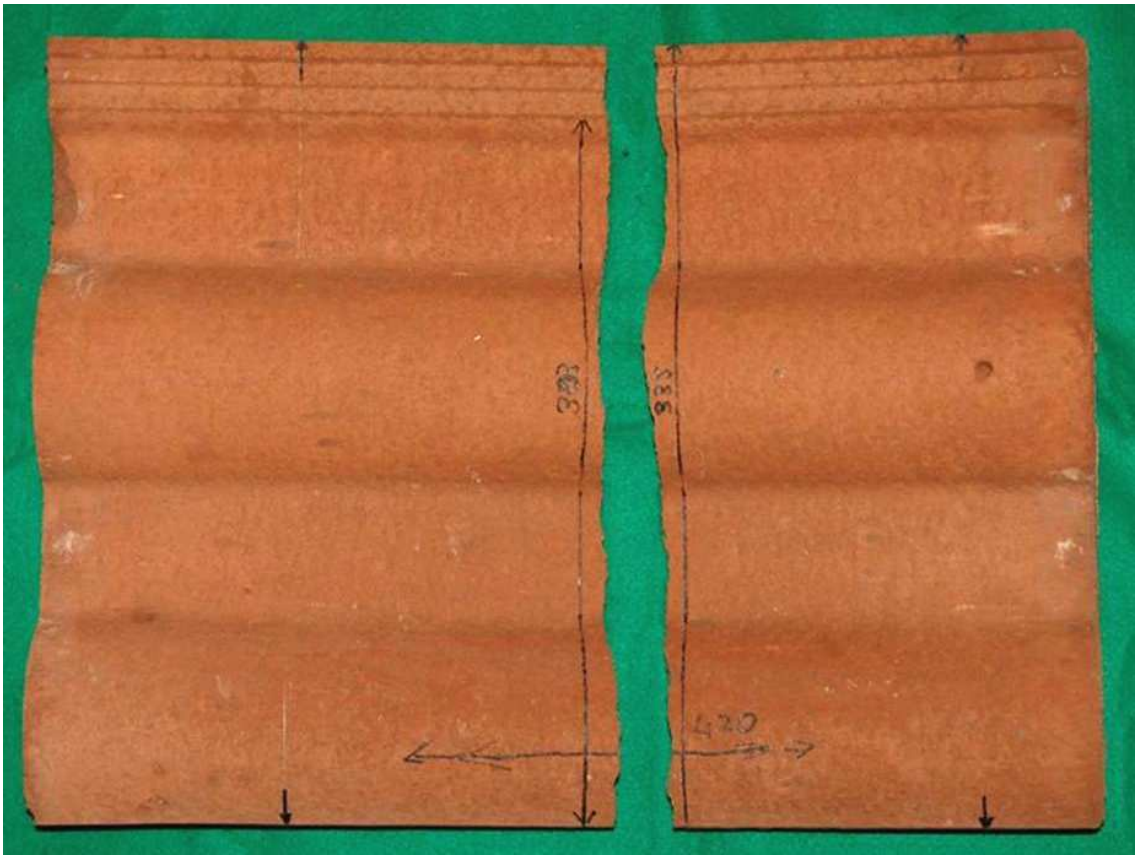

**Figure 3: Typical concrete tile sample after testing. Note the transverse failure, without any visible plastic deformation.**

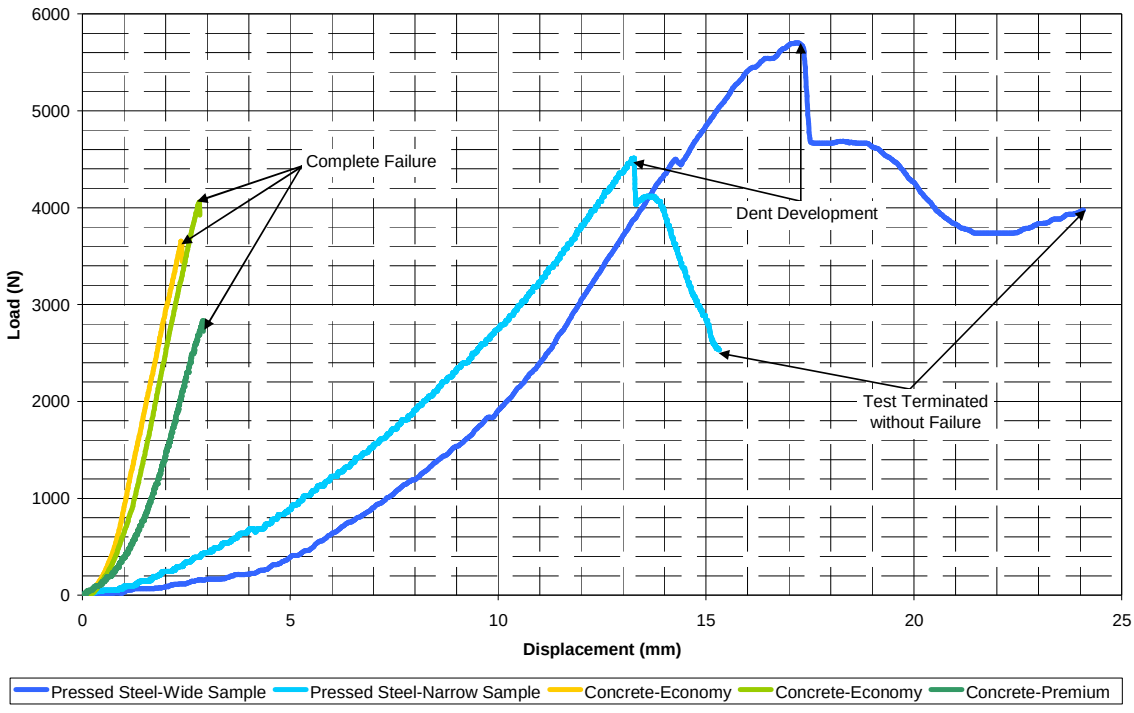


**Figure 4: Actual load values obtained during transverse bend testing.**

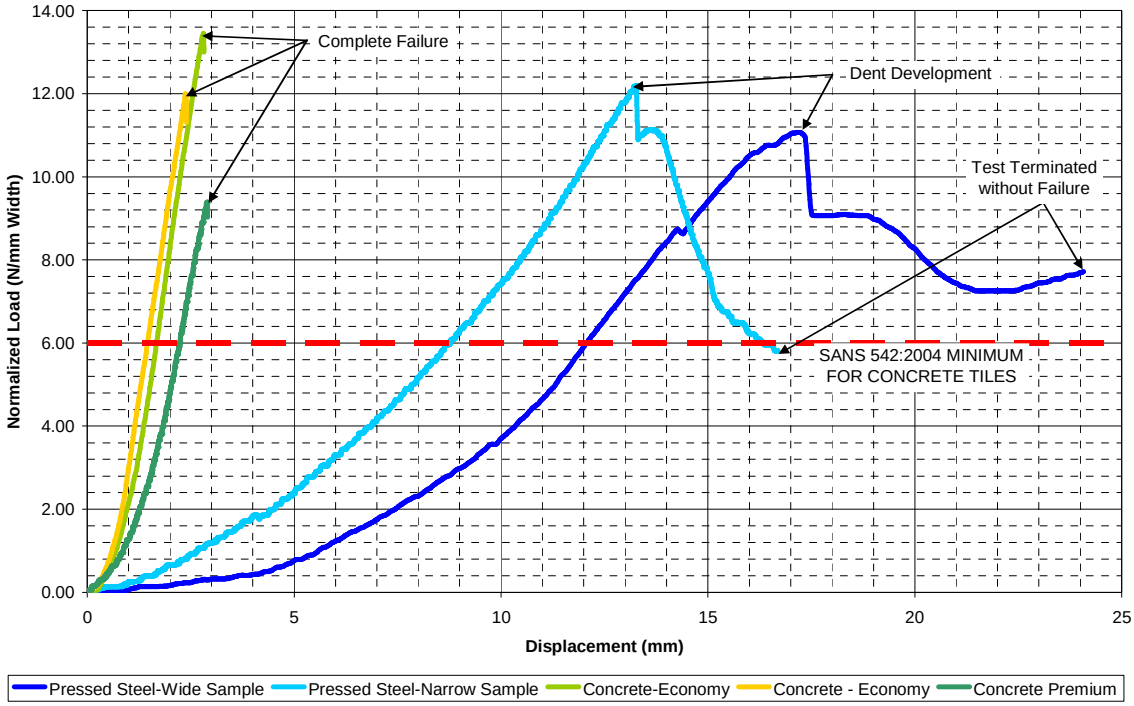


**Figure 5: Transverse bend test values normalized to unit width to established the rated transverse strength in accordance with SANS542:2004.**