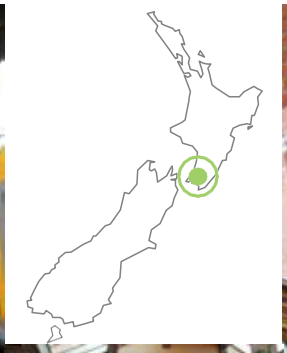





DuO membrane durability study in NZ climate conditions - Introduction

The development of DuO as a new concept for a high value, bituminous waterproofing membrane dates back to 1989. The first substantial DuO roofs were installed in 1990.
In 2000, after DuO had been launched as a revolutionary new roof membrane concept for over 10 years, De Boer nv (now Soprema nv) decided to do an objective, international investigation of the quality of this waterproofing membrane. This happened in coordination with SGS and BBRI (Belgian Building research Institute) and evaluated samples form roofs in Western & Northern Europe and Asia.
In 2005, another DuO durability test was performed and test roofs from other countries were added to the list. (Netherlands, Sweden, Japan and Singapore)
In 2011, De Boer nv (now Soprema nv) instructed SGS and BBRI to test the ageing DuO membranes again and two more roofs located in Germany and New Zealand were added. In 2018, another large scale durability investigation took place.
This document provides you a conclusion of the general test results and a summary of the results of the DuO membrane installed on the roof of Wellington Railway Station in 2002.

Location DuO roof : New Zealand

WELLINGTON RAILWAY STATION – NEW ZEALAND

Roof area	:	7000 m2
Height	:	>5 m
Wind zone	:	III
Installation year	:	2002
Built-up	:	Concrete roof + DuO primer + DeboFlex 2.5 T/F K180 basesheet (fully bonded) + DuO HT 4 BO/F C180
installation method	:	DuO cap sheet fully bonded
Construction	:	refurbishment

GENERAL CONCLUSION OF ALL THE TEST RESULTS:

- The samples indicate that there is no significant reduction regarding longitudinal tensile strength but a 10% decrease in transversal tensile strength which is still within the declared value.
- The elongation of the DuO membrane decreased by 25% over time which is still within the declared value range for a new DuO membrane.
- The nail tear resistance of DuO is high for the new membrane. Test results show that the resistance didn't deteriorate over time.
- The tests indicate that the tear resistance of DuO does not diminish through time.
- Maximum allowed shrinkage according to the norm is 0.3%. The test result of 0.1% for the older DuO membranes clearly score below that maximum allowance for new membranes. This indicates that DuO is a very stable waterproofing membrane.
- The cold flexibility of DuO stays within the norm for artificially aged membranes. It even stays within the norm for new membranes.
  The results show us that the cold flexibility of DuO stays very good in NZ climate conditions.
- The flow resistance of DuO stays within the norm for new and artificially aged membranes. Results of membranes installed show good temperature resistance of 150°C after ageing in NZ.
- The shear resistance of the DuO joint connection is still well above the norms that are stipulated for new membranes.

DESCRIPTION OF TESTS:

Resistance to tearing (Rivestyrke) – Laboratory TUM (Germany)
The butterfly tests are related to the tear resistance of a waterproofing system. This test is also used to determine the tear initiation and tear propagation.

Dimensional stability – Laboratory SP (Sweden)
This test method checks the free shrinkage in longitudinal direction. The minimum result as declared by the manufacturer corresponds to good practice.

Flexibility at low temperature – Laboratory BDA (The Netherlands)
This test method determines the flexibility of the membrane at low temperature.

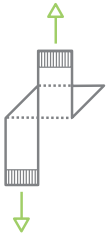
Flow resistance at elevated temperature – Laboratory Soprema nv (Belgium)
This test method determines the flow resistance (melting) of the membrane.
The minimum demanded result as declared by the manufacturer is more stringent compared to good practice.

Shear resistance of the joint - Laboratory BDA (The Netherlands)
This test method determines the shear resistance of the joint connection between two waterproofing membranes.

RESISTANCE TO TEARING (NAIL SHANK) – LAB TUM

RESISTANCE TO TEARING (BUTTERFLY TEST) – LAB TUM

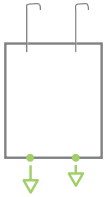
RESISTANCE TO TEARING (Rivestyrke) – LAB TUM



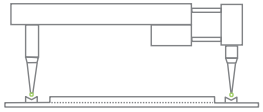
SHEAR RESISTANCE OF THE JOINT – LAB BDA

THICKNESS OF LAYERS

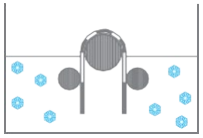
FLOW RESISTANCE AT ELEVATED TEMPERATURE – LAB DE BOER



DIMENSIONAL STABILITY – LAB SP



FLEXIBILITY AT LOW TEMPERATURE - LAB BDA



TENSILE STRENGTH & ELONGATION – LAB BDA

Observations during visual inspection:

- The general condition of the roof is visually in good condition with 'satisfactory' result by SGS New Zealand.
- Roof maintenance is not sufficient. Roof drains were blocked. Some accumulation of dirt was noticed and significant lichen growth.
- The samples were taken at different areas of the roof surface and were repaired in a professional and watertight manner.

TESTS		OFFICIAL LABORATORY VALUES - 2018 samples	
	specification	LONGITUDINAL	TRANSVERSAL
TENSILE STRENGTH *test method (UEAtc – 1984 en EN 12311-1)*	**880N ± 20%**	1065N	790N
ELONGATION *proefmethode (UEAtc – 1984 en EN 12311-1)*	**50 ± 15%abs**	38	37
RESISTANCE TO TEARING (NAIL SHANK) *proefmethode (EN 12310-1)*	**>250N**	292N	326N
RESISTANCE TO TEARING (BUTTERFLY TEST) *proefmethode (DIN 53515 en ISO 34-1 Methode B)*	**>110N**	129N	117N
RESISTANCE TO TEARING (NAIL SHANK) *proefmethode (DIN 53515 en ISO 34-1 Methode B)*	**>50N**	50N	53N
DIMENSIONAL STABILITY *proefmethode (SP 2187 en EN 1107-1 Methode B)*	**<0,30%**	0,1 %	

	specification	
SHEAR RESISTANCE OF THE JOINT *proefmethode (UEAtc – 1982 en EN 12317-1)*	**>500N**	811N

					OFFICIAL LABORATORY VALUES - 2018 samples	
	new		after aging 6 months at 70°C			
FLOW RESISTANCE AT ELEVATED TEMPERATURE *proefmethode (UEAtc - 1984 en EN 1110)*	TOT. MEM-BRANE	TOP COATING	TOT. MEM-BRANE	TOP COATING	TOTAL MEMBRANE	TOP COATING
	>100°C	**>140°C**	**>100°C**	**>150°C**	115	150

	new		after aging 6 months at 70°C		OFFICIAL LABORATORY VALUES - 2018 samples			
FLEXIBILITY AT LOW TEMPERATURE *proefmethode (UEAtc - 1982 en EN 1109)*	L & T topcoating	L & T undercoating	L & T topcoating	L & T undercoating	L topcoating	L undercoating	T topcoating	T undercoating
	-15°C	-20°C	-5°C	-5°C	-30	-34	-26	-29

Final conclusion:

The laboratory tests of existing DuO roof samples show that the results can still be compared to the characteristics that are declared for new membranes.

The results also show that DuO keeps its achievements in the New Zealand climate.

This durability report shows a bright future for the expected serviceability of DuO in the Oceania region.

We can conclude that the DuO membrane, installed on roofs in different continents and as a part of different roof concepts, still performs very well after an extra 5 years of natural ageing.

General conclusion: Taking into account that the oldest roofs in Europe are currently more than 30 years old, we can state today that, with a correct roof and roof detail maintenance, the previous expected lifetime can be confirmed, meaning that a lifetime expectancy of 35 years is achievable.