



# Renovation of "Torenflat", Zeist

Netherlands

  
EUROPEAN ALUMINIUM

# / Preface

To illustrate how the energy performance of existing buildings can be upgraded, the European Aluminium compiled the below case study.

The Torenflat (high-rise apartment block) contains 484 apartments on central corridors on 19 residential levels. One of the important objectives of this huge renovation, which was carried out entirely whilst people were living in the building, was to eliminate all the thermal bridges of the complex. This was achieved in 2008 by enclosing the entire building in a 'warm jacket', a light thermal skin comprised of fully prefabricated aluminium façade units that could be fixed onto the existing structure. Each apartment was given a new skin in one working day. By enclosing the building in this way, the thermal performance of the building was dramatically improved: the energy performance of the building has been improved by three categories according to the Dutch building energy labelling system. This project combined minimal investment with maximum social, economic as well as environmental benefit and won the European Aluminium in Renovation Award 2009 in the residential category.

A simplified life cycle assessment focused on greenhouse gases has been carried out and concludes a CO<sub>2</sub> payback period of 13 years, when recycling is neglected and a payback period of 4,4 years when end-of-life recycling is taken into consideration. The use phase data were modeled by Senter Novem, an agency of the Dutch Ministry of Economic Affairs. The production phase was modeled based on the material composition. The end-of-life phase was calculated as two scenarios, i.e. with and without end-of-life recycling. The CO<sub>2</sub> payback period is pretty long in this case due to the very ambitious scope of the renovation project which requested a new envelop skin for a big fraction of the building

An independent expert has been involved in order to secure the scientific validity and technical quality of the above calculations.

# / Torenflat: Description



- Building type: Residential
- Location: Zeist (NL)
- 20 stories
- 484 social apartments
- Construction year: 1973
- Floor: 36 864 m<sup>2</sup>
- Façade: 15 595 m<sup>2</sup>



# / Torenflat: Wrapped into a warm jacket

## Before renovation:

- Wooden frames
- Single glazing
  - $U_{gl}=5,8$  ( $g_g=0,87$  &  $\tau_g=0,85$ )
- No insulation between balconies & structure



## Overcladding:

- Thermally-broken aluminium profiles and panels fixed onto the existing structure
- 2 kind of panels
  - Transparent insulated glass panels,  $U_{gl}<1,1$
  - Opaque sandwich panels: glass, PU foam & aluminium sheet

# / Torenflat: Data for CO<sub>2</sub> calculation

## Bill of material for renovation

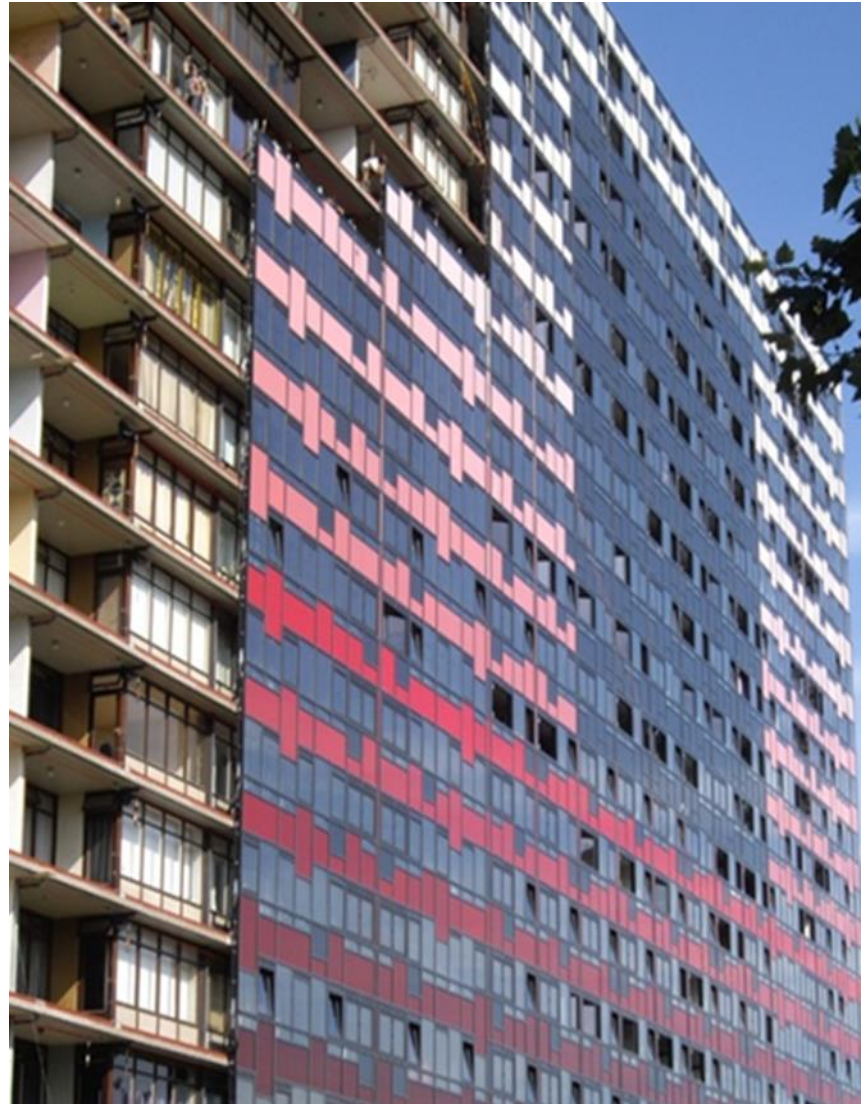
- Aluminium: 263 t
- Glass: 200 t
- Polythermide: 6 t
- EPDM: 24 t
- Rockwool: 26 t
- Polystyrene: 5 t
- Steels: 19 t
- Others: 1 t
- TOTAL: 543 t

Avoided CO<sub>2</sub> emissions  
thanks to the warm jacquet:

- 261 t/year

Heating energy source

- Natural gas



# / Torenflat: CO<sub>2</sub> calculation results

Savings during operation:

- Energy performance of the building improved by three categories according to BEG & REG (Dutch EPBD)
- CO<sub>2</sub> savings: 261 t/year

Production and recycling

- CO<sub>2</sub> emissions: 3.360 t, if recycling is ignored
- CO<sub>2</sub> emissions: 1.134 t, with 92% recycling credits\*

Payback period

- 13 years, if recycling is ignored
- 4,4 years, with 92% recycling credits\*

\*Considering the end-of-life recycling rate of 92% of 2,4 tonnes of aluminium contained in the new aluminium frames



## REVIEW STATEMENT

**Case Study:** Renovation "Torenflat", Zeist, Netherlands  
**Commissioner:** European Aluminium Association AISBL, Brussels, Belgium  
**Reviewer:** Prof. Dr. Matthias Finkbeiner, Berlin, Germany

### Scope and Reference of the Review

The review of the case study is focused on the general criteria of scientific validity and technical quality. The review assessed whether the methods used to carry out the CO<sub>2</sub> and energy calculation are scientifically and technically valid, whether the data used are appropriate and reasonable in relation to the case study and whether the interpretations reflect any limitations of the study in a transparent and consistent manner.

The assessment of formal compliance with a particular reference document or standard as well as the verification of individual data or results is outside the scope of the review.

This review statement is valid for the presentation and calculation provided on 01.12.2012.

### Review Process

The review process started with the delivery of the case study documentation to the reviewer.

The reviewer provided questions for further clarification on the data used for the case study.

The calculation was checked for plausibility and spot-checks were performed to assess the reproducibility of the calculation.

### Review Results

The calculation was documented transparently in a spreadsheet and provides a CO<sub>2</sub> payback period of 13 years (no recycling) respectively 4,4 years (with recycling). The use phase data were modeled by Senter Novem, an agency of the Dutch Ministry of Economic Affairs. The production phase was modeled based on the material composition, i.e. without production losses. The end-of-life phase was calculated as two scenarios, i.e. with and without recycling.

The data used are appropriate and reasonable in relation to the case study. The use of simulation data for the use phase and the simplification to model the production based on the material composition should be clearly documented.

Overall, the assessment was found to be technically and scientifically valid.

Prof. Dr. Matthias Finkbeiner  
Berlin, 04.12.2012

# / Study realized in cooperation with...

Building owner: Woningcorporatie SGBB

- [www.vestia.nl](http://www.vestia.nl)

Architect: Frowijn de Roos, Zeist

- [www.frowijnderoos.nl](http://www.frowijnderoos.nl)

CO<sub>2</sub> reduction calculations: SenterNovem

- [www.senternovem.nl](http://www.senternovem.nl)

Profile system supplier: Schüco & Kremers

- [www.schueco.com](http://www.schueco.com)
- [www.kremerstilburg.nl](http://www.kremerstilburg.nl)

Façade Builder: Aluminium Kremers

- [www.kremerstilburg.nl](http://www.kremerstilburg.nl)

Life-cycle analysis: European Aluminium

- [leroy@european-aluminium.be](mailto:leroy@european-aluminium.be), [vatavalis@european-aluminium.be](mailto:vatavalis@european-aluminium.be),  
[gilmont@european-aluminium.be](mailto:gilmont@european-aluminium.be)

External review:

- [matthias@professor-finkbeiner.com](mailto:matthias@professor-finkbeiner.com)