EASIE Congress 23092011

Retrofitting of Sandwich Panels

Actions to return the resistance

Cladding of sandwich panels

Paavo Hassinen
Repairing of a wall or roof made of sandwich panels

- Cleaning and painting of the surfaces and improving or replacing of the fasteners
- Repairing of defects
- Covering the panels with new cladding

- New architectural appearance of old and new facades

- Improvement of mechanical and physical behaviour and resistance

- Extension of the service life of the sandwich panel wall and roof
Returning of resistance of panels exposed to blisters or accidental attacks

Artificial defects
- simulation of real defects and faults

Development of repairing actions
- four different techniques
- suitability to conditions on site

Experimental verification
Returning the resistance of panels exposed to blisters or accidental attacks

Development of repairing actions
Experimental verification
Testing of the suitability of the techniques on site

Photo; Eric Rustemeijer
Returning of resistance of panels
Artificial defects in the tests in IsMainz

A

B

C

D1

D2

one circular dent
- diameter D1 = 200 mm
- depth d1 = 10 mm

two circular dents
- diameter D2 = 200 mm
- depth d1 = 10 mm

E1

E2

Vickers' shaped defect
- width B1 = 200 mm
- depth d1 = 10 mm
Wrinkling stress of PU-foam cored sandwich panels before and after reparation actions (I, II, III and IV) of artificial defects (A, B, C), results by Anton Kull, IsMainz
Wrinkling stress of PU-foam cored sandwich panels before and after reparation actions (I, II, III and IV) of artificial defects (D1, D2, E1, E2), results by Anton Kull, IsMainz
Returning the resistance of face layers with faults and damages

- techniques to return the resistance partially
- full returning of the wrinkling strength is a demanding task
- knowledge about the level of the return is highly important in practice
Retrofitting, new to old concept

Tests at IsMainz and Aalto University
Retrofitting; Cladding based on thin-walled purlins and sheetings

pu-foam cored and steel sheet faced ordinary panels, screw fasteners

Photos: Jessica Kochenbach
Cladding based on thin-walled purlins and sheetings

Wrinkling failure along the plane of the web of Z- and hat profile

Photos: Jessica Kochenbach

Reduction of the load bearing capacity
Cladding based on thin-walled purlins and sheetings

Compression failure of the profile and face sheet

Improvement of the load bearing capacity

Photos: Jessica Kochenbach
Cladding based on thin-walled purlins and sheetings

pu-foam cored and steel sheet faced panels, screw fasteners

A) Ordinary sandwich panel
B) Sinusoidal sheet direct
C) two hat-profiles longitudinal
D) hat-profiles transverse
E) Z-profiles transverse

Resistance and stiffness depend on the span
Cladding based on thin-walled purlins and sheetings

Design using analytical or numerical models
Shear flexibility of the transverse purlins and fastenings
Verification of the resistance of the panel, purlins, sheeting and fastenings
Repair and retrofitting
Cladding based on additional sandwich panels

Screw and rivet fasteners

EPS foam cored and steel sheet faced additional panel

EPS foam cored and steel sheet faced ordinary sandwich panel
Repair and retrofitting
Cladding based on additional sandwich panels

Comparison between experimental and calculated results

EPS foam cored and steel sheet faced additional panel fixed to EPS cored and steel sheet faced ordinary panel
Cladding with additional panels

Flange normal forces
Steel sheet faced panel + steel sheet faced additional panel

Steel sheet faced panel + additional mono panel

Additional panel: upper face lower face

Original panel: upper face lower face
Cladding with additional panels

Comparison of experimental load-bearing capacity and stiffness to those of the ordinary sandwich panel

![Graph showing comparison of load-bearing capacity and stiffness](image)

- **Additional panels**
- **Additional monopanels**

Repeated load of 5000 cycles no noticeable effects
Repair and retrofitting

Verification of the resistance of the ordinary sandwich panel and the additional sandwich panel

Monopanel fixed to the external face

Additional thin sandwich panel fixed to the external face

Mechanical fastening

Ordinary sandwich panel

Three normal forces in the faces

Four normal forces in the faces
Cladding based on additional sandwich panels
Visual appearance

Effect and visibility of the fastenings of the additional element
Repair and retrofitting
Adhesive joints between the cladding components

Benefits
- fluent flow of stresses without local stress concentrations
- no holes through the external face of the sandwich panels
- no visible fastenings in the cladding

Challenges
- cleaning and primary coating of the surfaces in contact, methods and technique depends strongly on the coatings
- possible prestress during the hardening of the joint
- work to be made on site
Product of EASIE project; Practical guidelines on cladding and repairing of Sandwich panels

- distributions of the external mechanical pressure load
- distribution and effects of the temperature on the components of the cladding systems and the ordinary sandwich panel
- local stresses and effects caused by the self-weight of the additional cladding
- static interactions between the ordinary sandwich panel and the additional cladding
- effects of the local damages
- long-term effects caused by ageing and repeated loads
- influence of the cladding on the other properties of the panel such as the thermal insulation etc.
- good practice, including the return of resistance, also