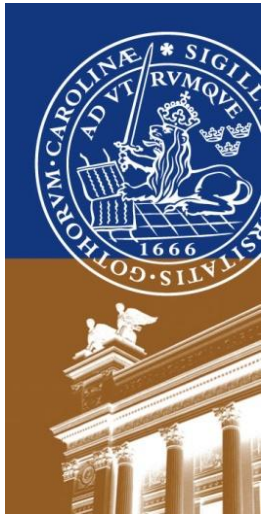
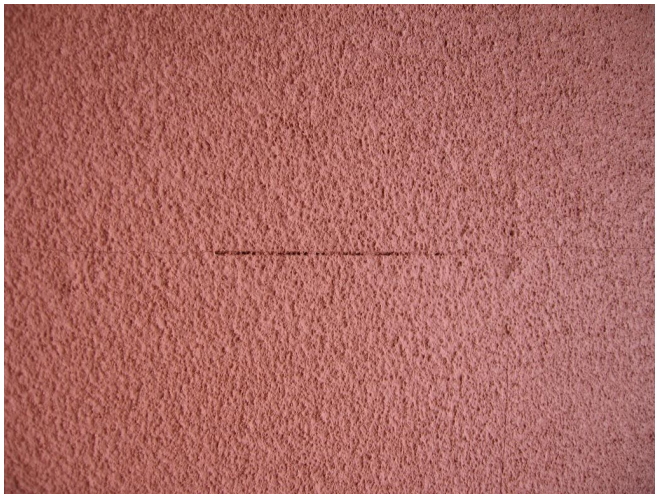
Tensile cracking of ventilated rendered rain-screen cladding systems

Miklós Molnár[1], Carl-Magnus Capener[2], Johan Jönsson[1] & Kenneth Sandin[1]
[1]Lund University, Sweden
[2]Saint-Gobain Byggprodukter AB, Sweden +SP

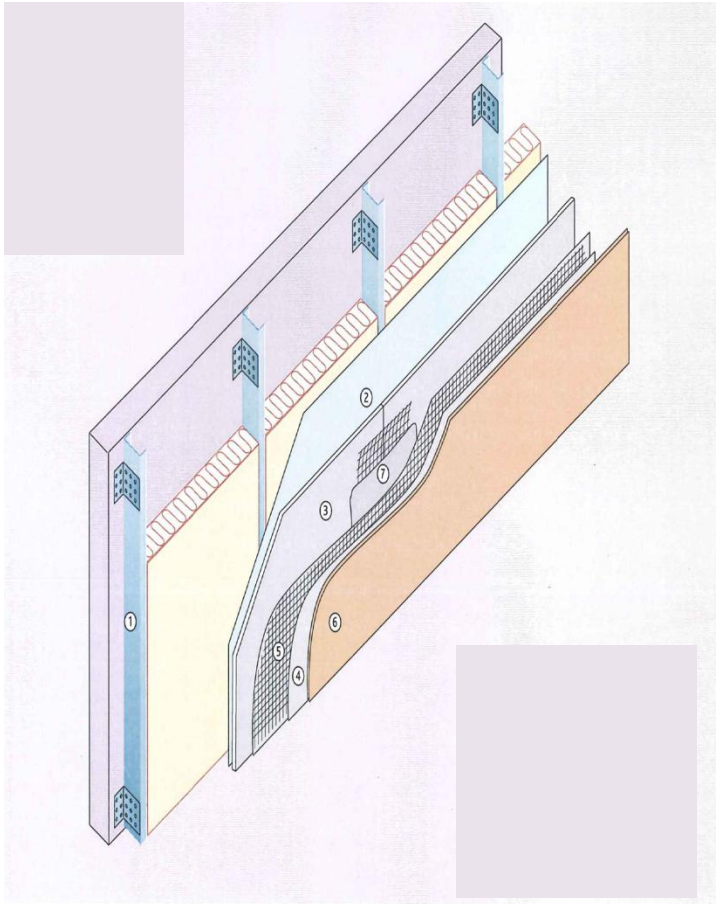


Ventilated rendered rain-screen cladding systems (VRRC)

- Increasing market shares in the Nordic countries due to moisture problems encountered with ETICS
- Available technical information is limited – lack of understanding among practitioners
- Cracks undesired from both moisture and aesthetic point of view



Components in a ventilated rendered rain-screen cladding system

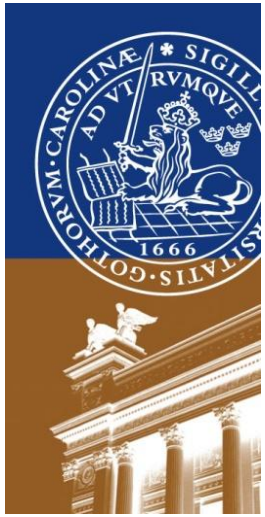


Source: Knauf Danogips

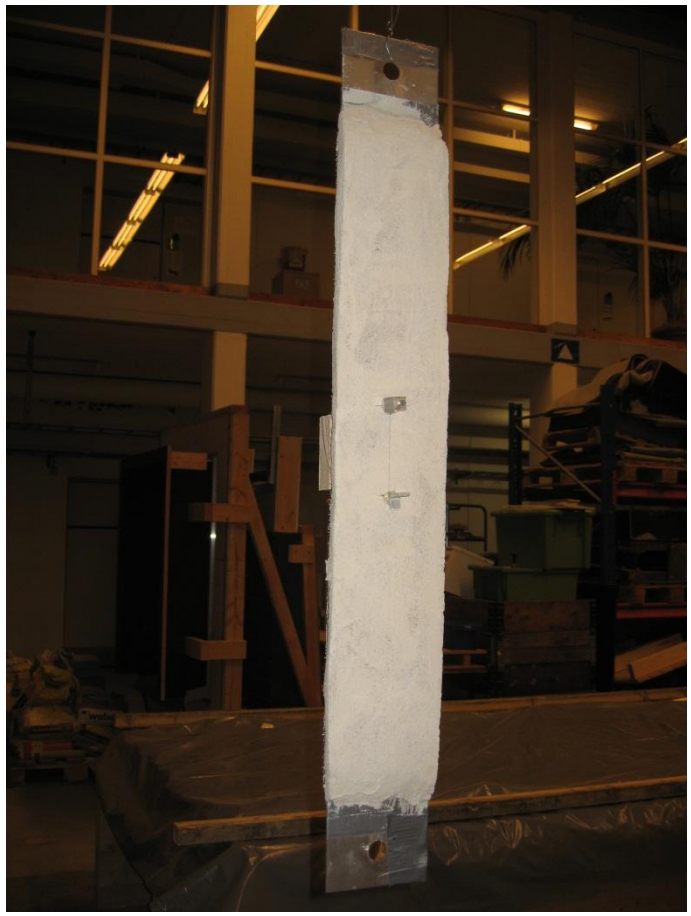
1. Lath – metal or wood
2. Weather barrier
3. Cement based board
4. Render
5. Surface reinforcement
6. Exterior finish
7. Joint filler and reinforcing strip

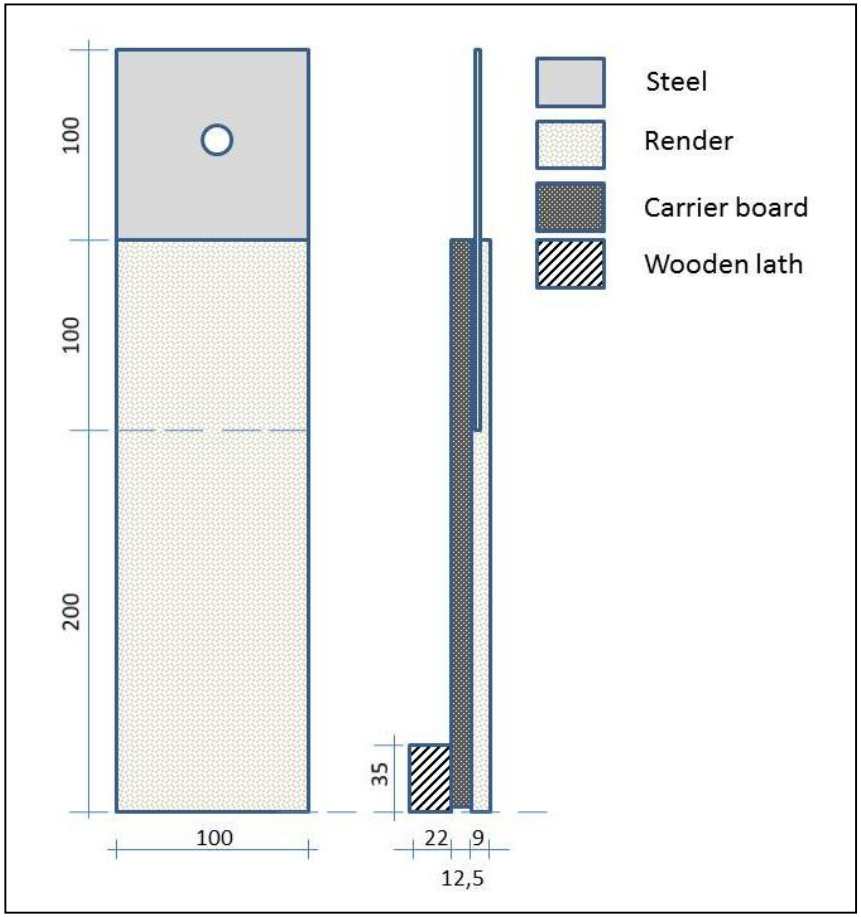
Tensile cracking at joints on timber laths

- Questions treated in the present paper:
  - At what levels of imposed deformations will cracks occur?
  - Do joints act as areas prone to cracking?
  - How do deviations from standard execution influence cracking of VRRCs?



Experimental details





Experimental details

Specimens

- Cement boards with surface reinforcement of glass fibre mesh
- Render of premixed cement mortar with dispersed fibre reinforcement and additives of plastic dispersion
- Joint reinforcement – strip of glass fibre mesh
- Surface reinforcement – glass fibre mesh
- Joint gap – partially filled with filler material

Testing machine

- MTS – displacement control (0.005 mm/s)

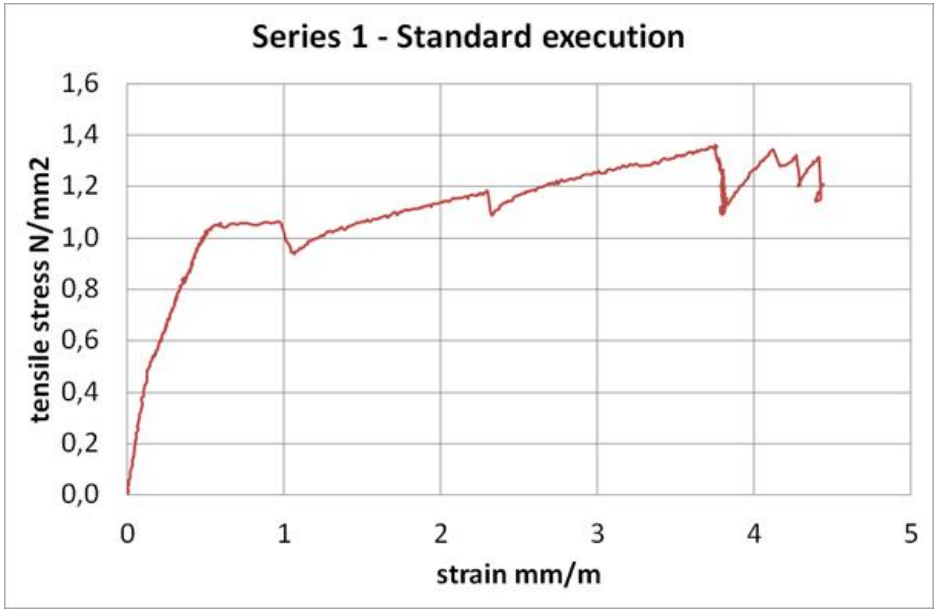
Measurement

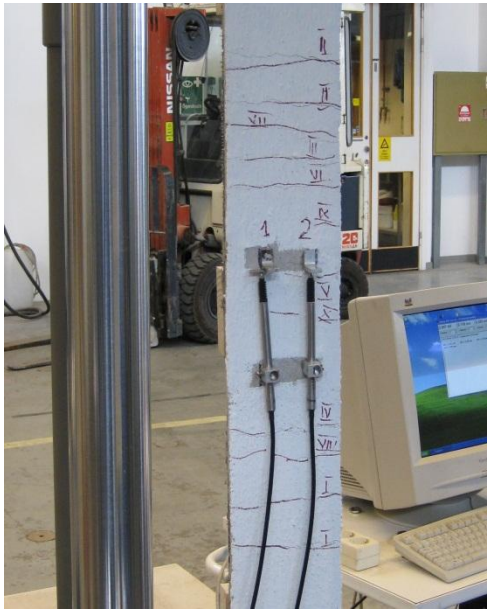
- Linear variable displacement transducers (LVDT) – attached in the vicinity of the joint

Test plan

- Standard execution – 3 specimens
- Omitted joint reinforcement – 4 specimens
- Omitted surface reinforcement – 4 specimens

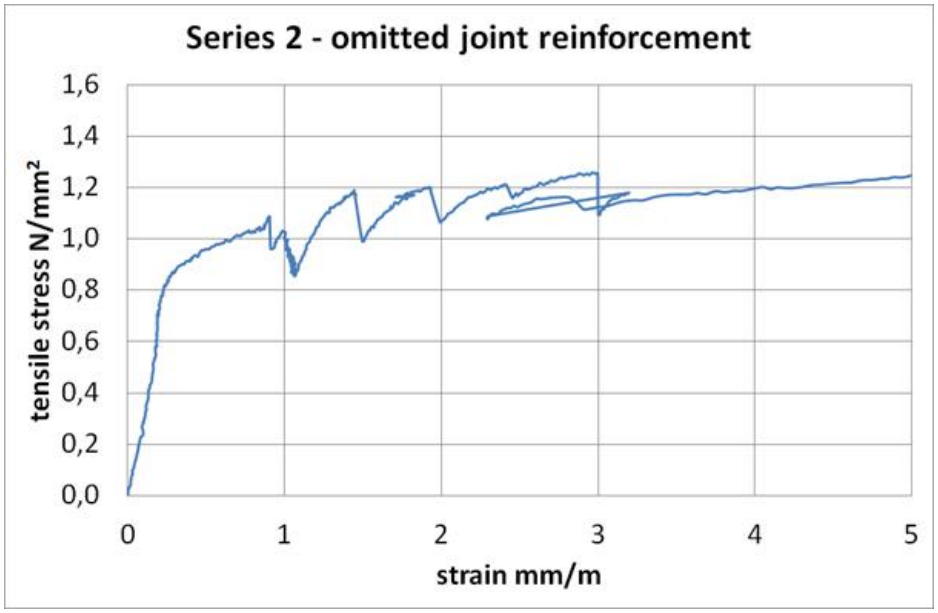
Results:
Series 1 - standard execution





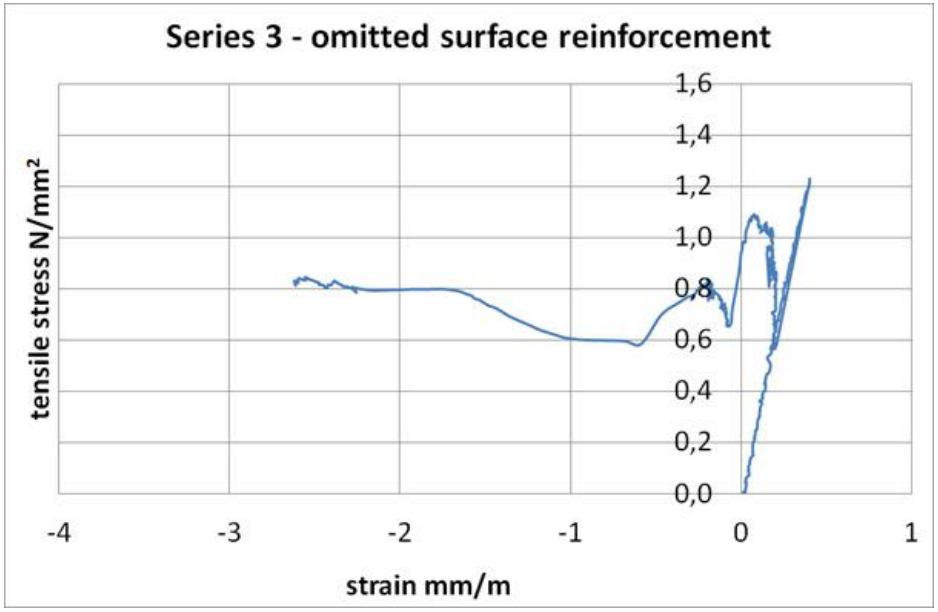
- Elasto-plastic behaviour of the joint area, without visible cracks at low levels of imposed strain
- The surface reinforcement results in limited crack width and cracks distributed over the entire specimen

Results:
Series 2 – specimens with omitted joint reinforcement



- Omitted joint reinforcement make cracks appear earlier in the vicinity of the joint
- Over-all crack pattern is similar to that observed on standard specimens

Results:
Series 3 – specimens with omitted surface reinforcement



- Omitted <u>surface</u> reinforcement results in fewer and wider cracks
- Higher stiffness due to homogeneous (undisturbed) render layer

Discussion

- Risk of cracking in VRRCs executed according to standard procedures
  - Moisture movement in cement based boards ~0.8 mm/m
  - Moisture movement in render > 0.7 mm/m
  - Future research – simulation of temperature and moisture conditions and related movements

- Joint areas are not more prone to cracking than the remainder of the façade – when properly detailed

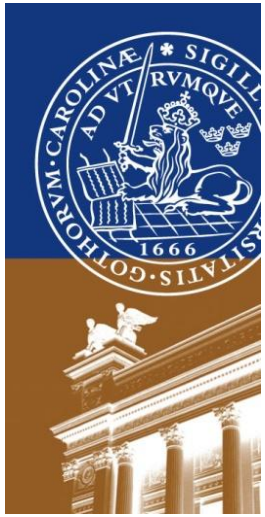
- Certain deviations from standard execution can have a detrimental effect on cracking properties of VRRCs
  - Omitting surface reinforcement results in large cracks

- Research design
  - Loading through steel plates induces stress concentrations
  - Long term effects, such as creep, might be significant – not investigated in this study
  - The beneficial effect of plastic additives might diminish with time – more brittle render?

Possible practical implications

- Joint reinforcement might be omitted – fasten all board extremities to lath
  - Shorter production process
  - Lower costs?

- Standard renders can replace renders with dispersed fibre reinforcement – surface reinforcement can be sufficient
  - Lower costs



Acknowledgements

- The Swedish Energy Agency (CERBOF grant 2008-59)
- The Development Fund of the Swedish Construction Industry (SBUF grant 12211)
- Weber - Saint-Gobain Byggprodukter AB