Southern Cross Station Melbourne

Kf. Fick / Corus Bausysteme Koblenz (D)
Southern Cross Station Melbourne

General description

• Traditional railway station, since 1859
• Formerly: Spencer Street (2005) and Batman’s Hill
• Renovation and redevelopment 2002 – 2006
• Architects: Sir Nicolas Grimshaw and Daryl Jackson (Grimshaw Jackson Joint Venture)
• Lubetkin Prize 2007 of Royal Institute of British Architects: „Most outstanding building outside the European Union. The station is simply a big roof over a complex piece of transport infrastructure, but really its vocation is as a civic structure“.
• 700 Mio Aus $ ≈ 450 Mio € ≈ 360 Mio £
Southern Cross Station Melbourne

Animation
Southern Cross Station Melbourne
Animation
Southern Cross Station Melbourne

Map of Station

22 tracks
14 platforms in use
Southern Cross Station Melbourne
Special Challenge

• The imagination of the dune-like roof shall be maintained
• No interruption of service allowed ⇒ most of work only by night possible (30 000 pass/day)
• Ready for the Commonwealth Games 2006
• Ambient cooling by natural ventilation
• To extract Diesel fumes from interstate trains and steam from occasional steam locomotives
• Dimension: 37 000 m² roof area
Southern Cross Station Melbourne

No interruption of service allowed!!
Southern Cross Station Melbourne

30 000 passengers per day
Southern Cross Station Melbourne

Short excursion to Kalzip

Kalzip? Where does it come from?

Kalzip Business Unit ⇒ Corus Bausysteme GmbH ⇒ Tata Steel Ltd

- Internationally networked: 4 legal entities
  Koblenz (D+EU+ME), Haydock (GB+US),
  Singapore (APac), Guangzhou (CN)
- Social: 600 employees worldwide
- Innovative: 48 applied patents for products and processes
- Safe: Health & Safety ISRS Level 8 at Koblenz
- Cooperative: International installer network > 120 partners
- Traditional: 40 years in the market
- Wide spread: Over 80 million square metres worldwide
- Successful: More than 10 companies have imitated Kalzip in Europe!
Southern Cross Station Melbourne

Short excursion to Kalzip

What is Kalzip?

**Standing Seam Roof System**

- Pre-fabricated (roll formed: in-house or mobile on site)
- Self supporting (spanning some meters)
- Seawater resistant Aluminium alloys
  (3000 series / AlMnMg-type)
- Metal or coloured surface (Al, Al+Zn, SP, PVDF)
- Various cross sections (50, 65 / 305 – 500)
- Shapes (from traditional straight to free form curved)
Zipped seam

Kalzip

Sheeting

Clip

Zipping the sheets

50 + 65

305 – 333 – 400 – 500
Zipping machine
Zipping the seams
Southern Cross Station Melbourne

Principle of Kalzip functionality

• Sliding of
  – Neighboured sheets relatively to each other
  – Sheeting over the clips

(Different to TRP or SWE)

• Aluminium: $\alpha_{th} = 24 \cdot 10^{-6} /K$
  – Therm. movement 2,4 mm/m at 100 K
  – E.g. Kalzip 65/400-1,0
    $F_{th}$: 58,4 kN/sheet in summer and 39 kN/sheet in winter

• Urgent necessary
  – Sliding ability for the sheets
  – One fixing point for each sheet
Kalzip metal surfaces

Stucco embossed

AluPlusPatina (pre-weathered)

AluPlusZinc (galvanized)
Kalzip Roof Built-up

Two layer roof (spanning from rafter to rafter)

- Roof decking
- Thermal insulation
- Intermediate structure
- Vapour control layer
- Inner shell: trapezoidal sheet
- Rafter (timber)
Kalzip Roof Built-up

Two layer roof (on purlins)

- Roof decking
- Thermal insulation
- Intermediate structure
- Vapour control layer
- Inner shell: trapezoidal sheet
- Purlin
Kalzip shapes

- straight
- convex curved
- concave curved
- tapered
- tapered-concave curved
- tapered-convex curved
Airport Barajas (E)

elliptically curved (bulged)

hyperbolically curved (contracted)
Kalzip shapes XT for free formed roofs and walls (bulging/contracting/curving about the strong and the weak axis)
Southern Cross Station Melbourne

Short excursion to Kalzip XT Roll Former
XT or scrab?
XT-Example: BMW Leipzig (D)
Kalzip in Scotland: SECC Glasgow
Edinburgh: New Craighall Fire Station
Edinburgh: New Royal Infirmary PFI
Southern Cross Station Melbourne

Roof construction

- 20 mountains
- Each different from the other (height, size and inclination)

Design procedure:
- Roof structure model sent from AUS to Koblenz/GER
- Design of a virtual surface and definition of each apex
More than 5,000 different single sheets

- Each sheet designed (3-D modelling)
- Drawn and numbered
- Design of accessories and details
- Data sent from Koblenz to Melbourne
- Produced close to site, numbered and installed
Southern Cross Station Melbourne
Design of Kalzip

Limiting points:
• Cover width 100 – 500 mm
• Sheet lengths ≤ 25 m
• Transversal joints in line
• To maintain ability to slide

Amount of time:
• 1 engineer ½ year
• 4 visits in AUS (2+2)
• (Very competent Australian installing company!)
Southern Cross Station Melbourne

Gutter detail

Gutter (36°) Detail

M 1:2

Kalzip 65 (Corus)
Clip 1100 (Corus)
Tube Sup. Clts (Corus)

2 x Riveted @ 5 x 12

Grip Angle (Corus)
Eave Filler Tape (Corus)
Eave Filler Rib (Corus)
Cut on Site
Southern Cross Station Melbourne

Fixing point detail

2x Rived Ø 5x12

Kolzip 65 (Corus)

Clip L100 (Corus)

Tube Sup. Clip (Corus)

Φ114

65
95
5
158
57
Southern Cross Station Melbourne

Overlap detail
Southern Cross Station Melbourne

Gable end detail
Southern Cross Station Melbourne

Roof construction

A free form roof construction requires an adequate substructure (whereas the railway service must go on!)

- Main girder: tubular construction in the “valleys”
- Rafters: tubular grid construction, filled with triangular cassettes (C-sections, sinusoidal sheets, final ceiling)
- Each of two installed first and after that connected with cassettes
- Intermediate construction to purlins: short tubes
- Tubular purlins (Ø 114 mm)
- Saddle shaped extrusions with intermediate foam pillows
- Clips and Kalzip
Southern Cross Station Melbourne

Substructure: Main girder
Rafters: tubular grid construction, filled with triangular cassettes (C-sections, sinusoidal sheets, final ceiling) Each of two installed first and after that filled with cassettes
Southern Cross Station Melbourne
Intermediate construction

- Triangular cassettes
- Consist of C-sections, sinusoidal sheets on top, final ceiling at bottom
- To connect two rafters to be installed first
- The gaps between filled then with the cassettes
- To close the station (prelim. roof)
- To have a free working place
Triangular cassettes with purlins
Waiting for Kalzip
Purlins
Saddle extrusion profile to adjust the clip position
How steep the mountains are!
Climbing the mountains
Stairway to heaven or misuse of Kalzip?
Climbing up the summit
The steam hats