Challenges in timber

Innovations in composite constructions

- connecting techniques - outlook

Dipl.-Ing. Matthias Gerold, Germany
Innovations in composite constructions
– connecting techniques – outlook

Introduction
Portage-viaduct of the Erie-railway (1851 - USA)

Timber –
the world‘s oldest building material
– also for crossing deep and wide valleys
97 m – tall-building

Redwoods California up to 120 m
High bending strength

Low weight

Slender cantilever construction:

Mobile tower

Rottenbuch (D)
Cantilever beam-bridge in Liling province Hunan (China)

Zamalong-bridge near Xining province Qinhai (China)
Long-spanned torsion tube (80 m):

- long service life
- separating and re-joining timber 2-D, 3-D – nearly unlimited dimensions
- combination with other materials
- suitable connecting techniques

Pedestrian bridge Neckarrems – Remseck (D)
Innovations in Composite constructions – connecting techniques – outlook
Composite timber – timber

Plates and boards

Bloc glued sections
Pedestrian bridge Reichenbach (D)
204 m long
Pedestrian bridge in Wernau over the river Neckar (D)
Bloc gluing
Composite timber – steel

Logs and cast iron knots
Prestressed girders
Cable bridges

Road bridge
München-Thalkirchen (D)
Composite timber – concrete

Road bridge near Innerferrera (CH)
Crestawaldbrücke near Sufers (CH)
Multi-storey-framework: Bloc 9 in the french quarter, Tübingen (D)

Floor slab

Reliable calculation methods to determine the influence of creep and shrinkage
Bonding
timber – glass

Structural glazing
Gluing

Dwelling house
Lill, Aichach (D)
Column - beam - glass front system
behind:
suspended facade

Office building Sortimo
Zusmarshausen (D)
Protection columns / beams from moisture

- timber - aluminium - posts
- resistant wood species
- plastic-coated surfaces

LG Service building Bollwerk, Stuttgart (D)
Bonding timber – plastic

e.g.

- High-grade-carbon sheets
- Glass fibre lamellas
- Textiles

Timber bridge near Sins over the river Reuss (CH)
CFK-reinforced girder
Textile structures

TU Dresden
Dowel connection
- glass fibre reinforced
Dowel connection
- glass fibre reinforced
- compacted wood

TU Dresden
Carbon or glass fibres for guying

Marien-church Meissen (D)
2 References to future abilities

Recycling products made of paper

Japanese pavilion at the EXPO Hannover 2000 (D)
Ashalt decks
directly on timber constructions

Andelfingen (CH)
Innovations in composite constructions

– Connecting techniques

– outlook
Zollinger roof (arched roof) at Ostfildern city (D)

Evolution: carpenters’s work / joint
BVD - anchordowel

Warnow-hall Rostock (D)
New exposition hall Karlsruhe (D) – multi-purpose-hall
construction testing
arched lamella
multi-purpose hall
coupling-joint

approval planning

Bollinger + Grohmann
special proposal / construction statics
Fa. WIEHAG
Multi-purpose-hall – end span between roof light and gable waal
"Breathing" of the roof
"Breathing" of the roof
International exhibition - EXPO Hannover 2000 (D)
Exhibition roof – bottom view

Mechanical fastener
Prestressed girder over the Main-Donau-canal near Essing (D)
Without glue -
without mechanical fastener

Wooden clamp
Servicability limit state

Gym Oulu (1985, SF)
Ultimate limit state with high stiffness

Today girders up to 95 m are economic in Germany

Pedestrian bridge Sindelfingen (D)
Innovations in composite constructions
– connecting techniques
– Outlook
Multi-hall Mannheim city (D)
Possibilities are nearly unlimited

Solemar Bad Dürrheim (D)
Wide variety of utilization

Assembly hall Padre Pio, San Giovanni Rotondo (I)
High level of prefabrication

„ structure = finish “

Gym of the elementary school Aichach-Nord (D)
Prefabrication improves quality, reduces construction time and offers a corresponding cost benefit.
Timber – sorting, CNC-application

→ High tech products
Homogenisation

→ dimensional stability

e.g. OSB, Parallam

Intrallam

Microllam, KERTO

TJI-girder etc.
Low follow-on costs
- even in case of remodelling, heightening or demolition
Low transport cost compared to concrete

„Dörfli“-bridge at Eggiwil (CH)
High load-bearing capacity

Wooden arch formwork for the concrete bridge over the Elorn near Brest (F)

⇒ timber supports concrete
Optimised structures

- hybrid systems, composite constructions
- exploitation of three-dimensional bracings
Optimised structures for

- wide-span girders subjected to bending
- arch constructions
- trusses with few joints
- light cross sections
- ...

Planning + construction
Period only 7 month

Economic costs 400,00 €/m²

Eposition hall VI in Sinsheim (D)
Fire protection
... is often already included
Benefits in terms of heat insulation

Elementary school Lichtenau (D)
High dynamic resistance!

Wind loads
Bridges
Seismic areas

Look-out tower Schauinsland, Freiburg (D)
Loop, Soltau (D)
High robustness
- Solid structures
Structural timber preservation

Mobile tower Rottenbuch (D)
Aggressive media - no problem

Gradierwerk Bad Kösen (D)
Innovations in composite construction
– connecting techniques – outlook

Conclusion
Timber is durable

Kapell-bridge Luzern (1333, CH)
High architectural appeal

Human factor

Dispatching hall (D)
Economic material
Unlimited possibilities
Regenerative

Positive ecological balance

→ Material for composite structures
Challenges in timber

Innovations in composite construction

- connecting techniques - outlook

Dipl.-Ing. Matthias Gerold, Germany