Connections in wooden construction

In wooden construction, mullion-transom connections can be so formed that they can stiffen a building. When subjected to loading through wind and weak earthquakes, these must be as rigid as possible in order to keep deformations to a minimum. In strong earthquakes, however, soft connections are advantageous. By allowing deformations, critical tensions cannot build up - the building can sway, but does not collapse.

The moment connectors developed at the Fraunhofer WKI are designed in such a way that the properties of the connector can be individually adjusted in accordance with the actual requirements. Figure 2 shows a schematic representation of a characteristic moment-distortion trajectory for the developed connectors. After an ideal linear-elastic initial rigidity (1 - wind and moderate earthquakes), a pronounced friction damping (2 - strong earthquakes) follows. Up to this point, the properties of the connector are completely reversible. Only during extreme earthquakes should plastic deformation occur, in order to absorb additional energy. By means of engineering methods, the connectors can be dimensioned for all loadings. Figure 4 shows the moment-distortion trajectories for differing connectors.

The developed moment connector was researched as a demonstrator within the EU project “SERIES – Seismic Engineering Research Infrastructures for European Synergies – High-performance composite-reinforced earthquake-resistant buildings with self-aligning capabilities”.

1 Newly developed moment connector with attached wooden components.
Newly developed moment connector with attached wooden components in the testing device.

The Fraunhofer IST thin film sensor, applied to a friction element for the moment connector.

Figure 2: Schematic representation of a typical moment-distortion trajectory with friction damping. © Jonas Leimcke

Figure 4: Actual moment-distortion trajectories for differing connectors under cyclic loading in accordance with DIN EN 12512. © Jonas Leimcke

and subsequently developed up to the prototype stage within the framework of a cooperation project with funding through the “Zentrales Innovationsprogramm Mittelstand – ZIM” (Central Innovation Programme for SMEs). The developed connector is fully functional. In order to investigate potentials and profitability assessments on real objects, the application of the connector is currently being planned in Italy.

Additional potential can be exploited with the sensors developed within the framework of the project, which offer new application possibilities in structural monitoring. The first experiments with the sensors developed by the Fraunhofer IST were successful. Figure 5 shows a sensor which is integrated into the connector and with which the loading conditions within the connection can be recorded. It is furthermore planned to develop actively reacting connectors; this, however, still requires considerable research. Whilst the current developed connector reacts solely passively to the influences, future connectors should actively alter their properties – depending on the loading situation.

3 Newly developed moment connector with attached wooden components in the testing device.

5 The Fraunhofer IST thin film sensor, applied to a friction element for the moment connector.

Figure 5: Actual moment-distortion trajectories for differing connectors under cyclic loading in accordance with DIN EN 12512. © Jonas Leimcke