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Wood is a hygroscopic and moisture-sensitive material that seeks to achieve equilibrium moisture content (EMC) with its surrounding environment. For softwood timber structures exposed to variations in climate throughout their service life, this behaviour results in variable moisture-content gradients that cause moisture-induced stresses in the direction of and perpendicular to the fibres. Although Eurocode 5 (EC5) states that moisture-induced stresses should be considered, they are often not adequately dealt with in building design due to the difficulties in predicting the stresses involved by hand. Accordingly, there is a need for advanced computer tools to study how the long-term stress behaviour of timber structures is affected by creep and cyclic variations in climate. A beam model to simulate the overall hygro-mechanical and visco-elastic behaviour of (inhomogeneous) glulam structures is presented. A two-dimensional transient, non-linear moisture transport model for wood is also developed and linked with this beam model. The combined models are used to study the long-term deformations and stresses in a curved frame structure exposed to both mechanical loading and cyclic climate conditions. It is shown that the moisture-induced deformations and stresses are of such magnitude that the design codes employed should take them into account. Thus it is argued that climate-related loads should be treated as separate load contributions that can be included in different load combinations.

General information

State: Published
Organisations: Department of Civil Engineering, Linnaeus University
Contributors: Ormarsson, S., Gislason, O. V.
Number of pages: 12
Pages: 307–318
Publication date: 2016
Peer-reviewed: Yes

Publication information

Journal: European Journal of Wood and Wood Industries (Print)
Volume: 74
Issue number: 3
ISSN (Print): 0018-3768
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.29 SJR 0.624 SNIP 1.186
Web of Science (2017): Impact factor 1.401
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.5 SJR 0.561 SNIP 1.096
Web of Science (2016): Impact factor 1.082
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.05 SJR 0.563 SNIP 1.044
Web of Science (2015): Impact factor 1.081
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.21 SJR 0.757 SNIP 1.419
Web of Science (2014): Impact factor 1.235
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.25 SJR 0.573 SNIP 1.397
Web of Science (2013): Impact factor 1.105
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 0.87 SJR 0.583 SNIP 1.281
Web of Science (2012): Impact factor 0.888
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 0.92 SJR 0.518 SNIP 1.117
Web of Science (2011): Impact factor 0.606
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.868 SNIP 1.403
Web of Science (2010): Impact factor 1.127
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.974 SNIP 1.254
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.78 SNIP 0.982
Scopus rating (2007): SJR 0.834 SNIP 1.046
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.46 SNIP 0.956
Scopus rating (2005): SJR 0.4 SNIP 0.827
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.462 SNIP 1.13
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.547 SNIP 1.004
Scopus rating (2002): SJR 0.485 SNIP 1.026
Scopus rating (2001): SJR 0.652 SNIP 1.04
Scopus rating (2000): SJR 0.319 SNIP 0.92
Scopus rating (1999): SJR 0.309 SNIP 0.552
Original language: English
DOIs:
10.1007/s00107-016-1006-5
Source: FindIt
Source-ID: 2292502615
Research output: Research - peer-review › Journal article – Annual report year: 2016