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Optimisation of the interval between trusses joined with nail plates in a farm utility building, with the use of MiTek software

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Abstract: *Optimisation of the interval between trusses joined with nail plates in a farm utility building, with the use of MiTek software.* The article presents investigations aimed at optimising the intervals between fink type truss components in a utility building. With assumptions concerning the loads, the span and other technical parameters, using the MiTek software for the dimensions and taking into account the costs of construction, the optimum interval between trusses was calculated as 1m to 1.2m.

Keywords: truss, nail plate, optimisation, interval

INTRODUCTION

When designing trusses joined with nail plates, we have to take into account a series of factors such as the load, the span and the interval. All these factors influence the roof construction cost, that is, the cost incurred by the investor. This paper's aim is to specify the optimum interval between trusses and, as a consequence, to minimise the investor's costs.

REFERENCE LITERATURE

The literature [1, 2,3,4] gives only recommendations concerning the intervals between trusses, paying attention to the economy of the design. Usually, it is assumed that the interval between trusses in timber frame buildings covered with oriented strand boards (OSB) is of 0.6m. In case of collar beam truss or queen post truss timber roofs, it is assumed that the optimum interval between rafters should be of 0.7 m to 0.8 m, then the amount of timber used to build the roof is the smallest [5, 6].

DESIGN ASSUMPTIONS

We analysed the most commonly used FINK[7] truss, assuming three angles of roof pitch: 15, 20 and 25 degrees. Moreover, we assumed that the farm utility building under analysis was located in the 2nd snow zone and the 1st wind zone, while the truss span amounted to 15m and the building was 50m long. Roof covering was done with trapezoidal sheet metal on wooden roofing battens – 0.12 KN/m^2, the bottom chord is a standard insulation of mineral wool: 150mm thick, two foils and plasterboard. Therefore, the total load of the bottom chord amounts to 0.35 KN/m^2. The interval between trusses assumed for the analysis was from 0.4 to 1.6 m, every 0.2m.The analysis took into account the cost of timber for the battens and for truss elements, as well as the cost of nail plates, on the basis of prices from 2012.

WORK METHODOLOGY

Snow and wind loads were calculated in accordance to Eurocode 1. Batten dimensioning was done in accordance to [1], taking into consideration two static diagrams of a double-span beam supporting its own load and the dynamic load in the first case, and its own load plus the load of a person with tools in the second case. The dimensioning of truss elements was made with the use of the MiTek software in accordance to Eurocode 5.

RESULTS AND THEIR ANALYSIS

Due to a very large amount of result data, we decided to present only the total cost for the truss under analysis, as on the Fig. 1,2.

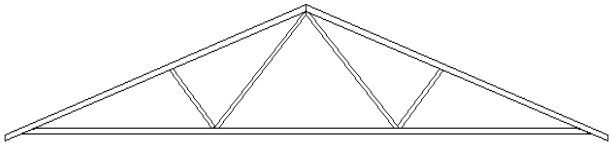

Fig. 1 Analyzed truss

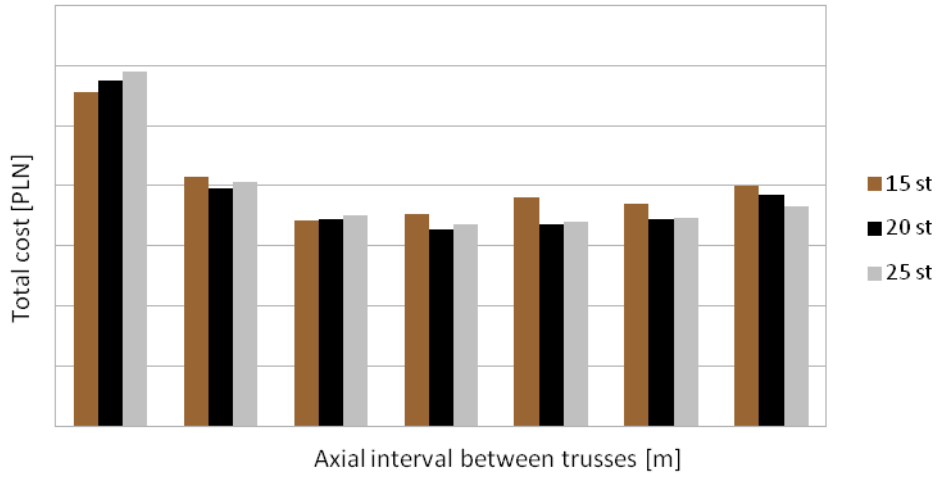

Fig. 2 Total cost of timber for battens, Fink trusses and nail plates in function of roof pitch and axial interval between trusses in the entire building.

The summary of cost changes in function of intervals and roof pitch has been presented with the use of regression curves, with the help of the STATGRAPHIC software. The charts are presented on Fig. 3

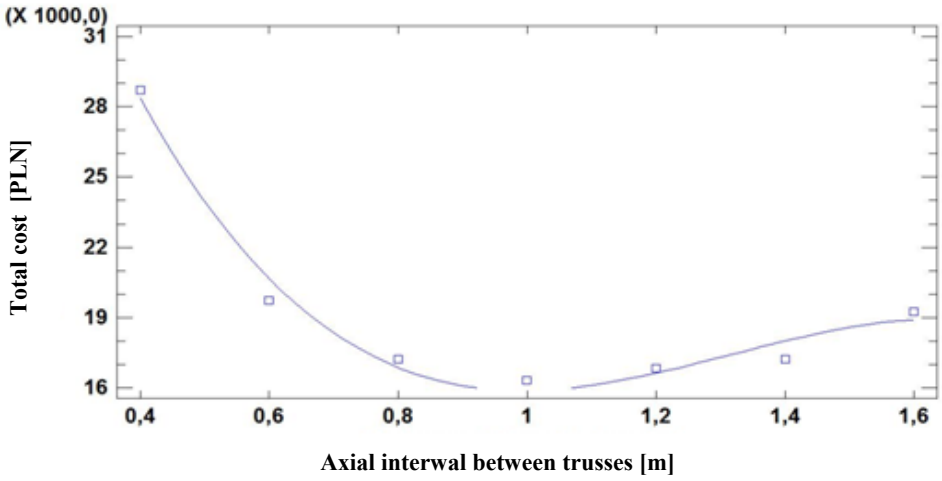

Fig. 3 Total changes of the costs of timber for battens, Fink trusses and nail plates at 20 degree roof pitch in the entire building. The regression curve obtained is: $f(x) = -22704.7x^3 + 896354.8\ x^2 - 110862x + 59811.5$

CONCLUSIONS

1. With the assumed parameters concerning permanent and variable loads, the most economical interval range for the truss under analysis is between 1m and 1.2m.
2. The impact of the cost of wooden battens on the total cost starts being visible at intervals bigger than 1m.

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Streszczenie: *Optymalizacja rozstawu wiązarów kratowych łączonych na płytki kolczaste w budynku gospodarczym przy wykorzystaniu programu MiTek.* W artykule przedstawiono badania mające na celu optymalizację rozstawu wiązarów kratowych typu FINK w budynku gospodarczym . Przy założeniach dotyczących obciążeń , rozpiętości i innych parametrów technicznych wykorzystując do wymiarowania program MiTek , oraz biorąc pod uwagę koszty wykonania stwierdzono że optymalny rozstaw wiązarów to 1m do 1.2m.

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