Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology No72, 2010: 378-381
(Ann. WULS-SGGW, For and Wood Technol. 72,2010)

Study on the application of different types of roof trusses in wooden constructions

ANDRZEJ TOMUSIAK
Department of Construction and Technology of Final Wood Products Warsaw University of Life Sciences-SGGW.

Abstract: *Study on the application of different types of roof trusses in wooden constructions.*
The study analyses the possibilities of using different types of roof trusses in wooden constructions. Such parameters as the usage of timber, the usage of gang nail connector plates and the value of forces in the truss elements were taken into consideration. The results of the study proved that the most useful type of truss for framing constructions is the FINK truss.

Keywords: truss, gang nail connector plate, timber, wood

INTRODUCTION

Roof trusses with gang nail connector plates are getting more and more popular in roof constructions. The reasons include their fast design [1,2], manufacture [3] and assembly at the construction site. Another doubtless advantage of such constructions is their cheapness.

OBJECT OF THE STUDY

The purpose of the study was to examine the possibility of using different types of trusses in timber roof constructions. The starting point for the study was:

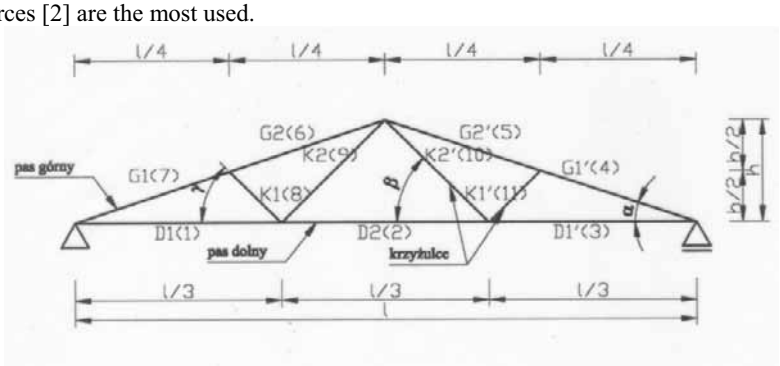
- the amount of timber used for the construction
- the amount of gang nail connector plates used
- the maximum forces acting on the elements of the truss.

Within the scope of the study there is:

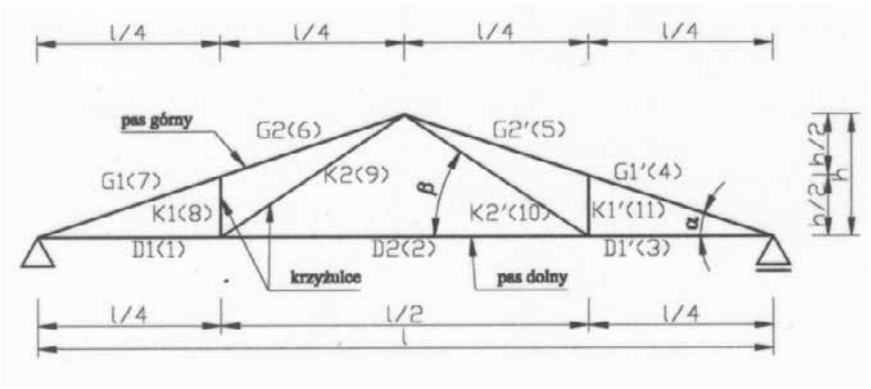
- the choice of trusses for analysis
- adopting project assumptions
- calculating the internal forces and designing the cross sections of the truss elements
- designing the surface of the gang nail connector plates.

PROJECT ASSUMPTIONS

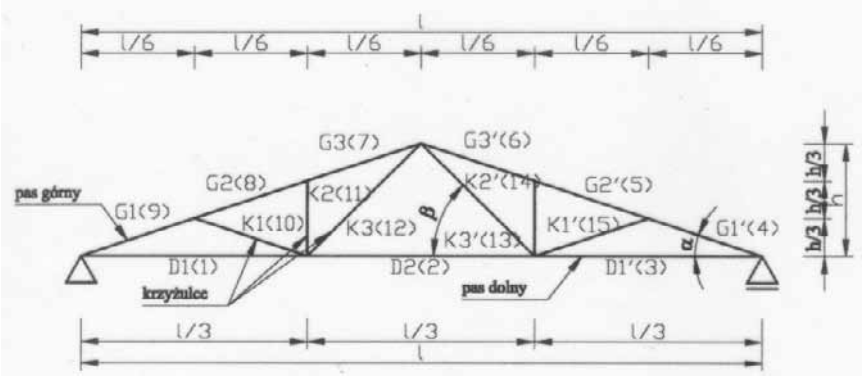
The trusses chosen for the purpose of the study were those used when the attics were not habitable. Therefore, the trusses used were as on the figure 1. Such trusses, according to the sources [2] are the most used.



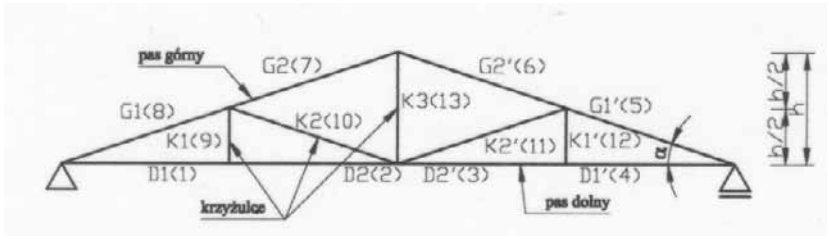
A



B



C



D

Figure.1 The trusses that were subject of the analysis: A – FINK, B – with vertical posts, C- with four diagonal members, D – "M" type

The trusses involved in the study were 8m, 10m and 12m wide. The pitch angle of the roof surface was the same in all types of trusses and amounted to 19 degrees – this is the angle which is the most frequently recommended [3]. Moreover, it was assumed that in the bottom chord there would be a suspended ceiling, the roof covering would be made of steel metal sheets, the spaces between truss units would be: 0.6m, the zone of snow load II [PN-EN 10/B- 02011], the zone of wind load I [PN-EN 08/B – 02010]. The class of timber in all the trusses was C27.

PROCESS OF THE STUDY

According to the rules of designing roof trusses, for the adopted assumptions, the values of loads at the nodes from vertical load on the top chord, bottom cord, and for wind load were calculated. Afterwards, the forces on the members were calculated for different load schemes.

After summing them up, the forces on the members were obtained [3]. Subsequently, the cross sections of the elements were planned, in accordance with the designing rules and the applicable norms [3]. Finally, gang nail connector plate surfaces were designed.

RESULTS

The results are presented in the tables from 1 to 3.

Table 1. Listings of maximum force values in the truss members [kN] for truss types A, B.

Truss type	A			B		
Span [m]	8	10	12	8	10	12
Member						
G_1	-12,7	-15,9	-19,1	-13,1	-16,4	-19,7
D_1	12,9	16,1	19,4	13,3	16,6	20,0
K_1	-2,2	-2,8	-3,3	-2,1	-2,6	-3,1
K'_1	-1,8	-2,4	-2,8	-1,8	-2,2	-2,6
K_2	3,7	4,7	5,6	5,9	7,4	8,9
K'_2	3,9	5,0	5,9	6,3	7,9	9,5

Table 2. Listings of maximum force values in the truss members [kN] for truss types C, D.

Truss type	C			D		
Span [m]	8	10	12	8	10	12
Member						
G_1	-13,9	-17,8	-20,9	-13,2	-16,5	-20,0
D_1	13,9	17,8	20,9	13,3	16,7	20,0
K_1	-2,2	-2,8	-3,3	0,8	1,0	1,2
K'_1	-1,9	-2,5	-2,9	0,8	1,0	1,2
K_2	-1,4	-1,8	-2,1	-4,6	-5,7	-6,9
K'_2	-1,2	-1,6	-1,9	-4,0	-5,0	-6,1

Tab. 3. The amount of timber used for manufacturing one unit of the truss [m^3] and the amount of Merit F gang nail plates used [dm^2] in each type of roof trusses.

Truss type	A		B		C		D	
Span [m]	Timber usage [m^3]	Nail plate usage [dm^2]	Timber usage [m^3]	Nail plate usage [dm^2]	Timber usage [m^3]	Nail plate usage [dm^2]	Timber usage [m^3]	Nail plate usage [dm^2]
8	0,091	40,4	0,095	41,4	0,100	50,5	0,104	42,2
10	0,133	43,2	0,145	49,7	0,125	66,2	0,159	48,1
12	0,180	45,7	0,201	51,4	0,200	69,4	0,201	55,0
average	0,135	43,1	0,147	47,2	0,142	62,0	0,155	48,4

RESULT ANALYSIS

The calculations which were carried out showed that the usage of timber grows by leaps and depends on the span of the truss units. However, for the 8m trusses, the A type has the lowest usage of timber ($0{,}091m^3$), whereas the D type has the highest usage of timber ($0{,}104m^3$), the difference being of 14%. For the trusses which are 10m and 12m wide, this difference amounts to 11,7%. Taking into account the average timber usage for all the spans, the smallest usage characterizes type A truss. The lowest usage of Merit F nail gangs occurs with the truss type A – an average of $43{,}1dm^2$, and the highest usage occurs with the truss type C- $62dm^2$, resulting in a difference of about 30%.

While comparing the maximum forces on the members, we may notice that they grow together with the span, which is natural. However, for the same span, the smallest forces characterize the truss type A, but the differences are small and amount to several percent.

CONCLUSIONS

On the basis of the study conducted, the following conclusions were drawn:

1. The lowest usage of timber is needed for the truss type A.
2. The surface of gang nail connector plates used for the joints of the elements in the truss type A, was the smallest.
3. The maximum axial forces for the truss type A have the lowest value.
4. The study confirmed the most frequent and most extended application of FINK trusses in wooden framing constructions of small cubature.

REFERENCES

1. KOTWICA J.2005:Konstrukcje drewniane w budownictwie tradycyjnym. Arkady, Warszawa.
2. MIELCZAREK Z.1994:Budownictwo drewniane. Arkady, Warszawa.
3. NOŻYŃSKI W.1994:Przykłady obliczeń konstrukcji budowlanych z drewna. Wydawnictwa Szkolne i Pedagogiczne, Warszawa.

Streszczenie: *Study on the application of different types of roof trusses in wooden constructions.* W pracy badano możliwości wykorzystania różnych typów wiązarów kratowych w konstrukcjach drewnianych. Wzięto pod uwagę zużycie drewna ,płytek kolczastych, wartości sił występujące w elementach kratownic. Stwierdzono że najbardziej przydatnym wiązarem w konstrukcjach szkieletowych jest wiązar typu FINCK.

Corresponding author:
Andrzej Tomusiak
Department of Construction and Technology of Final Wood Products
Szkoła Główna Gospodarstwa Wiejskiego
02-787 Warszawa, ul. Nowoursynowska 166
E – mail address: andrzej_tomusiak@sggw.pl
Poland