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LAMPIRAN

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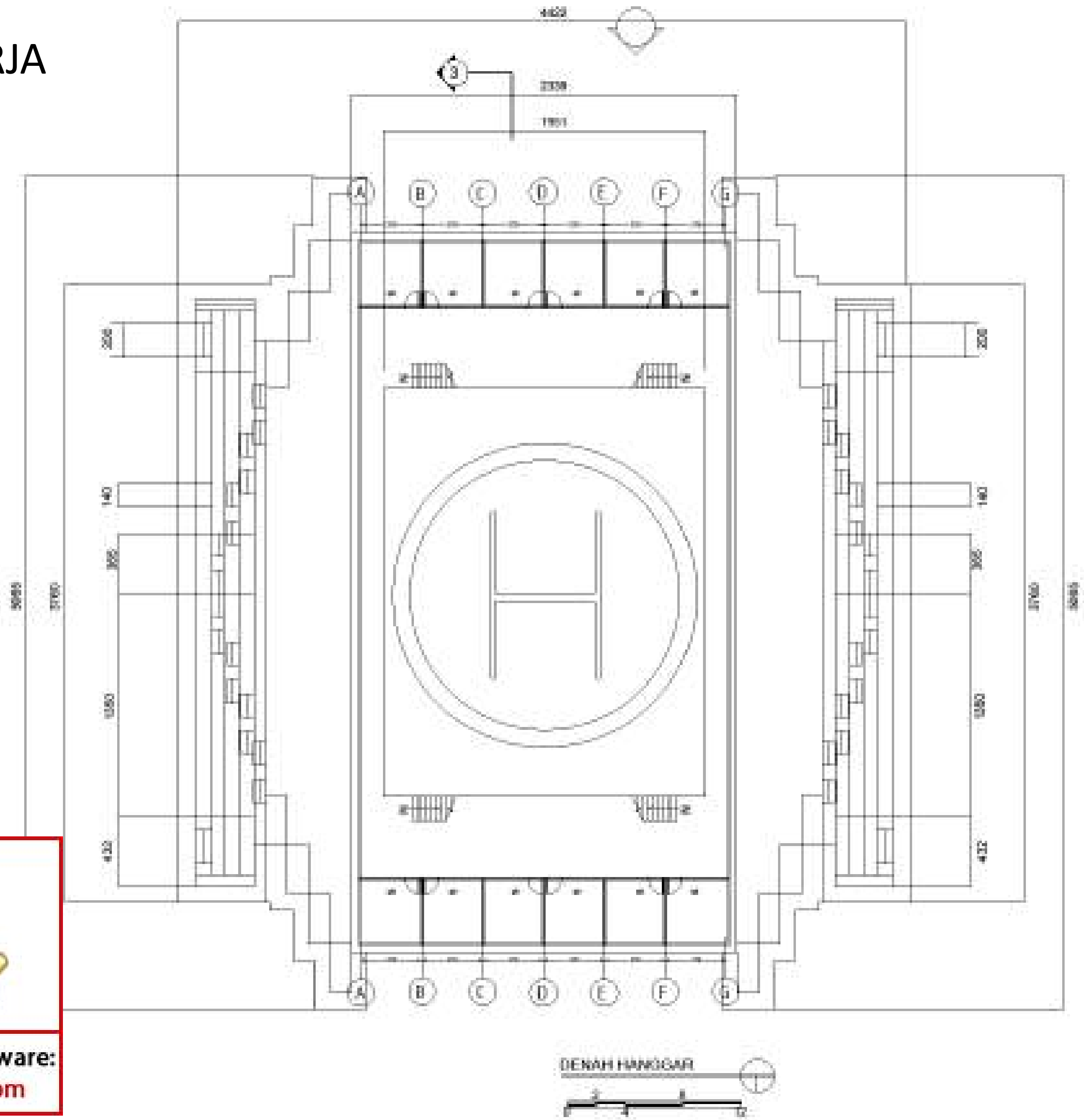

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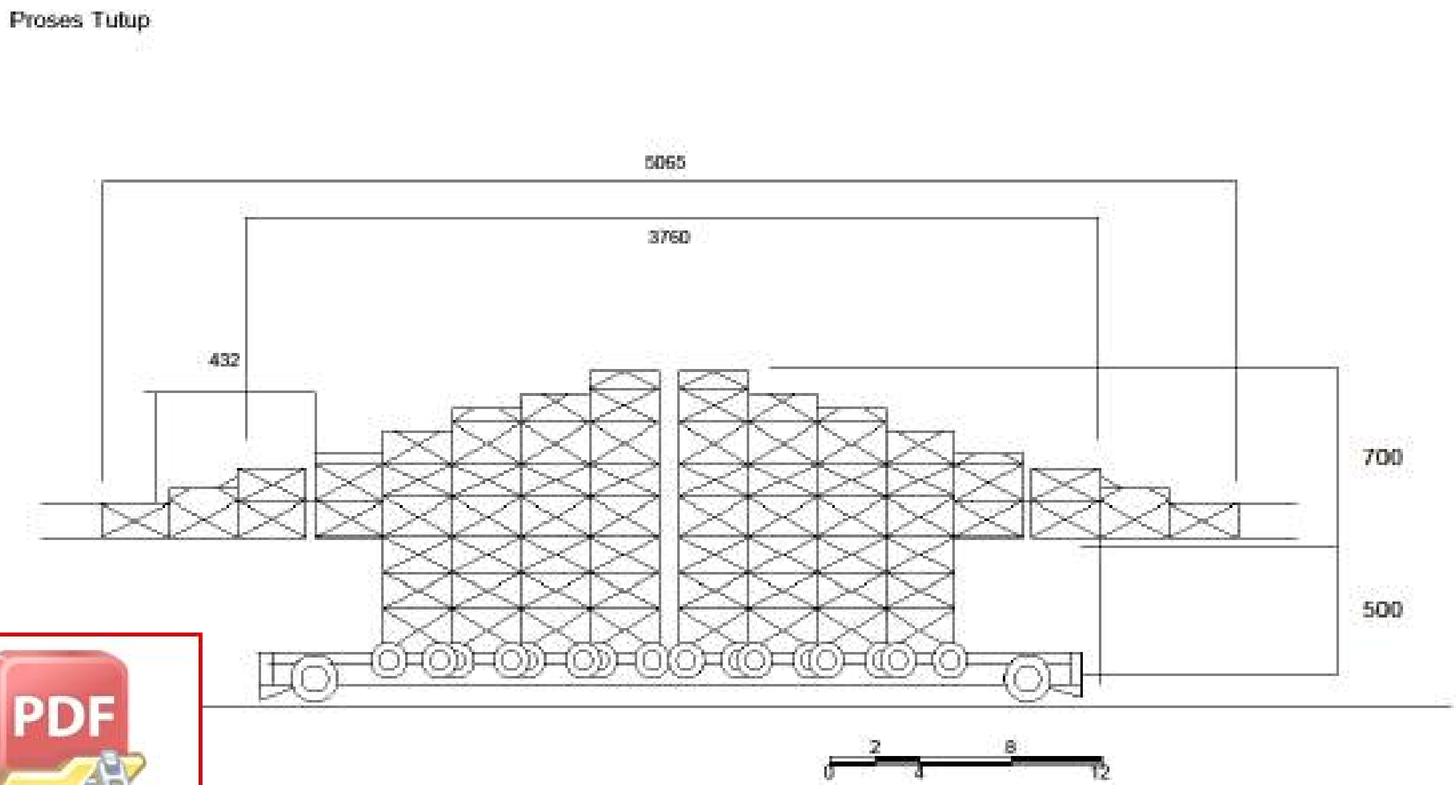

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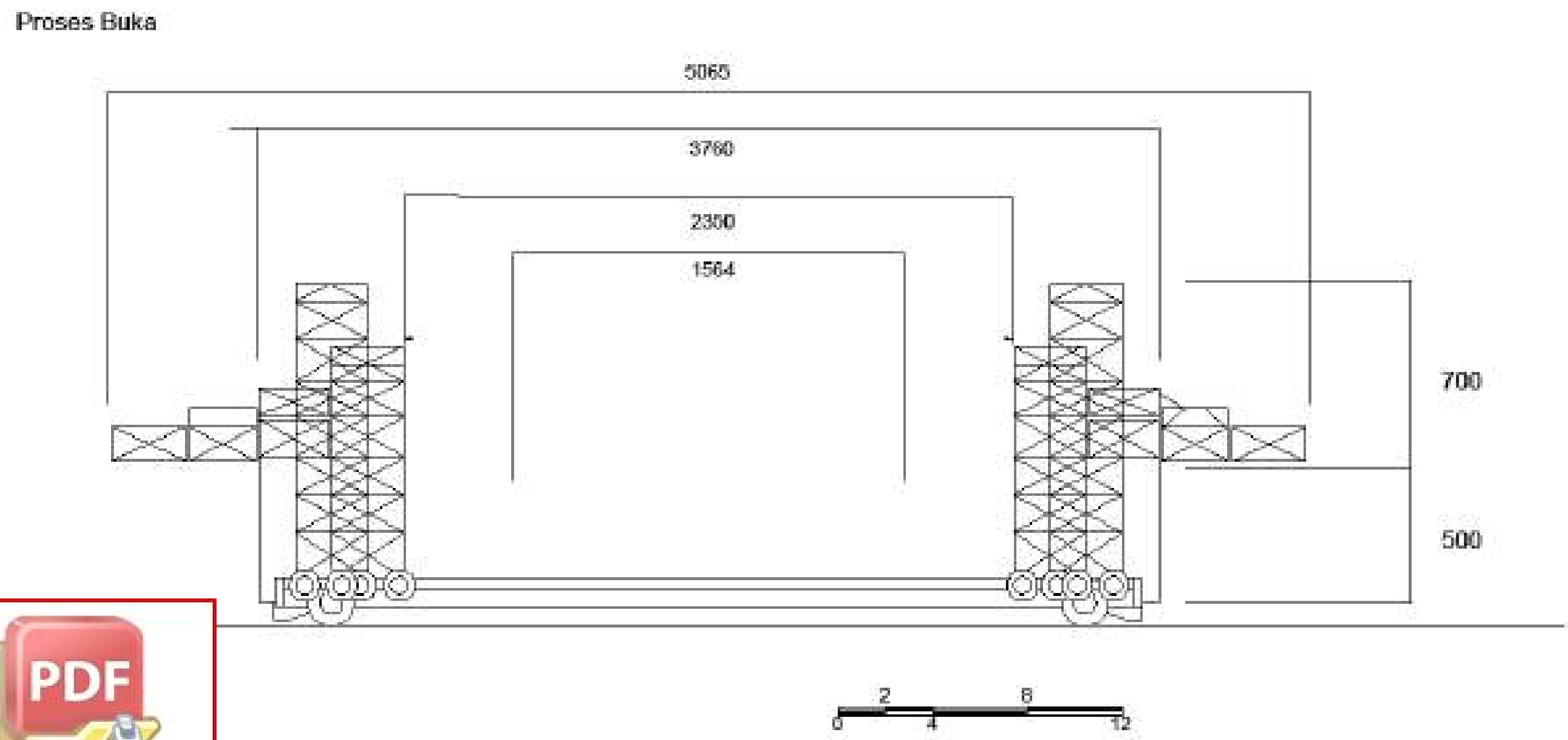

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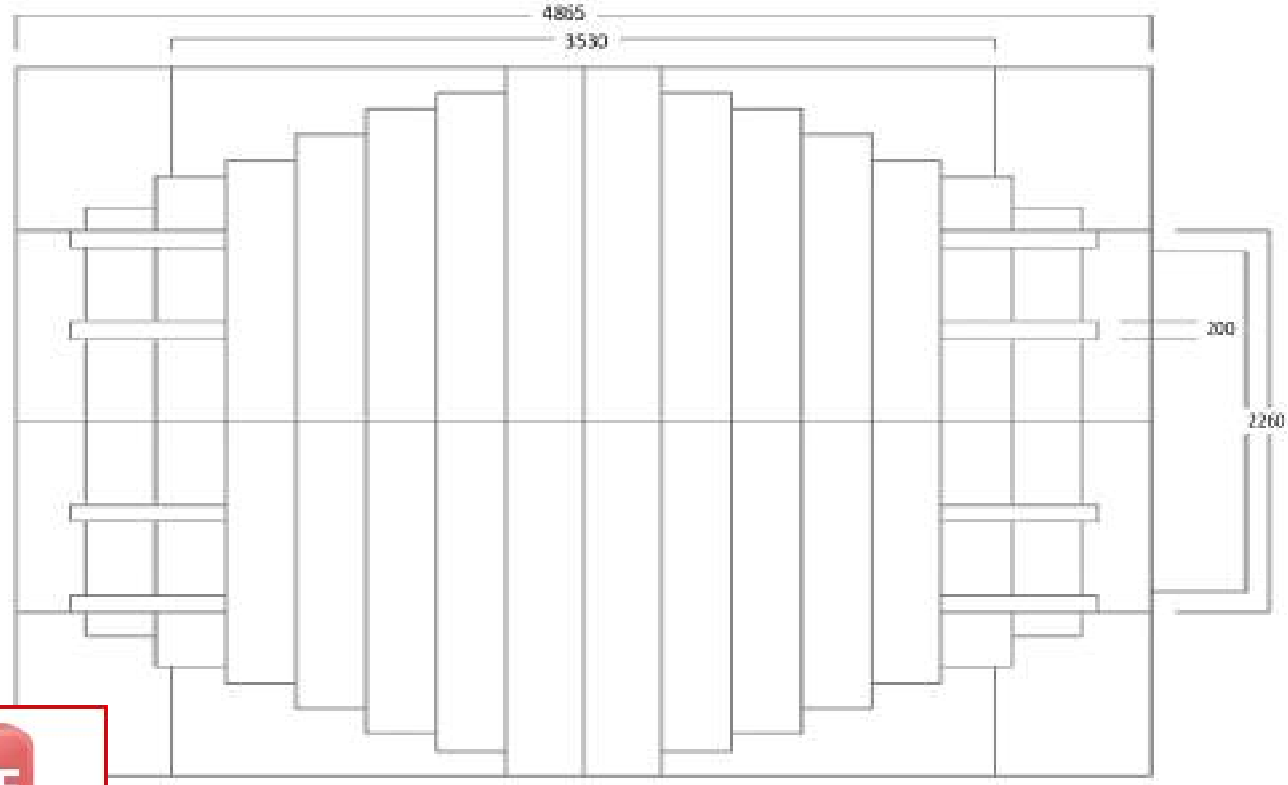

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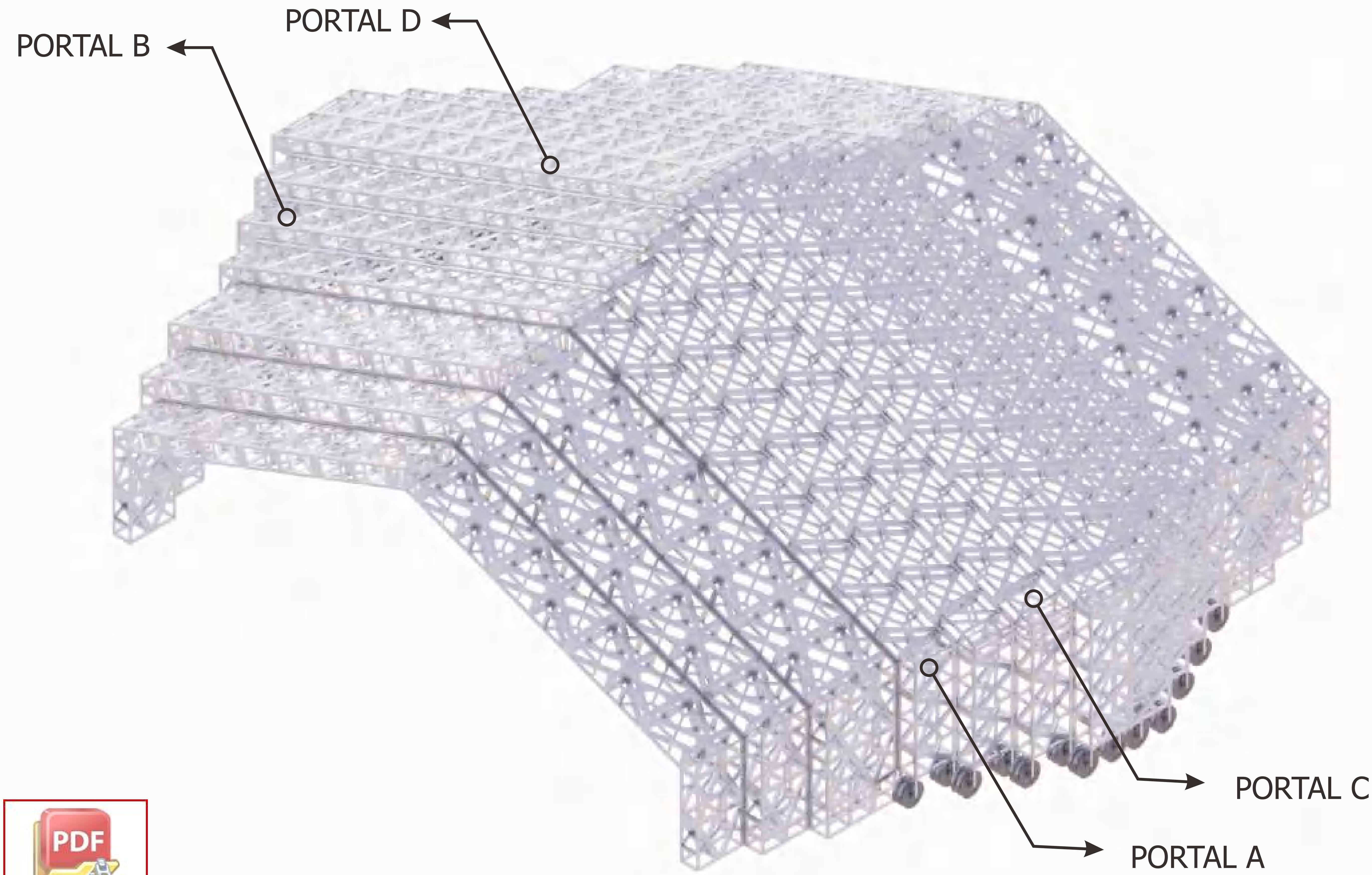

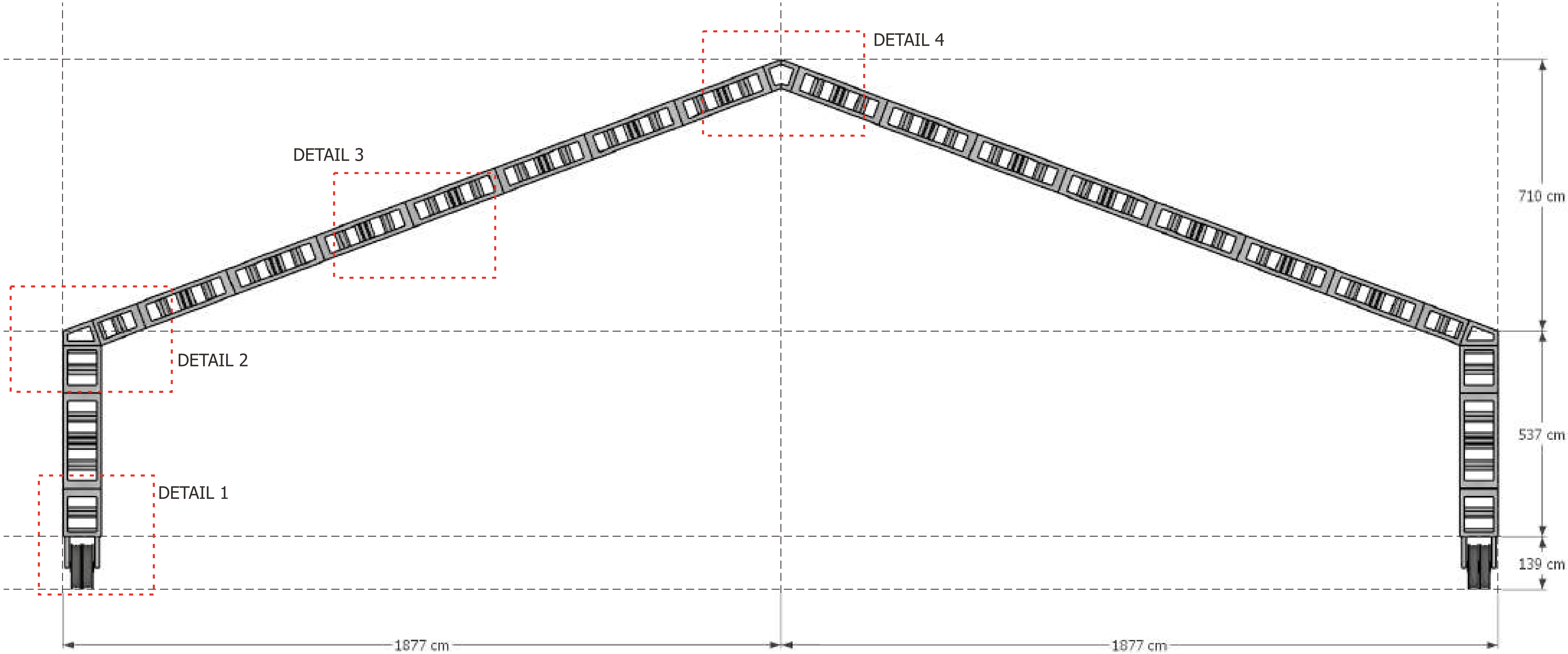

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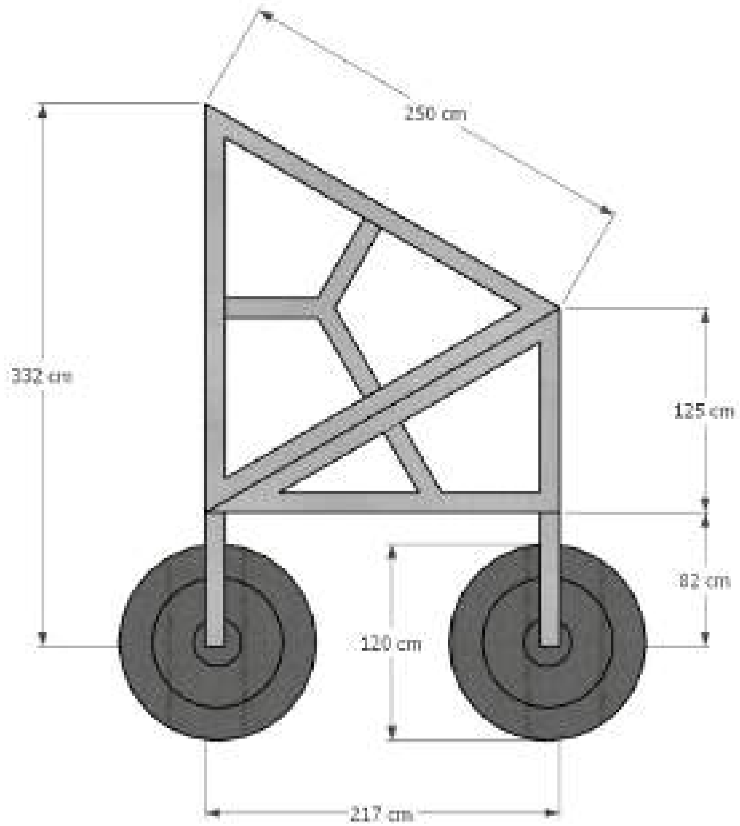
PORTAL A



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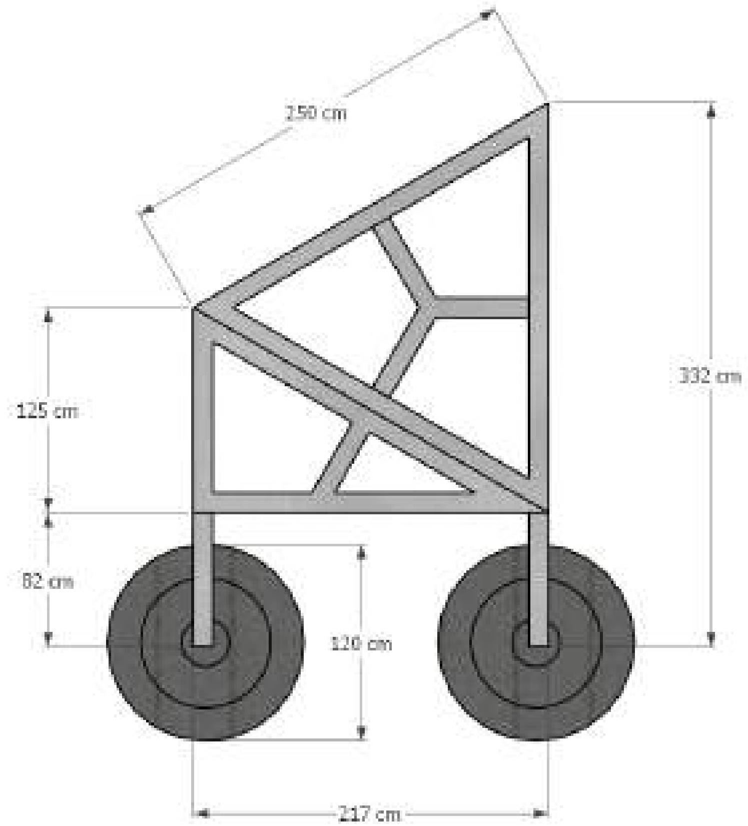

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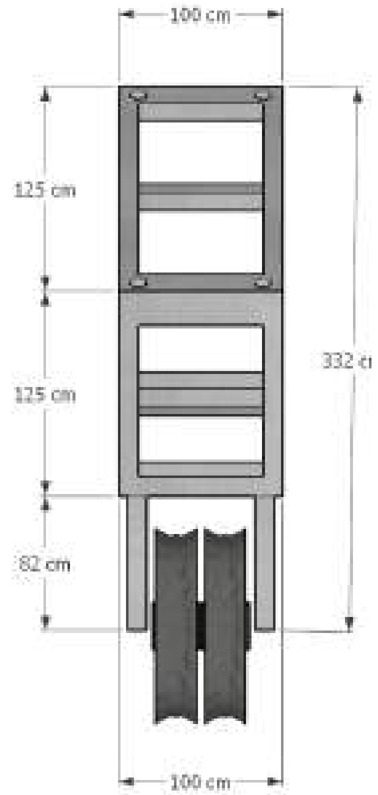

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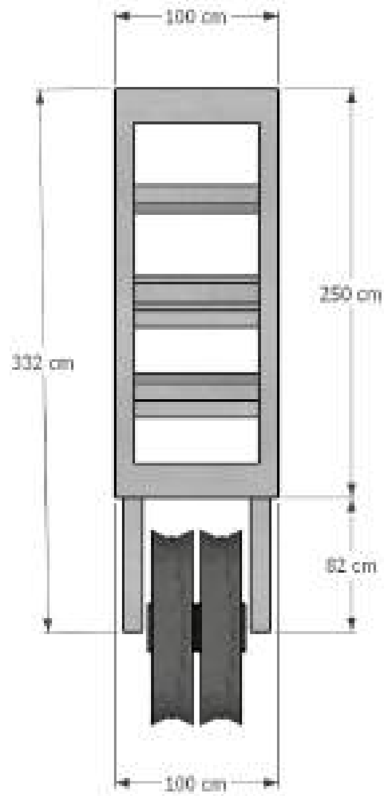

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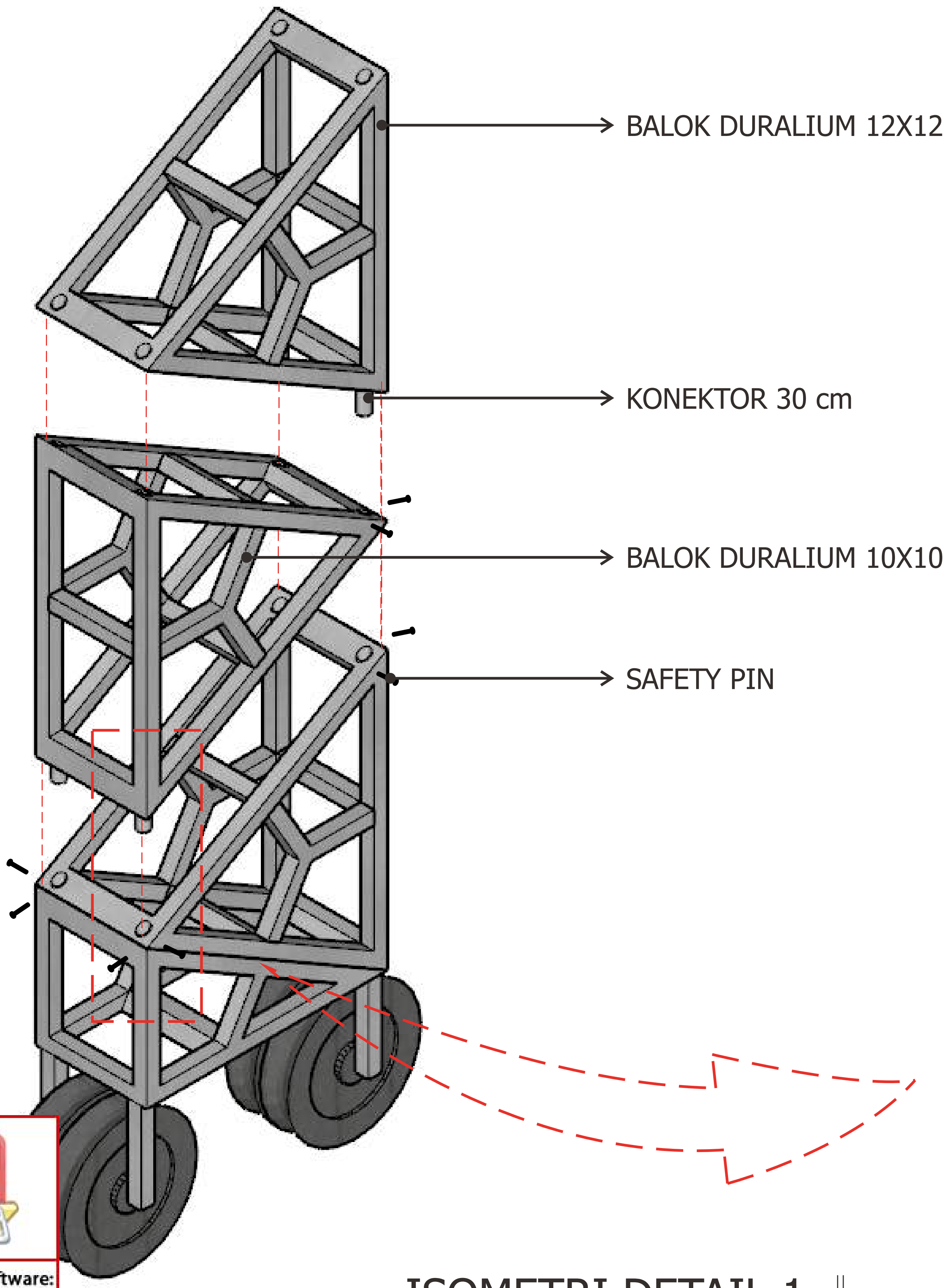

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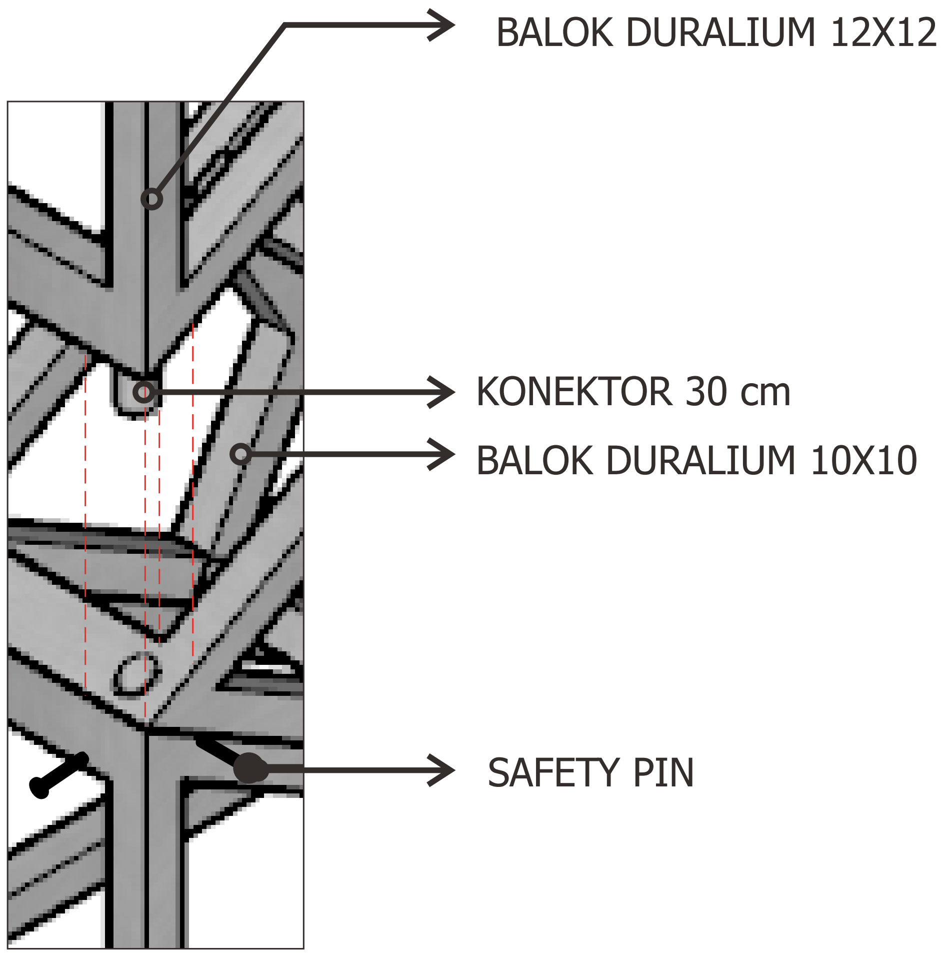

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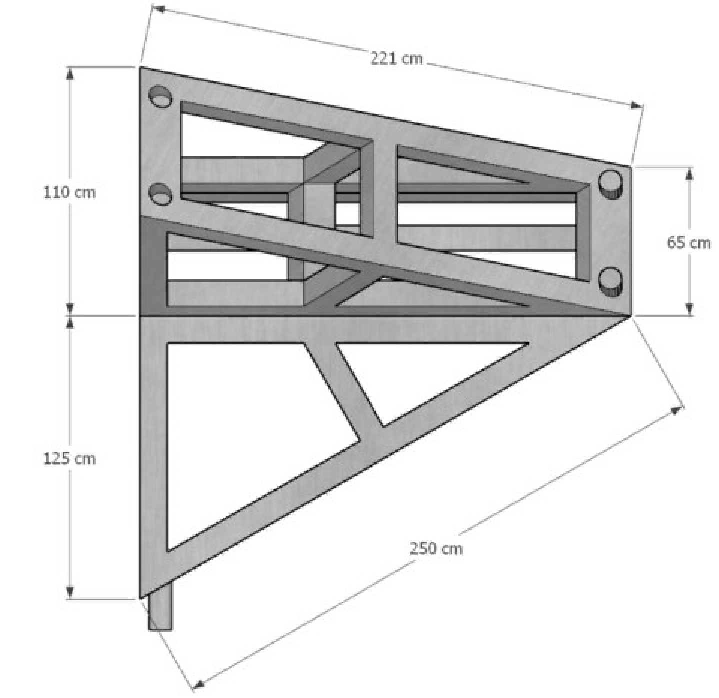

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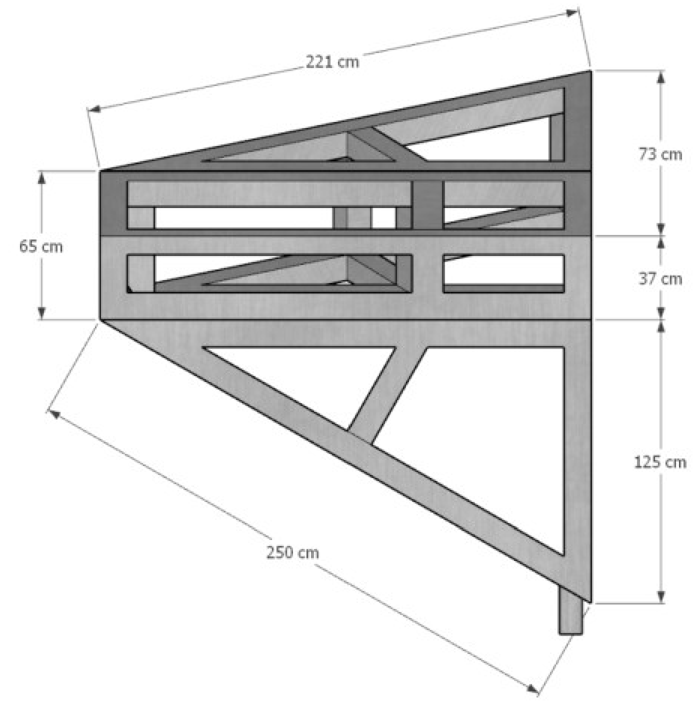

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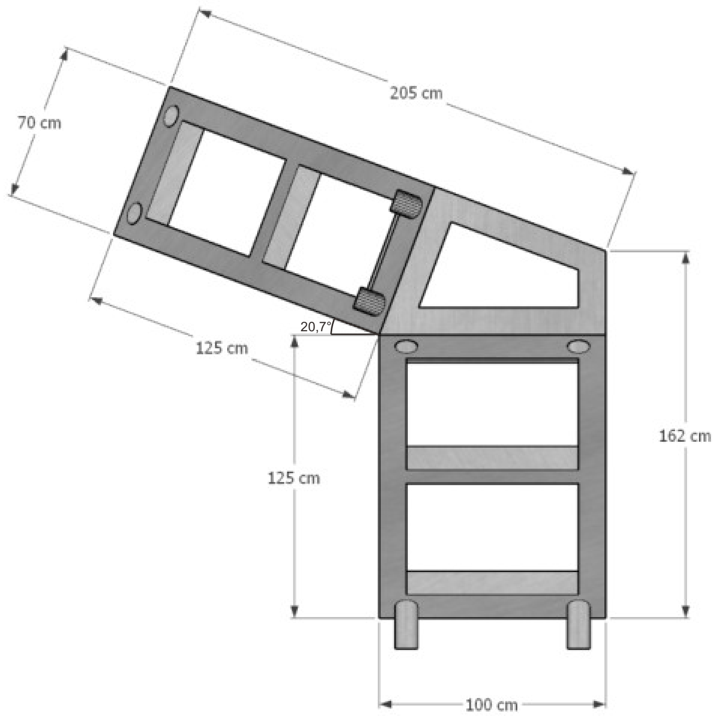

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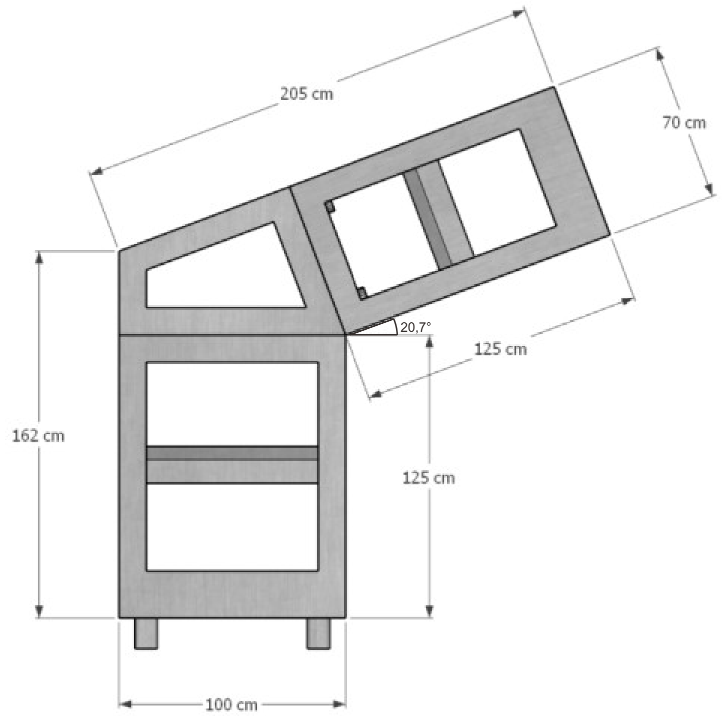

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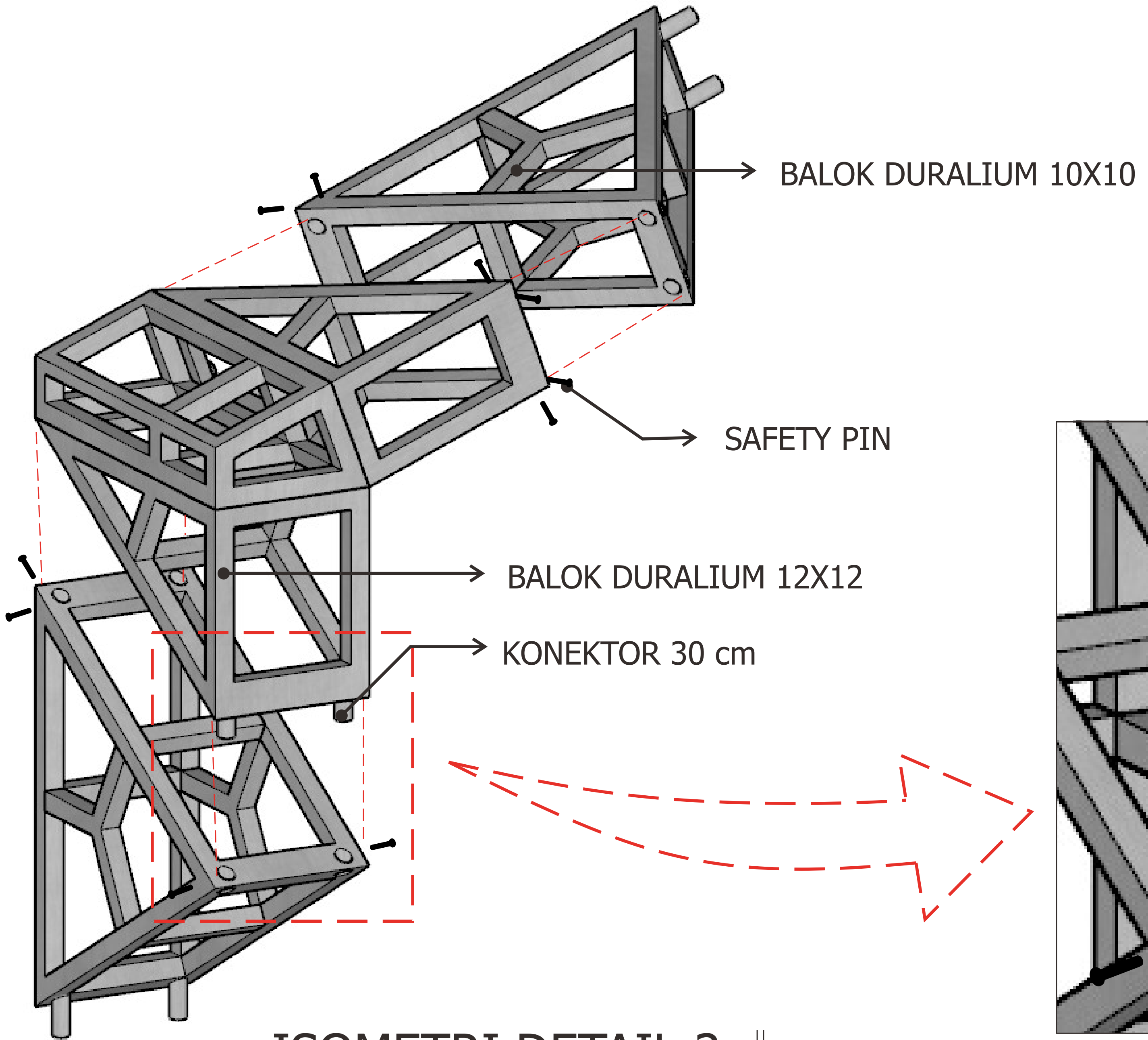

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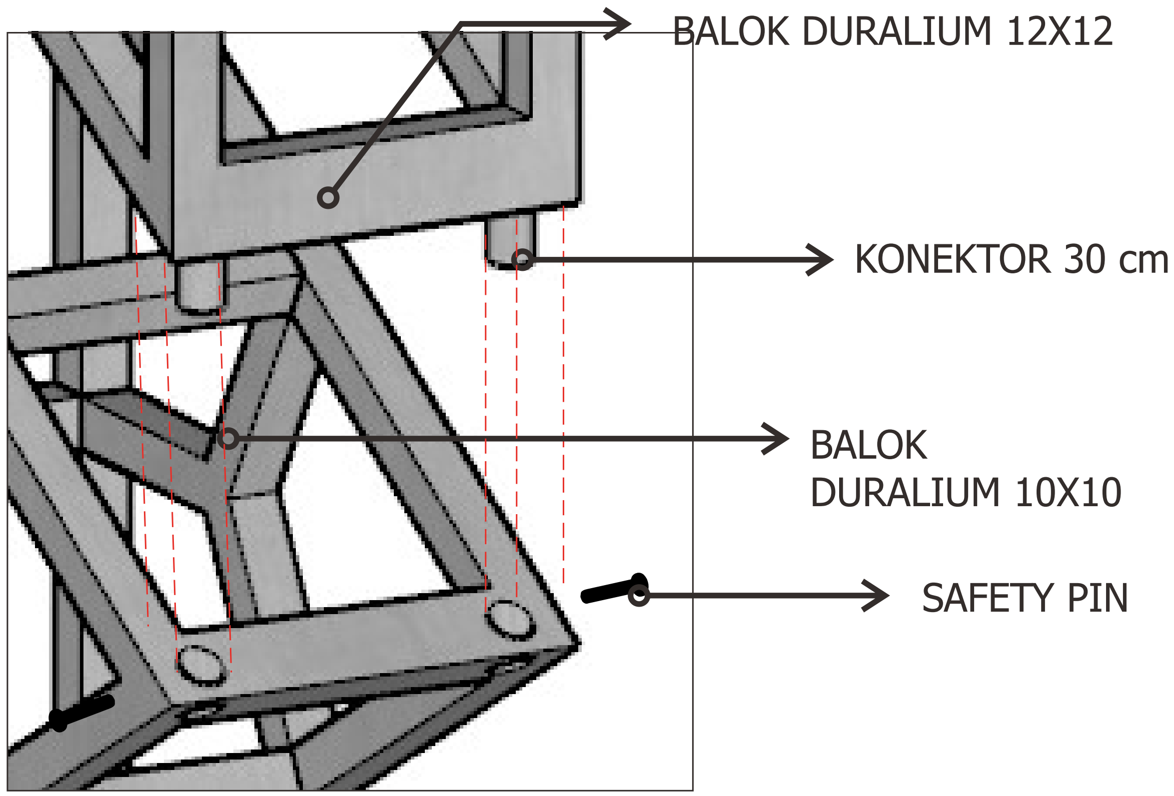

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PORTAL A

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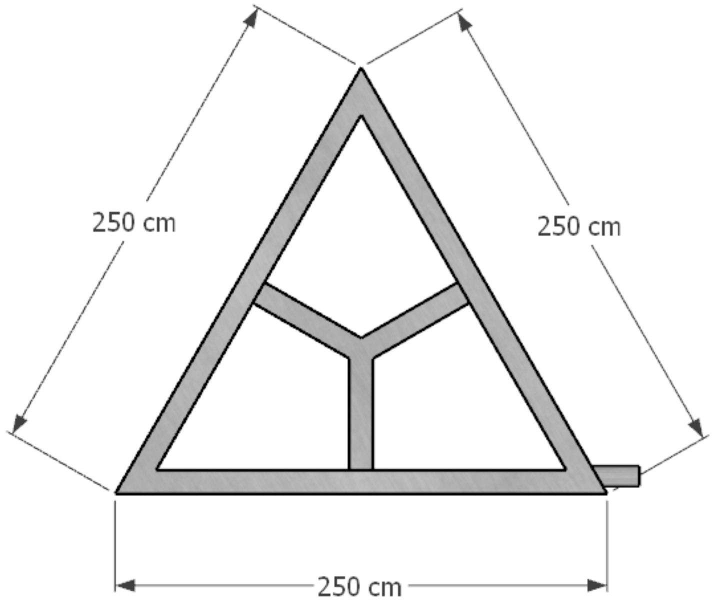

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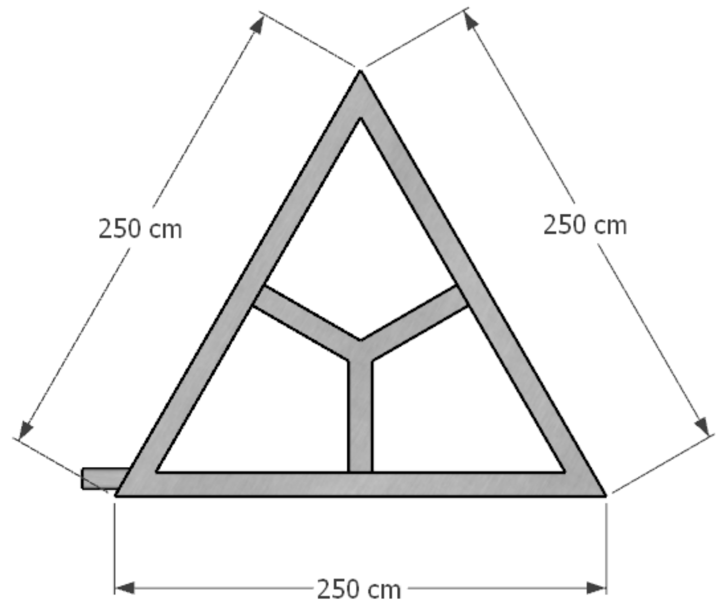

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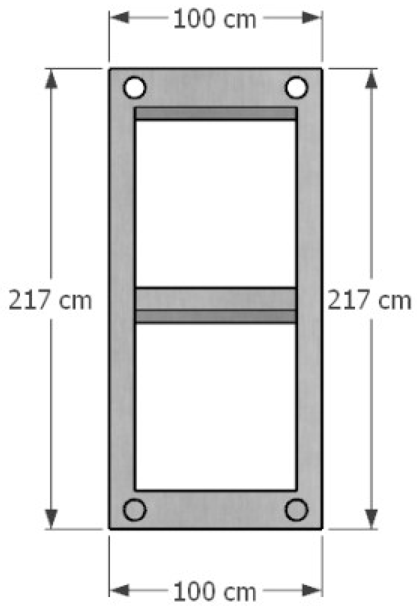

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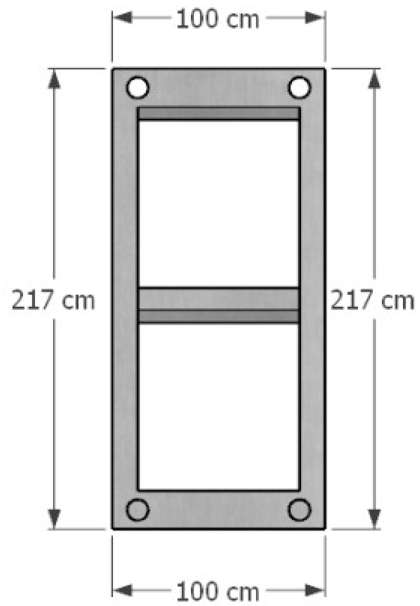

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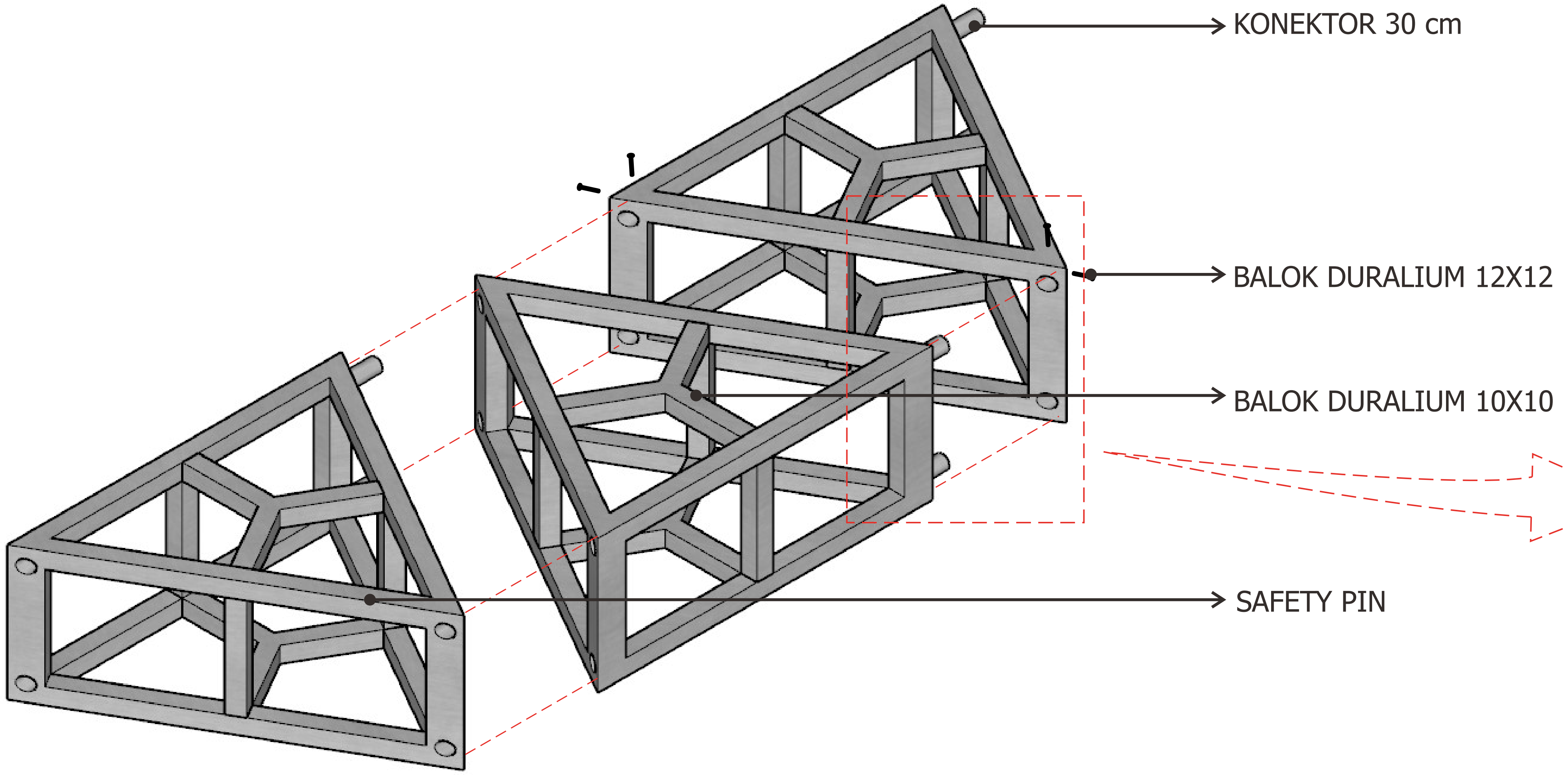

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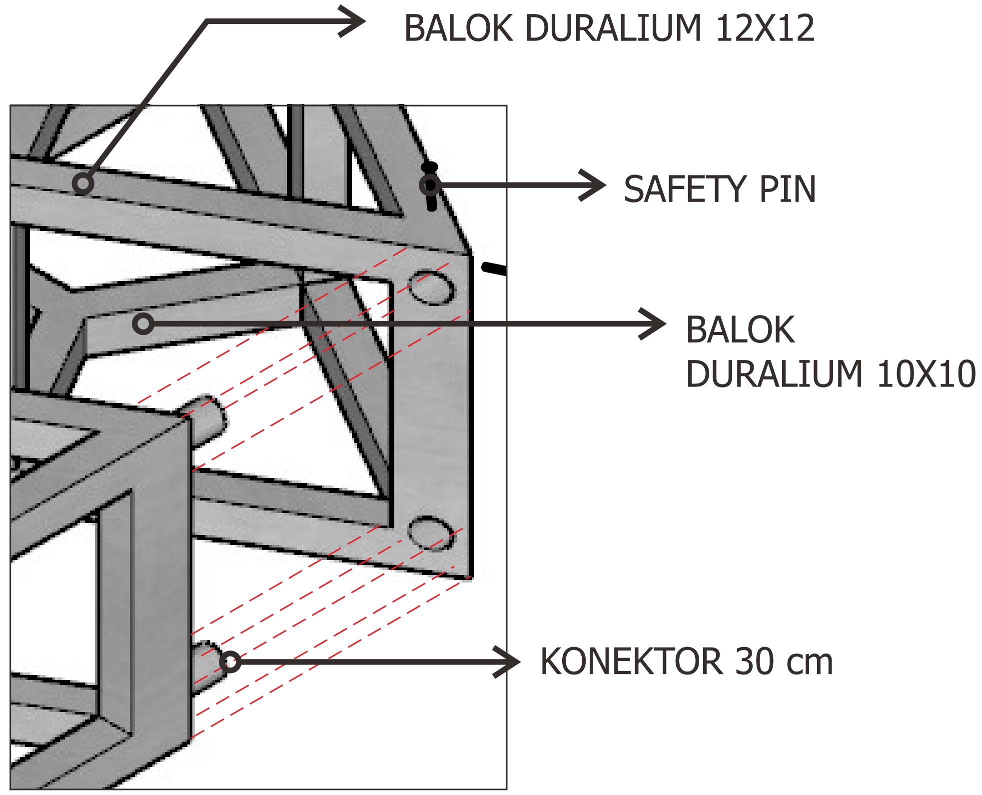

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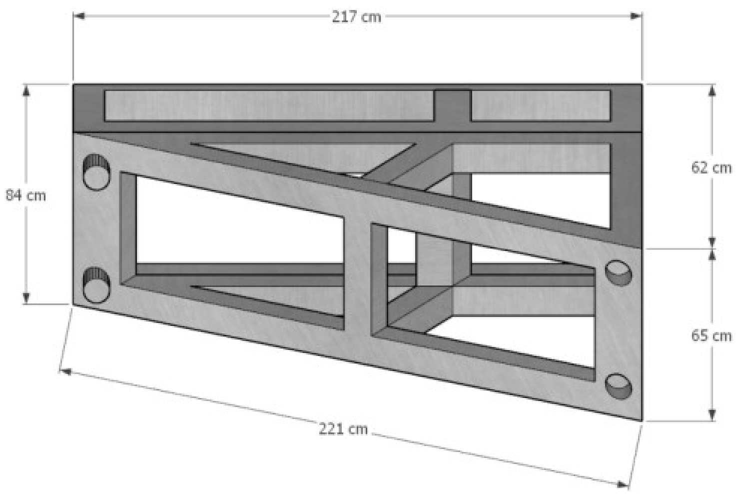

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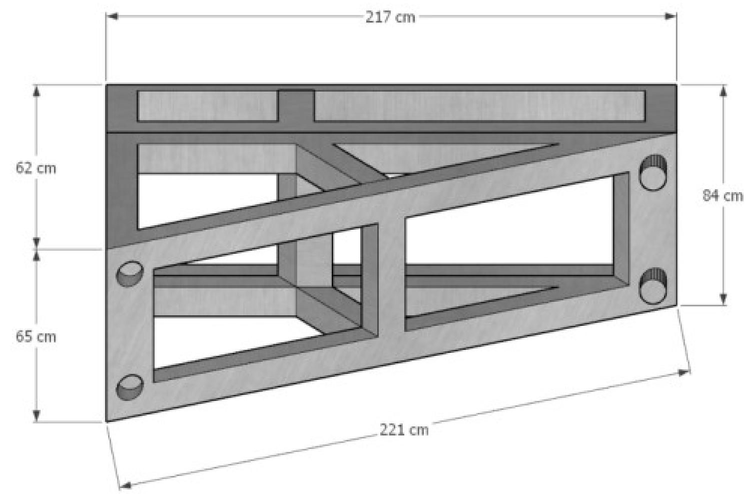

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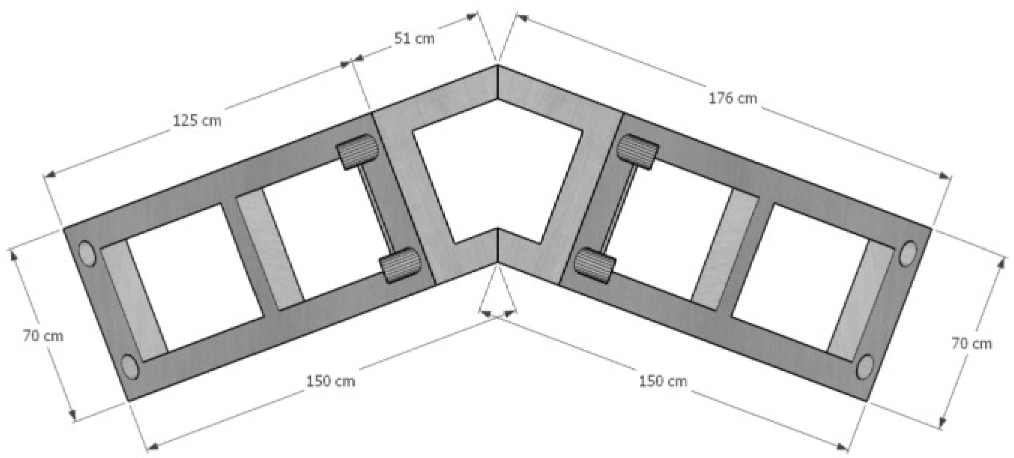

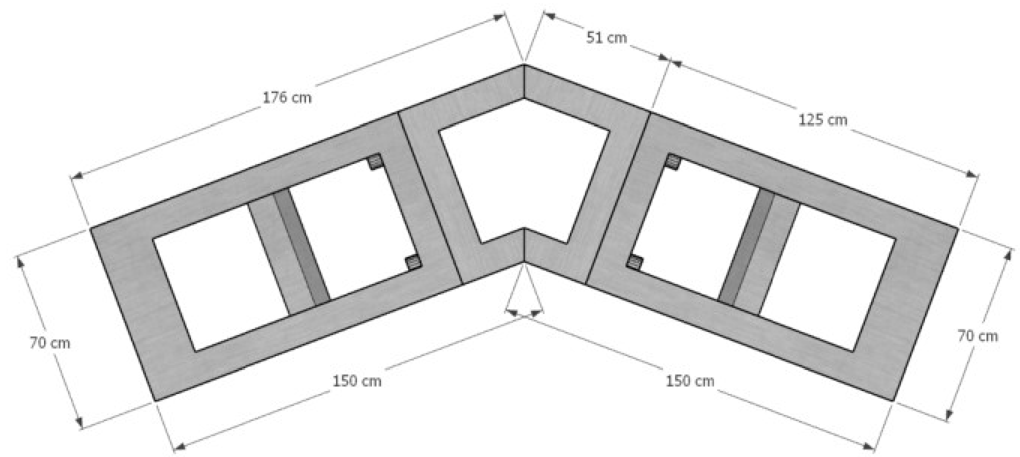

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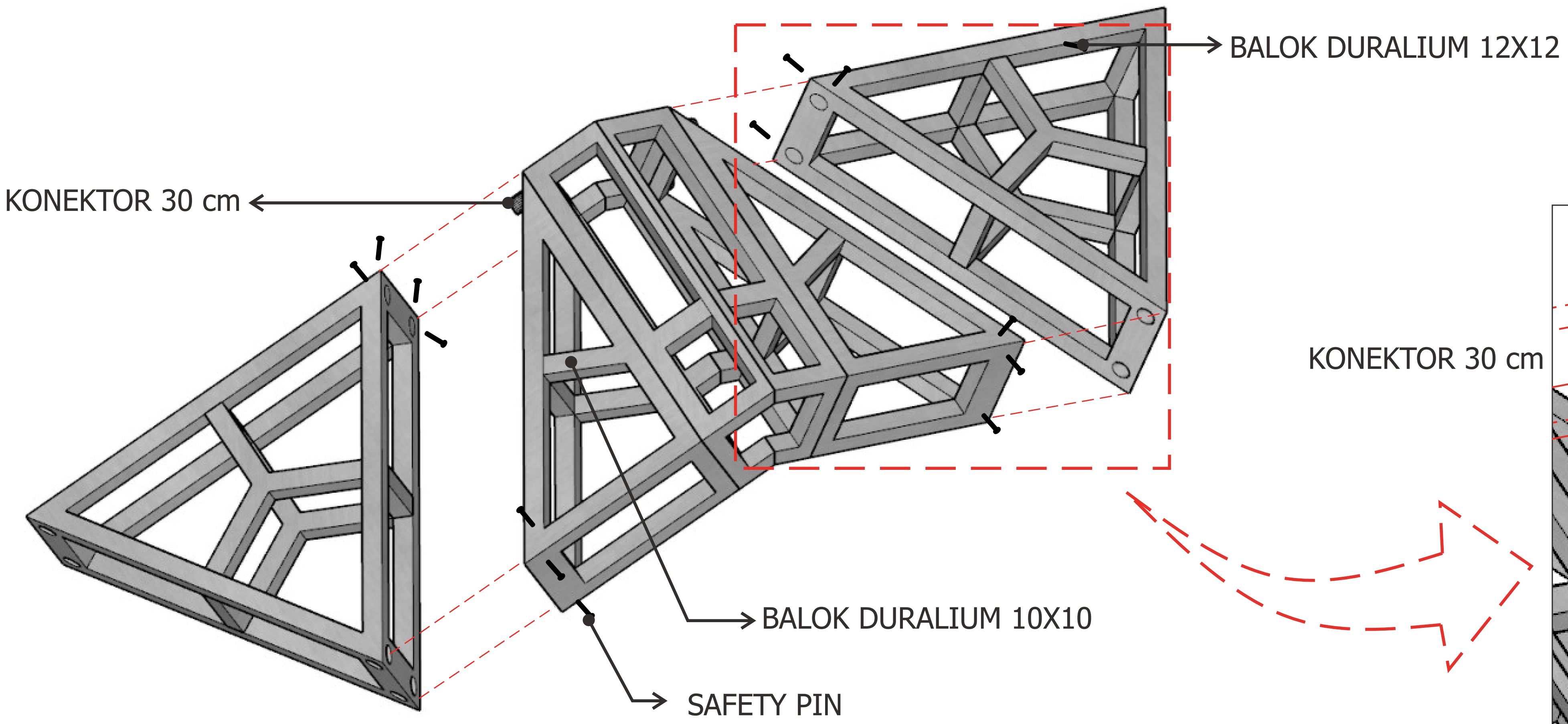

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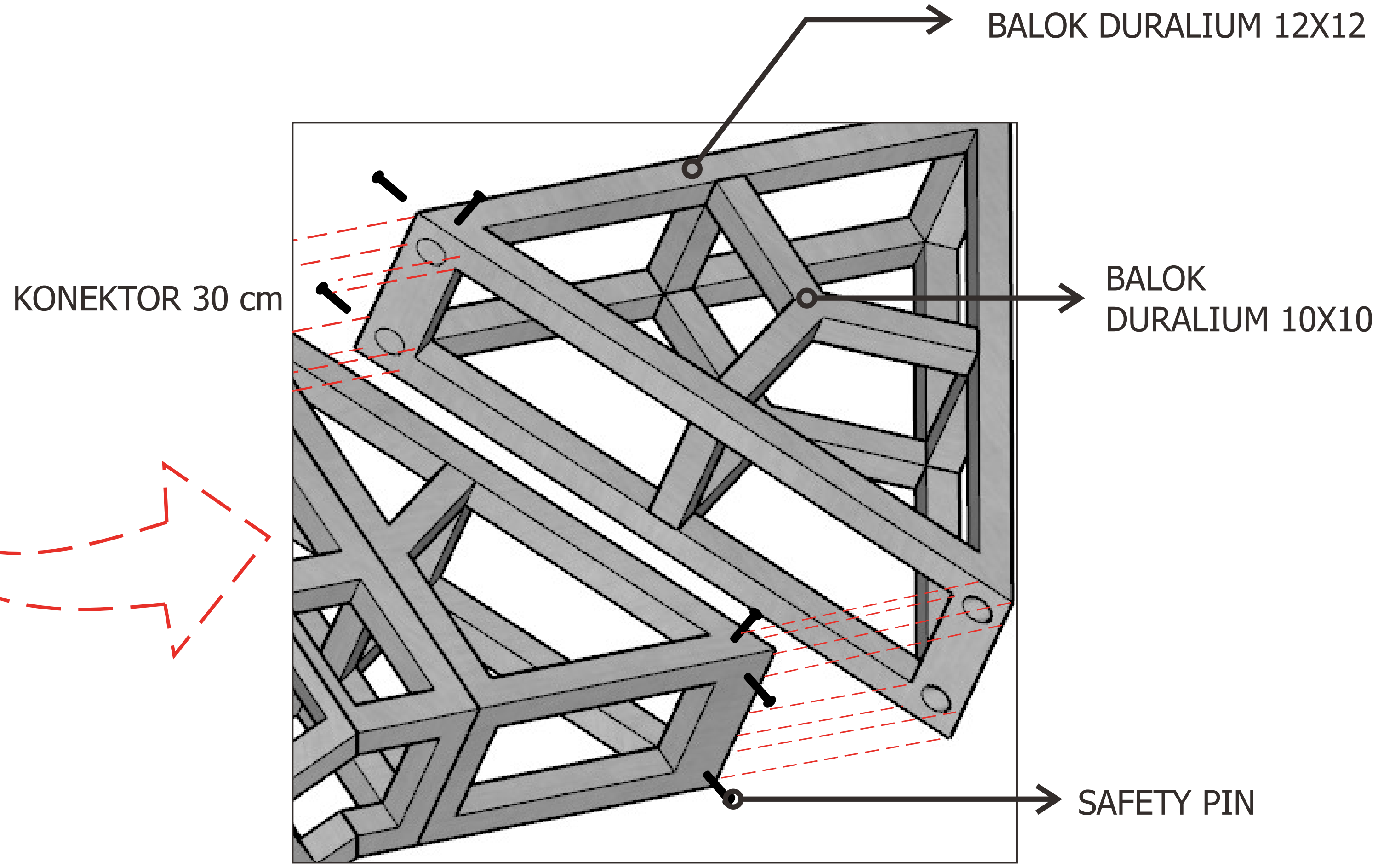

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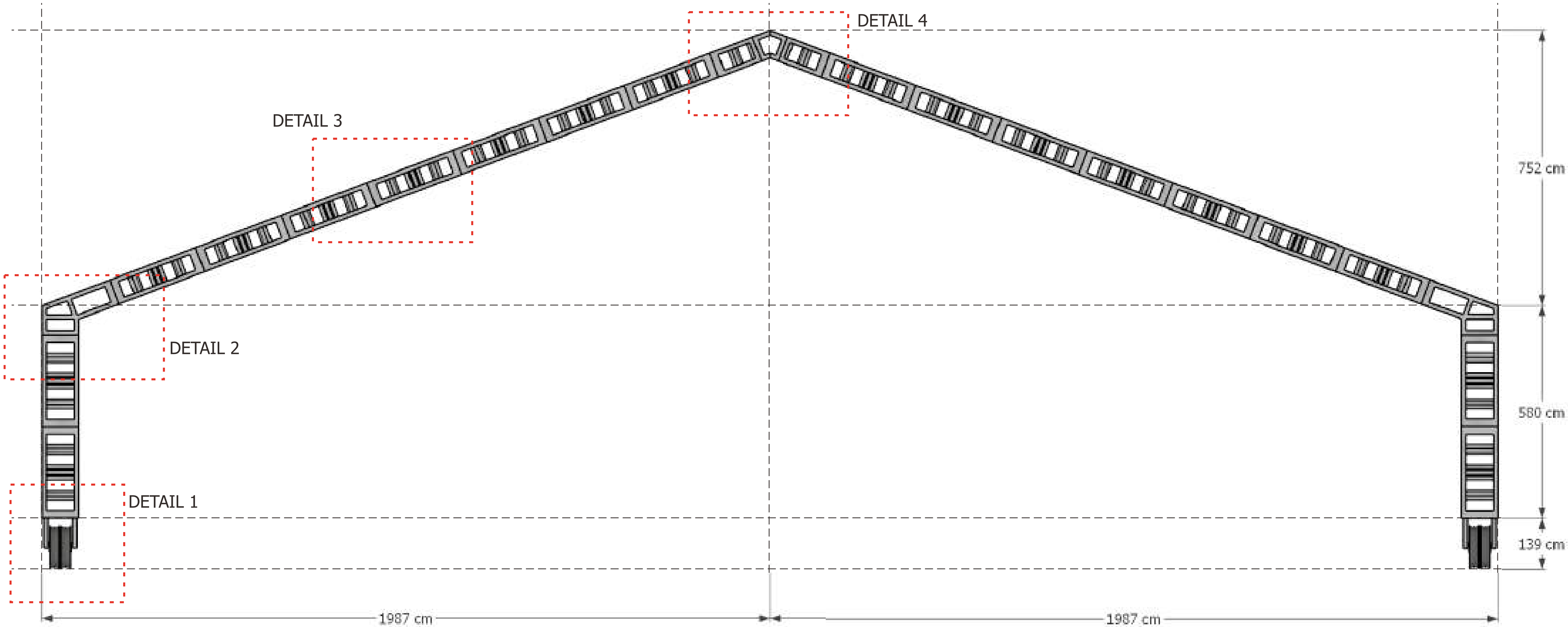
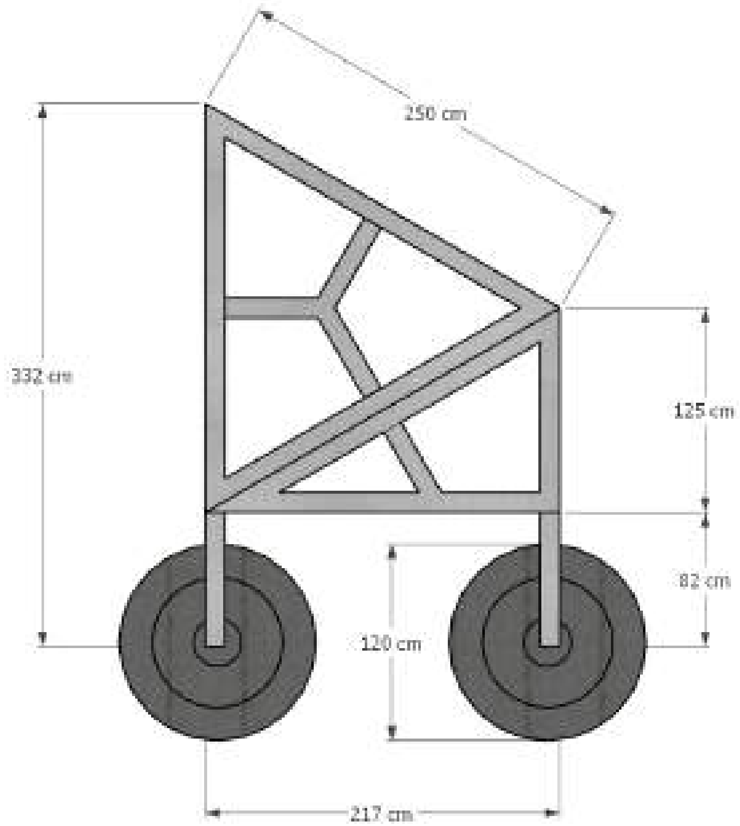


PORTAL B

SKALA 1 : 165

PORTAL B



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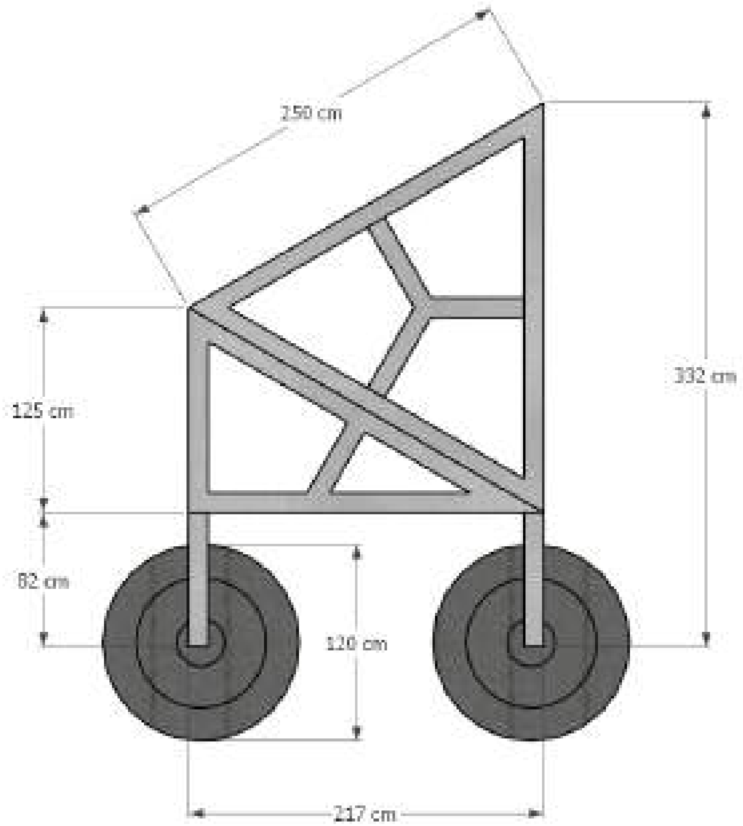

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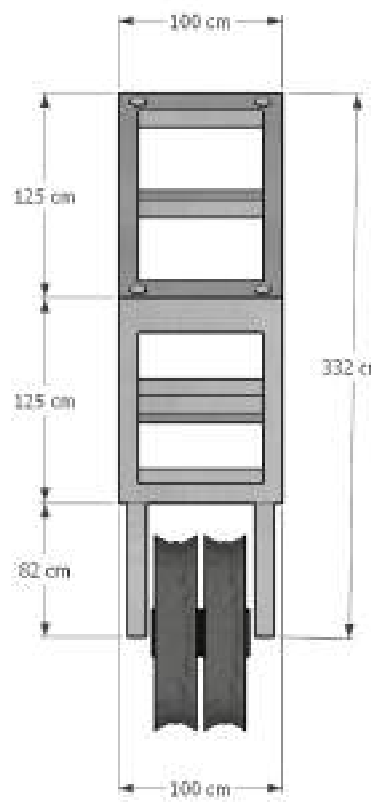

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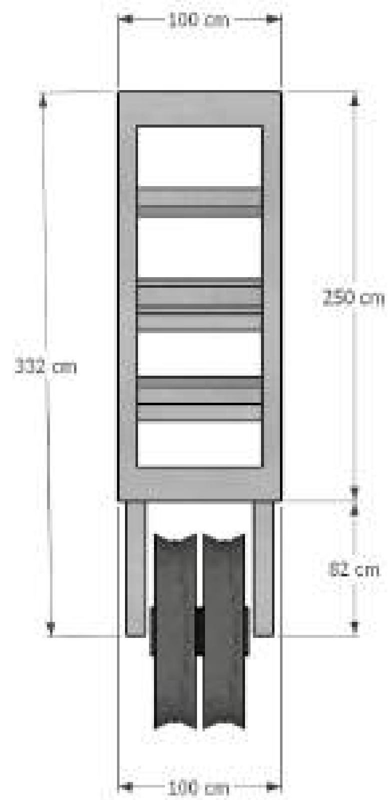

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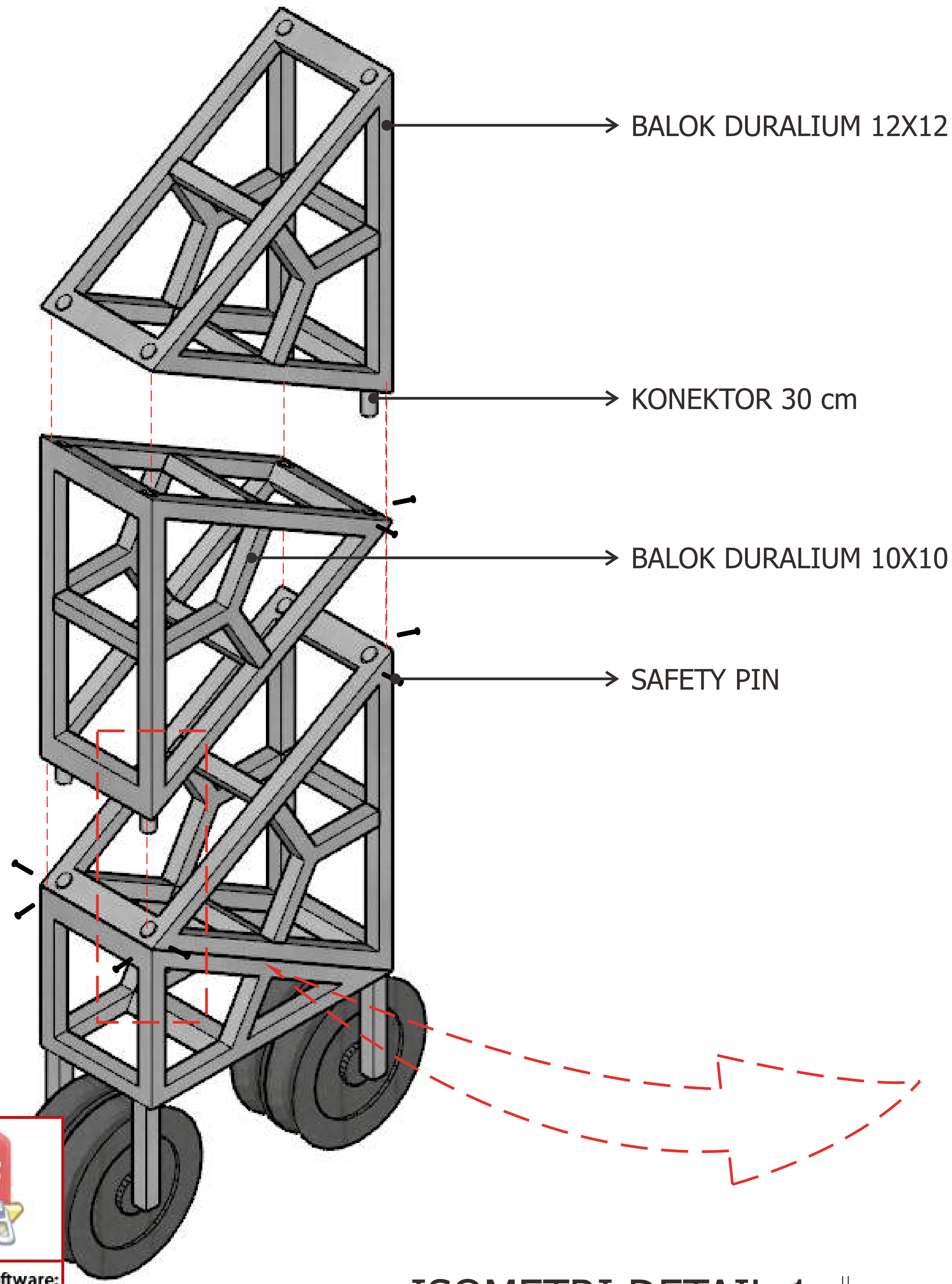

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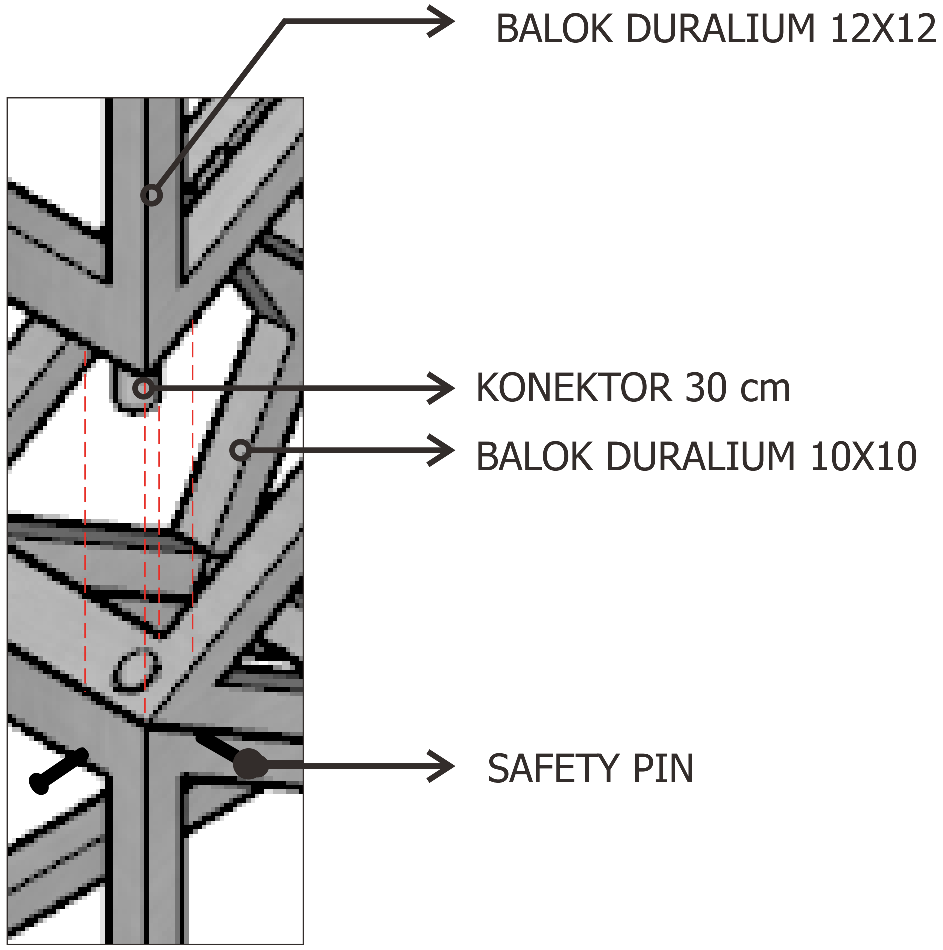

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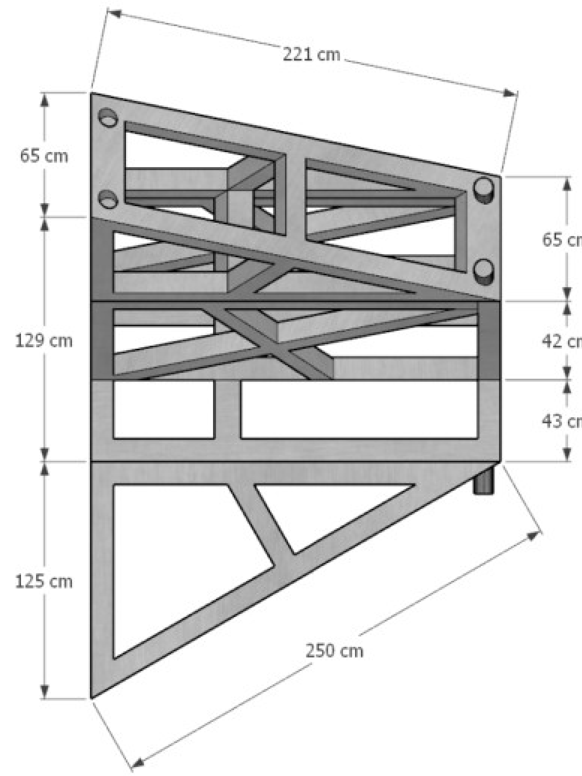

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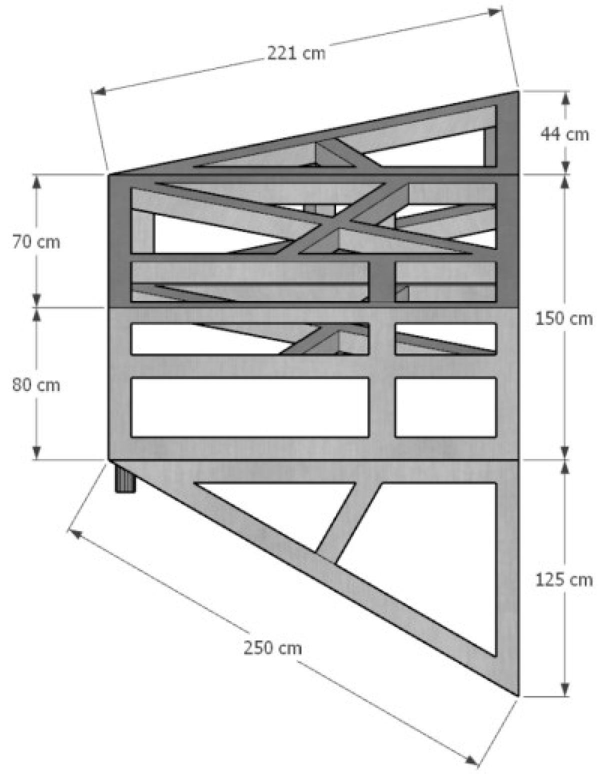

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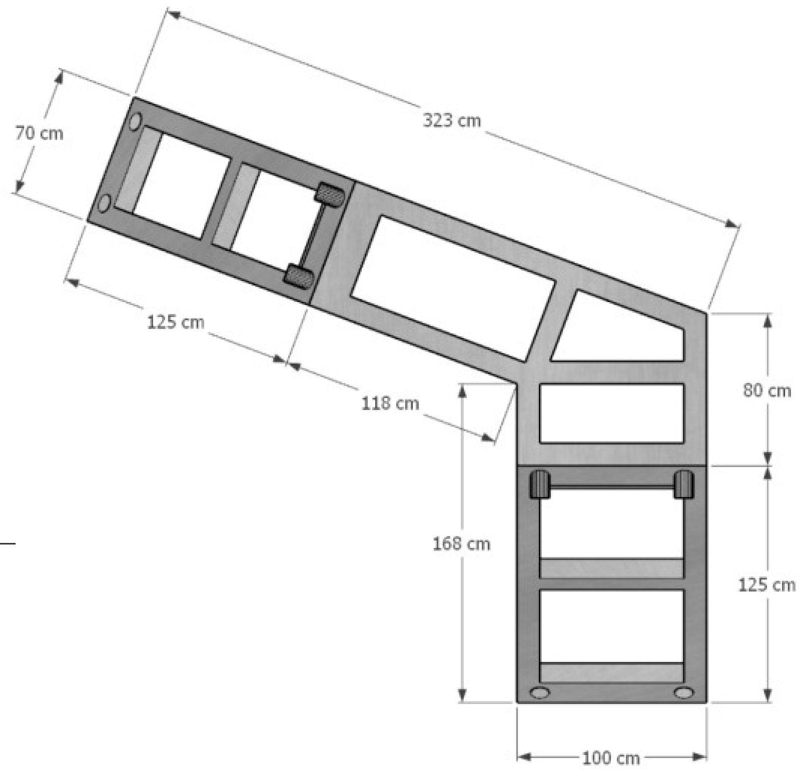

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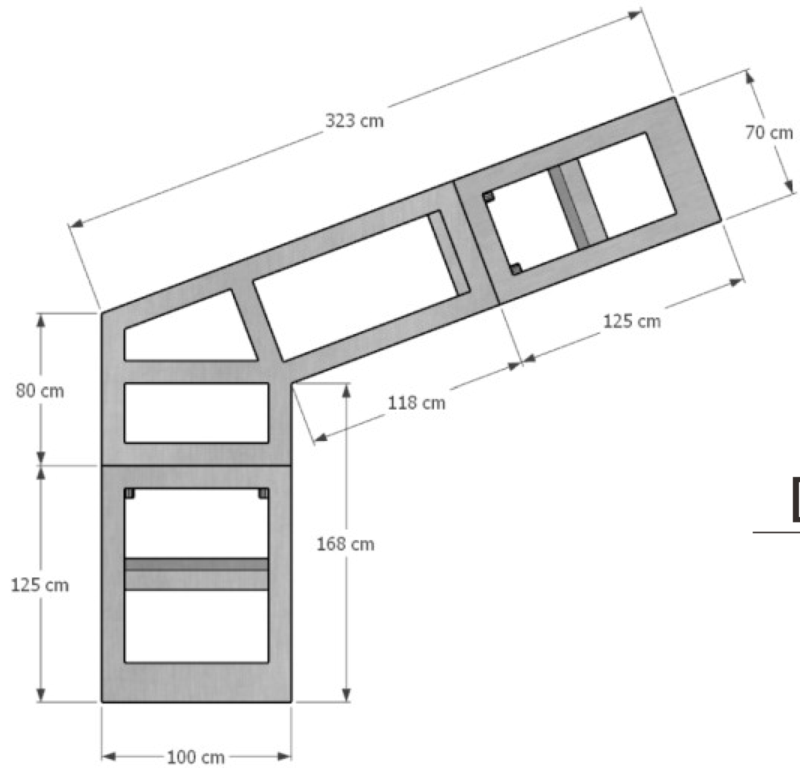

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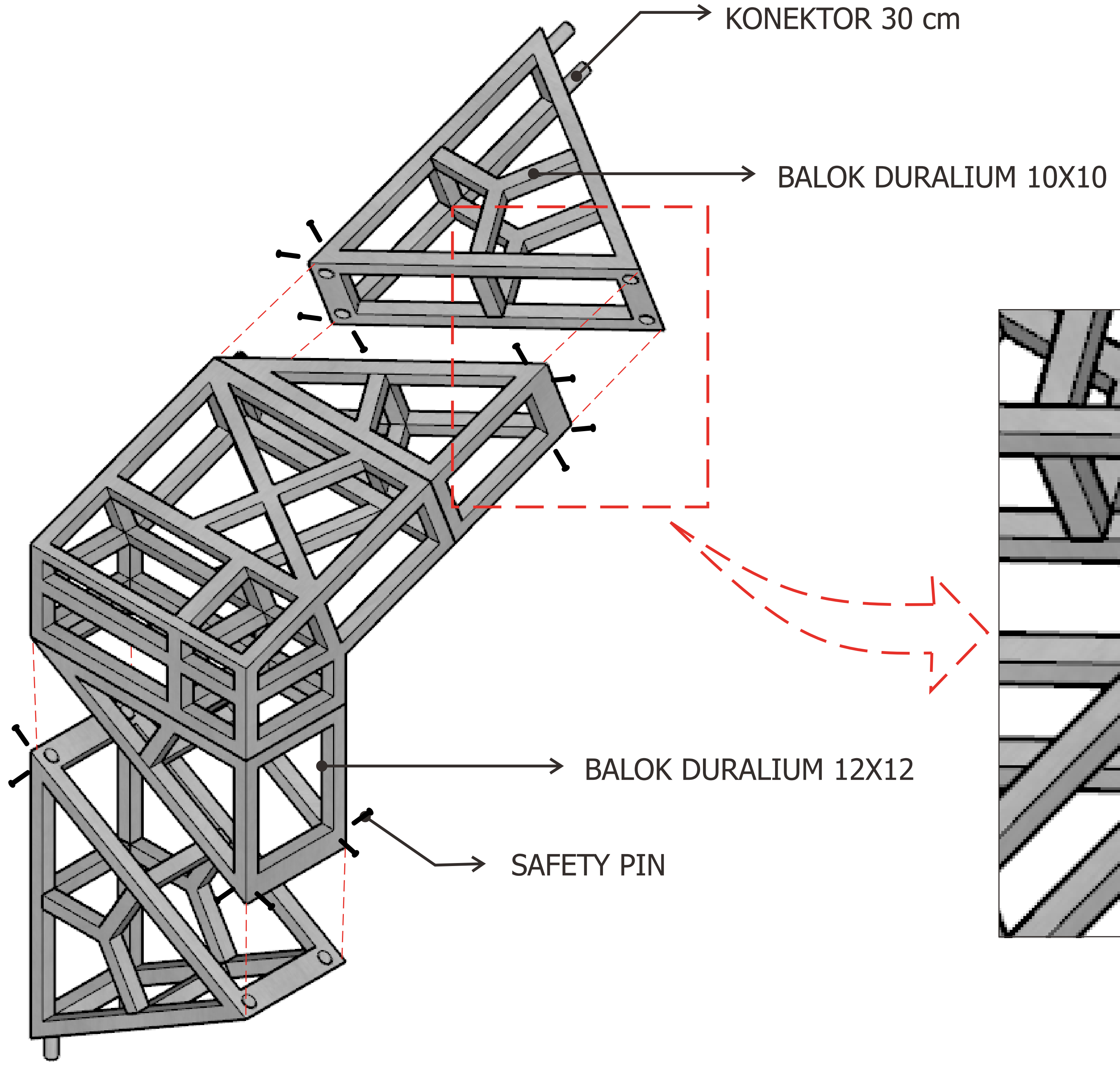

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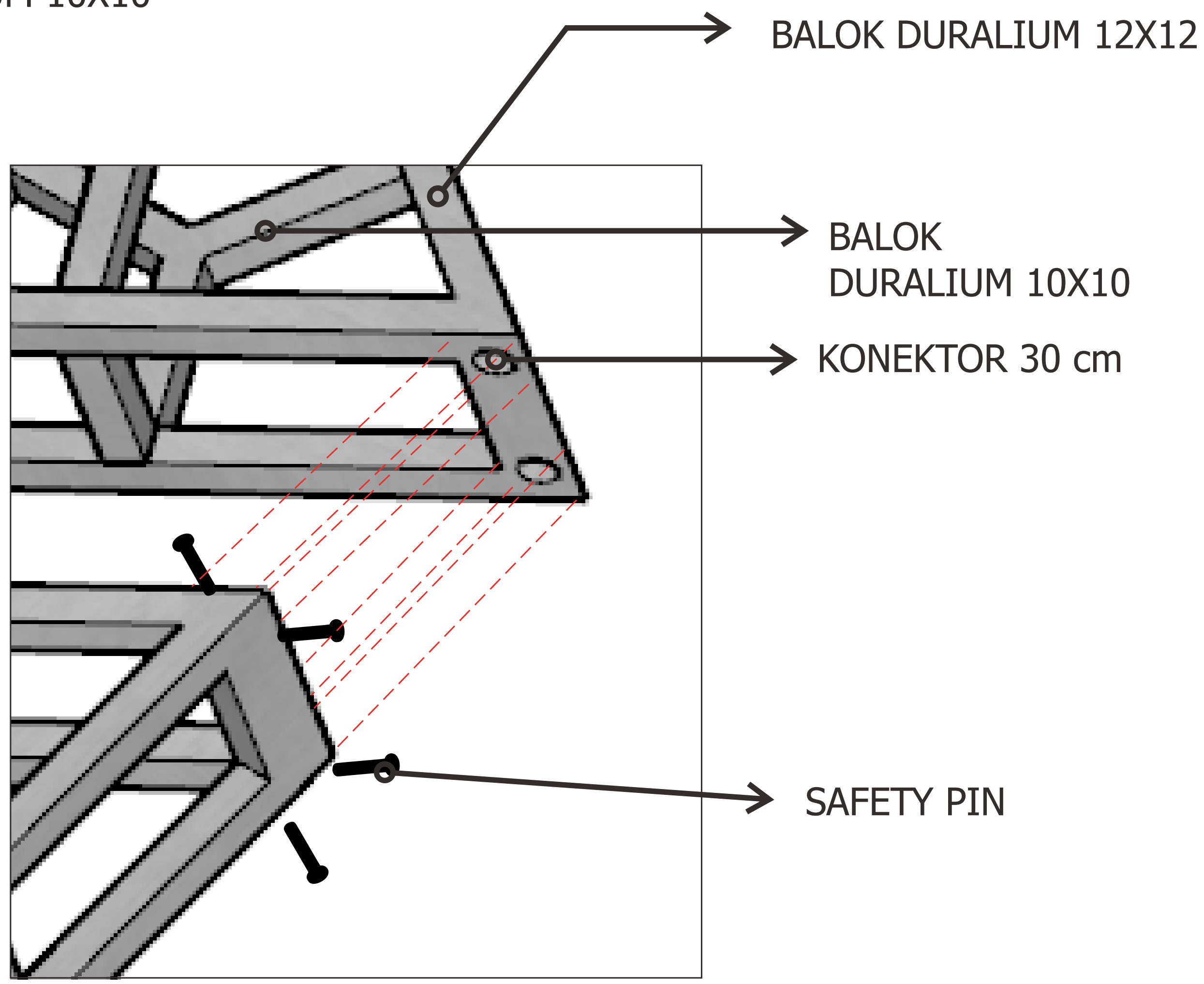

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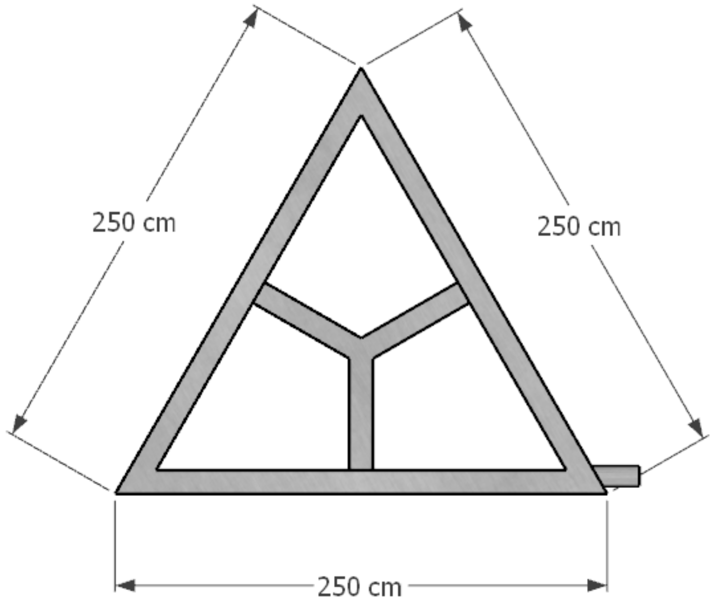

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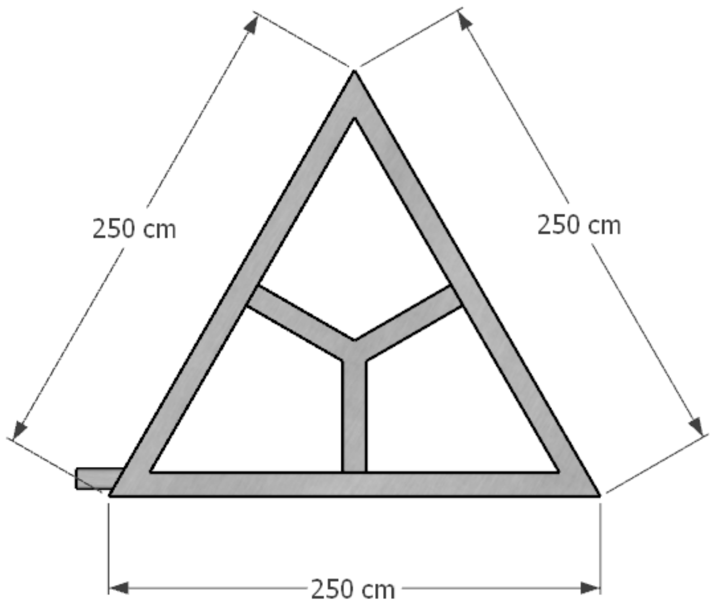

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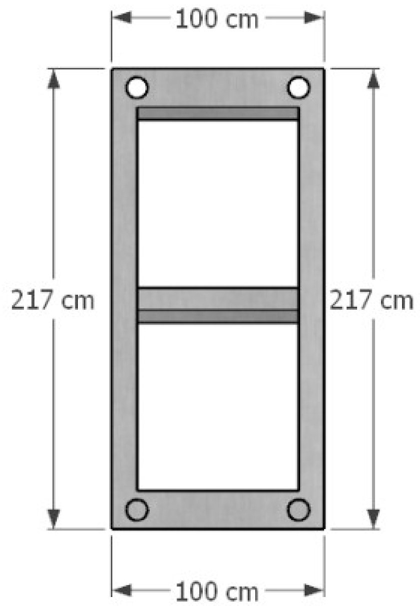

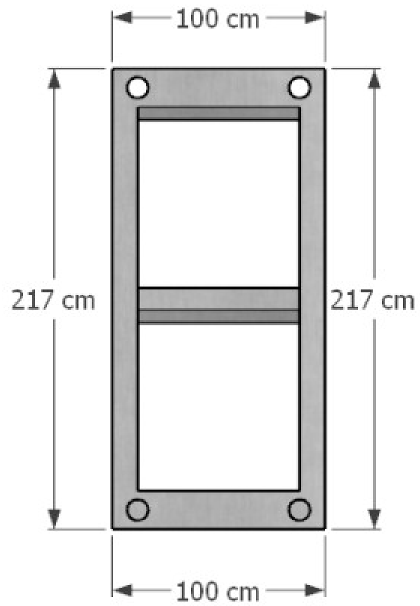

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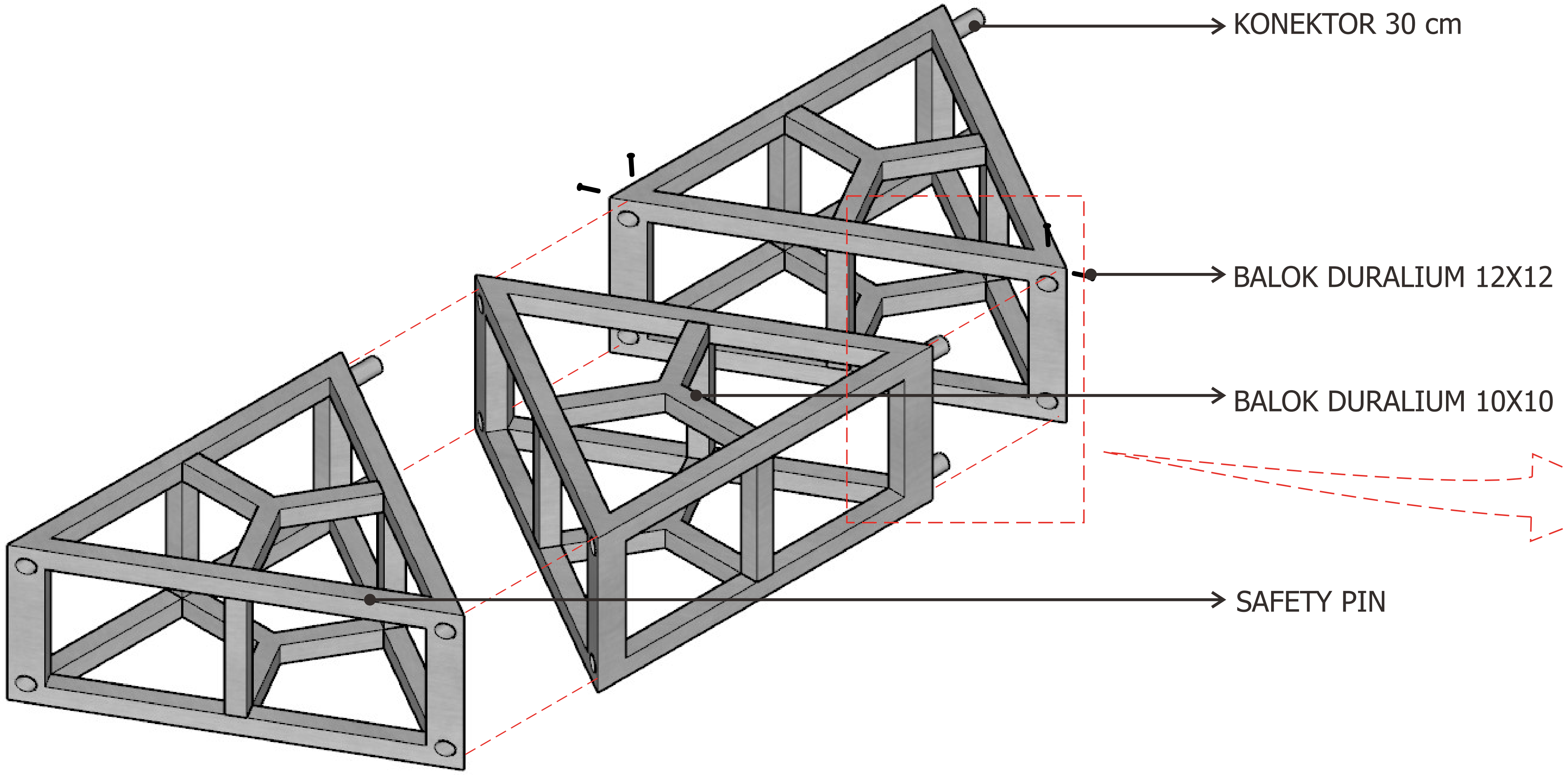

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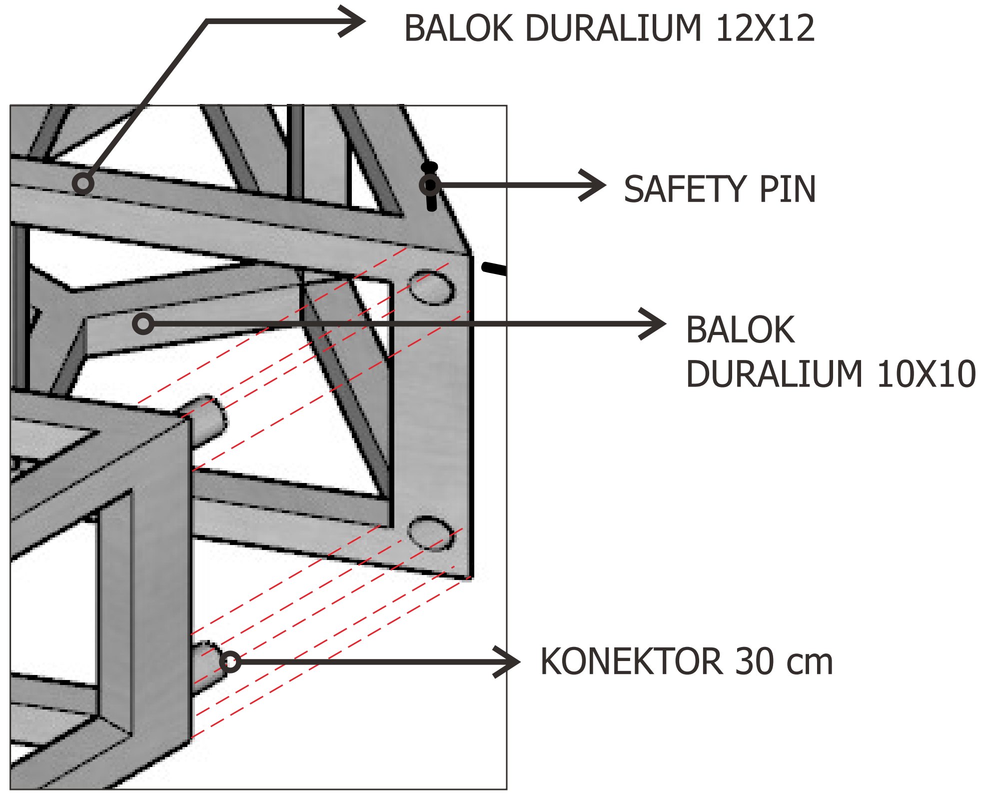

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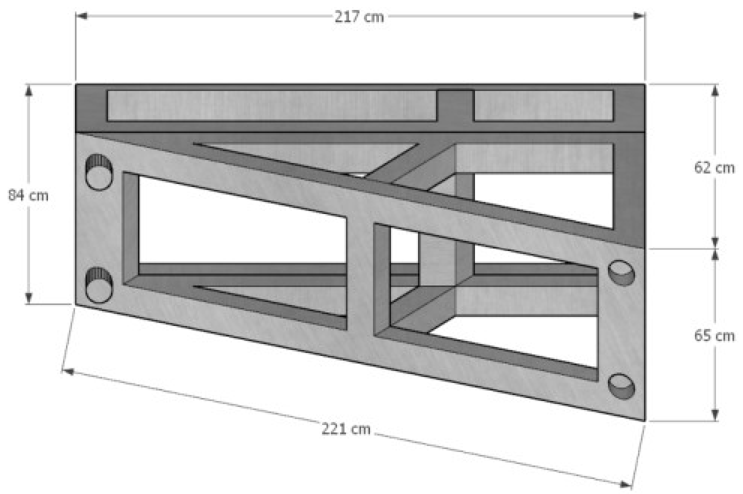

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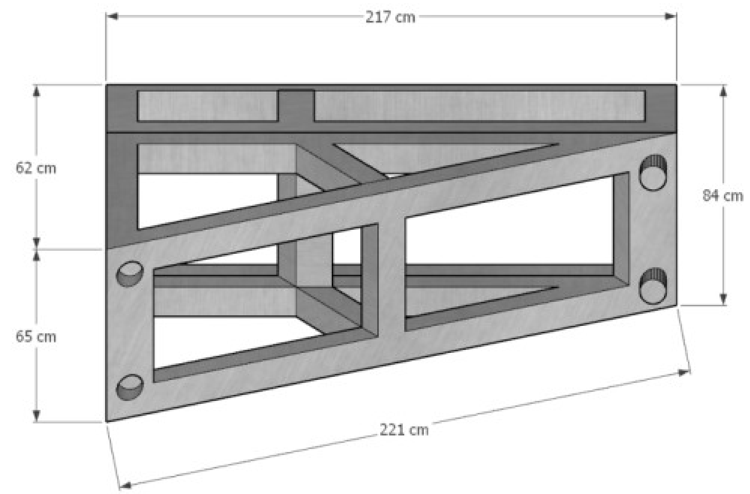

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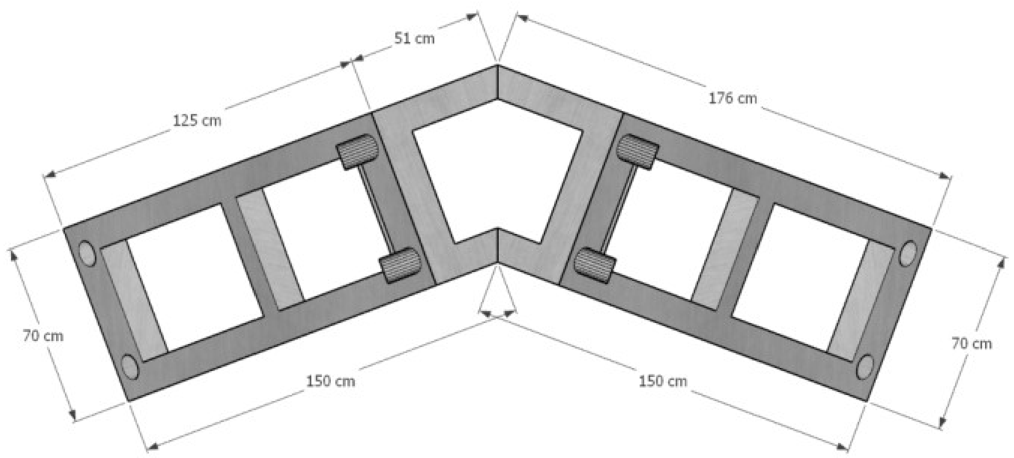

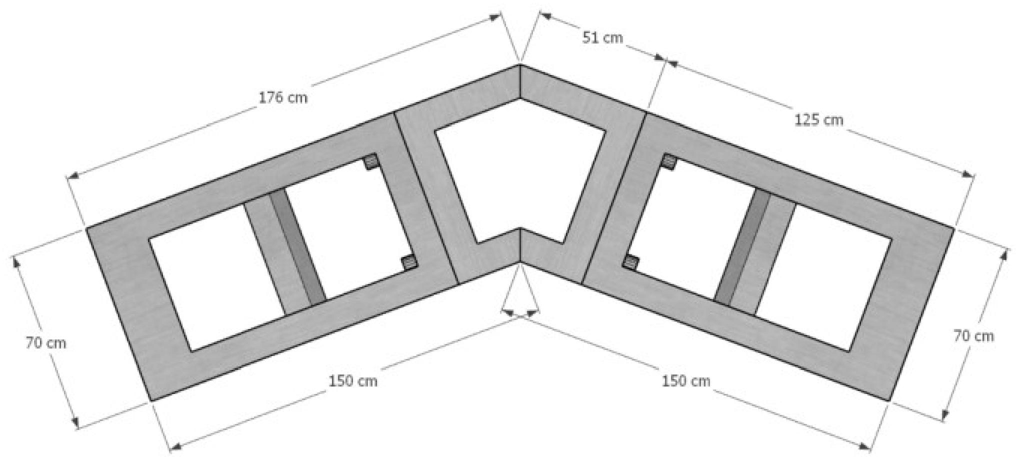

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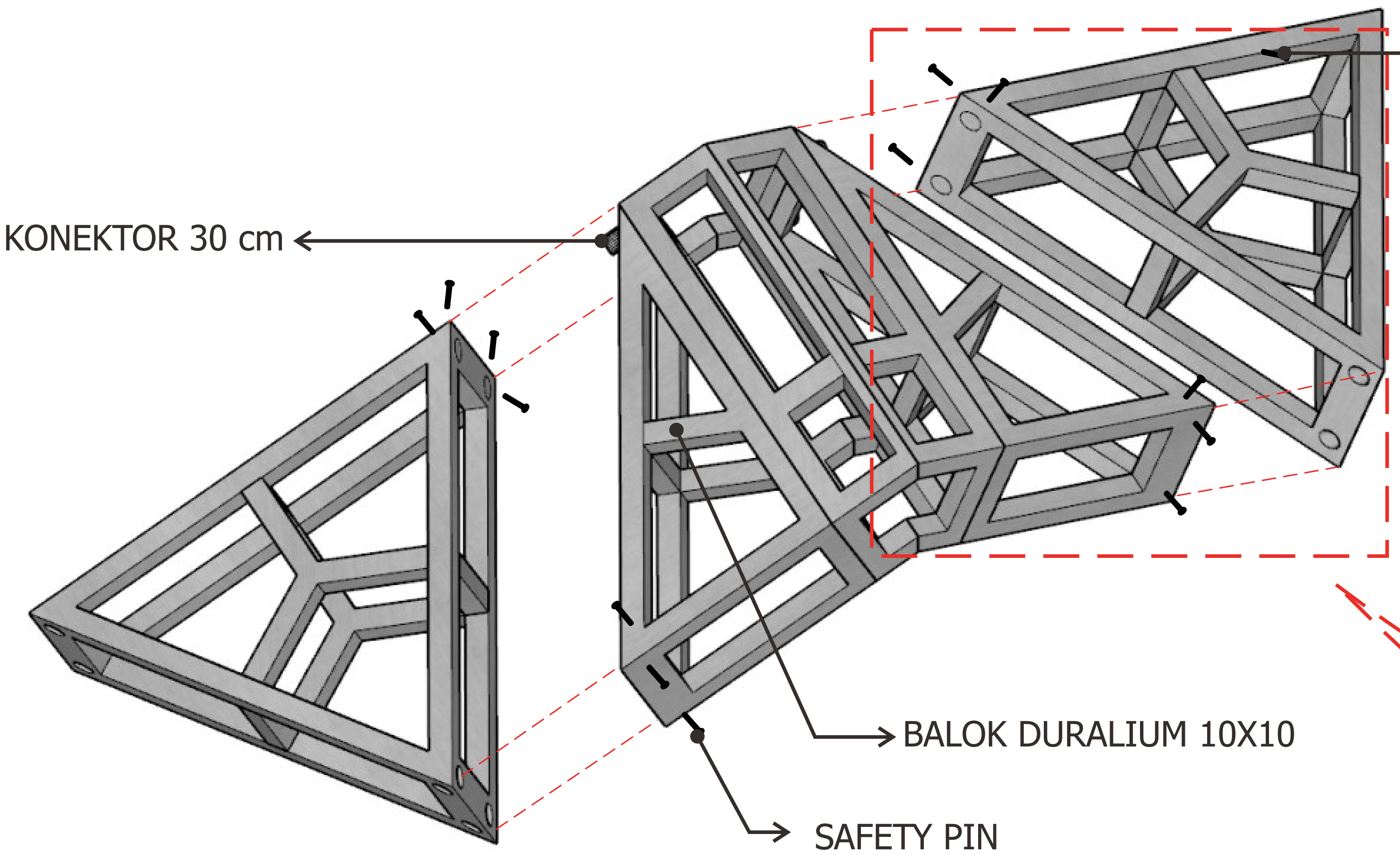

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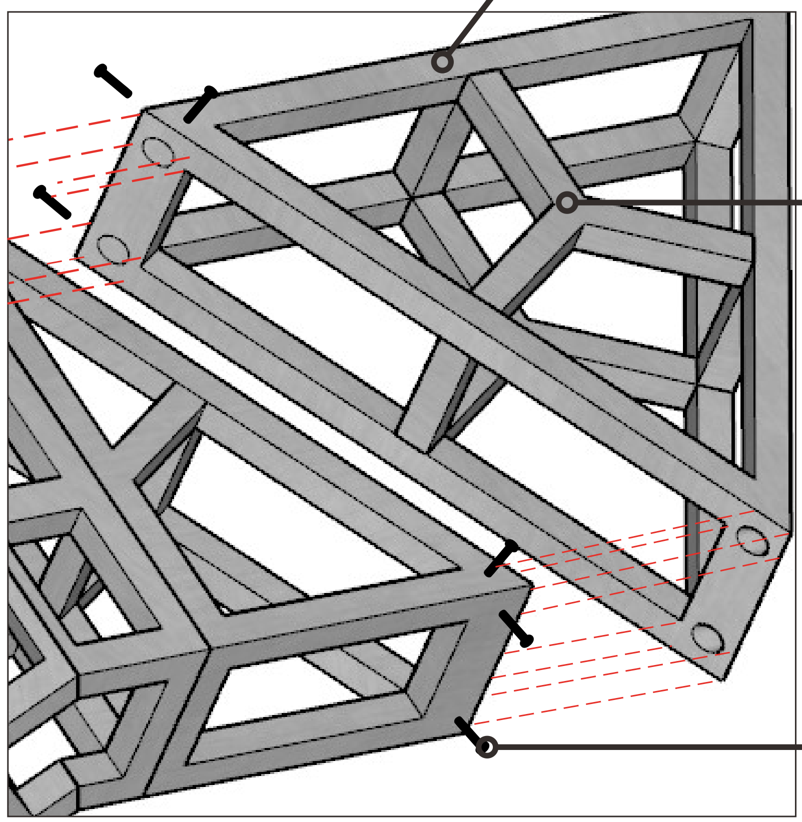

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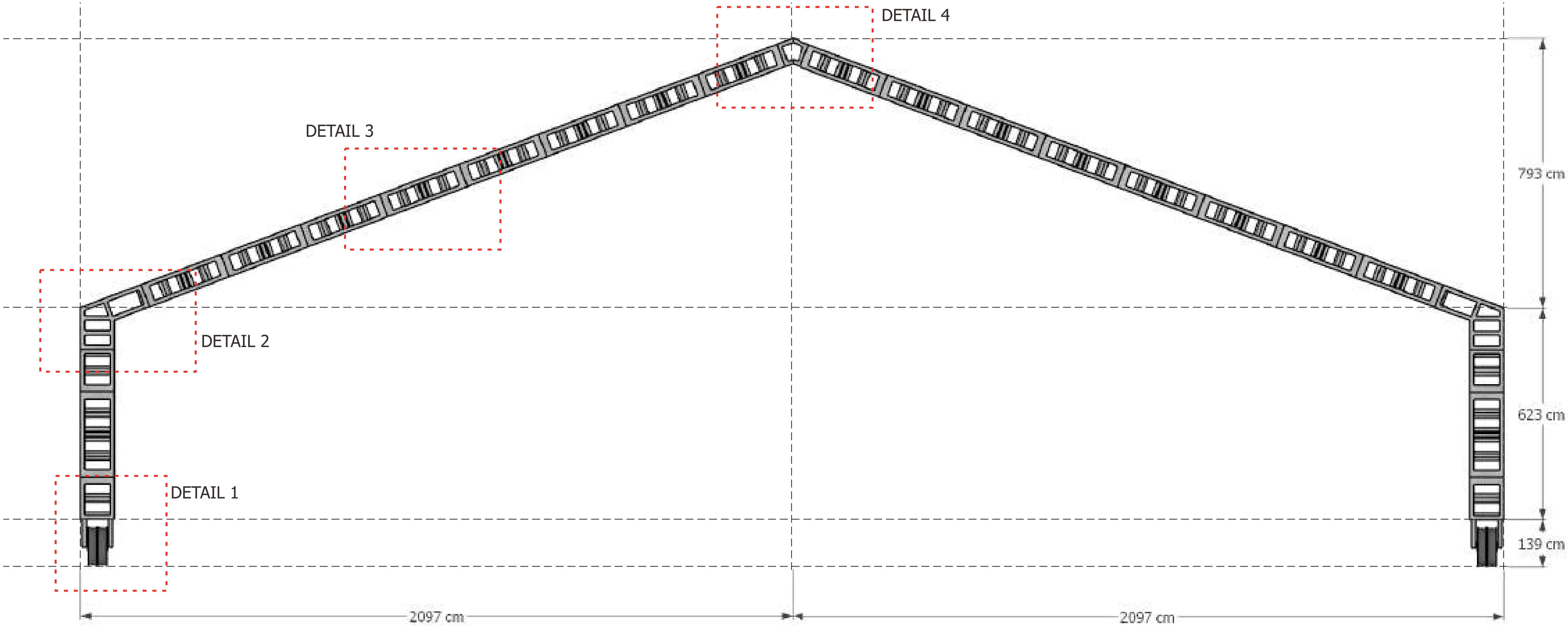

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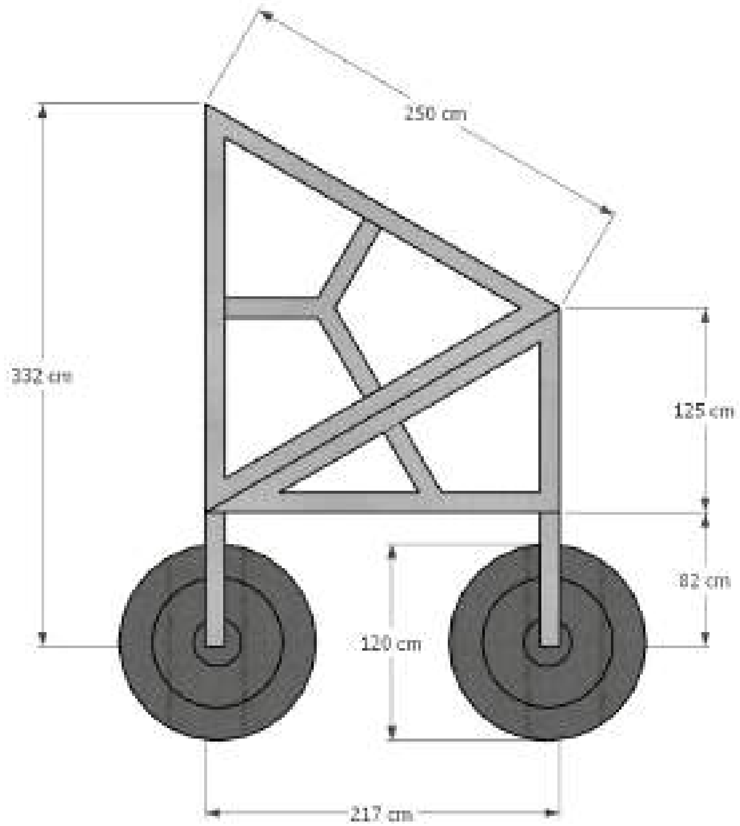
SKALA 1 : 170

PORTAL C



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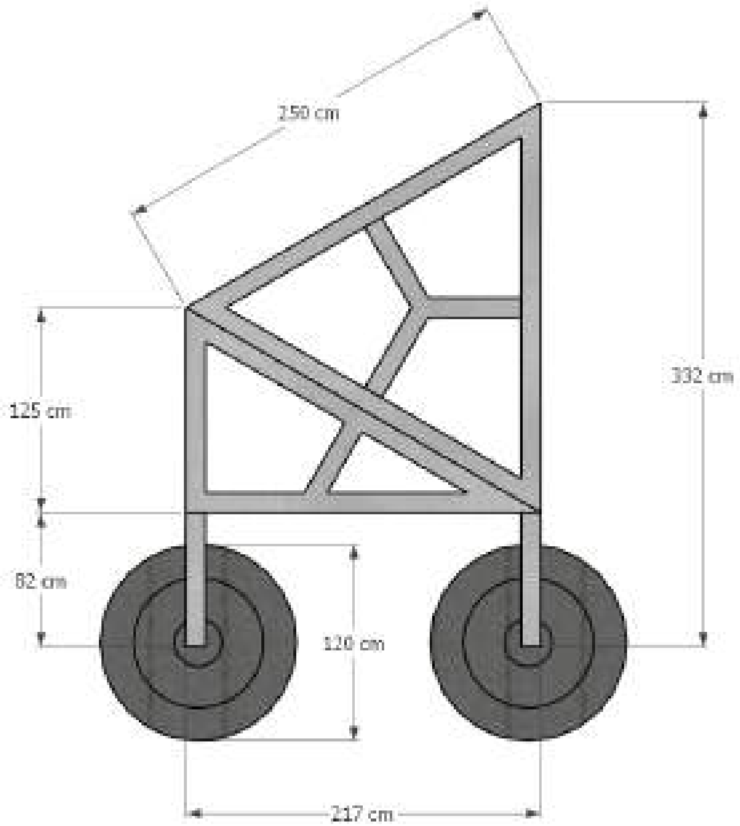

DETAIL 1.2
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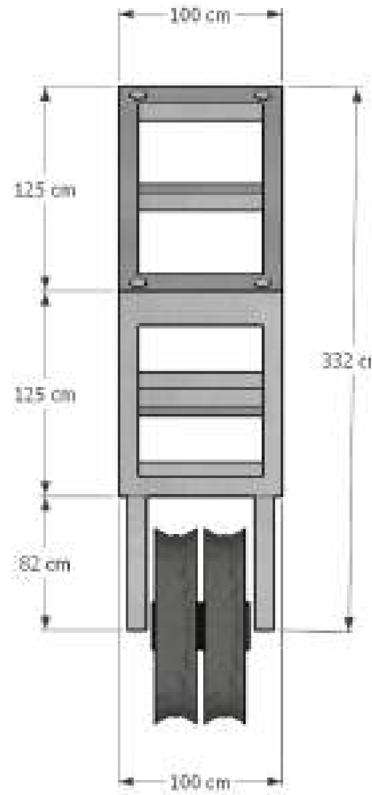
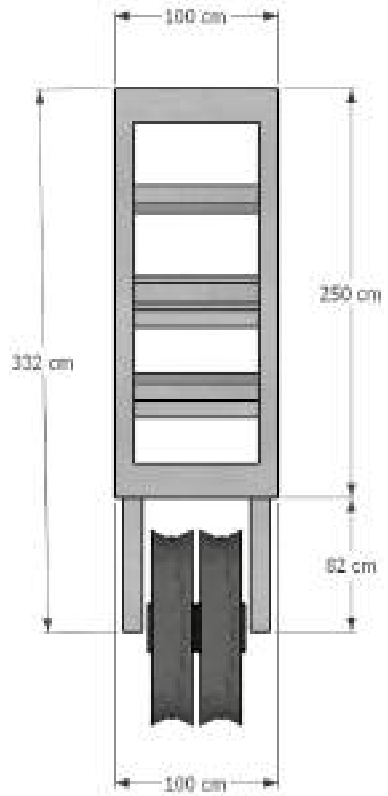
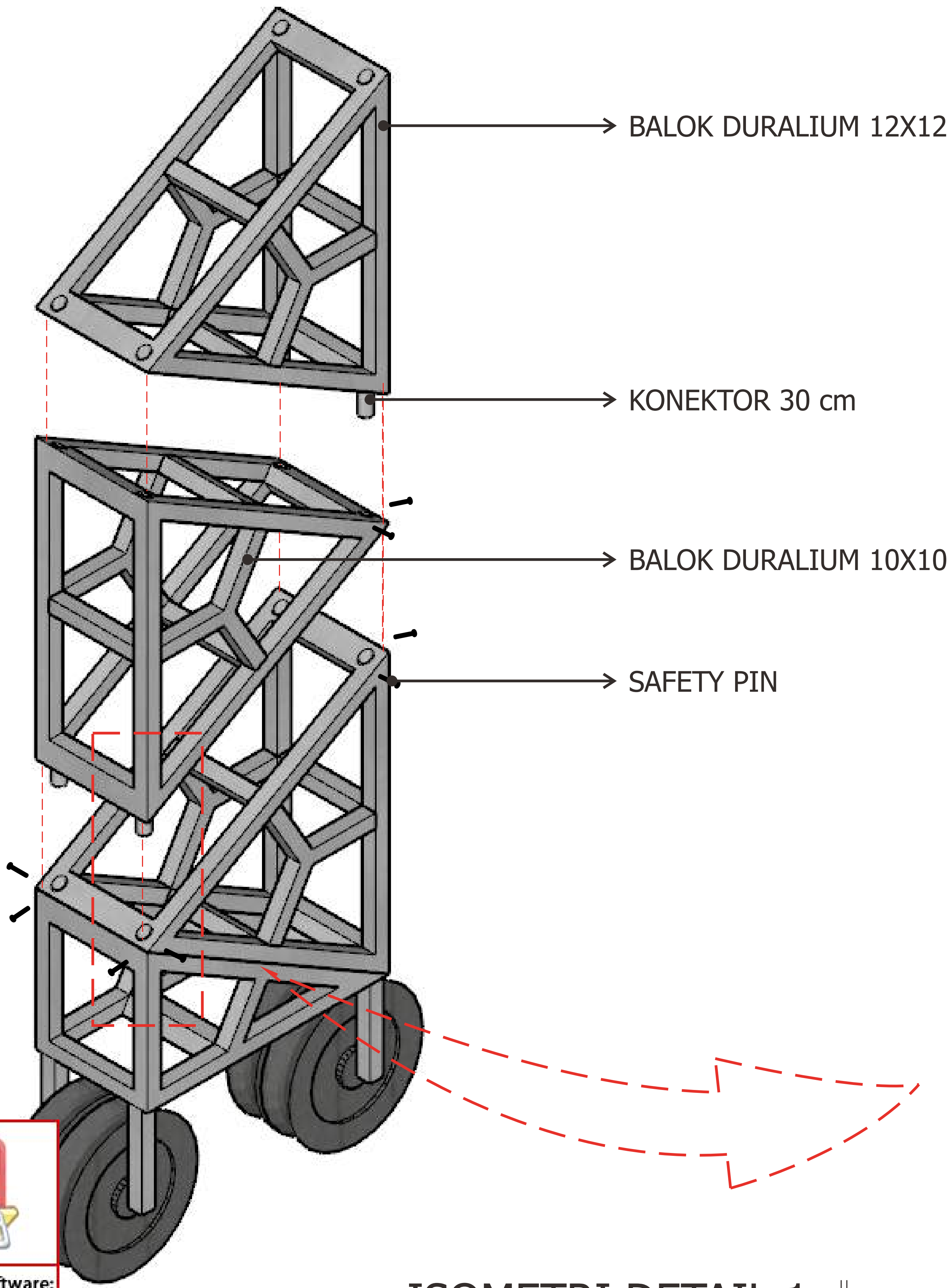


DETAIL 1.3
SKALA 1 : 40



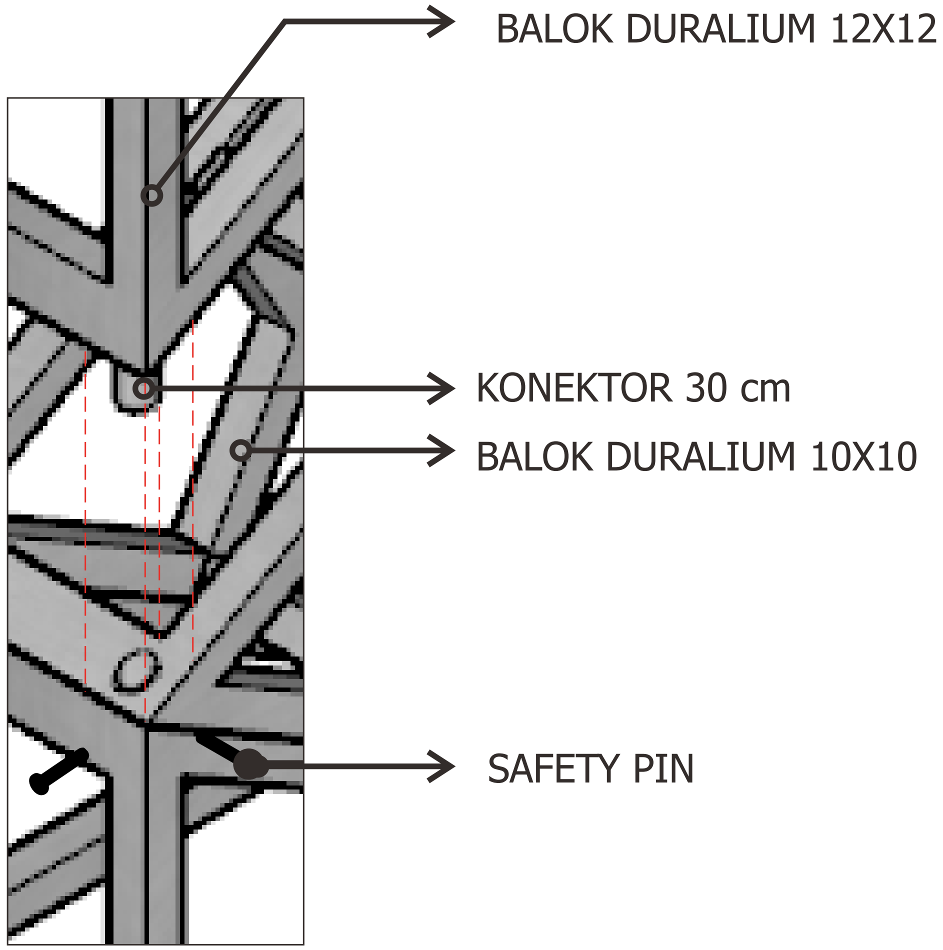
DETAIL 1.4
SKALA 1 : 40

PORTAL C



ISOMETRI DETAIL 1

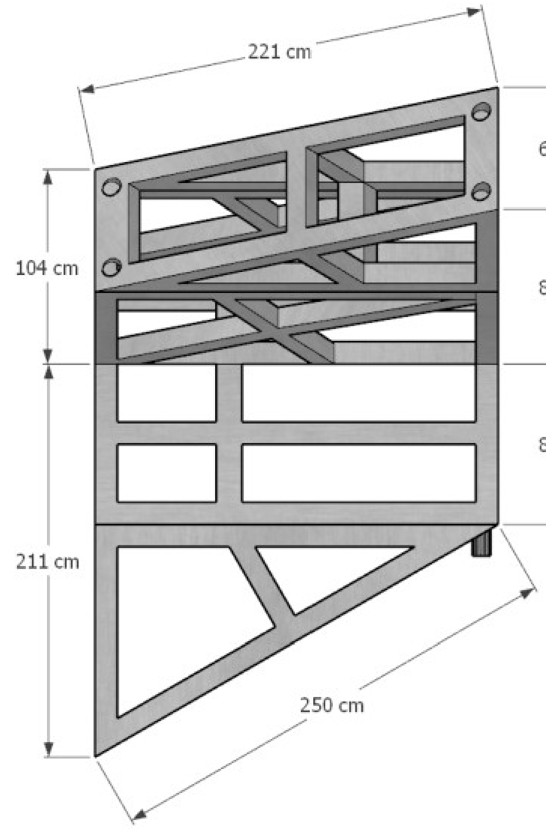
SKALA 1 : NTS



DETAIL SAMBUNGAN

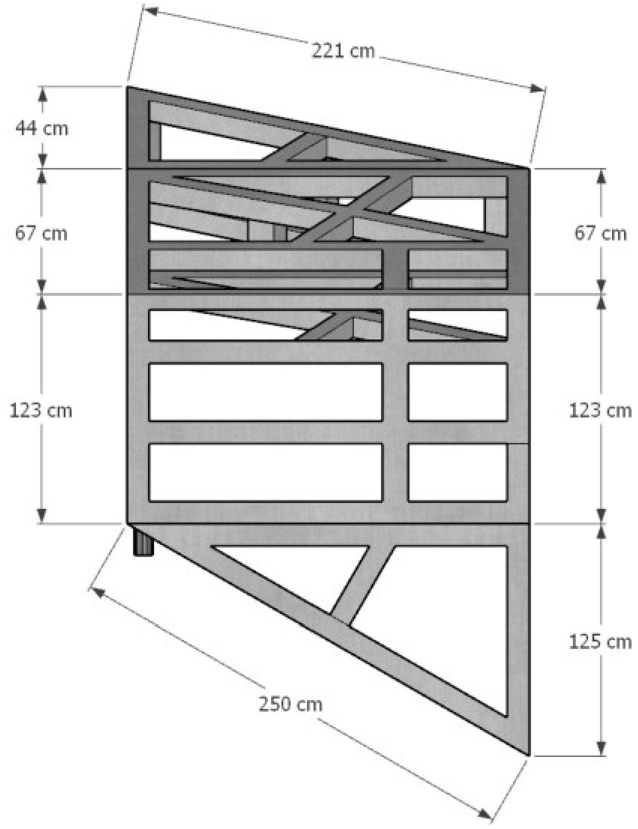
SKALA 1 : NTS

PORTAL C



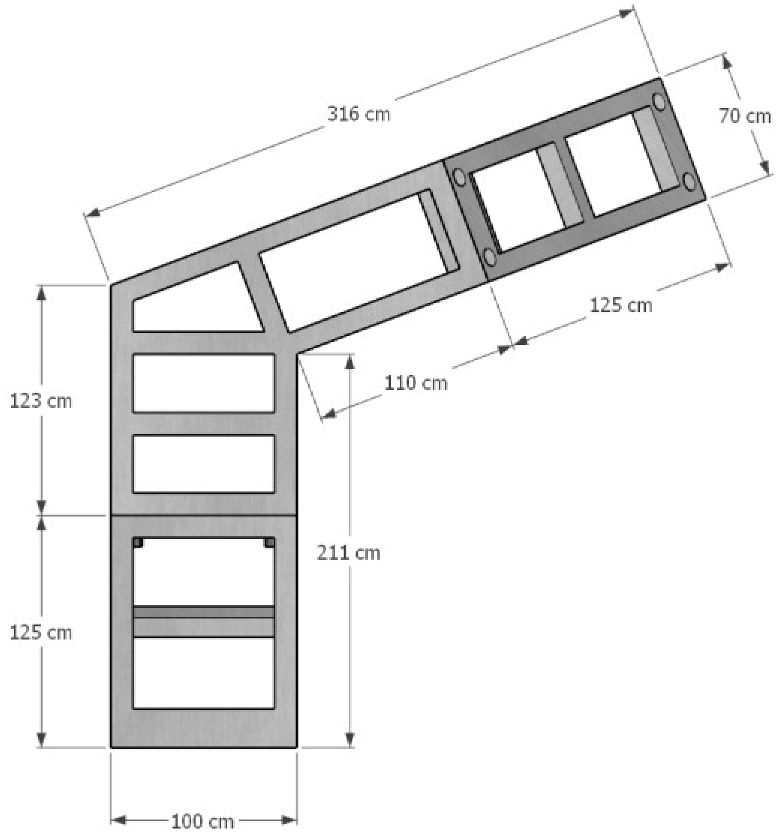
DETAIL 2.1

SKALA 1 : 40



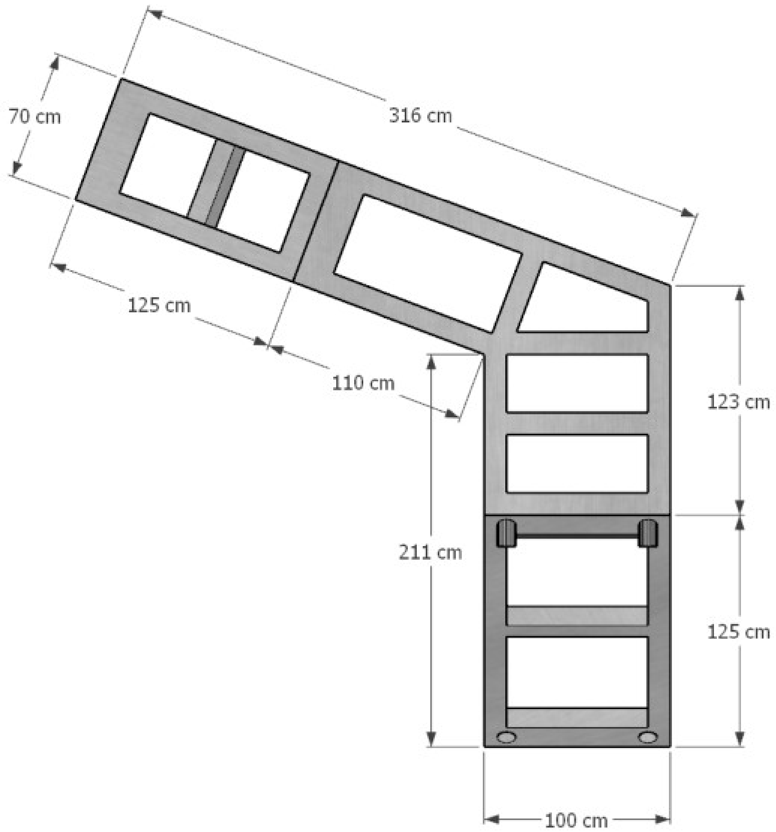
DETAIL 2.2

SKALA 1 : 40



TAIL 2.3

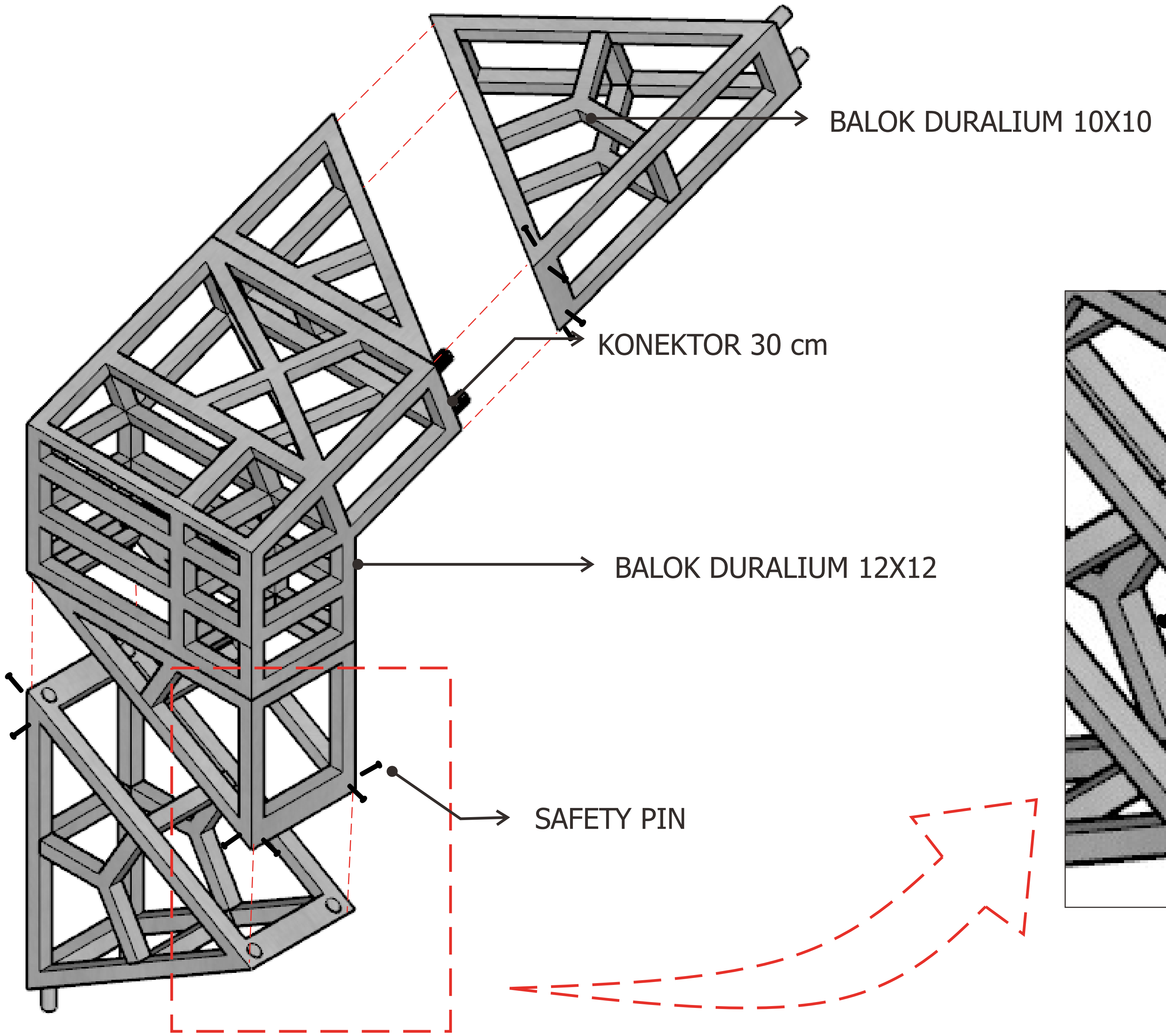
: 40



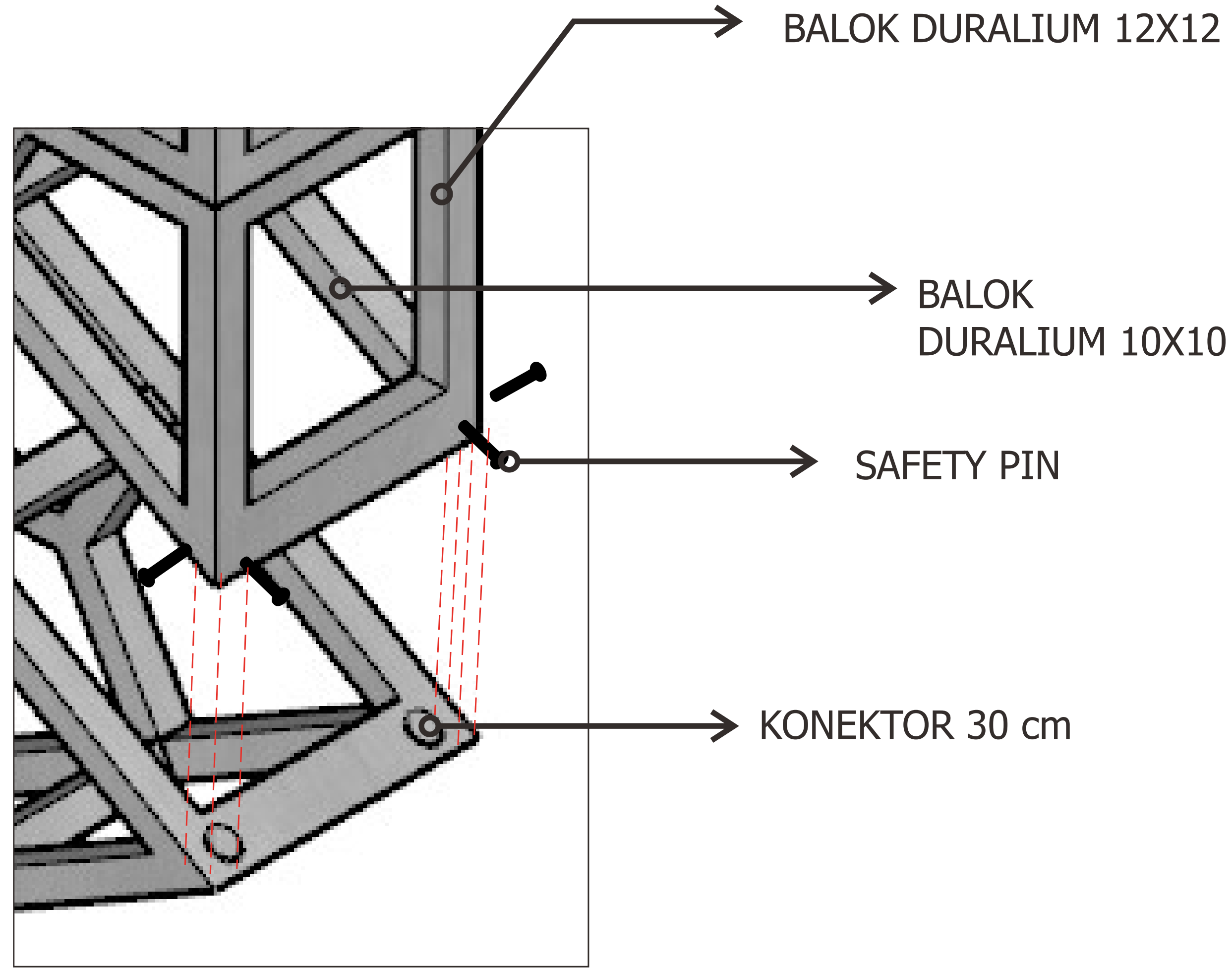
DETAIL 2.4

SKALA 1 : 40

PORTAL C



ISOMETRI DETAIL 2
SKALA 1 : NTS

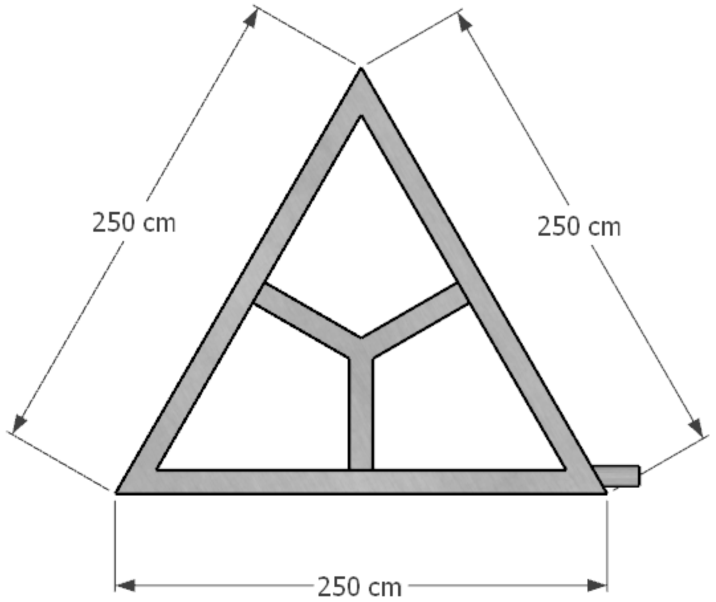


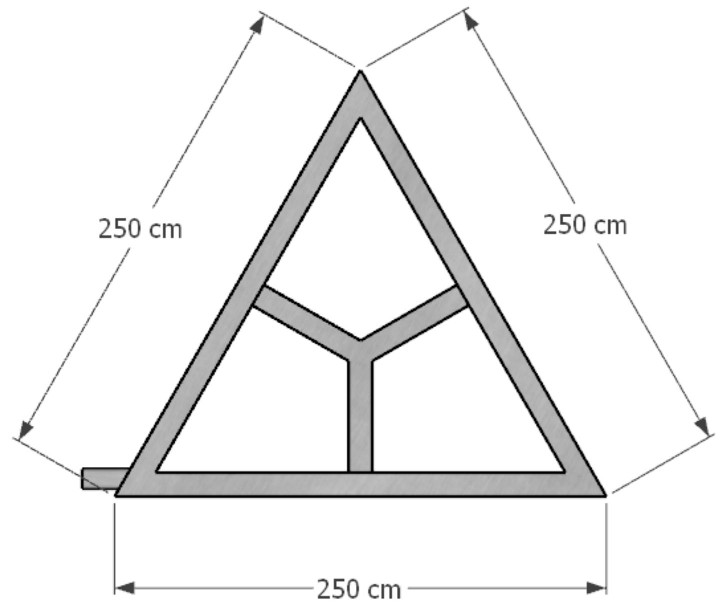
DETAIL SAMBUNGAN
SKALA 1 : NTS

PORTAL C

DETAIL 3.1

SKALA 1 : 40



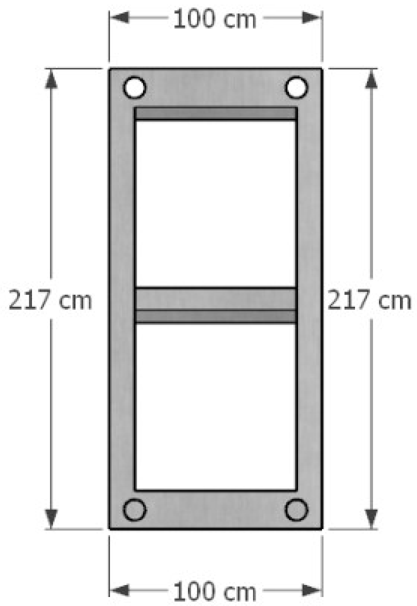


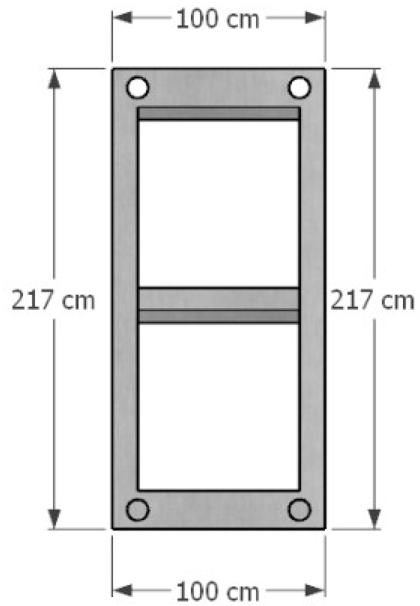
DETAIL 3.2

SKALA 1 : 40

DETAIL 3.3

SKALA 1 : 40

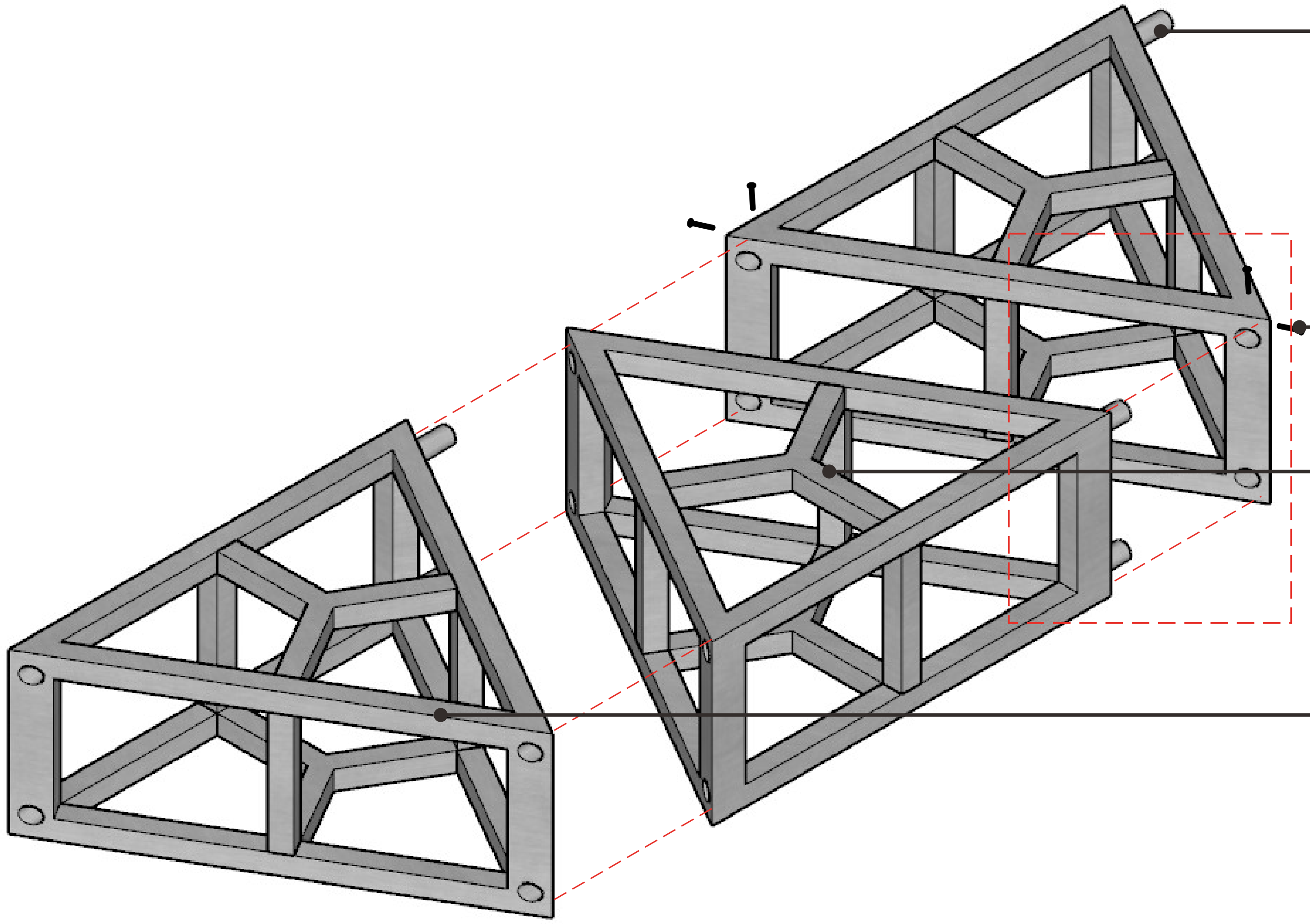




DETAIL 3.4

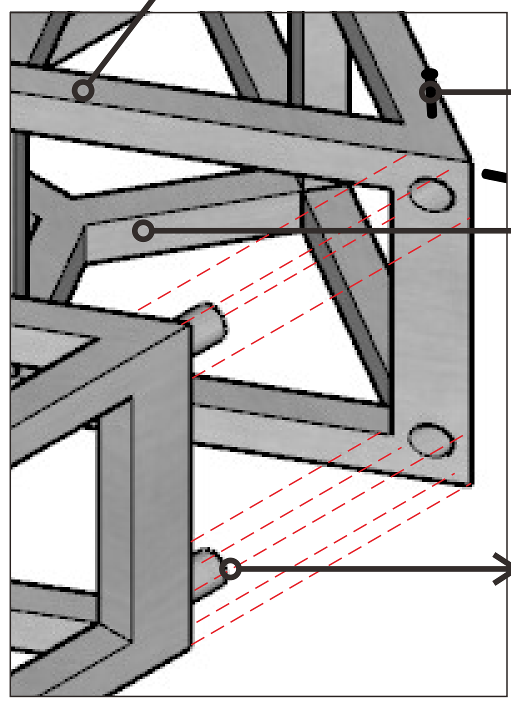
SKALA 1 : 40

PORTAL C



ISOMETRI DETAIL 3

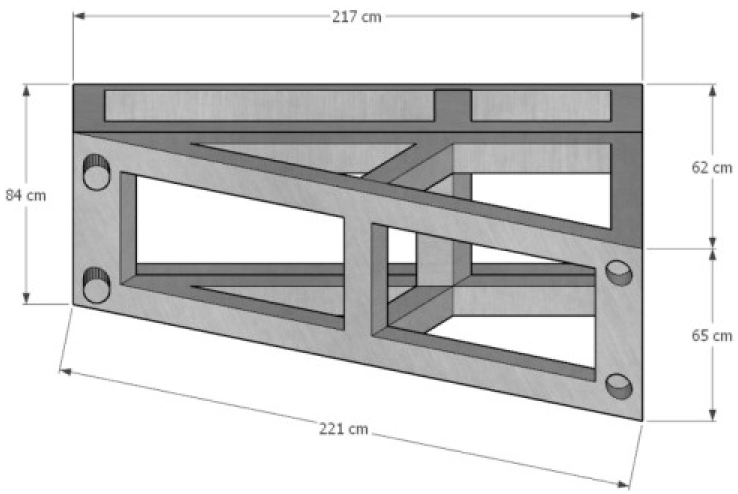
SKALA 1 : NTS



DETAIL SAMBUNGAN

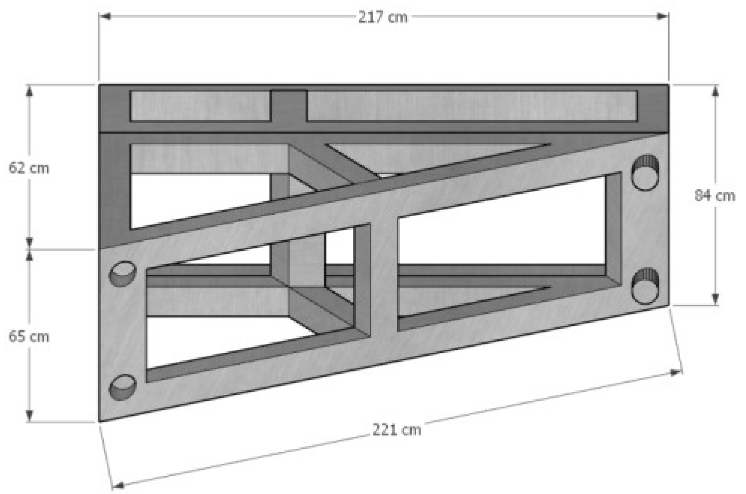
SKALA 1 : NTS

PORTAL C



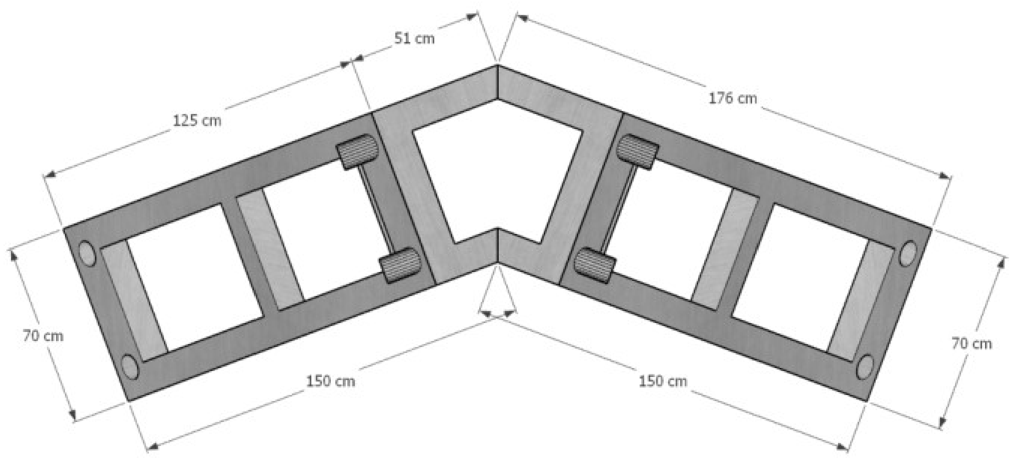
DETAIL 4.1

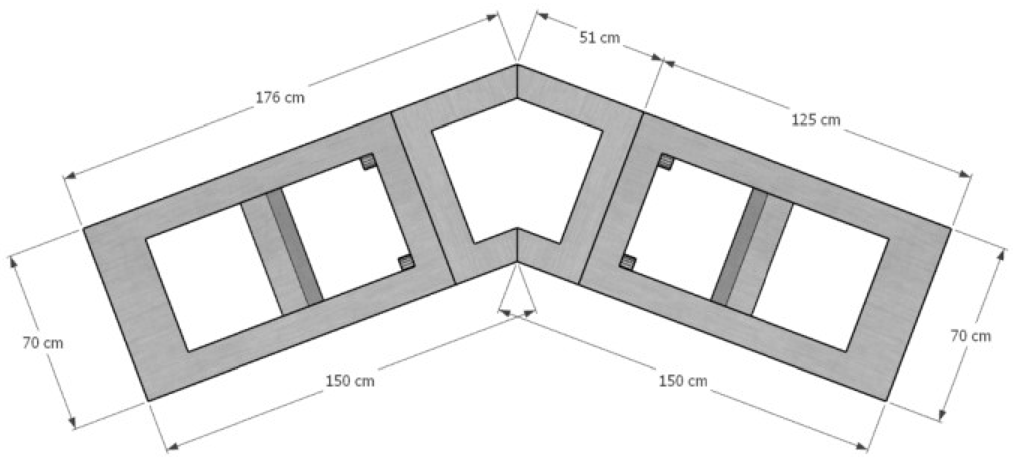
SKALA 1 : 40



DETAIL 4.2

SKALA 1 : 40



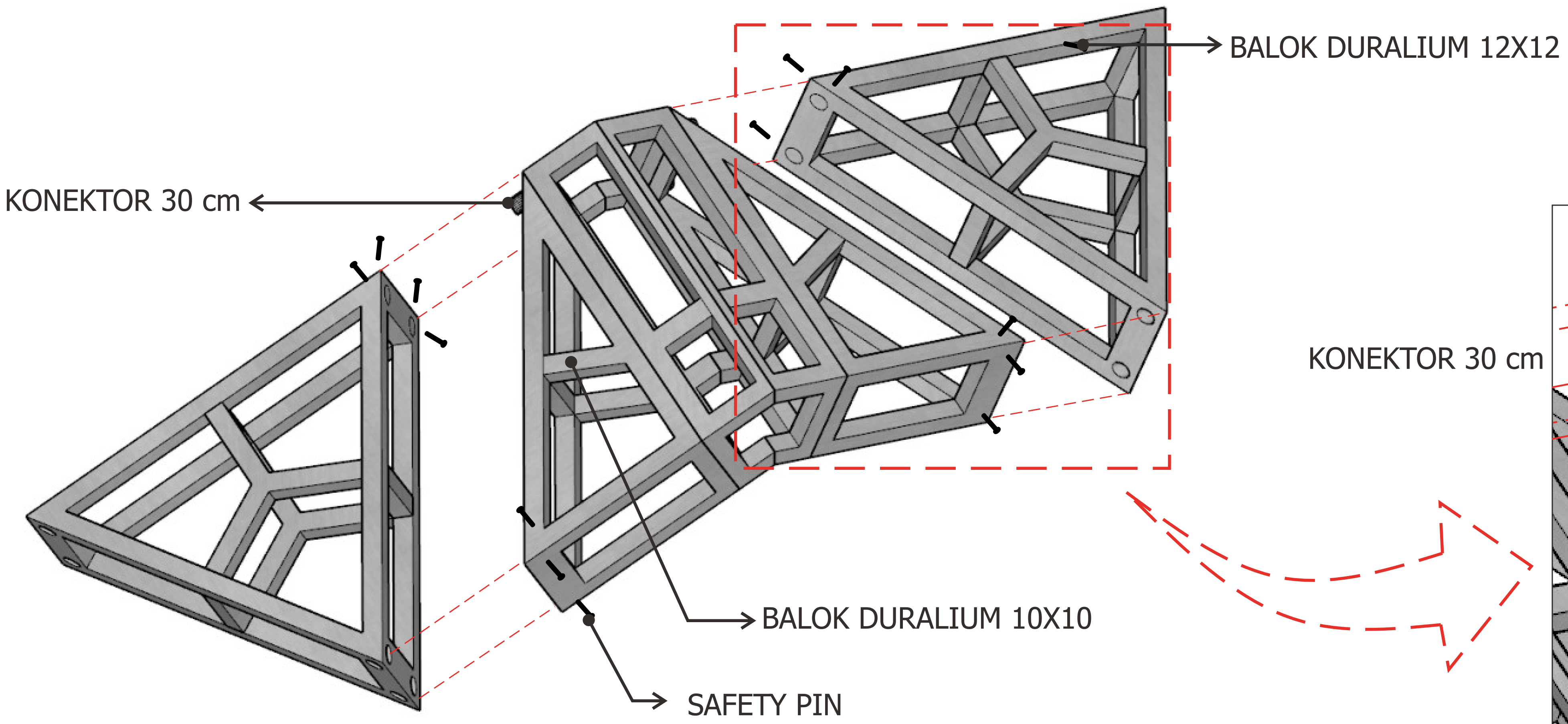


DETAIL 4.3

DETAIL 4.4

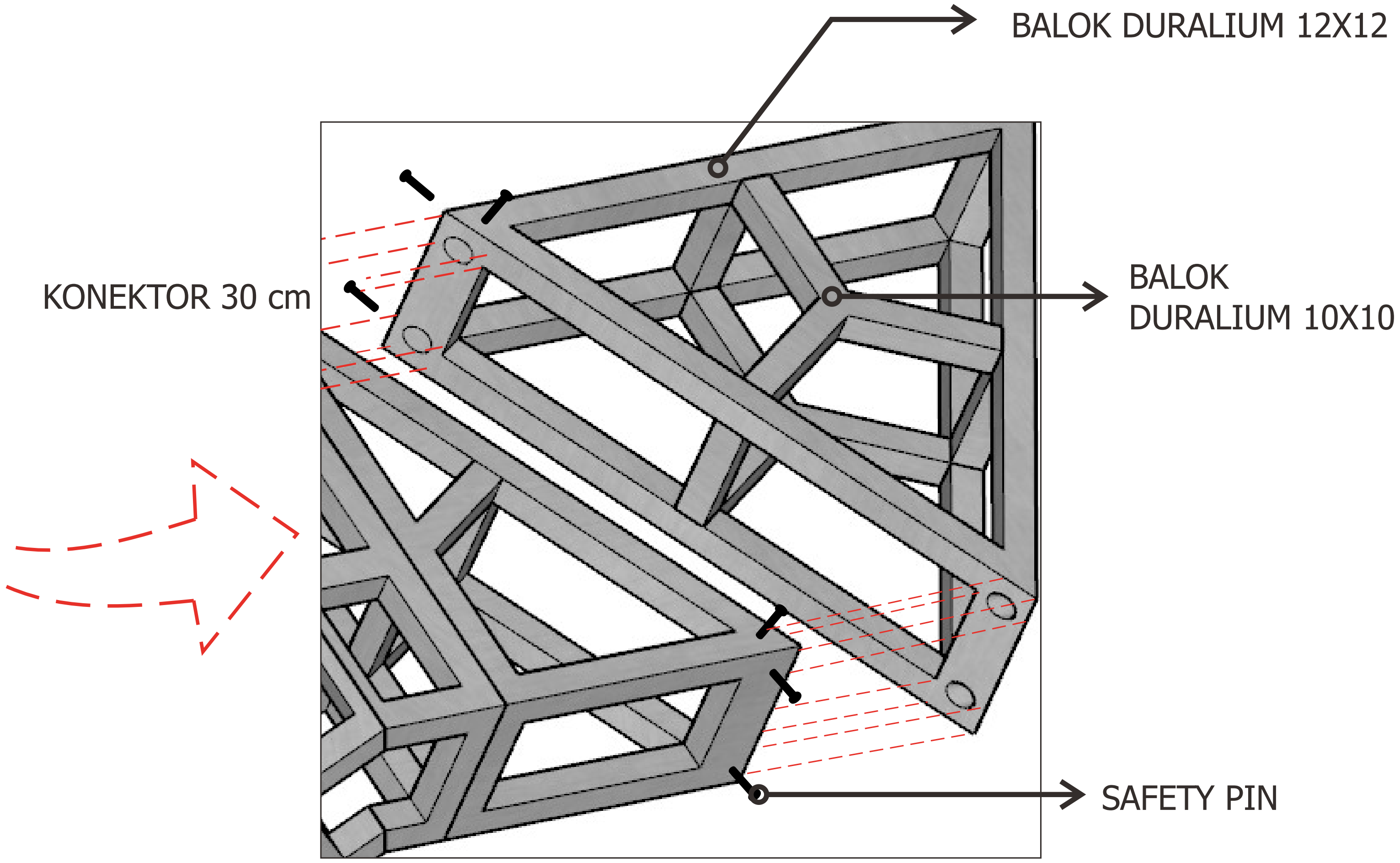
SKALA 1 : 40

PORTAL B



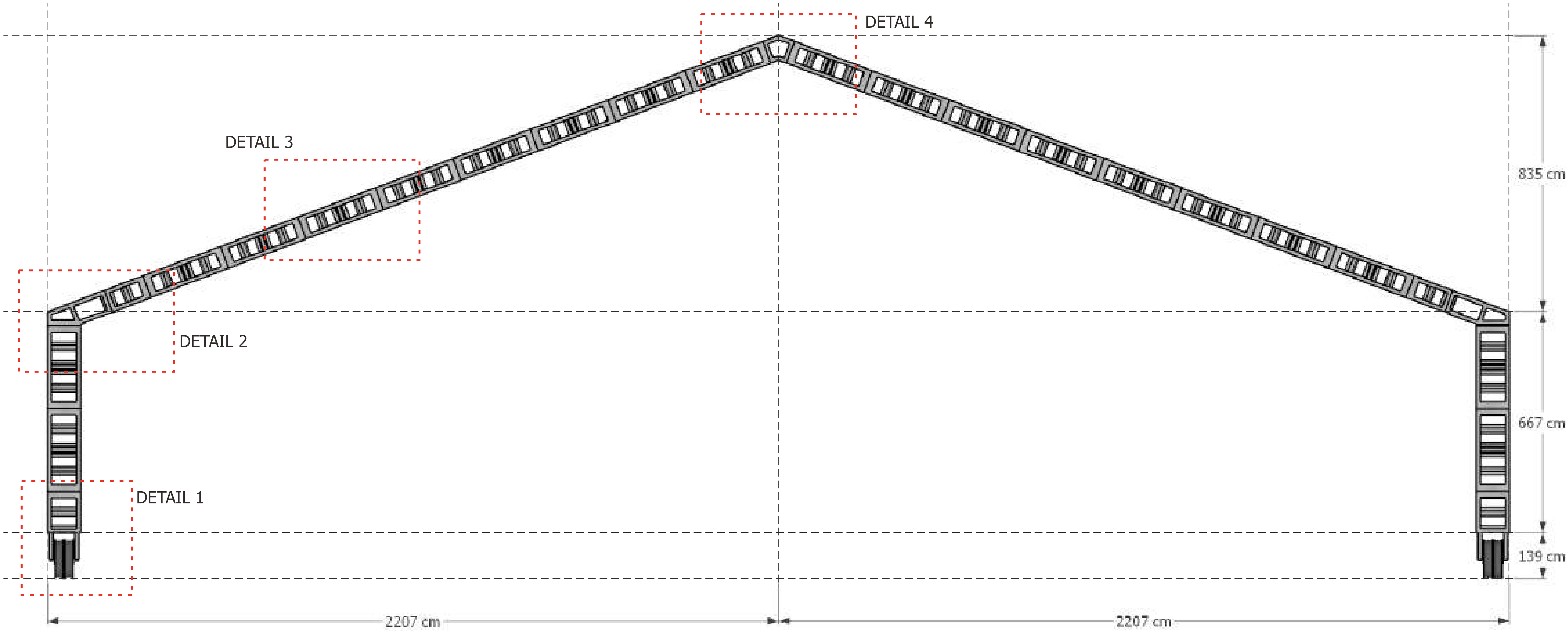
ISOMETRI DETAIL 4

SKALA 1 : NTS



DETAIL SAMBUNGAN

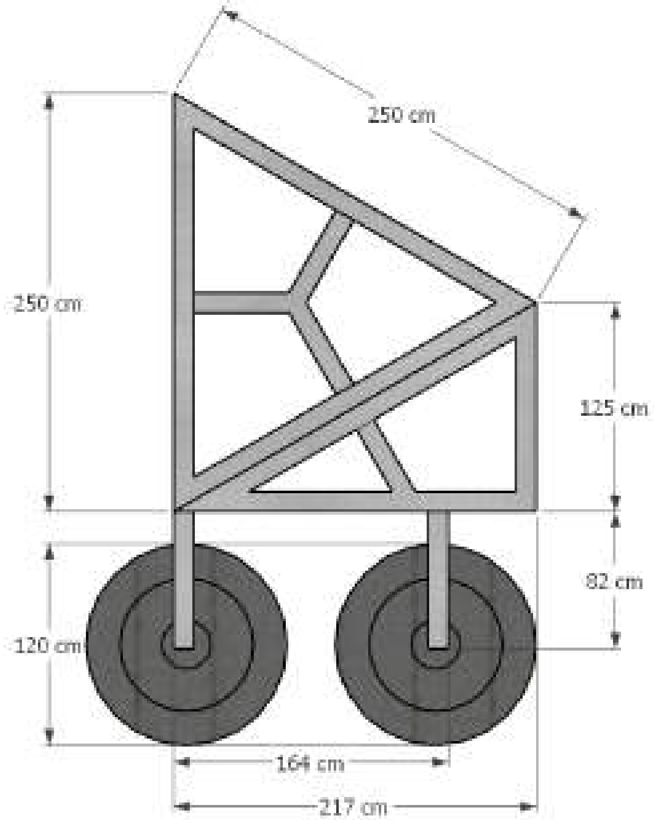
SKALA 1 : NTS



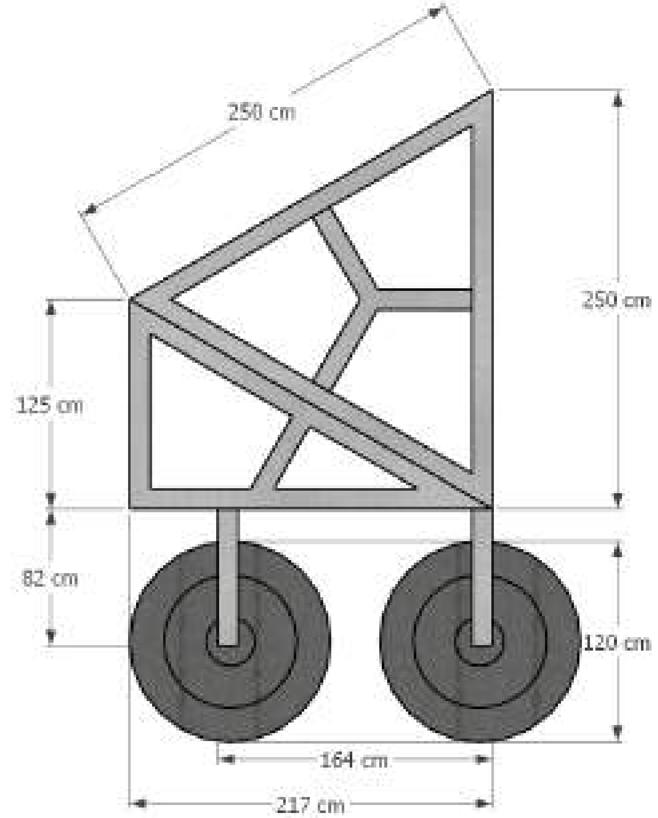
PORTAL D

SKALA 1 : 175

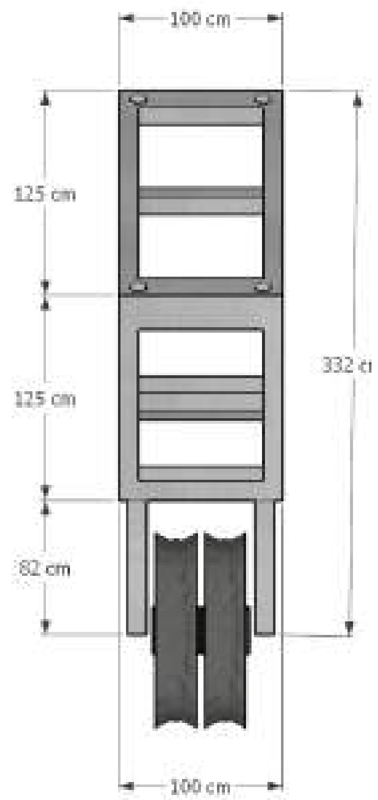
PORTAL E



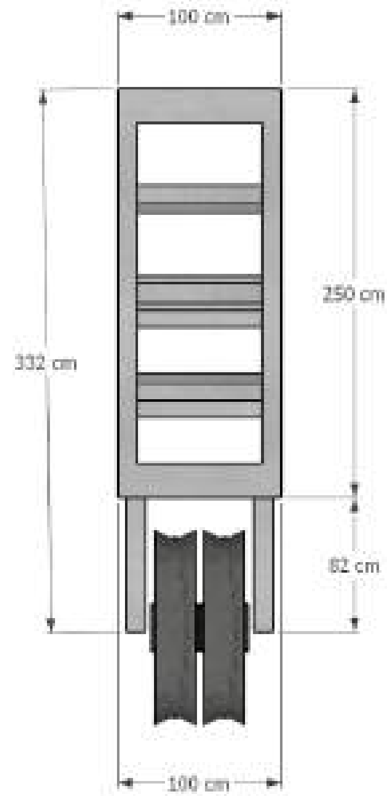
DETAIL 1.1
SKALA 1 : 40



DETAIL 1.2
SKALA 1 : 40

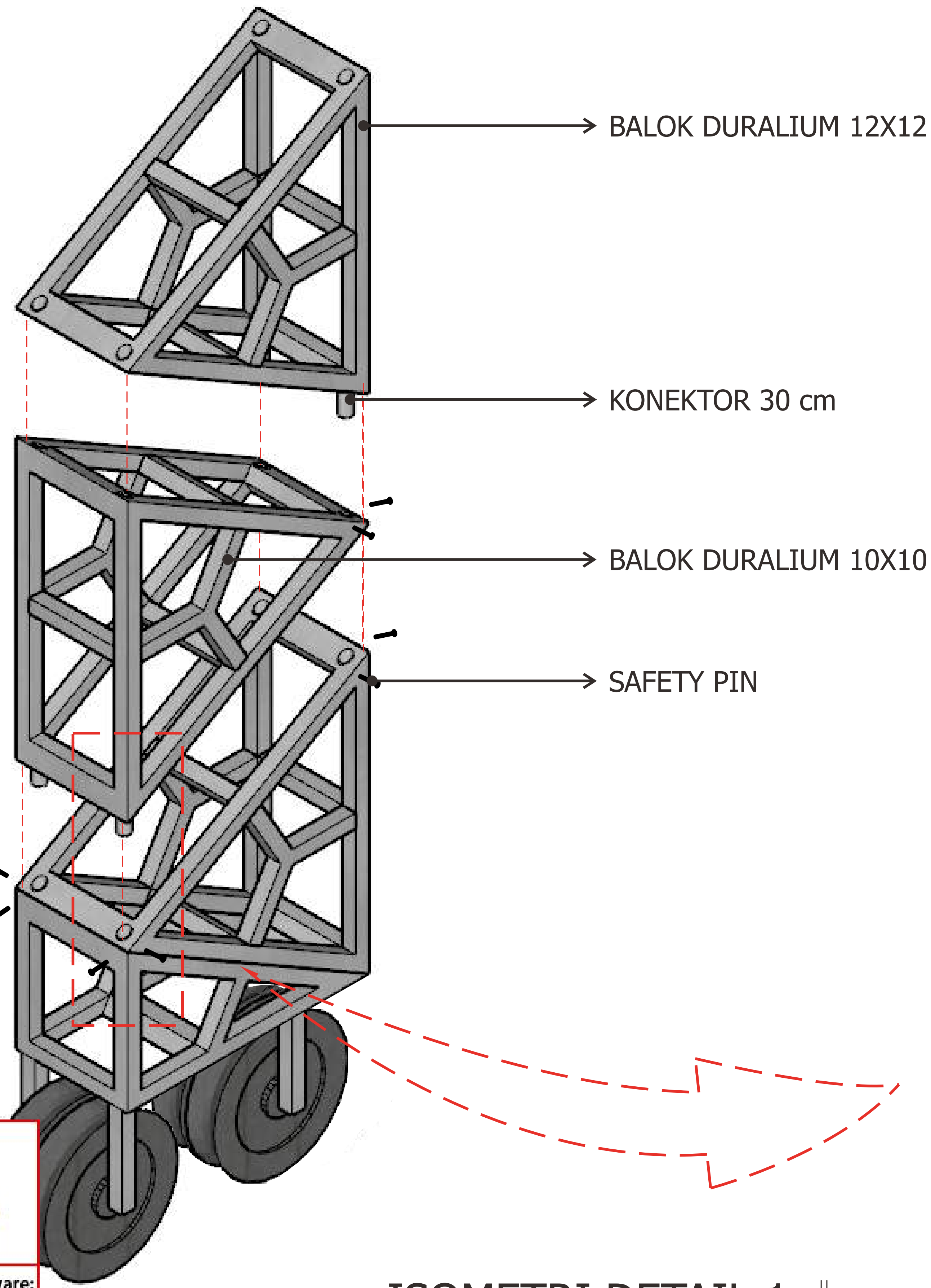


DETAIL 1.3
SKALA 1 : 40



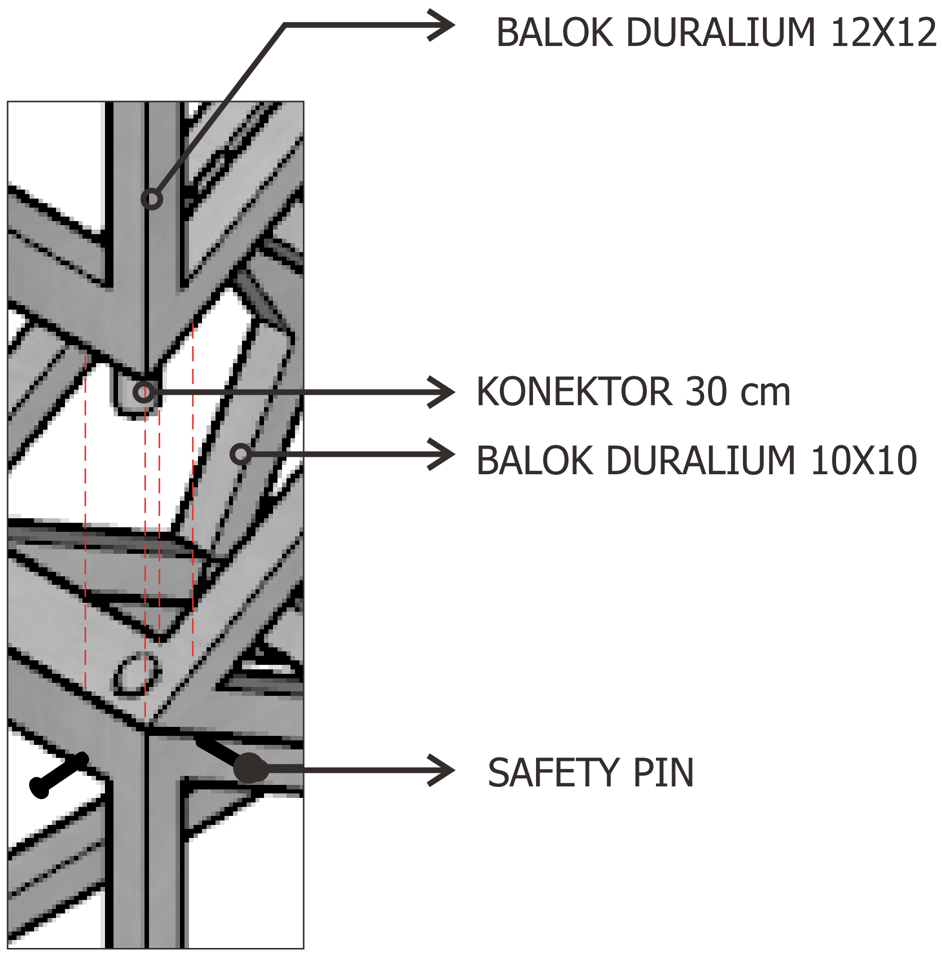
DETAIL 1.4
SKALA 1 : 40

PORTAL E



ISOMETRI DETAIL 1

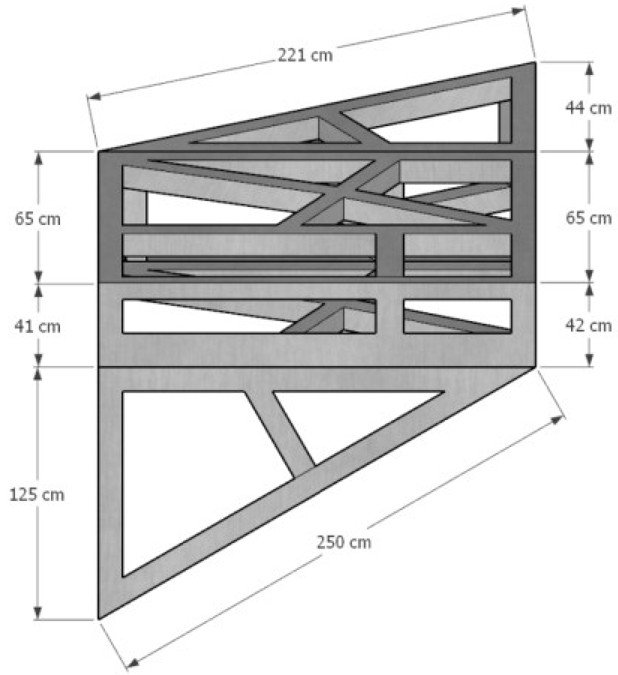
SKALA 1 : NTS



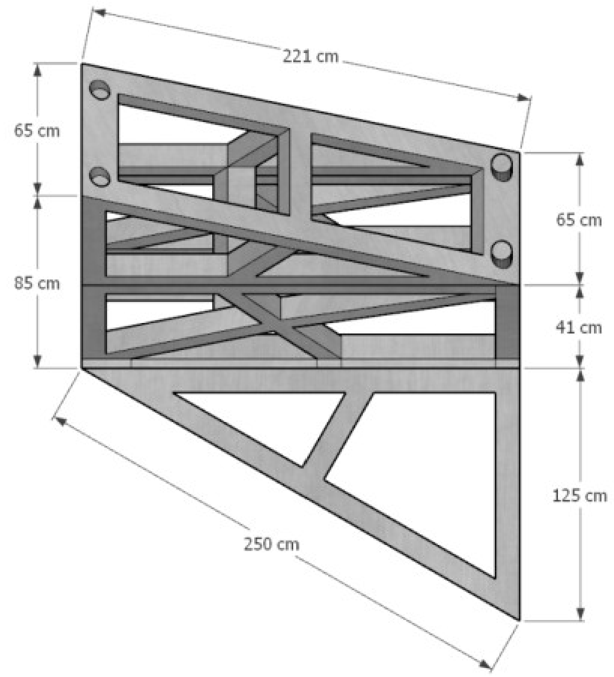
DETAIL SAMBUNGAN

SKALA 1 : NTS

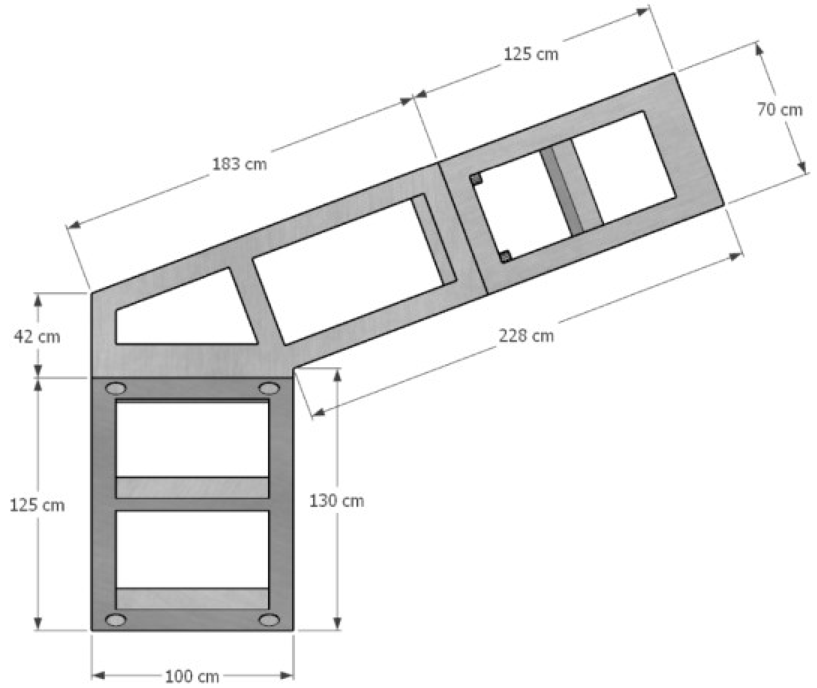
PORTAL D



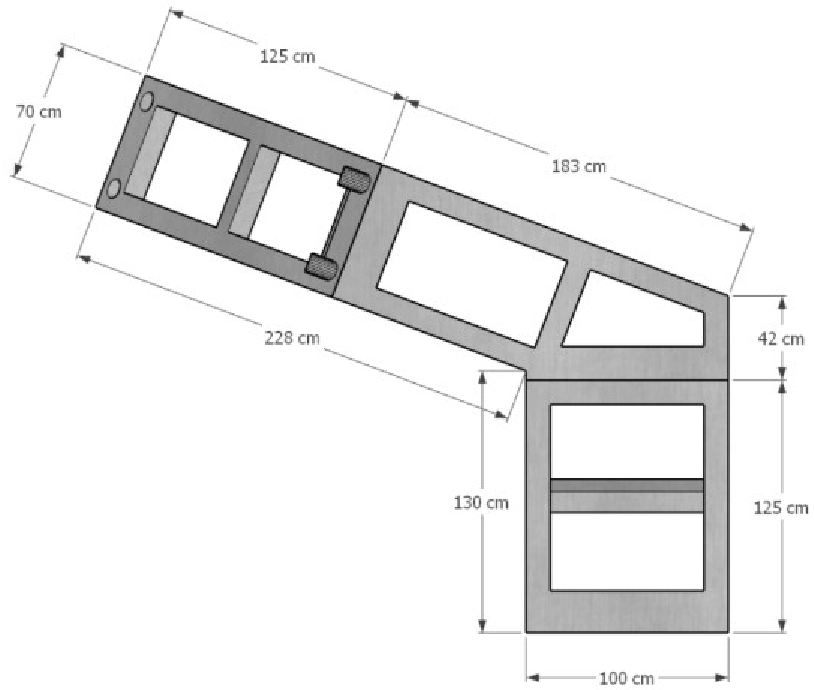
DETAIL 2.1
SKALA 1 : 40



DETAIL 2.2
SKALA 1 : 40

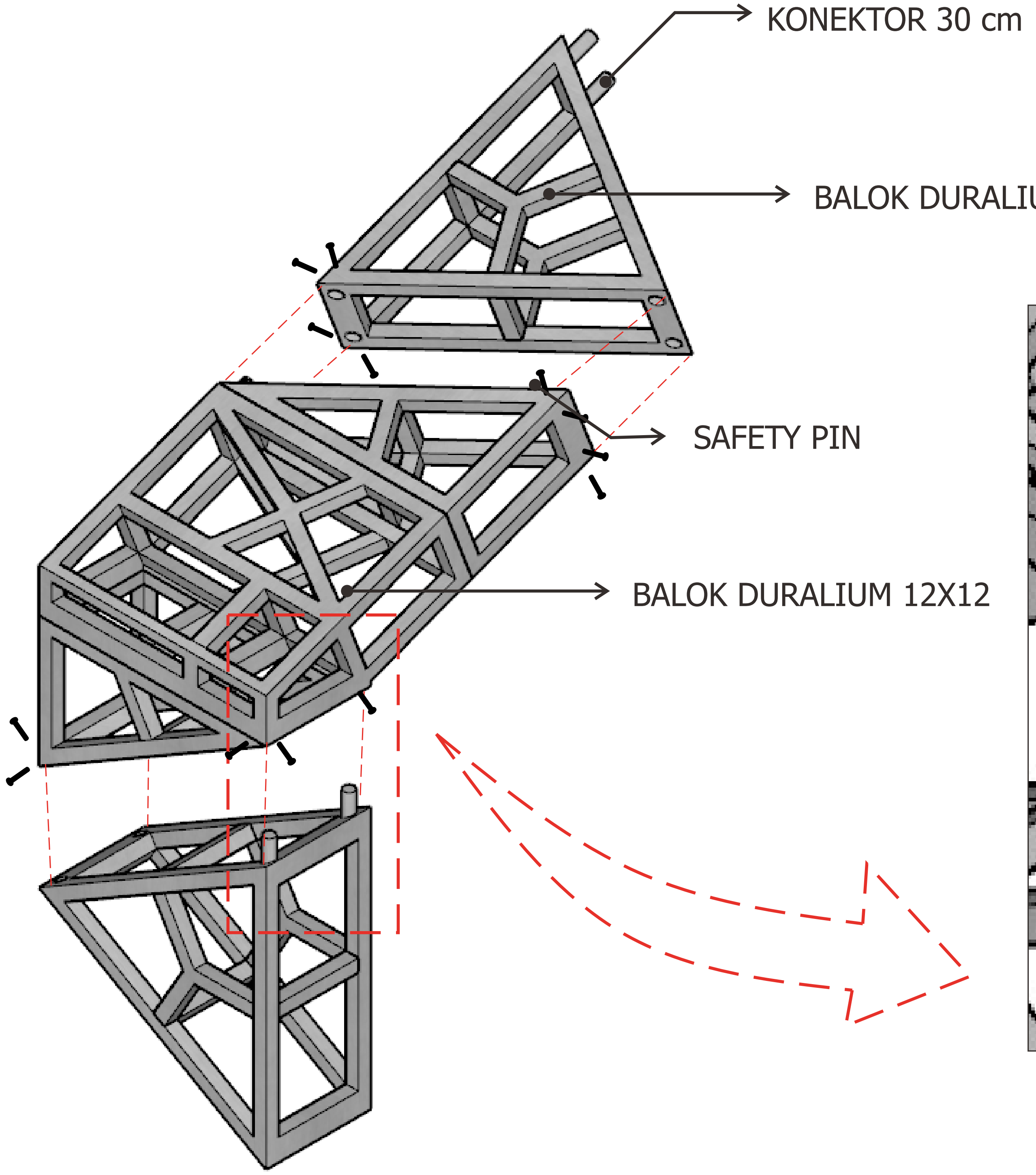


DETAIL 2.3
SKALA 1 : 40

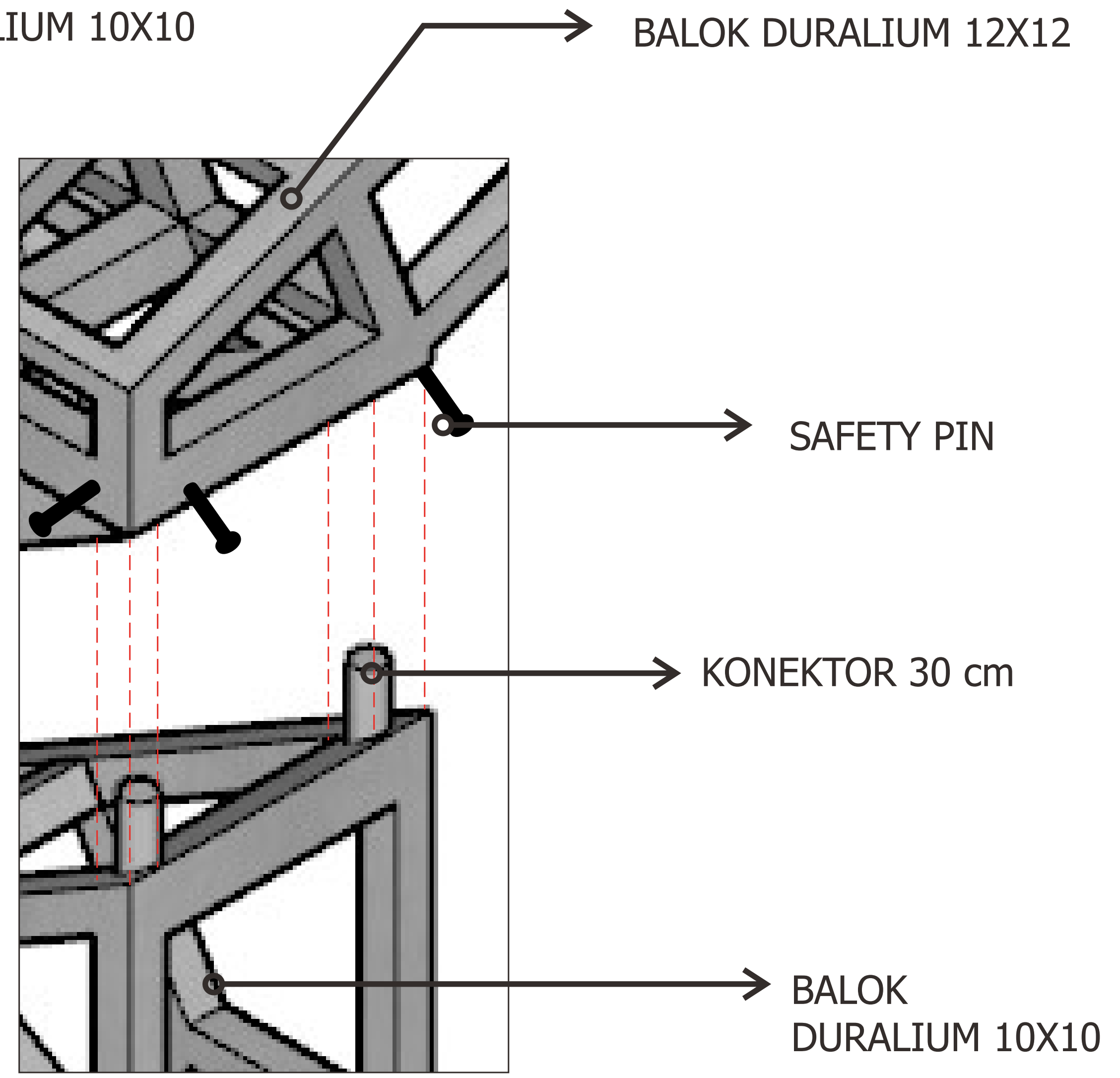


DETAIL 2.4
SKALA 1 : 40

PORTAL D



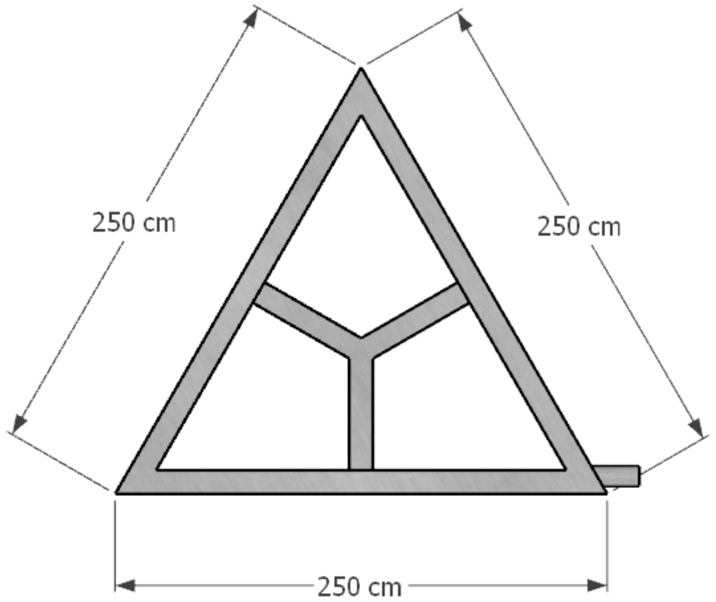
ISOMETRI DETAIL 2
SKALA 1 : NTS

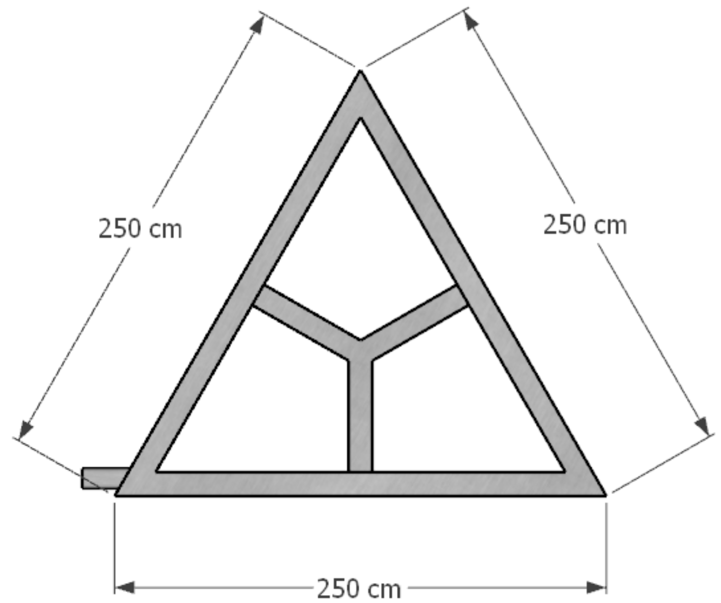


DETAIL SAMBUNGAN
SKALA 1 : NTS

PORTAL D

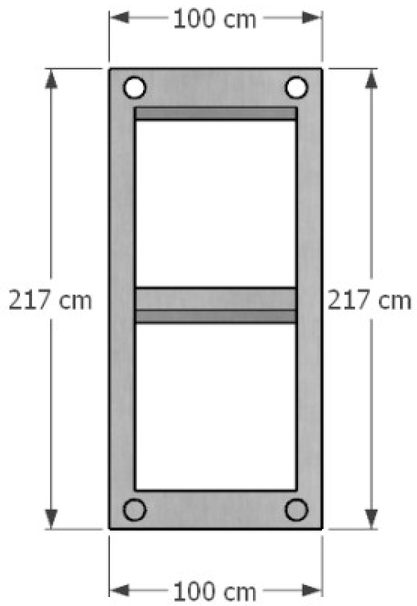
DETAIL 3.1
SKALA 1 : 40

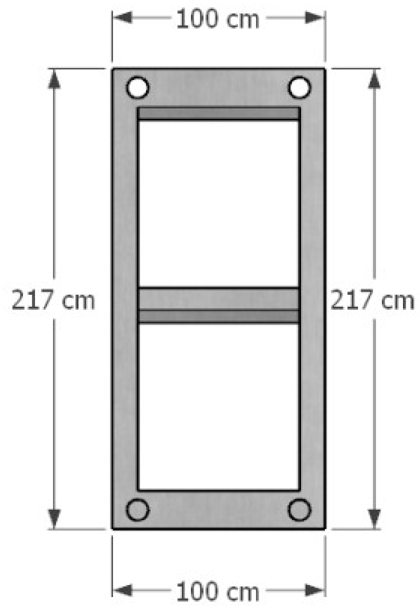




DETAIL 3.2
SKALA 1 : 40

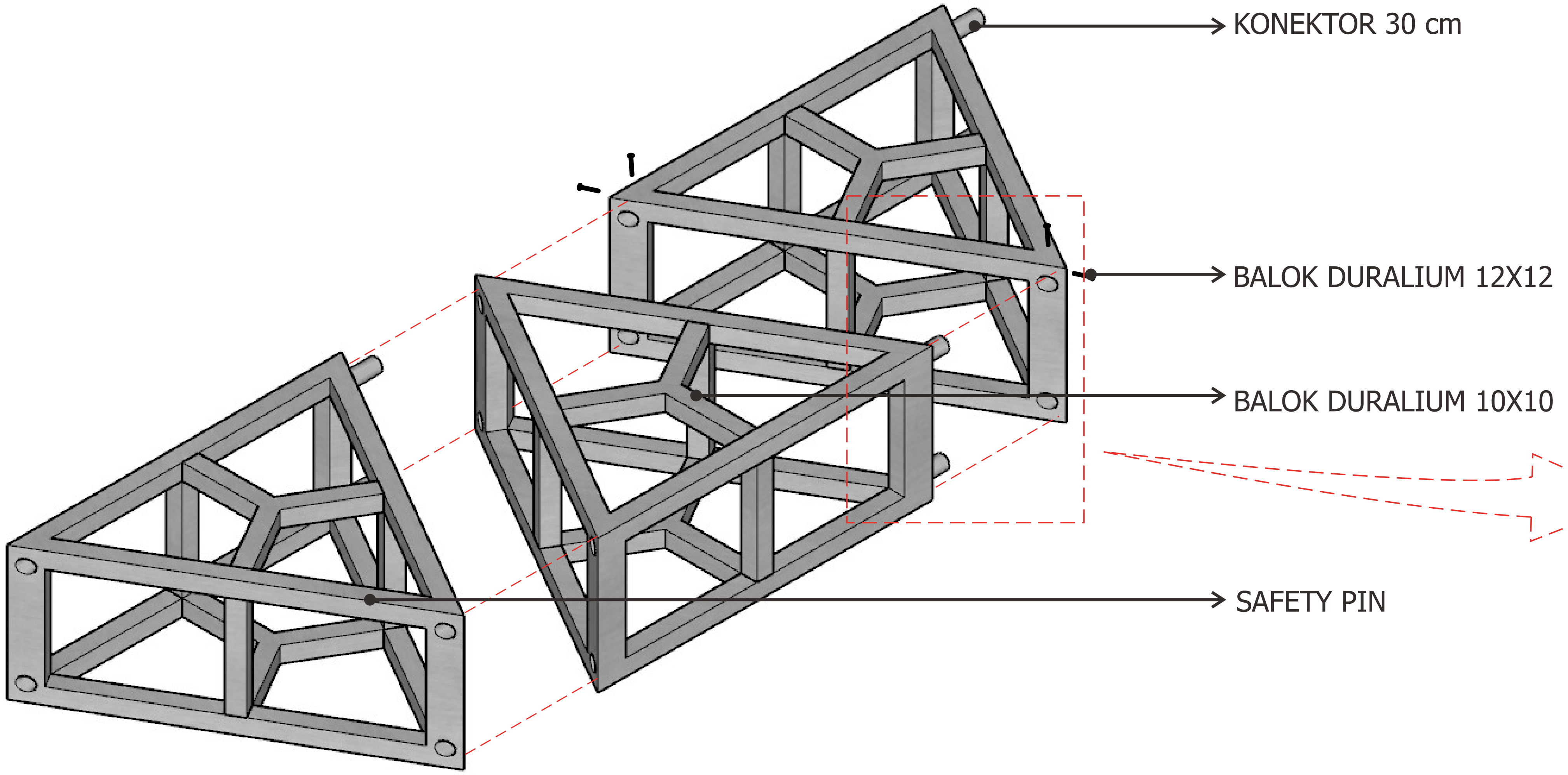
DETAIL 3.3
SKALA 1 : 40



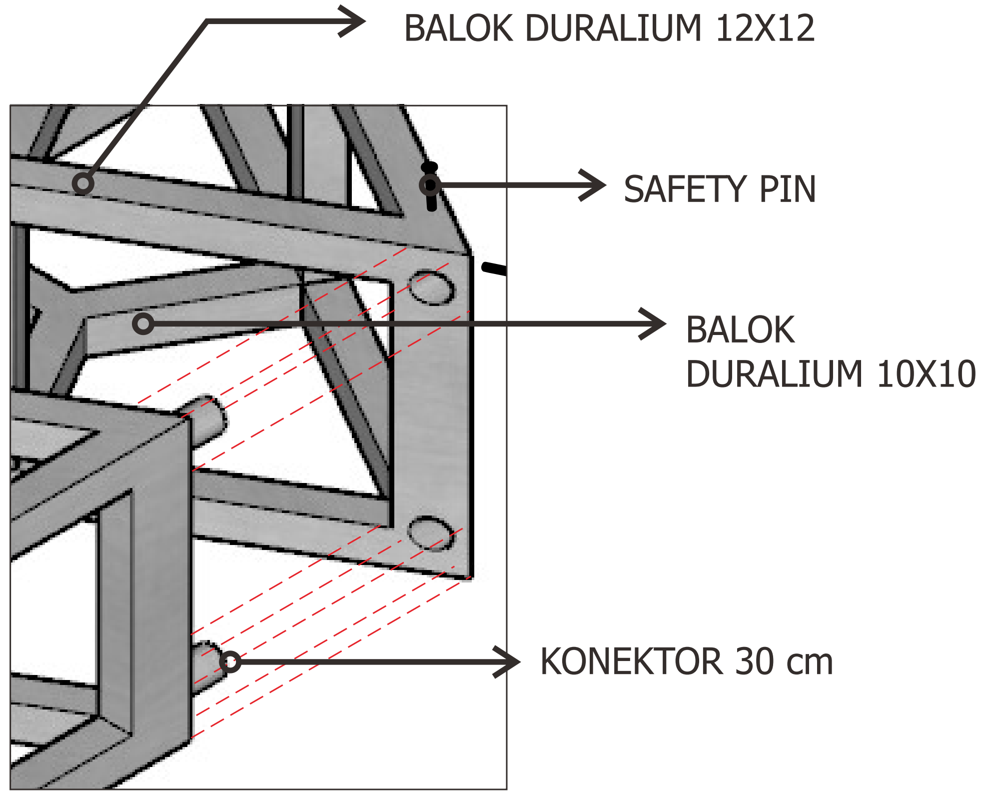


DETAIL 3.4
SKALA 1 : 40

PORTAL D

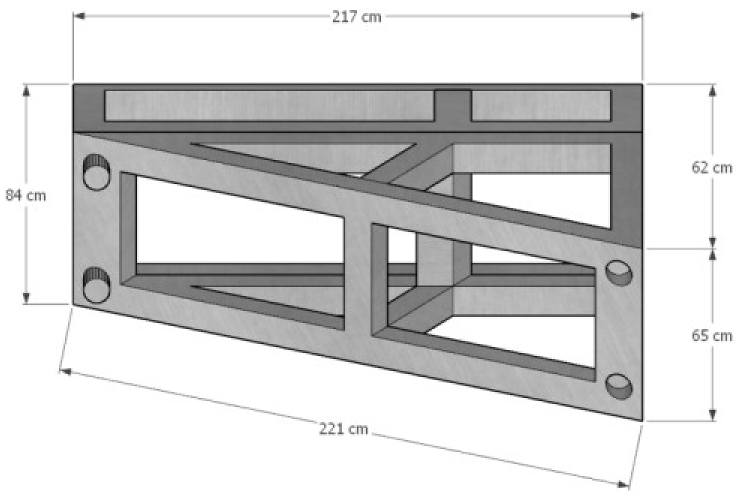


ISOMETRI DETAIL 3
SKALA 1 : NTS

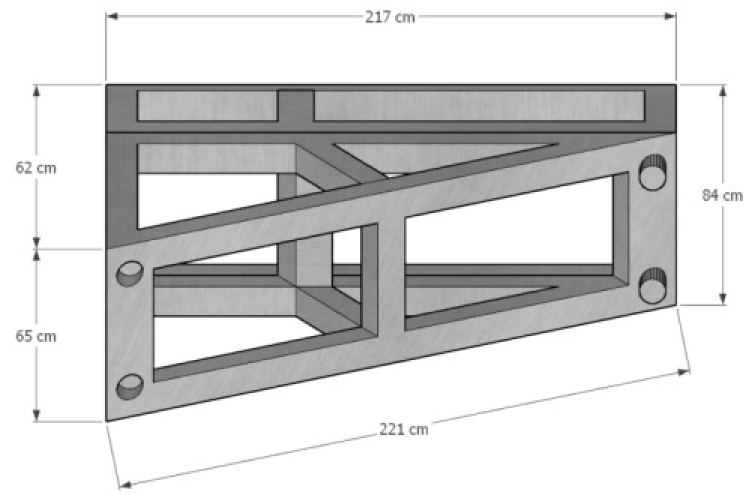


DETAIL SAMBUNGAN
SKALA 1 : NTS

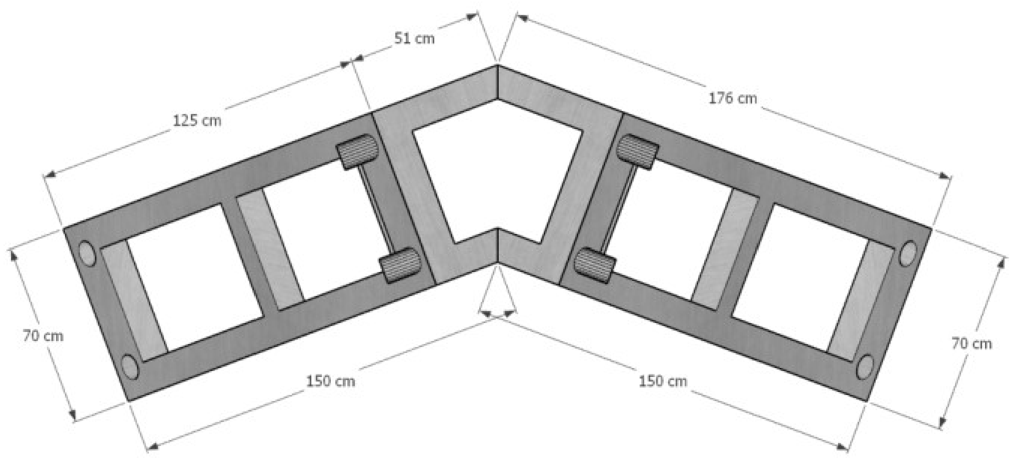
PORTAL D



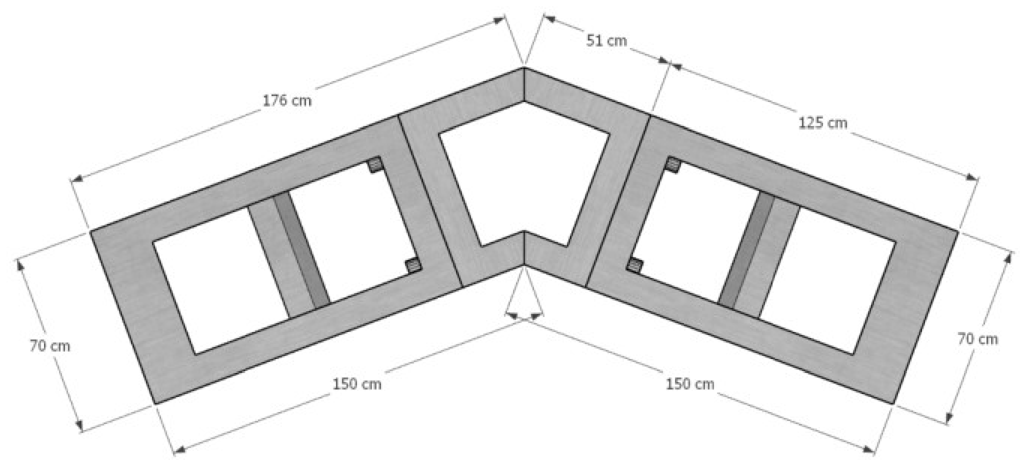
DETAIL 4.1
SKALA 1 : 40



DETAIL 4.2
SKALA 1 : 40

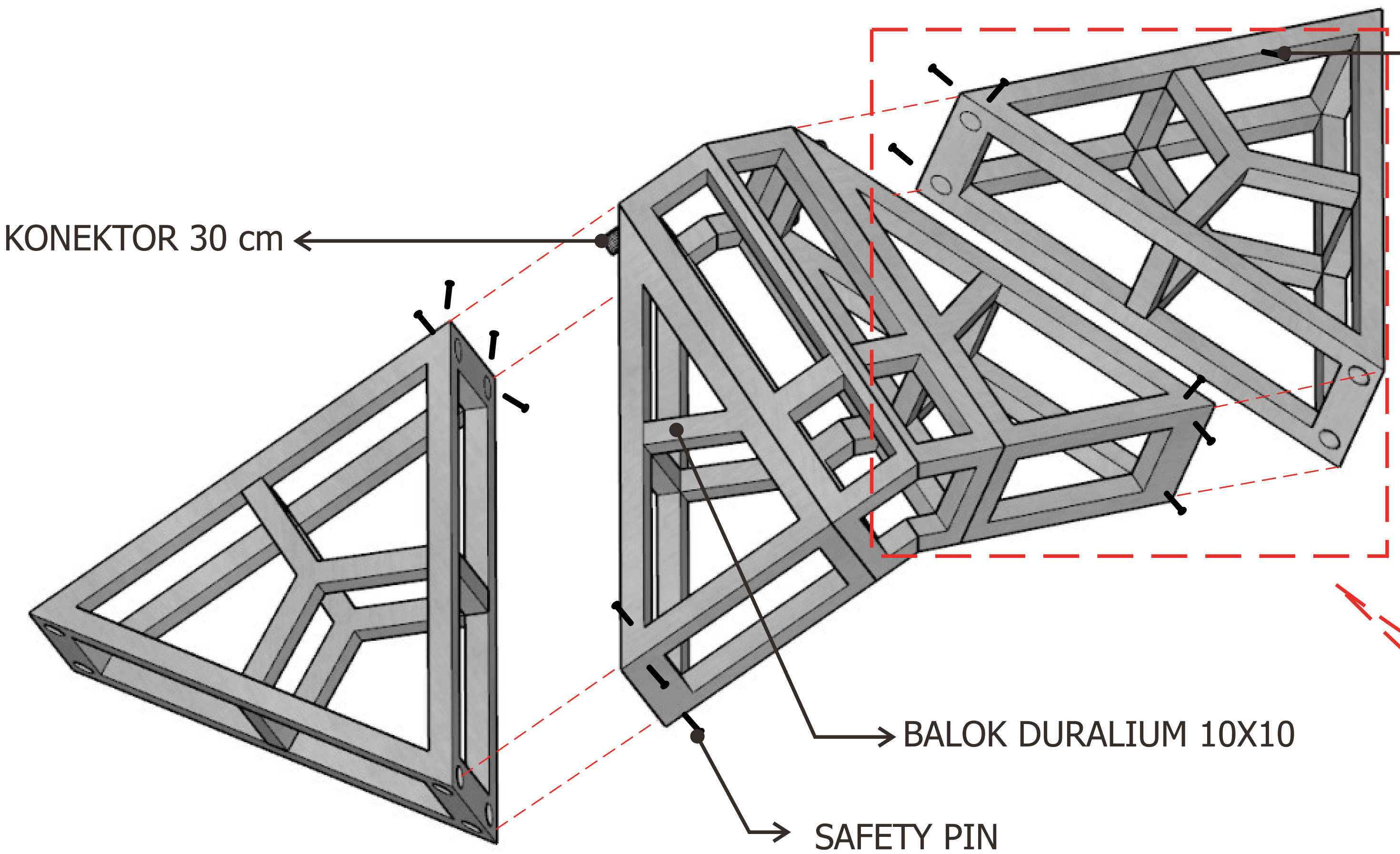


DETAIL 4.3



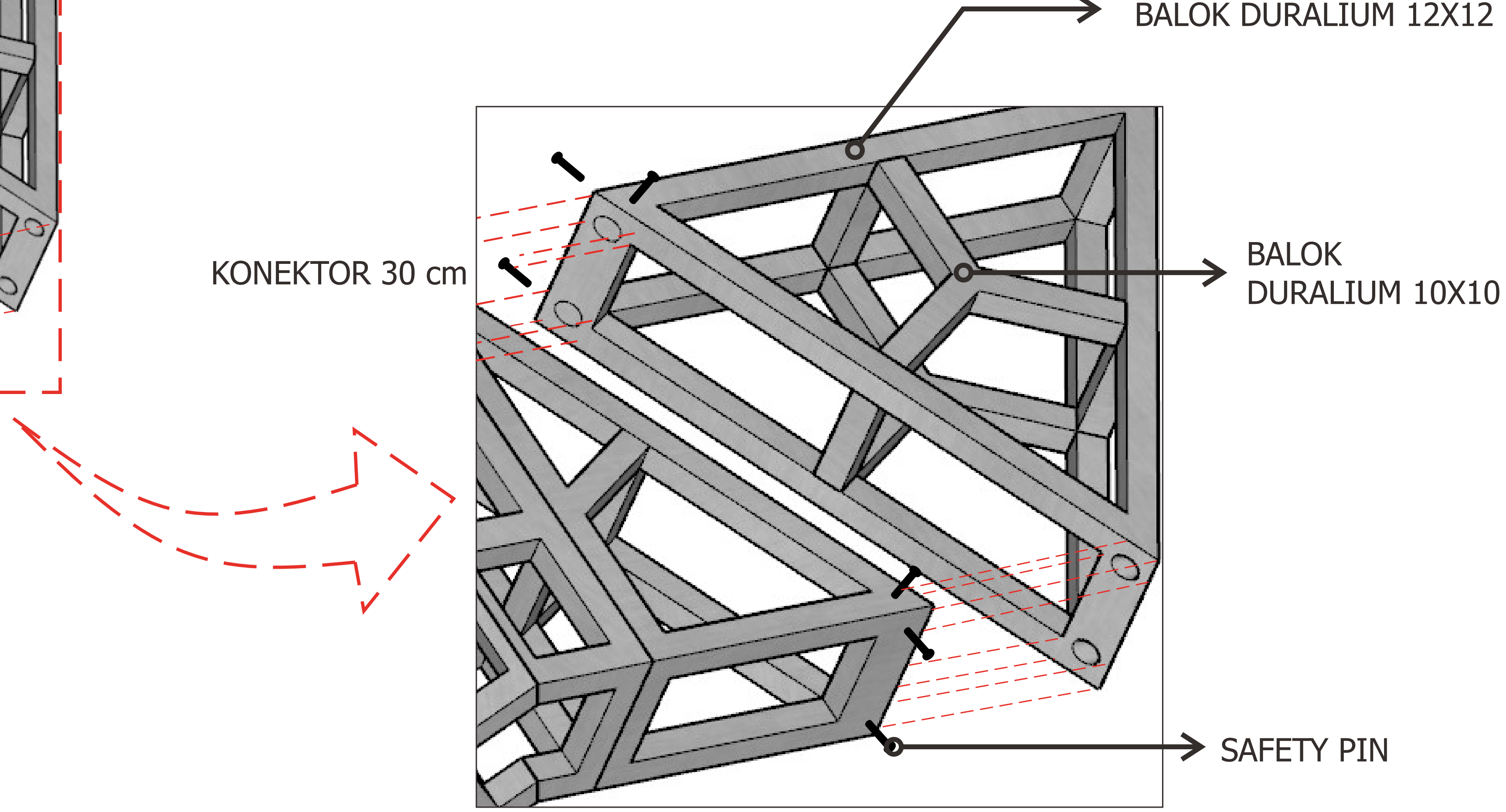
DETAIL 4.4
SKALA 1 : 40

PORTAL D



ISOMETRI DETAIL 4

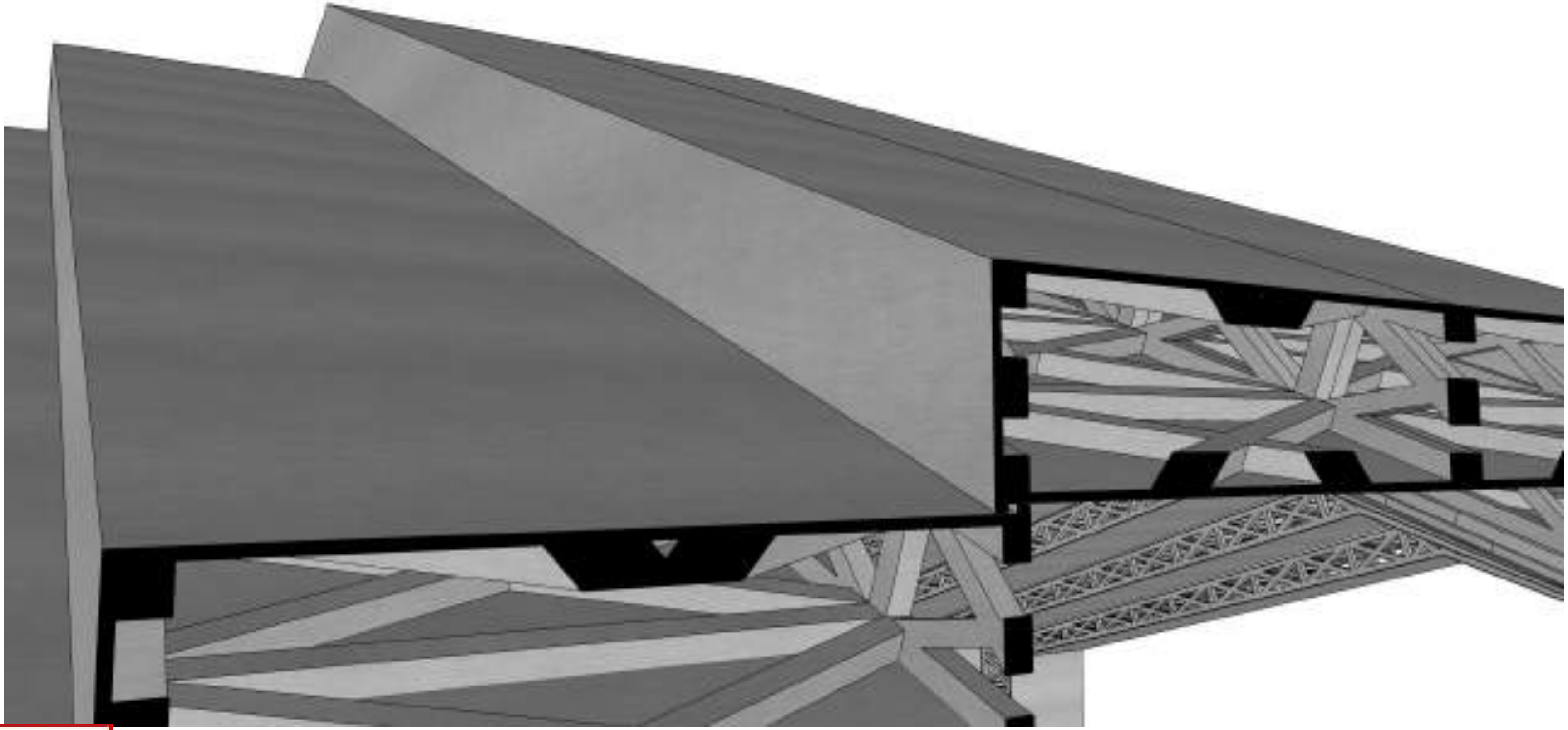
SKALA 1 : NTS



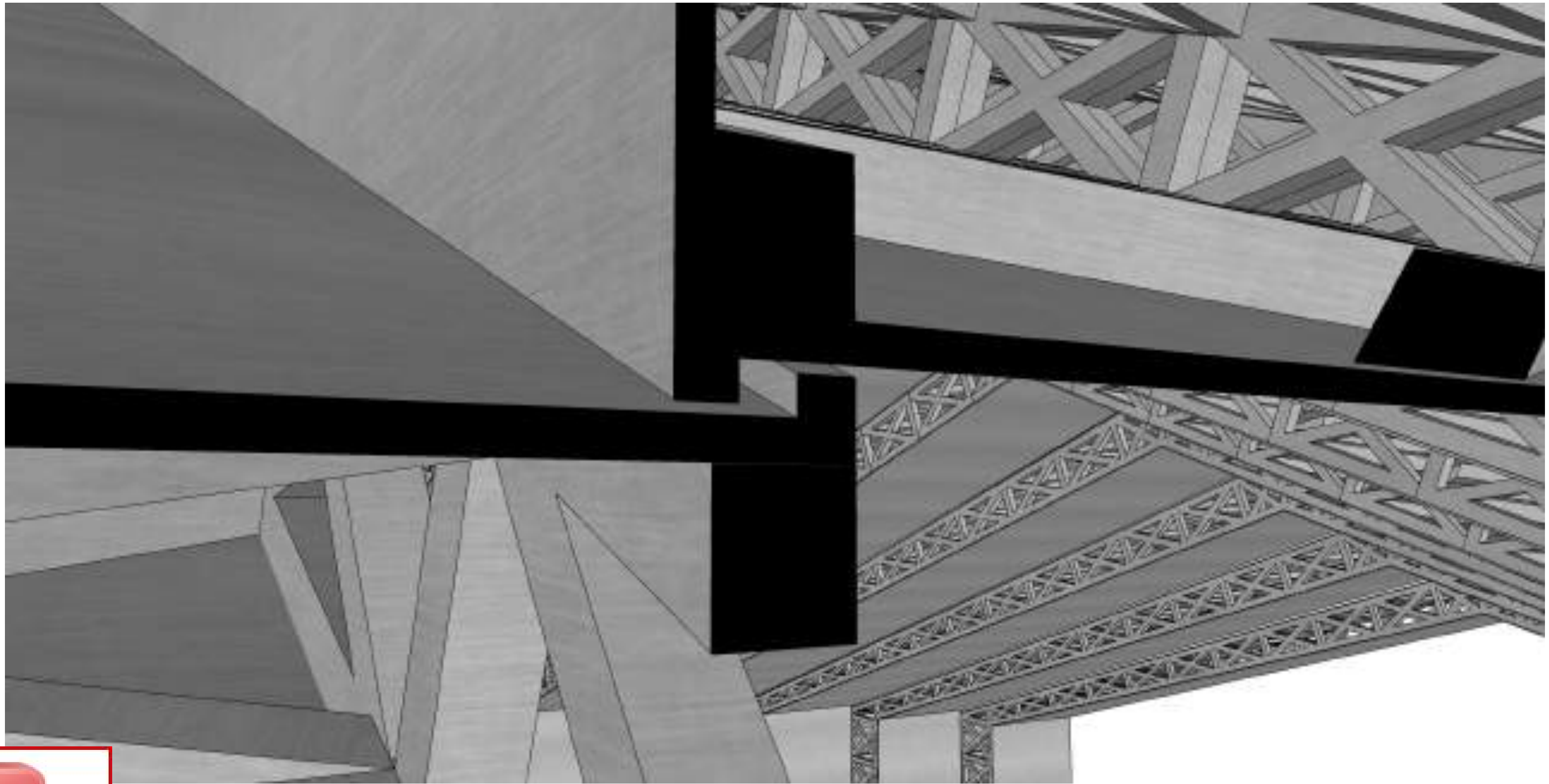
DETAIL SAMBUNGAN

SKALA 1 : NTS

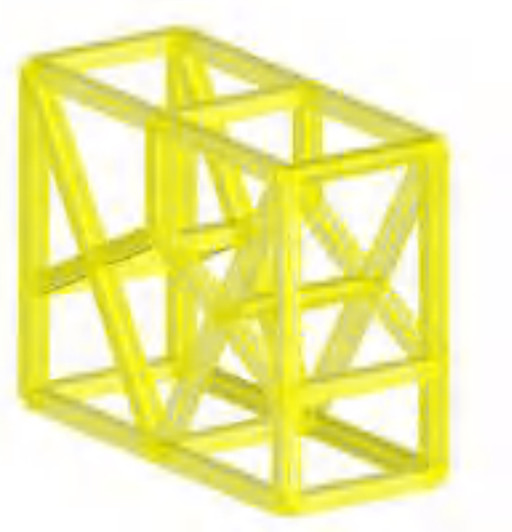
SAMBUNGAN INTERLOCK



DETAIL INTERLOCK



Perhitungan Kekuatan Sambungan



Ditentukan pasak rencana sebagai berikut:

d_b = 20 mm
f_y = 660 MPa
f_u = 830 MPa
A_b = 314.159 mm^2
m = 1 jumlah bidang geser
r_1 = 0.5

Untuk pelat yang akan digunakan:

t_p = 30 mm
f_u = 410 MPa

r_1 = 0.5 untuk baut tanpa ulir pada bidang geser
r_1 = 0.4 untuk baut dengan ulir pada bidang geser

•Tahanan Geser pasak

Rn	=	m	x	r_1	x	$f_u^{\ b}$	x	A_b
	=	1	x	0.5	x	830	x	314.159
	=	130376.095	N					
	=	130376.095	N/perpasak					
Rn	=	97782.071	N					

•Tahanan Tarik pasak

Rn	=	0.75	x	$f_u^{\ b}$	x	A_b
	=	0.75	x	830	x	314.159265
	=	195564.143	N			
Rn	=	195564.143	N/perpasak			

•Tahanan Tumpu pasak

Rn	=	2.4	x	d_b	x	t_p	x	f_u
	=	2.4	x	20	x	30	x	410
	=	590400	N					
	=	590400	N/perpasak					
Rn	=	442800	N					

Diketahui dari hasil analisis struktur melalui SAP2000 pada batang diperoleh nilai Pu sebesar 91780.79 N

Maka jumlah pasak yang digunakan ialah:

$$n = \frac{Pu}{Rn}$$

$$= \frac{91780.79}{97782.071}$$

= 0.939

= 1 buah

mlah Pasak yang digunakan 1 buah dengan diameter 24 mm dan tebal pelat 10 mm

Perhitungan Kekuatan Sambungan

Ditentukan pasak rencana sebagai berikut:

d_b =	15	mm
f_y =	660	MPa
f_u =	830	MPa
A_b =	176.715	mm^2
m =	1	jumlah bidang geser
r_1 =	0.5	

Untuk pelat yang akan digunakan:

t_p =	30	mm
f_u =	410	MPa

$r_1 =$ 0.5 untuk baut tanpa ulir pada bidang geser

$r_1 =$ 0.4 untuk baut dengan ulir pada bidang geser

•Tahanan Geser pasak

Rn = m x r_1 x $f_u^{\,b}$ x A_b

= 1 x 0.5 x 830 x 176.715

= 73336.554 N

= 73336.554 N/perpasak

Rn = 55002.415 N

•Tahanan Tarik pasak

Rn = 0.75 x $f_u^{\,b}$ x A_b

= 0.75 x 830 x 176.714587

= 110004.830 N

Rn = 110004.830 N/perpasak

•Tahanan Tumpu pasak

Rn = 2.4 x d_b x t_p x f_u

= 2.4 x 15 x 30 x 410

= 442800 N

= 442800 N/perpasak

Rn = 332100 N

Diketahui dari hasil analisis struktur melalui SAP2000 pada batang
diperoleh nilai Pu sebesar 36761.6 N
Maka jumlah pasak yang digunakan ialah:

$$n = \frac{Pu}{Rn}$$

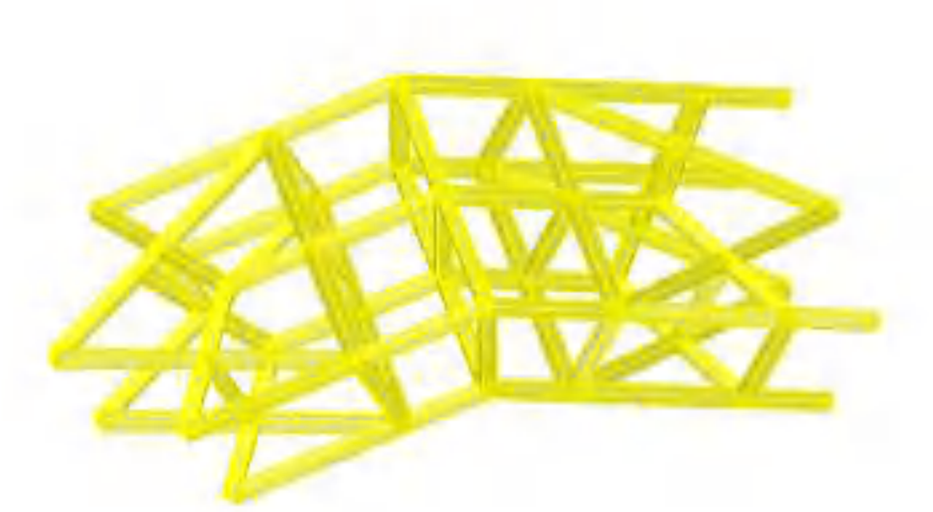
$$= \frac{36761.6}{55002.415}$$

= 0.668

= 1 buah

mlah Pasak yang digunakan 1 buah dengan diameter 24 mm dan tebal pelat 10 mm

Perhitungan Kekuatan Sambungan



Ditentukan pasak rencana sebagai berikut:

d_b = 22 mm
f_y = 660 MPa
f_u = 830 MPa
A_b = 380.133 mm^2
m = 1 jumlah bidang geser
r_1 = 0.5

Untuk pelat yang akan digunakan:

t_p = 30 mm
f_u = 410 MPa

$r_1 =$ 0.5 untuk baut tanpa ulir pada bidan
$r_1 =$ 0.4 untuk baut dengan ulir pada bida

•Tahanan Geser pasak

Rn	=	m	x	r_1	x	$f_u^{\,b}$	x	A_b
	=	1	x	0.5	x	830	x	380.133
	=	157755.075	N					
	=	157755.075	N/perpasak					
Rn	=	118316.306	N					

•Tahanan Tarik pasak

Rn	=	0.75	x	$f_u^{\,b}$	x	A_b
	=	0.75	x	830	x	380.132711
	=	236632.613	N			
Rn	=	236632.613	N/perpasak			

•Tahanan Tumpu pasak

Rn	=	2.4	x	d_b	x	t_p	x	f_u
	=	2.4	x	22	x	30	x	410
	=	649440	N					
	=	649440	N/perpasak					
Rn	=	487080	N					

Diketahui dari hasil analisis struktur melalui SAP2000 pada batang
diperoleh nilai Pu sebesar 100723.13 N
Maka jumlah pasak yang digunakan ialah:

$$n = \frac{Pu}{Rn}$$

$$= \frac{100723.13}{118316.306}$$

= 0.851

= 1 buah

mlah Pasak yang digunakan 1 buah dengan diameter 24 mm dan tebal pelat 10 mm

Perhitungan Kekuatan Sambungan

Ditentukan pasak rencana sebagai berikut:

d_b = 25 mm
f_y = 660 MPa
f_u = 830 MPa
A_b = 490.874 mm^2
m = 1 jumlah bidang geser
r_1 = 0.5

Untuk pelat yang akan digunakan:

t_p = 30 mm
f_u = 410 MPa

$r_1 =$ 0.5 untuk baut tanpa ulir pada bidang
$r_1 =$ 0.4 untuk baut dengan ulir pada bida

•Tahanan Geser pasak

Rn	=	m	x	r_1	x	$f_u^{\ b}$	x	A_b
	=	1	x	0.5	x	830	x	490.8739
	=	203712.649	N					
	=	203712.649	N/perpasak					
Rn	=	152784.486	N					

•Tahanan Tarik pasak

Rn	=	0.75	x	$f_u^{\ b}$	x	A_b
	=	0.75	x	830	x	490.873852
	=	305568.973	N			
Rn	=	305568.973	N/perpasak			

•Tahanan Tumpu pasak

Rn	=	2.4	x	d_b	x	t_p	x	f_u
	=	2.4	x	25	x	30	x	410
	=	738000	N					
	=	738000	N/perpasak					
Rn	=	553500	N					

Diketahui dari hasil analisis struktur melalui SAP2000 pada batang
diperoleh nilai Pu sebesar 140289.64 N
Maka jumlah pasak yang digunakan ialah:

$$n = \frac{Pu}{Rn}$$

$$= \frac{140289.64}{152784.486}$$

= 0.918

= 1 buah

mlah Pasak yang digunakan 1 buah dengan diameter 24 mm dan tebal pelat 10 mm

Tabel analisis pemilihan modul efektif

Pilihan	Alt 1			**Alt 2**			Alt 3		
Beban	sb X	sb Y	sb Z	**sb X**	**sb Y**	**sb Z**	sb X	sb Y	sb Z
P1 = 1KN	590 N/m2	442 N/m2	619 N/m2	**390 N/m2**	**285 N/m2**	**328 N/m2**	480 N/m2	452N/m2	476 N/m2
P2 =1KN	698 N/m2	588 N/m2	623 N/m2	**386 N/m2**	**342N/m2**	**355 N/m2**	485 N/m2	420 N/m2	481 N/m2
P3 =1KN	823 N/m2	798 N/m2	785 N/m2	**563 N/m2**	**594 N/m2**	**552 N/m2**	746 N/m2	801 N/m2	845 N/m2
Total	2111 N/m2	1828 N/m2	2027 N/m2	**1339 N/m2**	**1221 N/m2**	**1235 N/m2**	1711 N/m2	1673 N/m2	1802 N/m2

terpilih karena ringan efektif

Alt 2 terbaik

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Design Optimisation of an Aircraft Hangar with Various Parameters

Danush. J[1], J. Ajith[2], N. Kalaivanan[3]

[1]PG Student, Department of Civil Engineering, Easwari Engineering College, Chennai

[2]Assistant Professor, Department of Civil Engineering, Easwari Engineering College, Chennai

[3]Structural Engineer, Metal Scope (INDIA) Private Limited, Pondicherry

***Abstract*- Steel structures are the most common and smart choice for industrial construction they are basically because of its ability to create large span space at low cost. Along with the existence of Conventional Steel Building (CSB), the Pre-Engineered Building (PEB) came into being from 1960s. The methodology tracked followed in PEB is highly multifaceted not just because of the quality in pre-designing and pre-fabrication but also due to the light weight outcome and economically sound factor. In this study, using STAAD.Pro an Aircraft Hangar is designed for a clear span of 60m and is compared with PEB structure. Therefore, the most optimised structured is found by comparing different sections, support conditions, ridge angles and bay spacings for the same structure.**

***Index Terms*- Aircraft Hangar, Bay spacings/ Ridge angles(B/□), Conventional Steel Building (CSB), Pre-Engineered Building(PEB), Hollow Pre-Engineered Building(H-PEB).**

I. INTRODUCTION

Steel industry is one of the super growing industries in almost every part of the world. Being the second fastest growing economy in the world India has a huge percentage of it is attributed to the construction industries. They are not just economical but also highly eco-friendly when it comes to a treat of global warming, steel is 100% recyclable and the most recycled material. Thus, each ton of recycled steel saves 2,500 pounds of iron ore and approximately 1,000 pounds of coal. Steel members also have the advantages of high tensile strength and ductility. Steel is mostly used in the construction of industrial building with larger span when the concrete is not under the feasible state or the construction time is critical.

s used for columns and beams are ot rolled sections. The hot rolled red are of constant depth therefore on the area of low internal stress it leads to excess design of the member. The basis of the PEB concept lies in providing the required section at the location. The sections can be varying throughout the length according to the bending moment diagram by utilization of non-prismatic rigid frames with slender elements thus optimizing material usage and reducing the total weight of the structure. Tapered I section made with built-up thin plates, Standard hot-rolled sections, cold-formed sections, profiled roofing sheets, etc. are used for constructing PEB.

A hangar is a closed structure to hold aircraft in protective storage. Hangars are used for protection from weather, direct sunlight, maintenance, repair, manufacture, assembly and storage of aircraft on airfields, aircraft carriers and ships. Hangars need special structures to be built. The width of the doors is too large and spans from 30 meters to 120 meters and so on for the aircraft entrance. The bigger the aircraft, the more complex a structure is. Hence these structures are specially designed and engineered to fit together to satisfy the unique requirements of specific end-uses.

A literature review is carried out on various studies of conventional steel building and pre-engineered buildings. The study on various design procedures, codal provisions, structural problems, different kinds of sections and various type of analysis carried is studied thoroughly before starting this thesis.

A. Objective of study

The main objective of this project is to optimise steel usage for an Aircraft Hangar which is designed using STAAD.Pro. The objective of this project is also to compare and study the difference in Bending moment, reactions and steel takeoff between Conventional and PEB; Fixed and Pinned support;

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hot rolled, hollow and combination of both sections; different bay spacings and ridge angles.

II. STRUCTURE DESCRIPTION

The complete structure configuration details are given below:

Type of Structure : Aircraft Hangar
Location : Arakkonam, Tamil Nadu
Area : Primary Building - $3780m^2$
Secondary Building - $360m^2$
Total Building - $4176m^2$
Length : 63m
Width : Primary Building - 60m (Clear span)
Secondary Building - 6m
Total Building - 72m
Eave height : 23.15m
Ridge angle : CSB - 1in4
PEB - 1in10
Comparative study - 1in5, 1in6, 1in7.5, 1in10, 1in15, 1in20
Bay spacing : CSB/PEB – 6m
Comparative study - 6m, 6.667m, 7.5m, 8.57m
Crane Capacity : 5t
Purlin spacing : 1.2m
Grade of steel : 350 Mpa

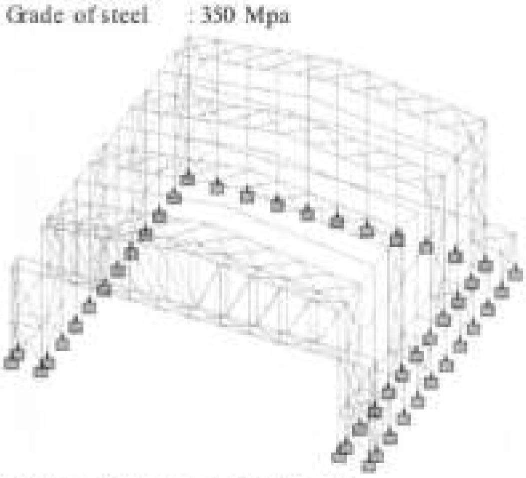

Figure 1 – Geometric view of PEB

A. Material

The yield strength of material used for PEB structure is 350Mpa whose density is $7850kg/m^3$ and Young's modulus (E) is 2.0×10^{11} N/m^2.

Analysis is performed using STAAD PRO V8i. A total of 152 load combinations as per IS 875 consisting of dead, live, collateral, wind, earthquake and crane loads are considered. The structure is designed for parameters as mentioned earlier; the ridge angle (θ), bay spacing (B) are varied i.e at a time one is varied keeping the remaining constant. The combination of parameters which gives the low quantity of steel are noted.

III. LOAD CALCULATION

A. Dead Load

Dead load comprises of self-weight of the structure, weights of roofing, steel sheets, purlins, sag rods, bracings and other accessories.

Roof Sheet – GI Sheet with unit weight of $5.6\ kg/m^2$
Purlin - Assuming purlin unit weight of $6.4\ kg/m^2$
Total Dead load on plan area = 5.6 + 6.4 = 12 kg/m2
Dead load on Rigid frame = Total dead load on plan area * Bay Spacing = $0.12\ kN/m^2$ * 6m
= 0.72 kN/m
Side Cladding load same as dead load w.r.t different effective width.

B. Live Load

For single-story metal building systems, roof live load, essentially an allowance for the roof loading during its construction and maintenance. According to IS: 875 (Part 2) – 1987, for roof with no access provided, the live load can be taken as $0.75\ kN/m^2$
Total Live load on plan area = $0.75\ kN/m^2$
Live load on Rigid frame = Total Live load on plan area * Bay Spacing = $0.75\ kN/m^2$ * 6m
= 4.5 kN/m

C. Collateral Load

Collateral or superimposed dead load is a specific type of dead load that includes the weight of any materials other than the permanent construction.
Total Collateral load on plan area = $0.05kN/m^2$
Collateral load on Rigid frame = Total collateral load on plan area * Bay spacing = $0.05\ kN/m^2$ * 6m
= 0.3 kN/m

D. Earthquake Load

Zone	= III
Zone factor (Z)	= 0.16
Important Factor (I)	= 1
Response Reduction Factor (R)	= 5

E. Crane Load

Sebagai perbandingan dengan struktur pesawat yang menggunakan logam duralium

Sumber : https://www.aeroengineering.co.id/2016/11/desain-struktur-rangka-pesawat-terbang/

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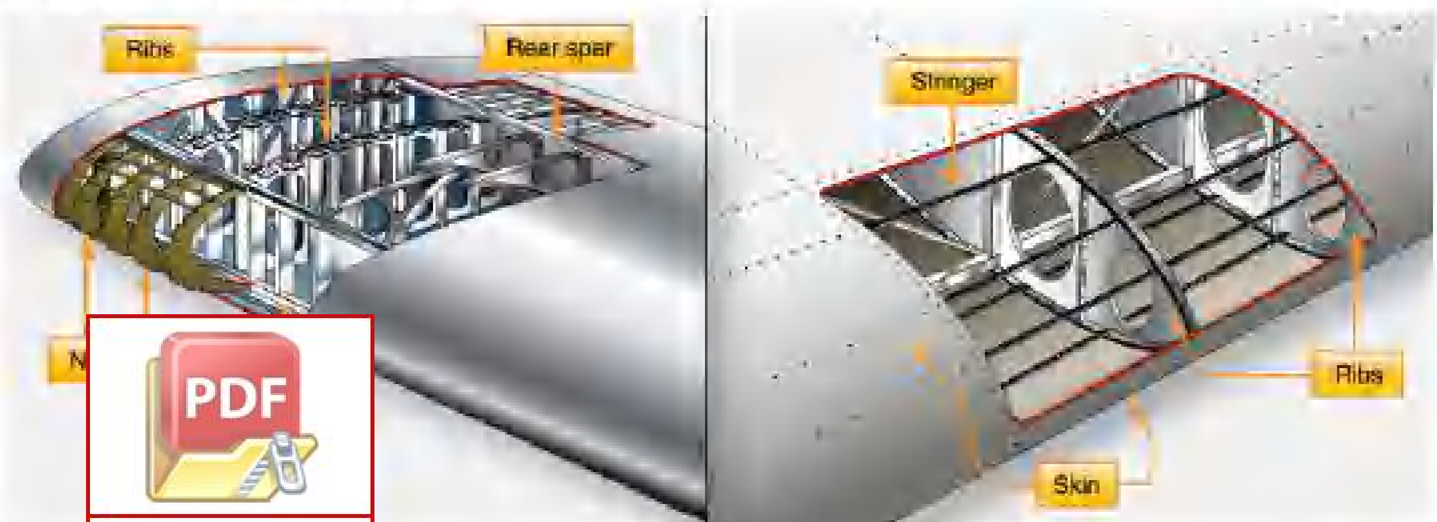
Struktur *truss* biasa digunakan pada pesawat-pesawat ringan dengan *cover fabric*. Struktur ini biasa dibuat dari bahan baja atau logam paduan aluminium. Kemudian struktur *monocoque* mengandalkan kekuatan *skin* atau lapisan luarnya untuk menahan beban, sedangkan rangka dalamnya hanya sebagai penahan bentuk dan kekuatan pada titik-titik tertentu. Struktur *monocoque* ini biasa digunakan untuk *skin* aluminium atau komposit (*fiberglass* atau karbon fiber). Yang terakhir adalah *semimonocoque*, tidak jauh berbeda dari *monocoque*, struktur ini dilengkapi dengan *stringer* untuk membantu menahan beban dan menambah kekakuan dari kulit. Struktur *semimonocoque* adalah yang paling sering digunakan karena relatif paling ringan dan kuat.

Kemudian hal yang cukup krusial untuk dipahami adalah struktur dari sayap pesawat, karena sayap menahan beban yang paling besar dan berulang pada pesawat. Berikut ini adalah bagian-bagian rangka sayap:



- *Spar* ... penokong utama dari sayap, spar menahan beban yang paling besar serta menghubungkan sayap dengan *fuselage*.
- *Ribs* : *Ribs* adalah struktur bantu yang digunakan untuk membentuk airfoil pada sayap sekaligus meningkatkan kekakuan pada beberapa titik sayap.
- *Stringer* : *Stringer* adalah struktur yang menempel pada ribs yang berfungsi untuk meningkatkan kekakuan dan tempat menempelnya *skin* atau kulit lapisan luar sayap.

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Quick, Easy and Exact Prefabrication Structural Module

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Quick, Easy and Exact Prefabrication Structural Module

M Mulyono[1*], V Sampebulu[1], Nasruddin[1], and Hartawan[1]

[1] Department of Architecture, Hasanuddin University

*Corresponding author: mmichaelm1726@gmail.com

Abstract. This study focuses on buildings designed to be placed anywhere in all regions of the country. With rapid economic growth and increasingly advanced technology, supported by advanced knowledge, it is necessary to have a wide span structure for buildings made in a simple and mass nature. Recently, there have been prefabricated technologies found for houses and dwellings. Unfortunately, the application of wide-span buildings, such as mass industrial buildings, has been lacking in development. This prefabricated technology is very useful for constructing buildings that are expected to be simpler and more precise. It is believed to be very beneficial in building construction not only for economic consideration but also for energy use. Furthermore, the time obtained is faster in completing building construction by using the disassembly module [1]. Also, to be adapted to the needs following the development of the present time and answer future needs. Because it experienced proper progress on the expected findings, the structural module of each part will later determine this prefabricated system with a knockdown system. In addition, it is expected that mass production in appropriate quantities and adapted to existing growth needs can be used in all regions of the world in response to future technological developments [2]. With advances in technology, structural modules are fast, easy, and precise and can be used in all regions of the world.

1. Introduction

Wide-span building structures are very attractive to be made in a compact way with accurate precision. Therefore, the right way of prefabrication is an option. Moreover, in this modern era, all rely on technology and computer applications to help humans, so tools help and make it easier for us to solve these problems. New prefabrication for houses and concrete buildings that are made conventionally generally requires high costs and is permanently built, so it is challenging for future development, or there is a need for expansion in these houses. This condition has been experienced by the middle to lower class, which is more like a burden.

The permanent buildings sometimes lack space for occupants' activities; thus, the owners often decide to expand the building. The method of building structures and constructions from military facilities brings a new idea, where the building structures were modulized and prefabricated, resulting in a fast, easy, and precise method to be applied to industrial building construction. Therefore, prefabricated technology gives rise to another consideration: the flexibility of materials used on ...e disassembled—Furthermore, local materials can be used without compromising ...hetic value. From the formulation of the background of the problem, it can be ...e prefabricated system on the wide span module of the building" gets a solution for ...tical building methods with aspects of speed, convenience, and accuracy that will be ...to the purpose of dismantling later.

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This research aims, among others [3], were to provide an overview of the prefabricated structure system with a modular system that can be assembled-disassembled with a fast, precise and easy construction method with two considerations: a) it can be applied in all regions / any area, and b) it can reduce the costs of wide spans buildings in general. The expected contributions of this research are: a) provides new insights into the architectural knowledge of disassembled wide-span structures, b) provides extensive knowledge on mass-produced and sustainable prefabricated production and c) can become a reference for the building design concept with a wide-span that is practical and inexpensive for future building methods.

2. Literature Review

2.1. Wide-span buildings

There are a lot of wide-span buildings in the industrial world today. Therefore, wanting to advance the country automatically must advance the industry first to improve the country's economy. With a rapidly improving economy, the country is also developing simultaneously. By becoming a developed country automatically, the level of education and the economy of its population will also be advanced. It is expected to increase the country's per capita income. Therefore, the right industrial sector to support progress and, in this case, wide-span buildings is expected to be mass-produced and sustainable [2].

2.2. The prefabricated structure module system

This prefabricated structure module system will later be intended for wide-span buildings to support the industrial sector as a mass-produced and sustainable industrial building. This construction system method is more beneficial than similar conventional construction methods regarding construction time, building cost, and labour needed. This objective is in accordance with the concept of ease, speed and accuracy in building cost, prefabricated with the concept of structural modules with a knockdown system that can be reused elsewhere.

The system used as a solution in creating a component form that is mass-produced and with a building process has the following advantages [4]:

a. It is a less complicated installation compared to conventional systems.
b. It has good precision in the modules because they are well-connected and robust.
c. It needs less time because the time required to finalise the construction is shorter than conventional building methods.

The principles used are following prefabrication theory using technology in the structural module circuit system (Hi-Tech Architecture), including:

a. Mass-produced and sustainable.
b. Modules are used as structures that are directly applied to the building.
c. It consists of several modules modelled as standard components and precision in the size and shape of each module.
d. The connections between the modules have an easy locking system so that they can be disassembled and reassembled quickly.
e. A prefabricated system with a lightweight, sturdy and rust-resistant duralium material structure module so that it has a long service life that can be used repeatedly and is guaranteed for life.

2.3. Prefabricated structure module with disassembly system

In this prefabricated module system, the theory of Hi-Tech Architecture structure with structural art is

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Given the current industrial development, the best solution is to build a module system that can be installed and dismantled for long-term use (long-life knockdown module systems). Considerations for prefabricated structure modules to be used include:

a. Ingredient
b. Dimension
c. Lightweight.

Considering the above considerations, the material that is suitable for structural material is duralium because aluminum and the content used is right for the structure used in the material. Because the duralium material is consistent with Cu 3 - 4.5 %; Mg 0.4 – 1%; manganese 0 – 0.7%; Al can change the composition. Ir 0.4 – 1%; Si 0.3 – 0.6% (10).

3. Methodology in Research

The research methodology used is a quantitative approach which is carried out to test whether or not the experimental variables are influential. Experimental research is commonly used in the exact sciences.

3.1. There are two types of experimental research, quasi and search, namely:

a. The experimental method is used in the evaluation to obtain information which is an estimate that can obtain actual data. Various quantitative research methods, such as experiments, are usually used in conditions where it is impossible to control and manipulate the relevant variables.
b. The evaluation uses the experimental method to examine the possibility of cause and effect. This method is done by applying one or more treatment conditions to one or more experimental groups and comparing the results with one or more control groups that are not subject to treatment conditions.

This experiment will prove the speed of prefabrication construction which will require a short time because a robust structural module is prepared, and it is easy to install the installation method because the method is followed each module step with good accuracy. These are prefabricated symmetrically and systematically in accordance with specified standards.

3.2. The architectural approach

This study followed several approaches for architectural design starting from: 1) the data collection stage, which adapted Palmer's theory in "the architect guide to facility programming" [5], which includes: a) study literature, b) experiment and c) other information sources. In the data analysis stage, G. Broadbent theory of Design in Architecture [6] was adapted considering several factors such as: a) human factor, b) building factor, and c) environmental factor.

Meanwhile, Rowe's theory with his approach in architecture was used for the design stage. Several architects were concerned with this approach, including:

a. Santiago Calatrava with "reflective approach theory", which is very sensitive and intelligent in observing local conditions. Introduction of technology applied to building structures intentionally exposed as Open Structures with character strength for the building (high tech). Have knowledge of the material and combine it in a series of structures that support each other in the building.
b. Rafael Vinoly. This architect has produced many designs with excellent works, and they have received many awards for their designs. The philosophy used as a design idea in every experience, namely by paying attention to each design and constantly going through a complex process, can be seen in the differences in the contributions and wishes of the client, including the existing physical conditions (existing) and cultural conditions.

Th... he basis for the design concept with a systematic and many different aspects and ... ood design alternatives. Design can be measured by:

...).
...on).
... construction costs).
...ea (city/ suburb)- urban/ suburban.

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- community capacity (competent public).
- schedule (schedule).

These parameters can be measured on 3D models, floor plans, and sections.

c. Renzo Piano and Richard Rogers

Together, these architects designed the Pompidou Center in Paris, France, while still displaying the existence of a powerful design which is the design philosophy by combining an understanding of materials with advanced technology (hi-tech).

4. Research Results

4.1. Plan

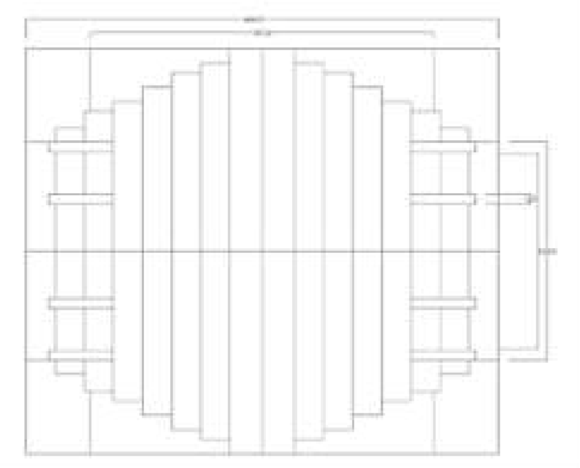

Figure 1. Building Plan

4.2. Piece

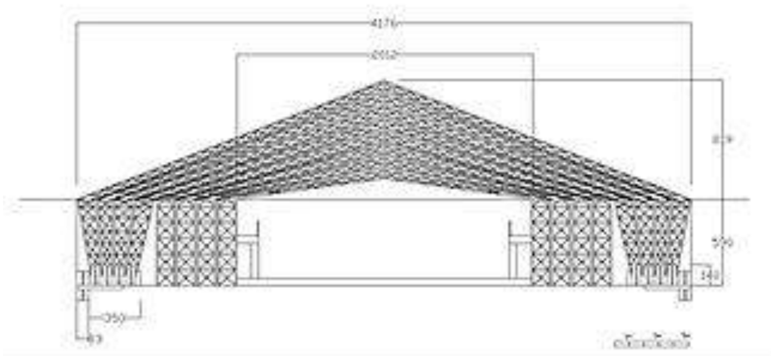

Figure 2. Building Section

4.3. Calculation Structure

the structure according to the flexibility method analysis system [7] regarding the moment of motion on the frame of the portal with the movement at the same point is ovements and the rotation at each end is considered in the application of the sign

t of the load at one point at each end as a result of the external load received by the so that by formulation, the thickness is 12 cm.

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4.4. Research Discussion Structure module used

a. Alternative Structure Module II

a) Structure module

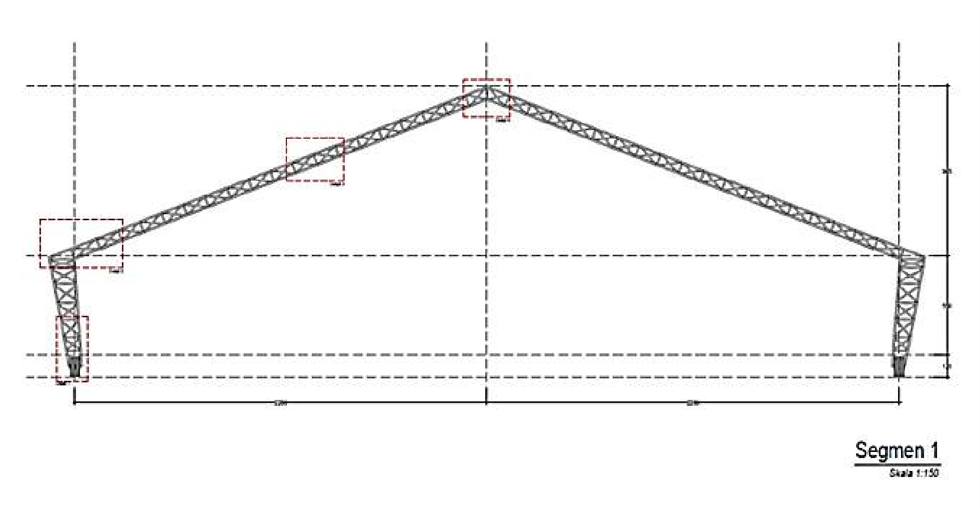

Figure 3. The 1st segment of wide-span building structure

b) Structural Module Part 1

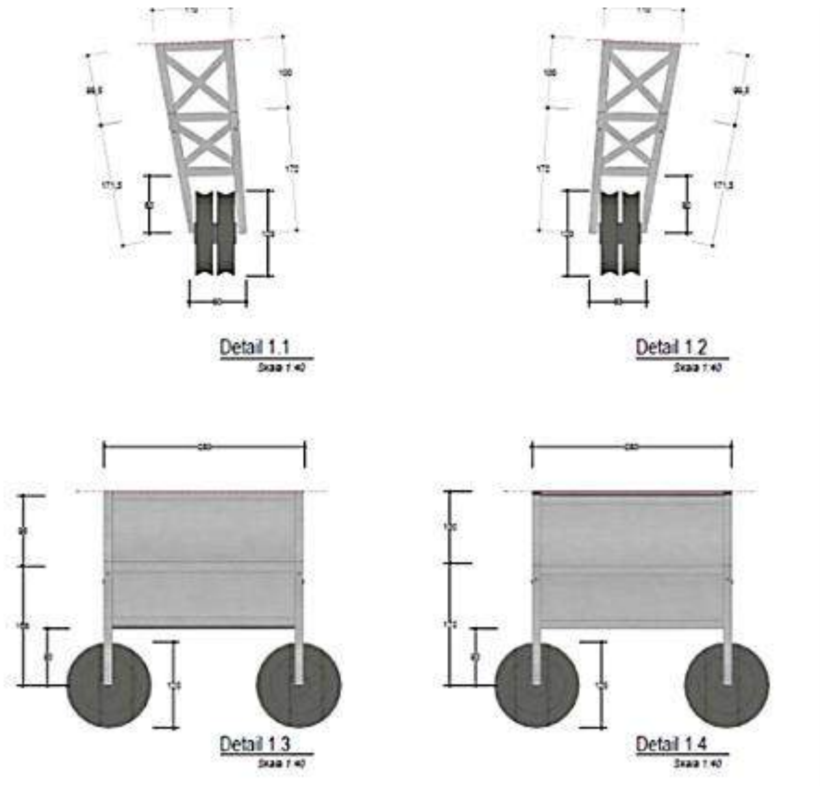

Figure 4. The 1st module part of structural segment

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c) Structural Module Part 2

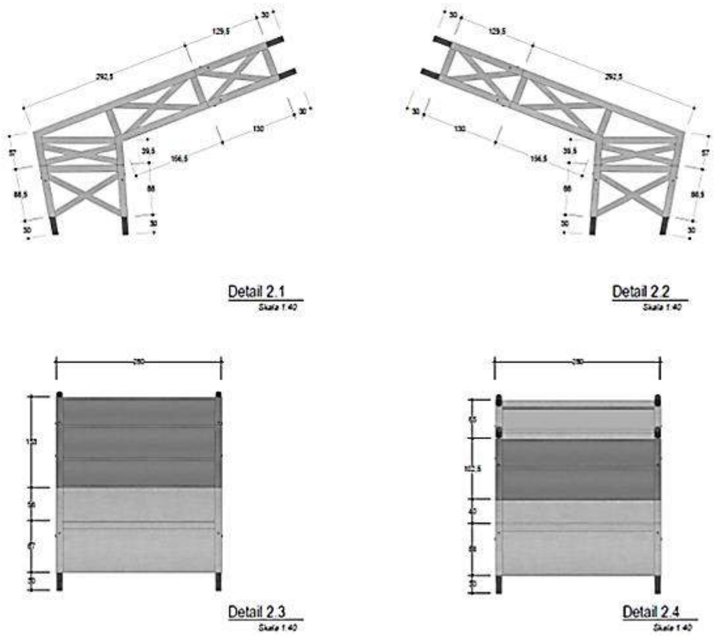

Figure 5. The 2nd module part of structural segment

d) Structural Module Part 3

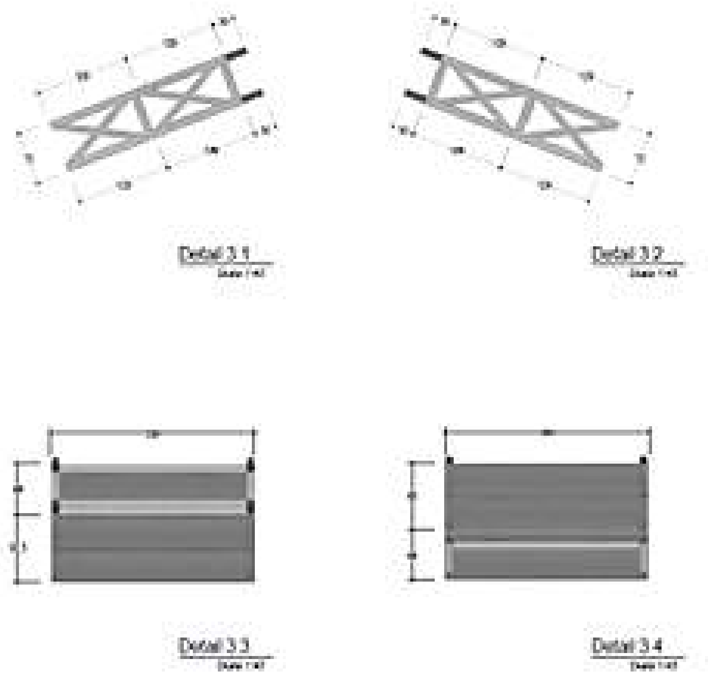

Figure 6. The 3rd module part of structural segment

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e) Structural Module Part 4

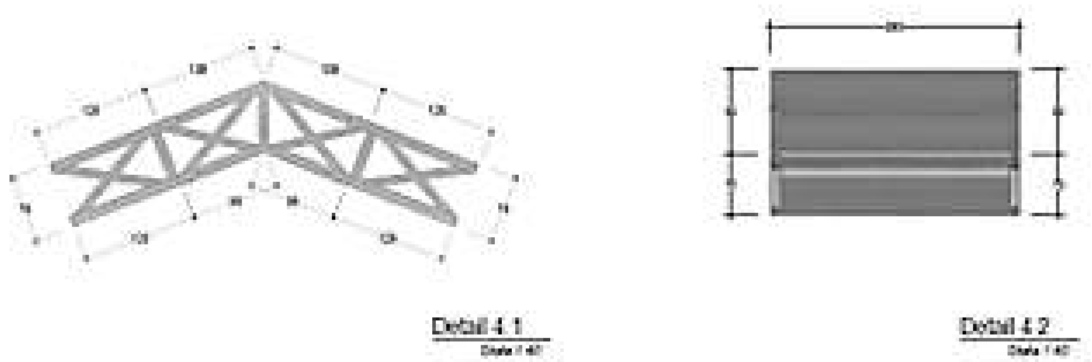

Figure 7. The 4th module part of the structural segment

b. Installation method of structure's modules

a) Installation method of module's structure part 1

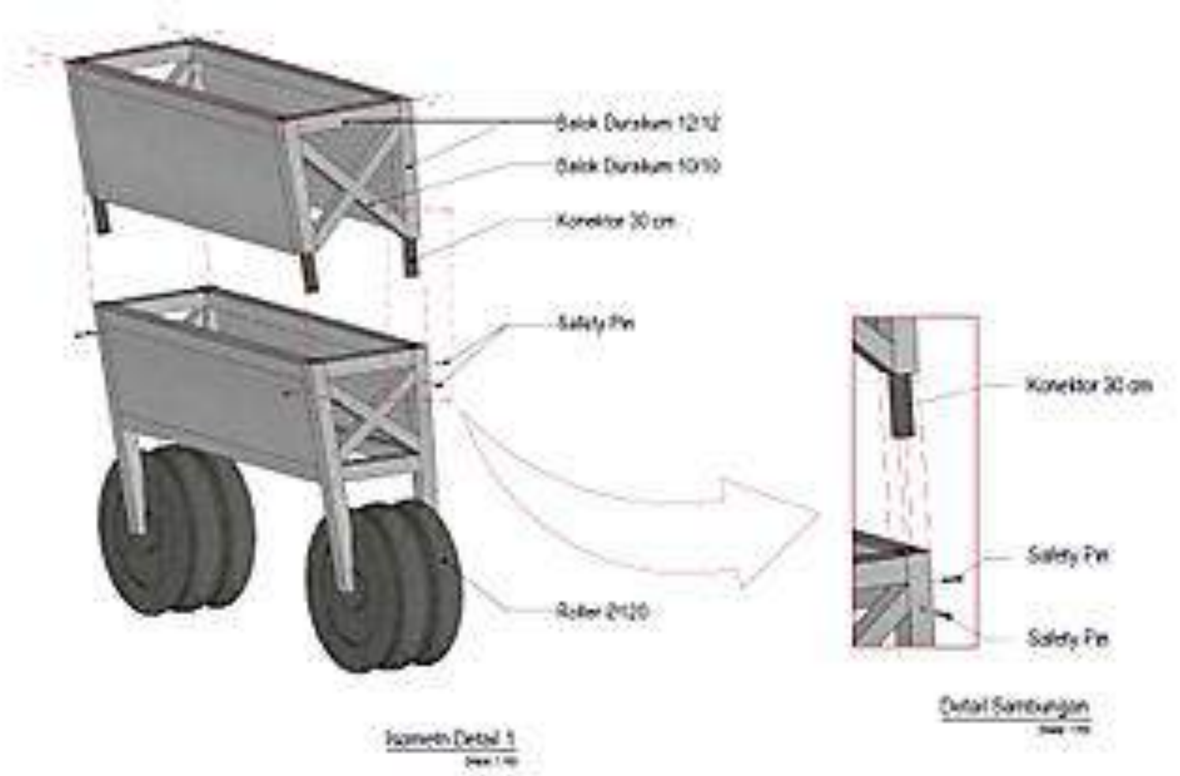

Figure 8. The installation method for the 1st module

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b) Installation method of module's structure part 2

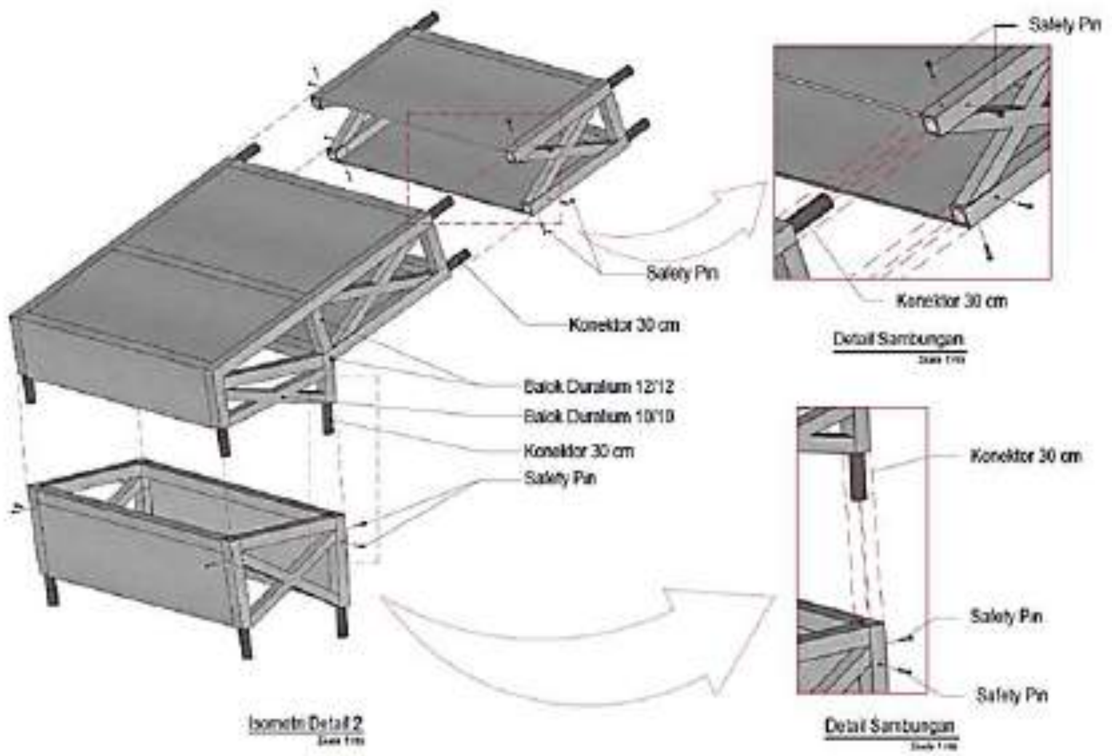

Figure 9. The installation method for the 2nd module

c) Installation method of module's structure part 3

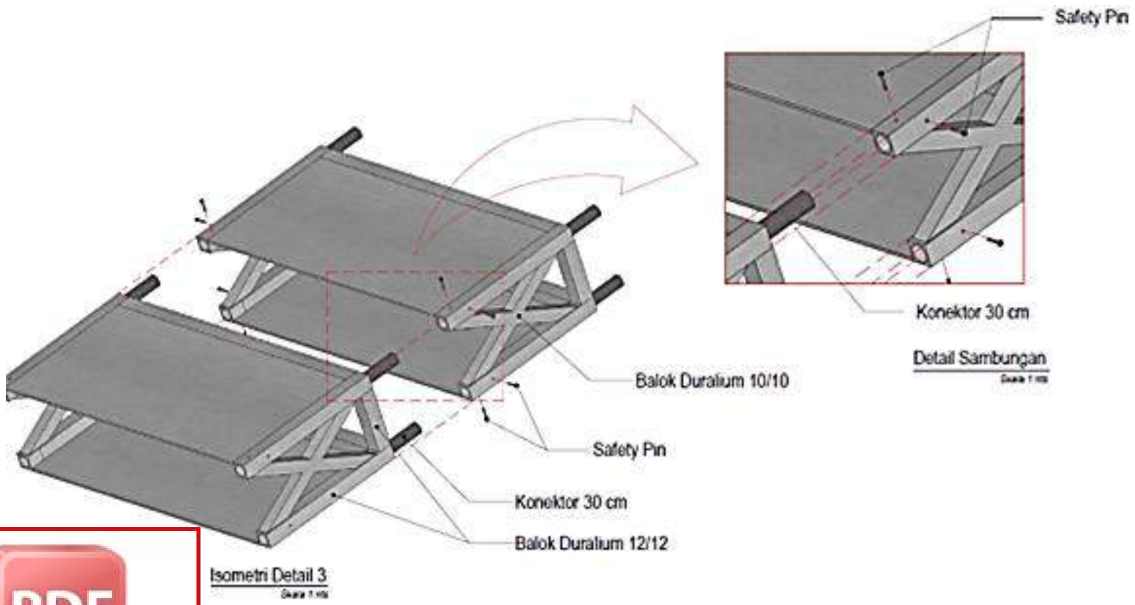

Figure 10. The installation method for the 3rd module

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d) Installation method of module's structure part 4

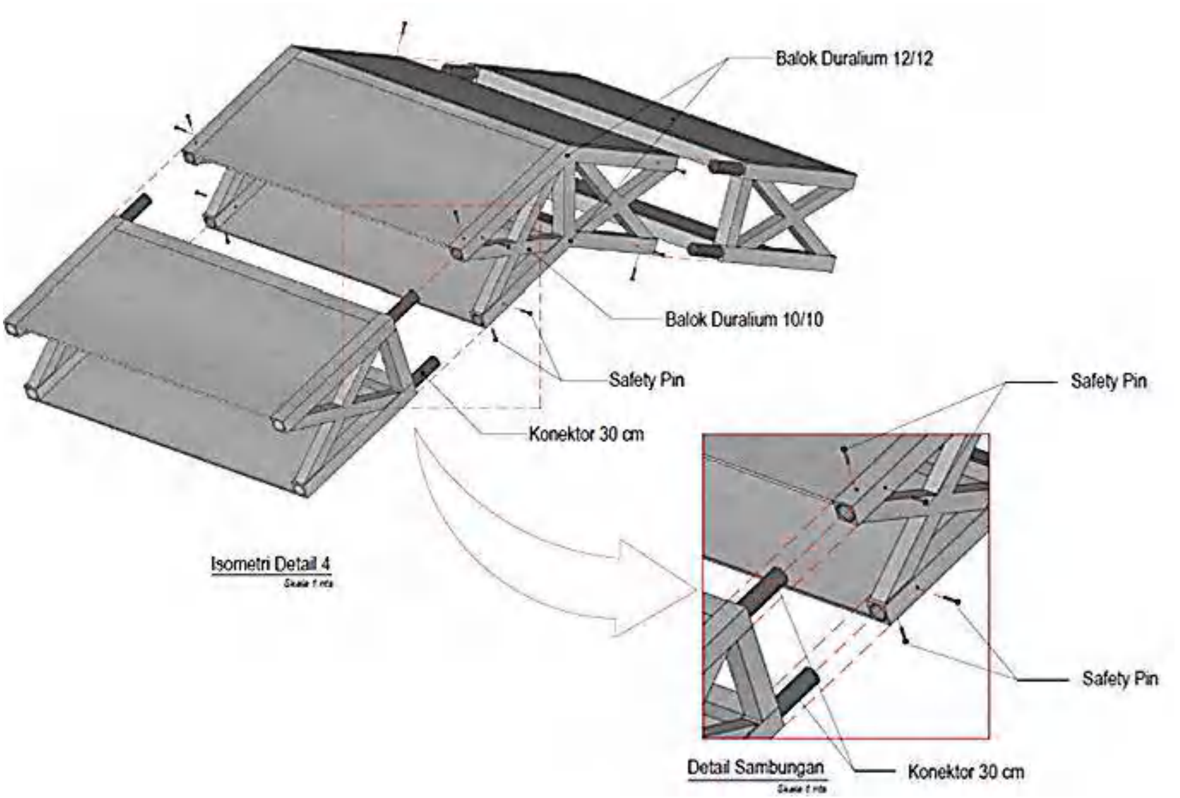

Figure 11. The installation method for the 4th module

The use of prefabricated structural modules disguised by the disassembly method has the following criteria:

a. Build speed, as follows:
   a) Prefabricated technology through the module system is one way to achieve build speed.
   b) Short-planned time
   c) Save the workforce that implements.
b. Ease of building, as follows:
   a) The number of modules used with variations in the number is not much
   b) Fixed structure module models and their interrelationships with each other
   c) Can be built and assembled anywhere according to local natural conditions.
c. Build accuracy, as follows:
   a) The model used by the structural module is more precise and accurate in its dimensions and shape.
   b) Each module has a different size so that they are not confused with each other or reduce the error rate in assembling them.
   c) Has the form of a module that is integrated with the other.

The main structural material used will use duralium as the basic material for this building. Duralium is consistent with Cu 3 - 4.5 %; Mg 0.4 – 1%; manganese 0 – 0.7%; Al can change the composition. Ir
).6%. This alloy is used in a wide field not only for household appliances but also
purposes, namely for the aircraft industry, automobile components, regulator
ier constructions.
al content is dominant with Aluminum (Al), this metal must have a very light weight
veight of steel, and the presence of copper (Cu) and magnesium (Mg) and manganese

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(Mn) metals, making this alloy metal has a very strong strength and can match the strength of steel, for the strength of this metal has been proven in various studies.

This duraluminium metal has a very light weight and strength equal to steel, because it has been applied to airplanes, ships, train cars, motor vehicles, as well as in bridges and in buildings. This metal can be easily mixed and formed with concrete of the right size and needs to form wide spans with guaranteed strength and functionality. Also, for use in household appliances and decoration (because aluminum is resistant to rust, it is easy to be plated with nickel/Ni), and for making pipes and bolts, it is light and rust-resistant, also because it is non-toxic.

Duralium has shown an increase in its mechanical properties (tensile strength, ductility, toughness, and hardness) under a graded maturation process. The precipitate has the smallest size in the second stage of aging (200-300 nm while in the third stage of aging, CuAl2 precipitate becomes larger (400-500 nm).

Duraluminium (chosen as industrial structural material) contains 94% Aluminum metal, 3.5 – 5.5% Copper metal, 0.05% Magnesium metal, and 0.5 – 0.8% Manganese metal. The most perfect mixture because in addition to being resistant to rust, it is also strong against strain and tensile stress against motion and load.

4.5. Mechanical Research

The aim is to determine the strength of the material, so it is tried by examining the quantities that can be used as a guide to determine the strength of the construction, because in general they experience tension and pressure, but what can be ascertained by testing the strength is tensile strength, so that other forces such as compression and formulate with something on the tensile strength of the unit applied to the stress (kg/mm^2).

Mechanical research is carried out by:

a. Pull experiment (at best).
b. Urgent experiment.
c. Test.
d. Slide experiment.
e. Torsion test.

4.6. Explanation

a. Research on tensile experiments (tensile investigations)

This tensile investigation aims to obtain the tensile strength given by the tensile-fracture stress. tensile-fracture connection is obtained from the maximum strength in the fracture experiment over a cross-sectional area of the sample. Next is the elasticity (elasticity) whose magnitude can be determined by the strain = l until a certain limit, namely the proportional limit point (P) then the increase in is proportional to the increase = constant.

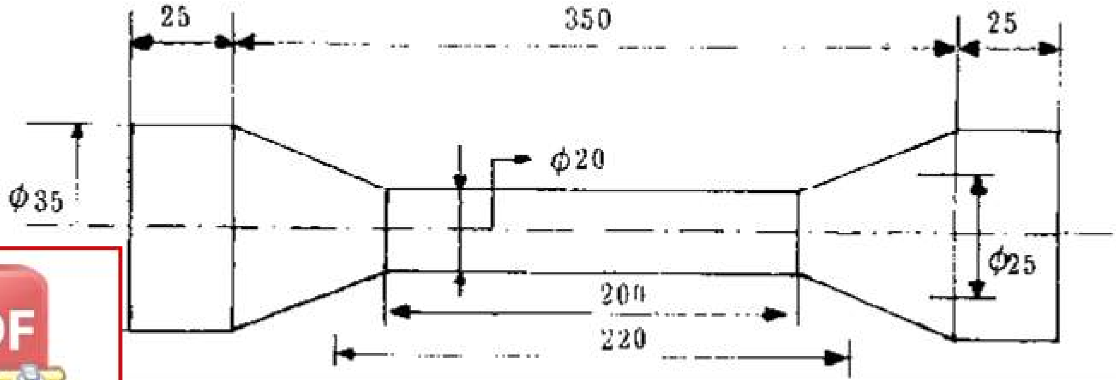

Figure 12. xx

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The example used for several countries for the purpose of this research is Hooke's theorem so that the cross section gives a different area but the length can exceed the limit, the example used in Indonesia is taken from the Netherlands or also from Germany.

b. Research on the pressure experiment

The purpose of this experiment is to determine the strength of the load is still the same as the material under normal temperature conditions and the results obtained are dependent on the speed in carrying out the experiment. The factors that must be considered are the voltage received (stressed) with the temperature that affects it.

c. Research in this experiment

The purpose of this experiment is to determine the change in plastic shape in the cold state, if the estimated strength is sufficient by experiment, but for the purposes of machining work it can be carried out on hot plastic changes in the incandescent plastic state.

For example, it is rotated with an electric motor with a rotation of 3000 RPM (revolutions per minute) with a certain load (σ B) and rotated up to 5,000,000 to 10,000,000 times, if there are no cracks, then it meets the requirements well.

d. Research on the sliding experiment

The purpose of this shear experiment is to determine the magnitude of the strength of the material against the force divided by its cross section (kneading strength). usually applied to bolts and other strength. In this experiment using a frame having column legs is given by measuring it on a swing which is, in general, 6 x R (cosβ- cosα) and is determined in kg/m.

e. Research on torsion experiments

The purpose of this experiment is to determine the strength of the material due to the torsional force due to the resulting motion. This is done by controlling crushed items and automatically connecting them to a marking device to detect any changes that occur in the material. The way to prove it is done by using a roller controller that is installed and this rod moves 40m / detects a disturbance that shows a smaller between 0.75 - 0.75 - 0.75 mm.

The result is that these metals can be easily mixed and molded with molds to suit your size and requirements to form wide spans with guaranteed strength and functionality.

5. Conclusions and Suggestions

5.1. General Conclusion

After going through the research process with various alternative designs, it can be concluded in general about the design of industrial buildings available from the google earth program, namely by respecting the environment around the building and applying the need for technology (hi-tech) in buildings by applying movable structure made of duraluminum and has a driving motor with a solar cell source to answer the phenomena that arise due to technological advances in this IT field [3]. While expression is an aesthetic value that arises as a result of an appreciation that is received or seen by providing a new experience and can give an impression to the observer (impressive). Hi-tech architecture has the power of expression for buildings and can answer problems on the phenomenon of advances in information technology that is developing at this time, either in general or more specifically [8].

The structure is an absolute requirement that must exist in every building as a stiffener and support for the load arising from each heavy material received with lateral weight so that it can have a solid strength according to the needs and desires of its users [1].

And with the right architecture, it can answer the expected speed of development with the accuracy eved in the field on the site and is logistical and in conditions of accommodating all their equipment in a space with the right and functional form.

lear that science and technology are closely related to architecture so that they can sign to get maximum results well. So this scientific writing is an effort to contribute ly to the intended target [2].

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5.2. Special Conclusion

Scientific writing of this design is focused on industrial and factory problems which are supported by strength and technology in the structure to be able to express industrial buildings that are needed in mass-producing industrial products [9].

The design problem solves industrial buildings with motorized movable structures on a fast, precise and easy disassembly structure module system in the building method that is expected to be achieved and respects the landscape form so that it is an answer to the need for industry. Later, it is hoped that it can become a reference for future development that is all-machine in the era of global machines, so that it becomes the future artificial intelligent architecture as a new theory in the world of architecture in the face of the 5.0 technology era.

5.3. Suggestion

The author feels that there are shortcomings in this writing, although the author tries hard to make it even better, so that it can be useful in the field of architecture in the world and in the future which is increasingly rapidly developing.

While artificial intelligence in architecture is expected to be not just smart bulding, but includes the manufacturing process, structure to the application used, a significant difference with smart building is that smart building only uses the tools that are applied to the building itself, not from the building itself. In other words, smart building only includes a few tools used in the building. So even a traditional building when the same tools are installed, the name is still smart, in other words, a smart building is built with an architecture that is created but only the tools are attached, however the architectural form does not affect the tool used, for example the application of the lighting system, the door locking system, or the system. other security. Because all the tools that are integrated with the building are not from buildings that use tools and functions related to the system, both in structure and function, because scientific writing is to present existing theories and apply them in a design because of the need and explanation of the problems designed with the same method. building fast and precise is also easy because it is divided into precise and simple modules. And it is also expected that there will be a response to this discussion or improvement of existing deficiencies [9]. Because there are still possibilities that can be developed further in the future.

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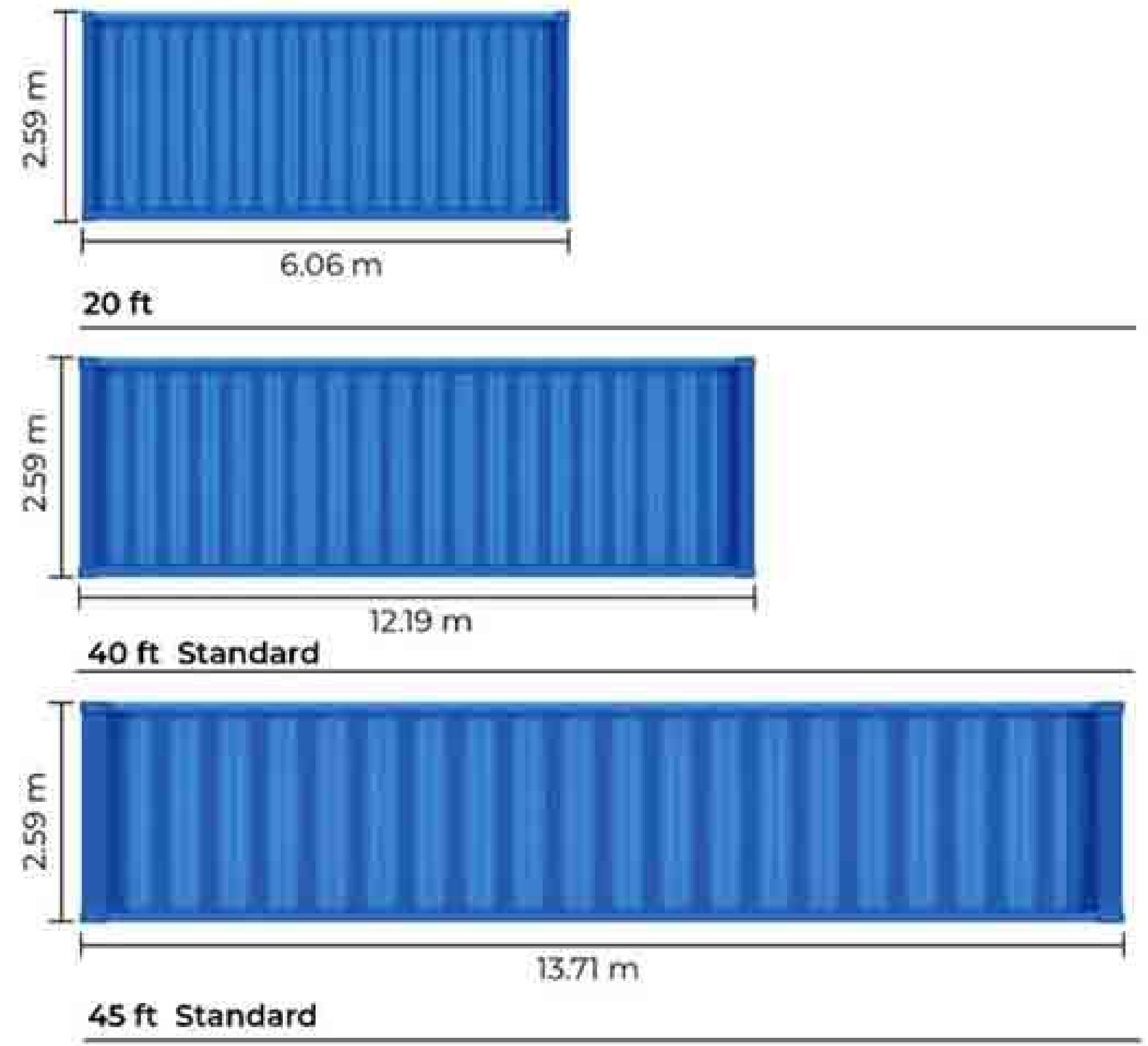
2.44 m


2.59 m
6.06 m
20 ft
2.59 m
12.19 m
40 ft Standard
2.59 m
13.71 m
45 ft Standard

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Authors: **Michael Mulyono, Nasruddin Junus, Hartawan & Imrianti**

Sustainable Building Design and Construction : Integrated Disassembly Principles with Pre-fabricated Structural Modules For Wide-Span Structures

Dear Michael Mulyono, Nasruddin Junus, Hartawan & Imrianti,

Thank you for sending the paper after revisions. I write to confirm that the above paper has been accepted for publication in the Volume 10 Issue 12 of the ISVS e-journal, to be published in December 2023.

ISVS e-journal is Q1-Scopus-indexed, and we maintain the highest standards. Your paper will appear online in the first week of January 2024, available at "https://isvshome.com/e-journal.php". You can access it at the pulldown menu listing all the journal issues, or from the current issue link at the bottom of the page.

Thanking you for publishing in the ISVS e-journal,

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LOGICAL ARGUMENTATION METHOD AND FACTORIAL DESAIN EXPERIMEN

- Penerapan Metode Dengan Pemodelan Dengan Teori Arsitektur

Arsitektur *Hi Tech*

Gerakan Arsitektur Modern yang fokus kesan **struktur dan teknologi**

Arsitektur *Labirin*

mentreatment konsep pada layout pembagian bangunan dan pengolahan lansekapnya

Metode BIM
(Building Information Modelling)

Manusia dengan Mesin

Arsitektur *Landscaping*

Kontras, Proporsi, space atau ruang, kesatuan,
angan, Irama dan pengulangan,Penekanan dan aksentuasi,
hanaan