



شركة فسفاط قفصة
Compagnie des Phosphates de Gafsa

esprit

Ecole Supérieure Privée
d'Ingénierie et de Technologies

ANNEX

Design and Development of an
Electric Industrial Heavy-Duty
Transfer Cart



By: Mohamed Belhassan

Academic supervisor: Mr. Yassine Boussaâ

Corporate Internship Supervisor: Mr. Salem Debaoui

List of stock materials

Type	Specification	Cross section	Material	Quantity
Beams	UPN80		Steel S355J2G3	13 m
	UPN60		Steel S355J2G3	10 m
	Hollow Beam 80 x 80		Steel S355J2G3	1 m
	Hollow Beam 80 x 40		Steel S355J2G3	3 m
	Hollow Beam 40 x 40		Steel S355J2G3	22 m
	Solid beam		XC48 Steel	0.5 m
Sheet Metal	T : 5 mm	T : 5 mm	AL alloys	7 m ²
	Hot Rolled Thick Plate	T : 10 mm	NF EN 10025	5 m ²
	T : 30mm	T : 30mm	NF EN 10025	0.2 m ²

List of Used Components

Mechanical Components			
Name	Quantity	Model	Characteristics & Description
Wheel	4	135/80R13	- Diameter : 546.2 mm - Width: 135 mm
Rack & Pinion	1	1EH1	- Course: 250 mm
Seat	1	Linde X1149CM	- Height 519 mm - Width 437 mm
Brake Disc		Single cylinder	- Diameter: 227 - Thickness :10.7 mm
Master cylinder	1	Fiat Uno	- Bore Diameter : 19.05mm
Brake Booster	1	Fiat Uno	- Vacuum Diameter: 158.5 mm
Steering Knuckle	1	Fiat Uno	- 5936726 Genuine
Bearings	4	R600-5	- Deep groove
Calipers	2	SKU: FT32118	- Diameter: 48 mm - Wear Thickness : 1.5mm
Steering Wheel	1	Fiat Uno	- Diameter : 381 mm
Bearings	4	R600-5	- Outer Diameter 47 mm - Inner Diameter 25 mm
Bushings	2		- Length 39 mm - Outer Diameter 26 mm - Inner Diameter 24 mm
Hinges	4	Butt Hinge	
	6	M3	- Socket Cap 20mm
	2		- Socket Cap 40mm
	2	M5	- Socket button 10mm
	6		- Socket button 18mm
	10	M6	- Socket button 18mm
	6		- Socket button 18mm
Bolts	3	M7	- Socket Cap 20mm
	6		- Hex 25mm
	4		- Socket button 20 mm
	5		- Socket Cap 25 mm
	8		- Socket button 20mm
	4	M10	- Socket button 25mm
	1		- Shoulder Bolt 20mm
	4		- Hex 130mm
	4		- Hex 90mm
	10		- Hex 50mm
	8		- Hex 45 mm
	5		- Socket Cap 25 mm
	4		- Hex 50mm

	2		- Hex 60mm
	2		- Socket Cap 40mm
	6	M12	- Hex 70mm
	1		- Hex 50mm
	8		- Socket Cap 20mm
	6	M14	- Hex 70mm
	12		- Hex 60mm
	3		- Shoulder Bolt 12mm
	8		- Hex 21 mm
	2	M16	- Hex 35mm
	2		- Hex 55mm
	6		- Socket Cap 30mm
	6		- Hex 30mm
	8	M18	- Hex 85mm
	8		- Hex 70 mm
	8	M20	- Hex 50 mm
	6		- Hex 70 mm
	3		- Hex 25mm
	2	M30	- Hex 130 mm
Nuts	6	M3	
	2	M5	
	18	M6	
	3	M7	
	6	M8	
	21	M10	
	32	M12	
	28	M14	
	32	M16	
	12	M18	
Washers	24	M20	
	2	M30	
	6	M6	
	2	M8	
	2	M10	
	15	M12	
	10	M16	
	4	M18	
	14	M20	

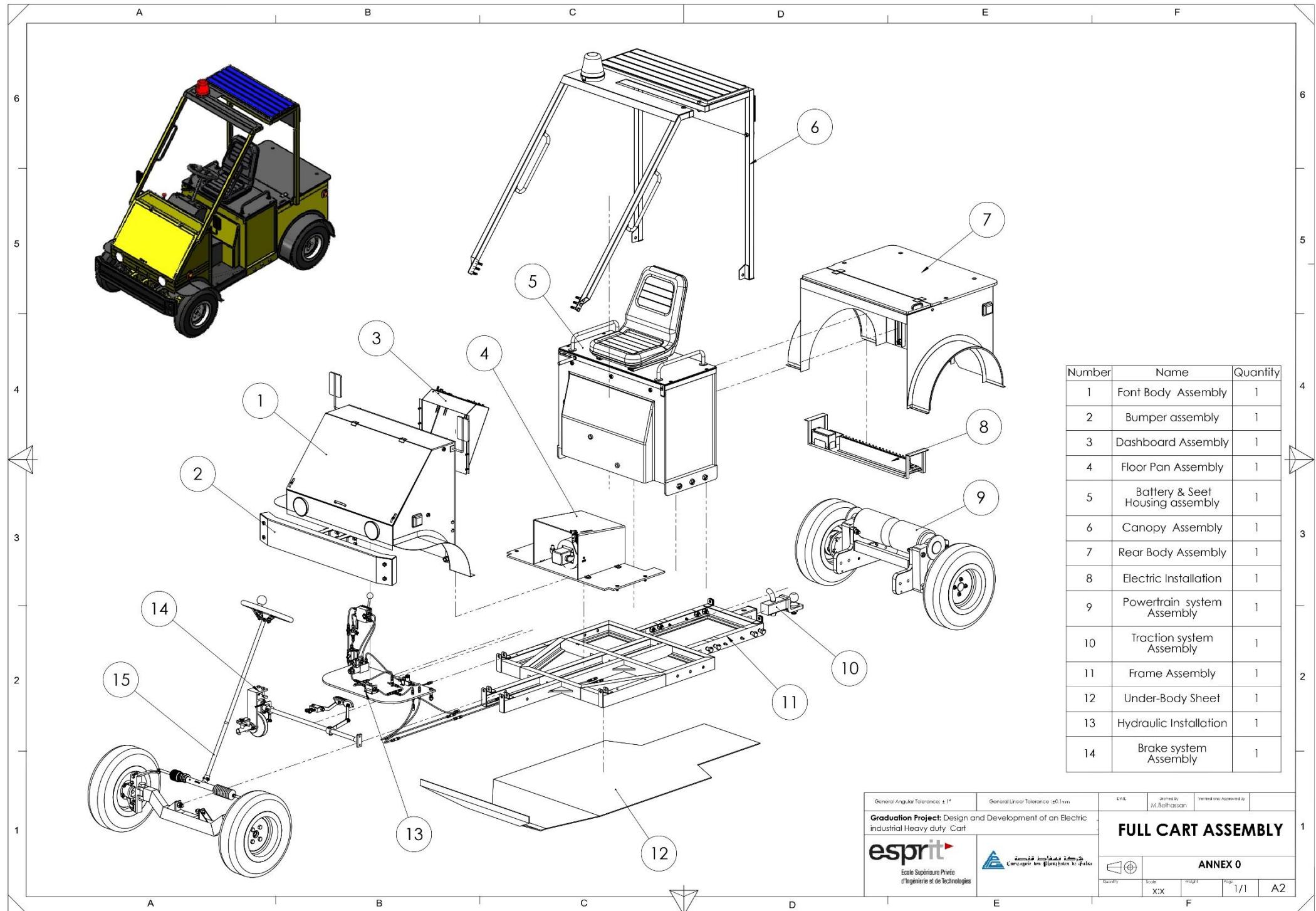
Electric Components				
Name	Quantity	Model	Characteristics & Description	
DC shunt motor	2	DC shunt GF114-14/1.1	<ul style="list-style-type: none"> - Current absorbed : 104 A - The Reduction Ratio: 20.07 - Total Power: 4 kw - Torque: 802 Nm 	
Acid Battery	1	Assad Batteries 8 PzV 1120	<ul style="list-style-type: none"> - Output : 24V - Autonomy : 1120Ah per 5H 	
Solar Panel	1	ZXM5-72- 190/MS(GA)	<ul style="list-style-type: none"> - Type; Si- Monocrystalline - Watt-peak: 190 WP - Power Output :31V 	
Solar Battery	1	Electrona 6y112- starting	<ul style="list-style-type: none"> - Output : 12V - Autonomy : 130Ah 	
Regulator	1	SPT-1212 MPPT converter	<ul style="list-style-type: none"> - maximum power capacity: 160W - Voltage Rating: 12V - Current Rating: 10A 	
AC-DC Rectifier	1	E ENERSYSTE	<ul style="list-style-type: none"> - Input Voltage : 230 V - Output Voltage : 12V 	
Relay coils & contactors	10	Contactor Linde H1118	<ul style="list-style-type: none"> - 104 A - 24 V 	
	7	Contactor Linde G1321	<ul style="list-style-type: none"> - 10 A - 12 V 	
Pedal Potentiometer	1	Noco EV & Forklift parts JKH-114-A-65	<ul style="list-style-type: none"> - Input Voltage: 2:24V - Resistance range: 0-5K Ω 	
Keylock Switch	1	Linde P1246 Key switcj	<ul style="list-style-type: none"> - 2 Positions 	
toggle switches	1	Linde P1844	<ul style="list-style-type: none"> - 2 Positions 	
	2	Linde P1400		
Fuses	7	DIN 43560	<ul style="list-style-type: none"> - Currennt Rating: > 104 A - Voltage Rating : > 24 V 	
	2	DIN 43560	<ul style="list-style-type: none"> - Currennt Rating: > 10 A - Voltage Rating : > 12 V 	
Resistors	10		<ul style="list-style-type: none"> - Resistance Capacity 0.23 Ω 	
	1		<ul style="list-style-type: none"> - Resistance Capacity 950 Ω 	
	1		<ul style="list-style-type: none"> - Resistance Capacity 50 Ω 	
	2		<ul style="list-style-type: none"> - Resistance Capacity 2800 Ω 	
Road Lights	6	Linde E1075		
Emergency Light	1	Linde E1021C	<ul style="list-style-type: none"> - Input Voltage: 12V 	

Blinkers	4	Linde E1116	- Power: 21W
Horn	1	Linde P1051	
Indicators	3	Green LED	- Input Voltage: 2.2 V
	4	Red LED	- Current : $10 \cdot 10^{-3}$ A
Micro Controller	1	ESP32 WROOM <i>[ANNEX]</i>	- Input Voltage: 5 V - Current : $150 \cdot 10^{-3}$ A

Hydraulic Components			
Name	Quantity	Model	Characteristics & Description
Motor Pump	1	Gp 116-14/5.5	- Power: 5 kW - Voltage: 24 V - current absorbed: 260 A - speed: 2500 RPM
Control Valve	1	VFD 180 Series	- 4/2 Electric control
	1	VFD 170 Series	- 4/3 Manual control
flow control Valve	1	VFD 50 Series	- 2 Way Manual control
Relief Valve	1	RV 125 Series	
Shutoff Valve	1	ILFC Series	
Check valve	2	NR Series	

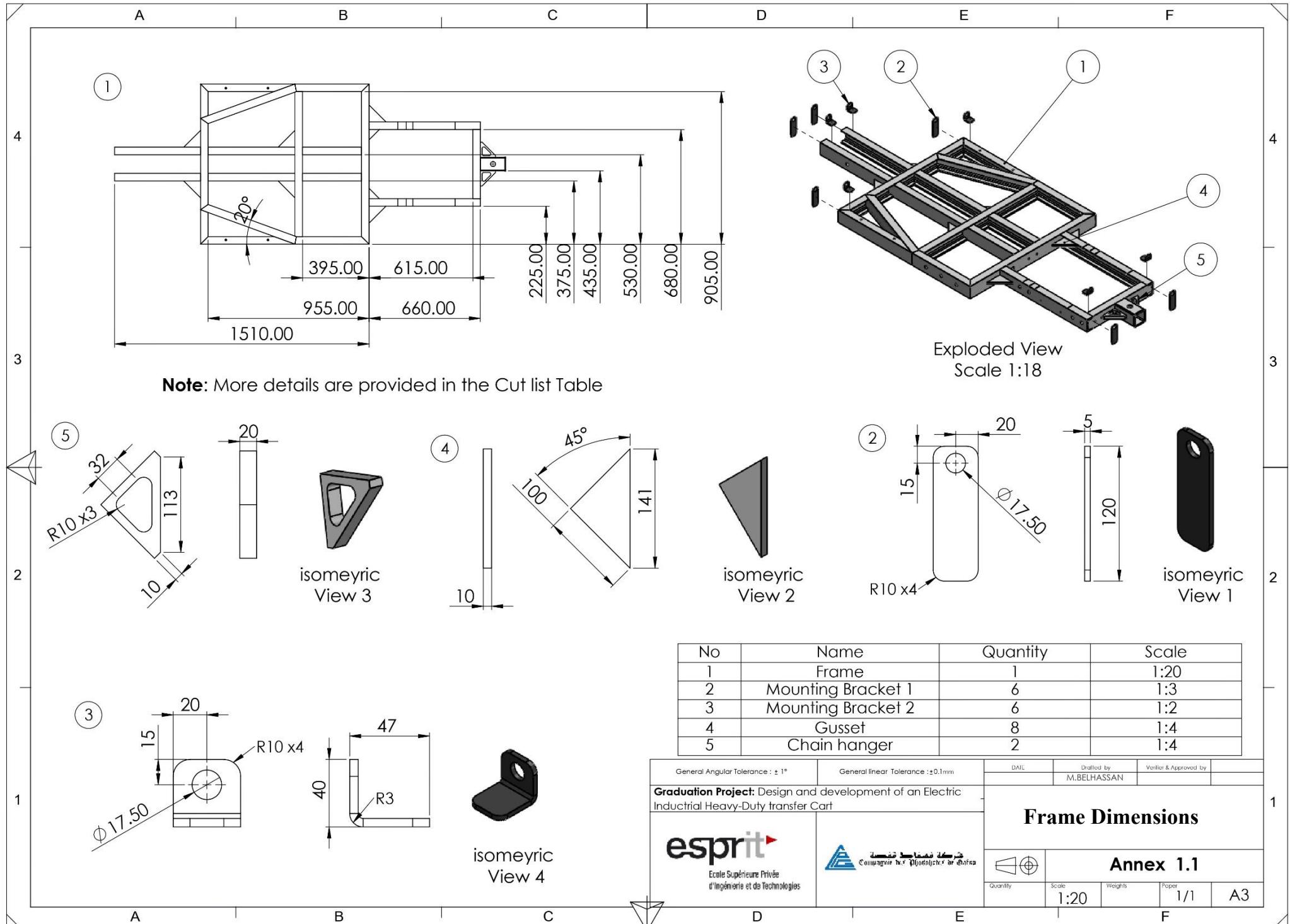
[Annex 0]

Full Cart Assembly

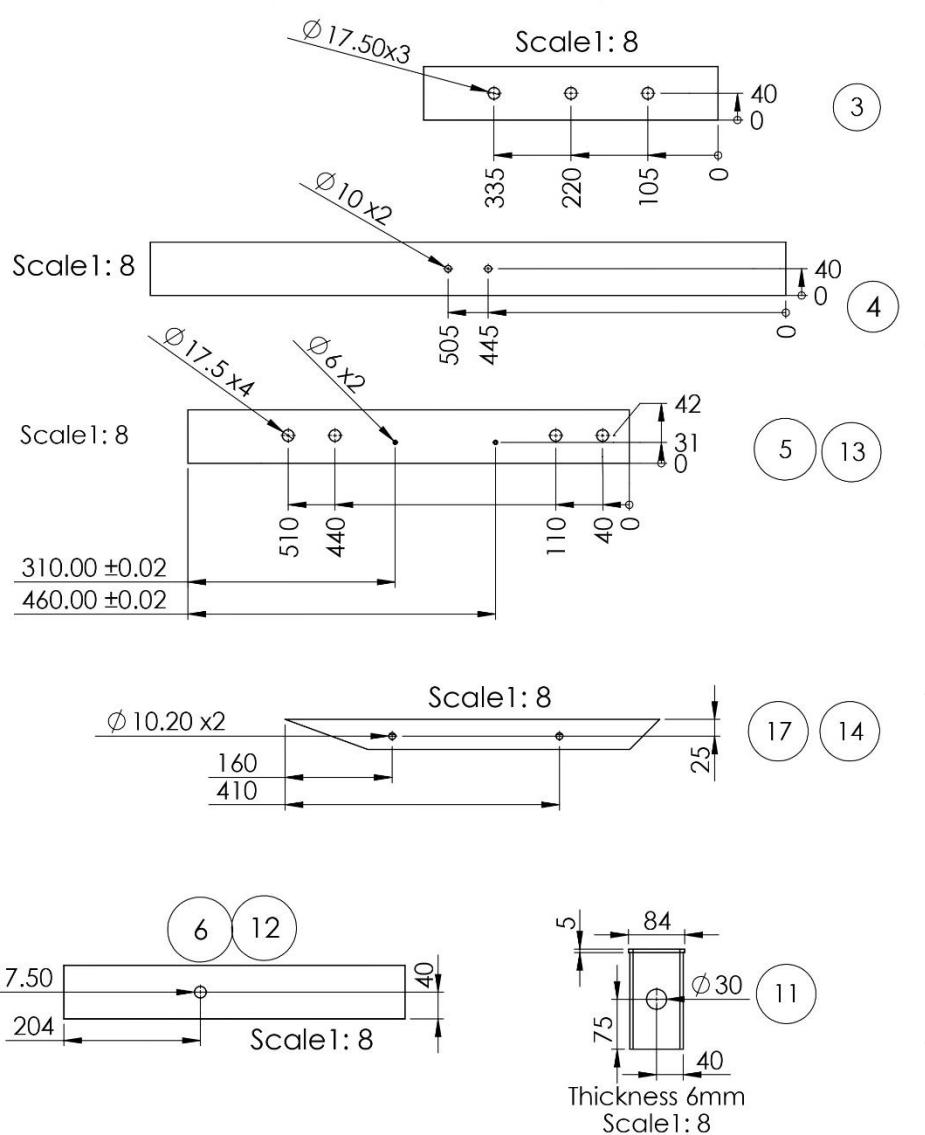
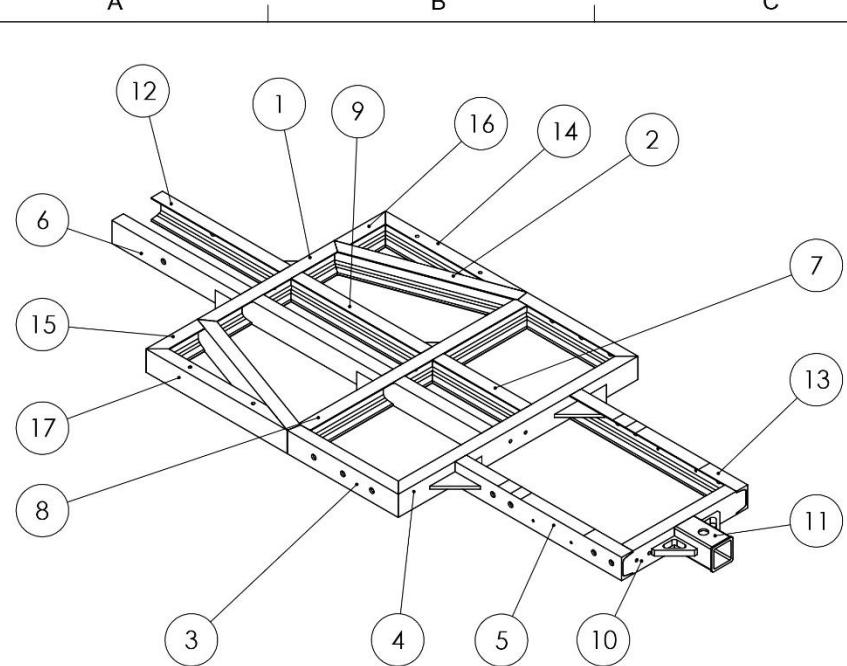


[Annex 1]

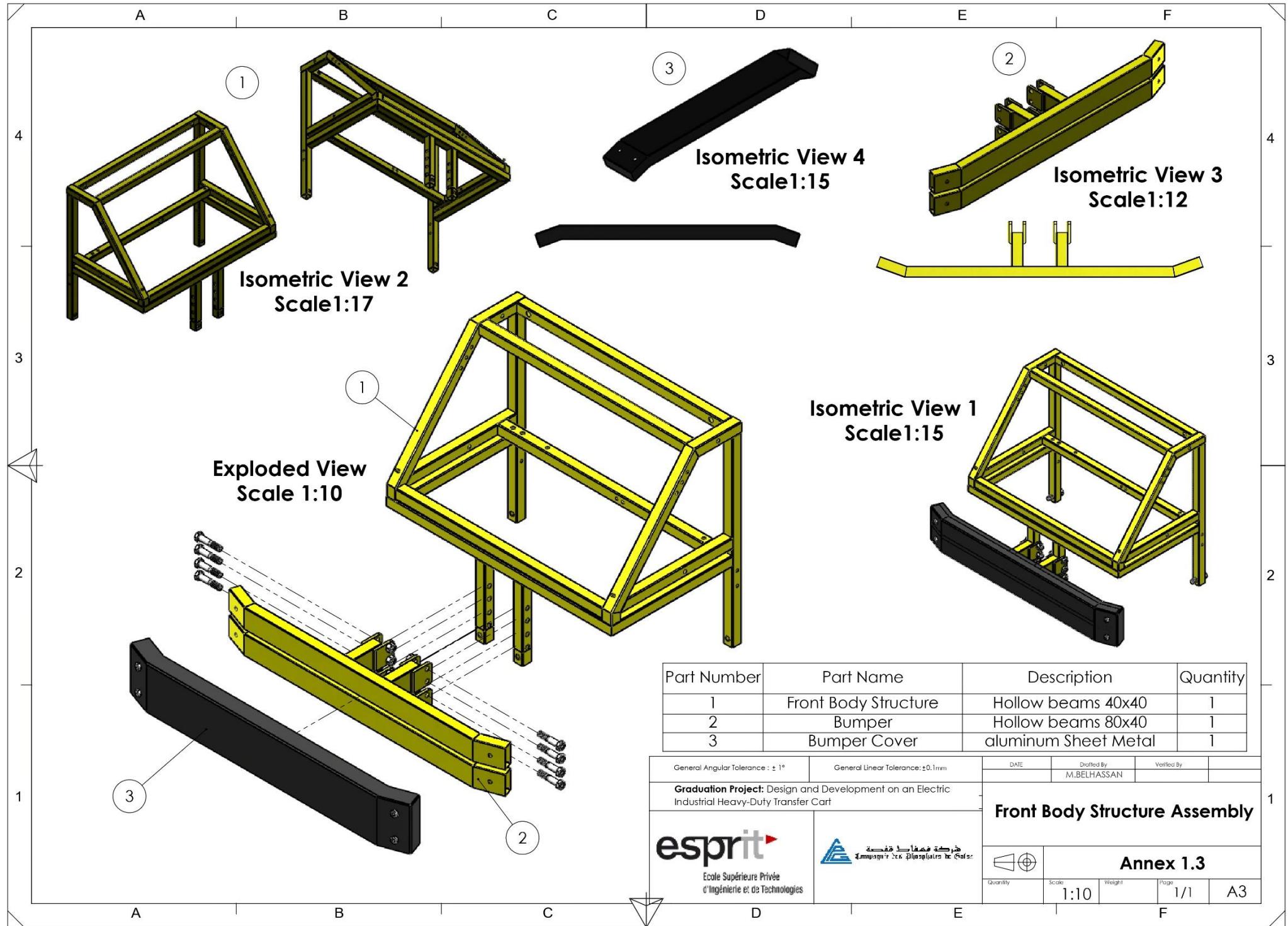
1. Frame Dimensions [Annex 1.1]
2. Frame Cut list [Annex 1.2]
3. Front Body structure Assembly [Annex 1.3]
4. Front Body Structure Dimensions [Annex 1.4]
5. Front Body Structure Cut List [Annex 1.5]
6. Bumper Dimensions [Annex 1.6]
7. Bumper Cut list [Annex 1.7]
8. Rear Body Structure Assembly [Annex 1.8]
9. Rea Body Components Dimensions [Annex 1.9]
10. Real Body Structure Dimensions [Annex 1.10]
11. Real Body Structure Cut List [Annex 1.11]
12. Canopy Structure Dimensions [Annex 1.12]
13. Canopy Structure Cut List [Annex 1.13]

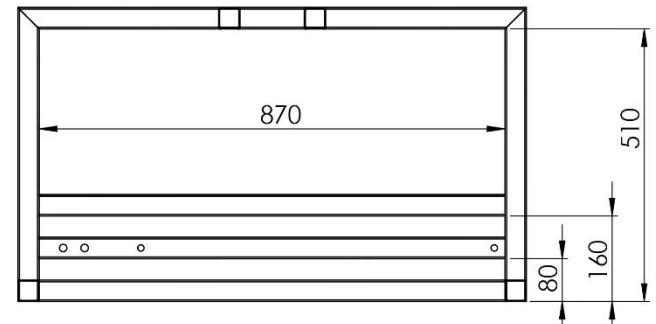


ITEM NO.	QTY.	DESCRIPTION	LENGTH	ANGLE1	ANGLE2	Angle Direction
1	1	UPN80	542.3533 38	35°	35°	Same
2	2	UPN80	595.9395 53	10°	35°	Same
3	2	UPN80	440	45°	10°	Same
4	1	UPN80	950	45°	45°	Opposite
5	1	UPN80	660	0°	0°	-
6	1	UPN80	510	0°	0°	-
7	2	UPN80	428	-	-	-
8	1	UPN80	938	-	-	-
9	2	UPN80	554	0°	-	-
10	1	UPN80	488	-	-	-
11	1	HOLLOW BEAM 80x80	150	0°	0°	-
12	1	UPN80	510	0°	0°	-
13	1	UPN80	660	0°	0°	-
14	1	UPN80	560	45°	70°	Opposite
15	1	UPN80	203.8233 31	20°	45°	Same
16	1	UPN80	203.8233 31	20°	45°	Same
17	1	UPN80	560	45°	70°	Opposite



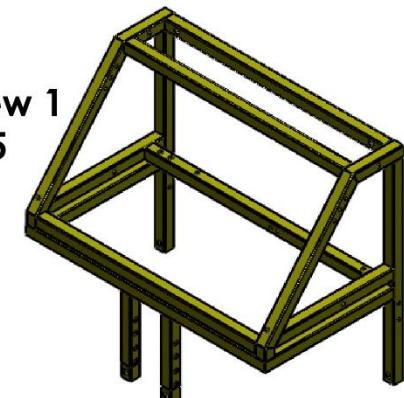
General Angular Tolerance: $\pm 1^\circ$	General Linear Tolerance: $\pm 0.1\text{mm}$	DATE	Drafted By	Verified and approved by
Graduation Project: Design and Development of an Electric Industrial Heavy-Duty Transfer Cart				
esprit 				
Annex 1.2				
Quantity	Scale	Weight	Page	A3



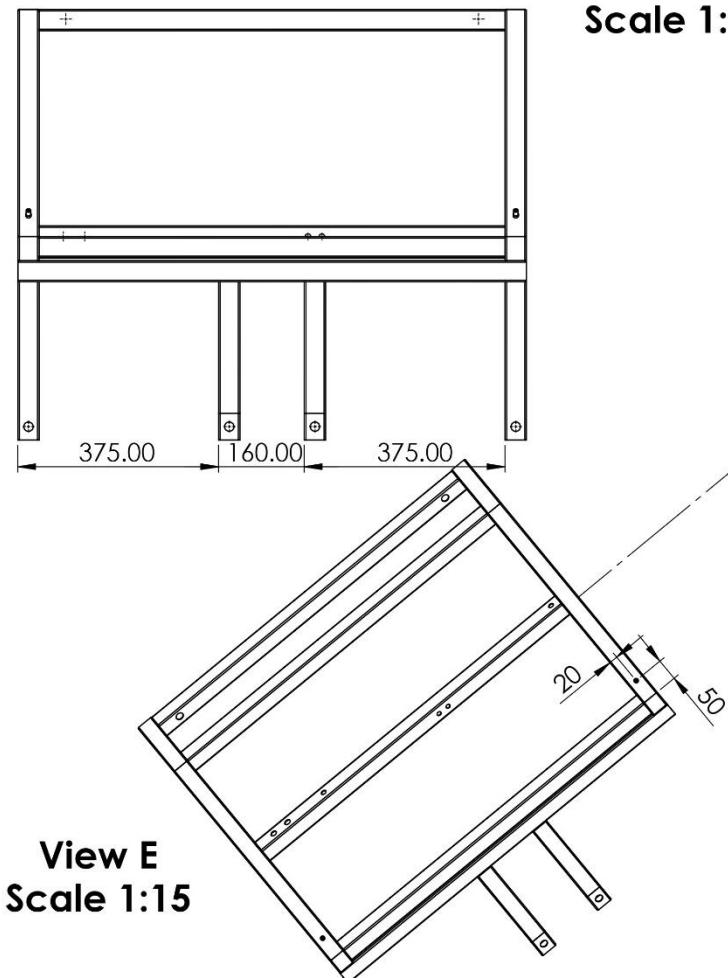


Isometric View 1

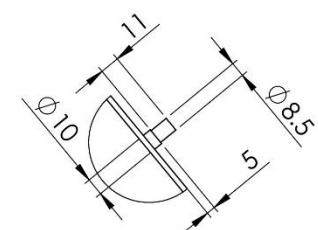
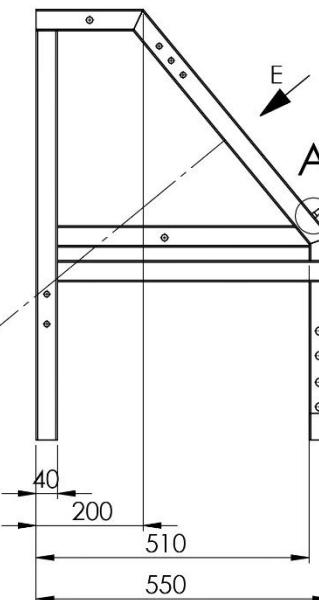
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Scale 1:10

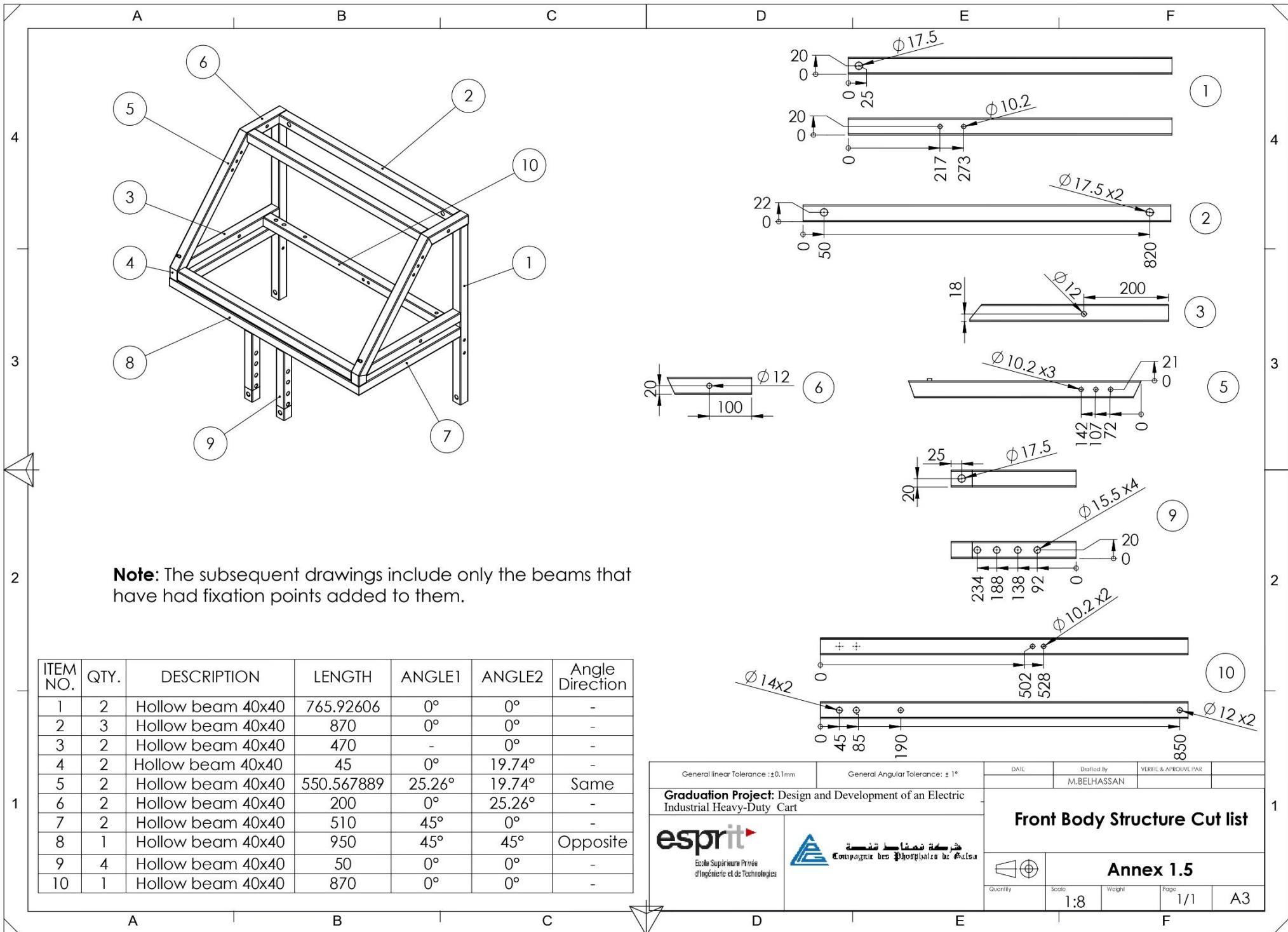


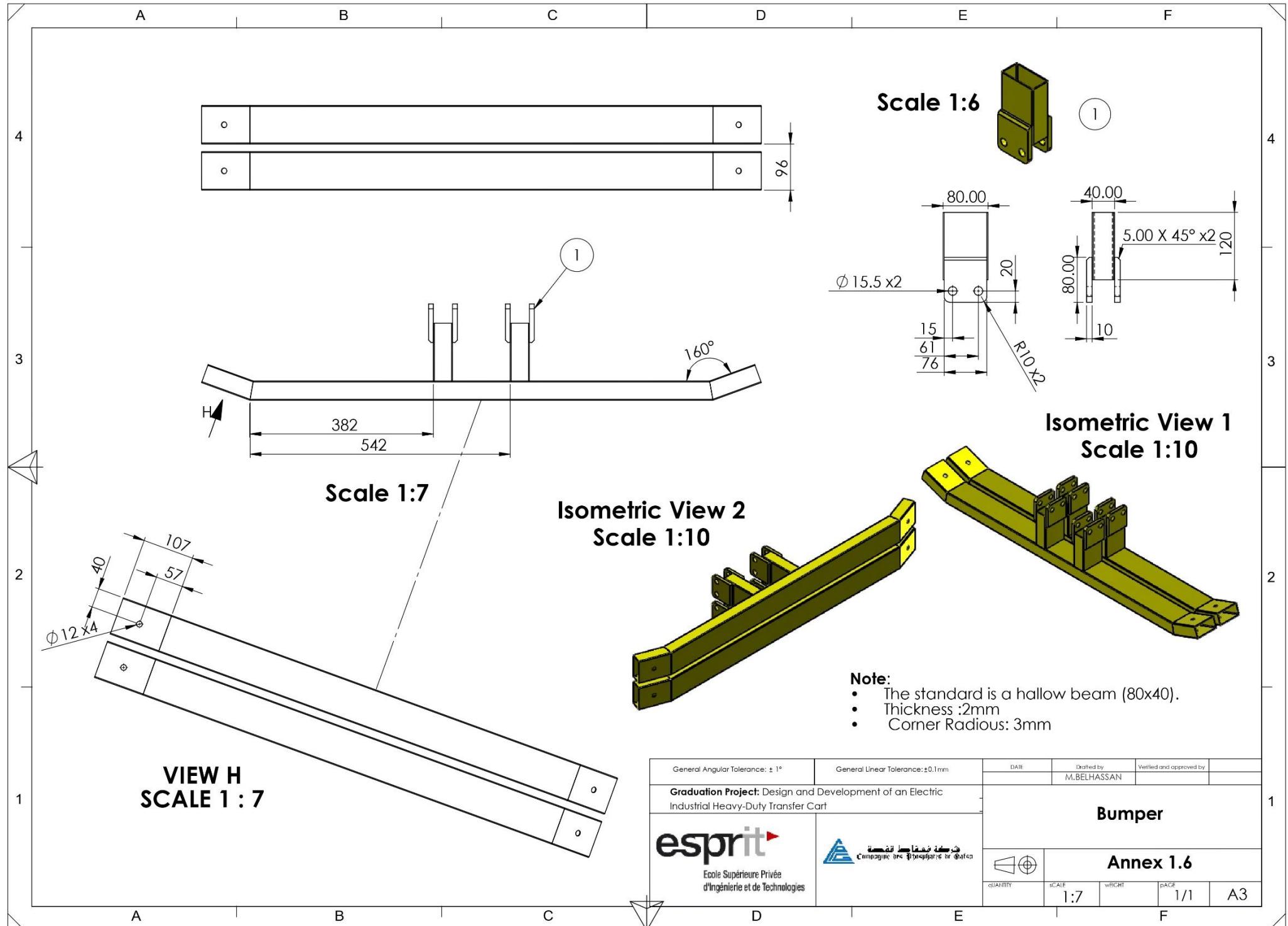
View E
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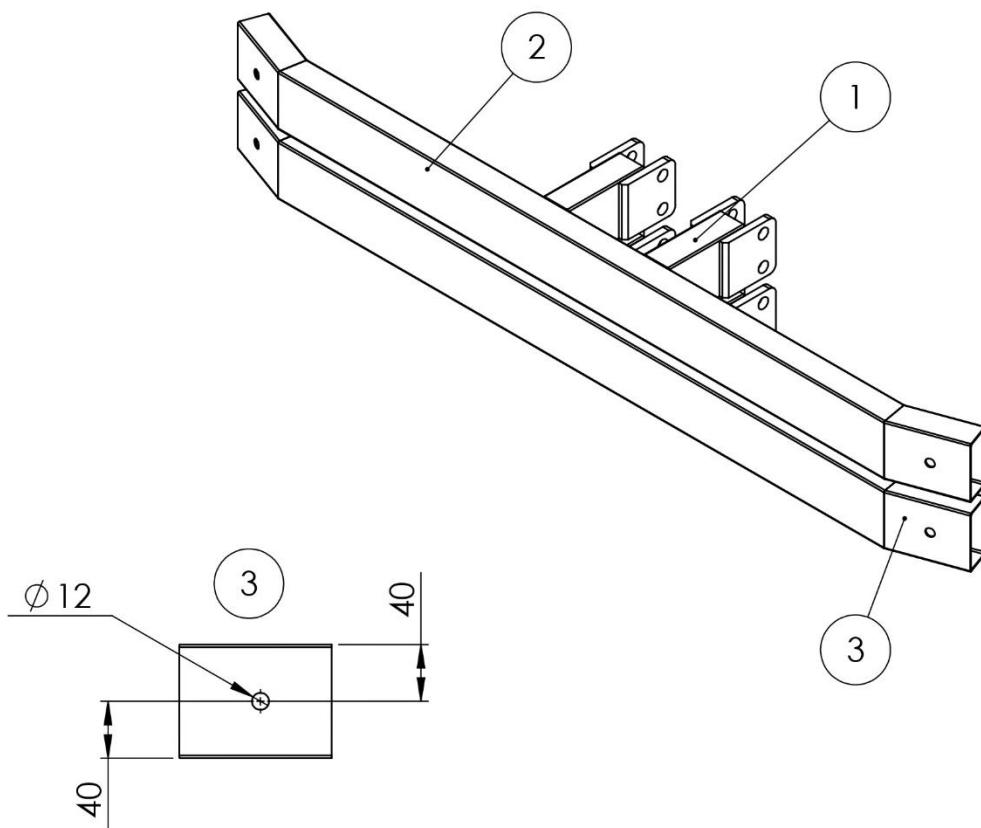


DETAIL A
SCALE 1 : 3

General Angular Tolerance: $\pm 1^\circ$	General Linear Tolerance: $\pm 0.1\text{mm}$	DATE	Drafted By	Verified By										
Graduation Project: Design and development of an Electric Heavy-Duty Transfer Cart			M.BELHASSAN											
esprit Ecole Supérieure Privée d'Ingenierie et de Technologies	 مملکة مalta Ministry of Education of Malta	<h2 style="text-align: center;">Front Body Structure</h2> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; width: 20%;">Quantity</th> <th style="text-align: center; width: 20%;">Scale</th> <th style="text-align: center; width: 20%;">Weight</th> <th style="text-align: center; width: 20%;">Page</th> <th style="text-align: center; width: 20%;">A3</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1:10</td> <td></td> <td></td> <td style="text-align: center;">1/1</td> <td style="text-align: center;">A3</td> </tr> </tbody> </table>			Quantity	Scale	Weight	Page	A3	1:10			1/1	A3
Quantity	Scale	Weight	Page	A3										
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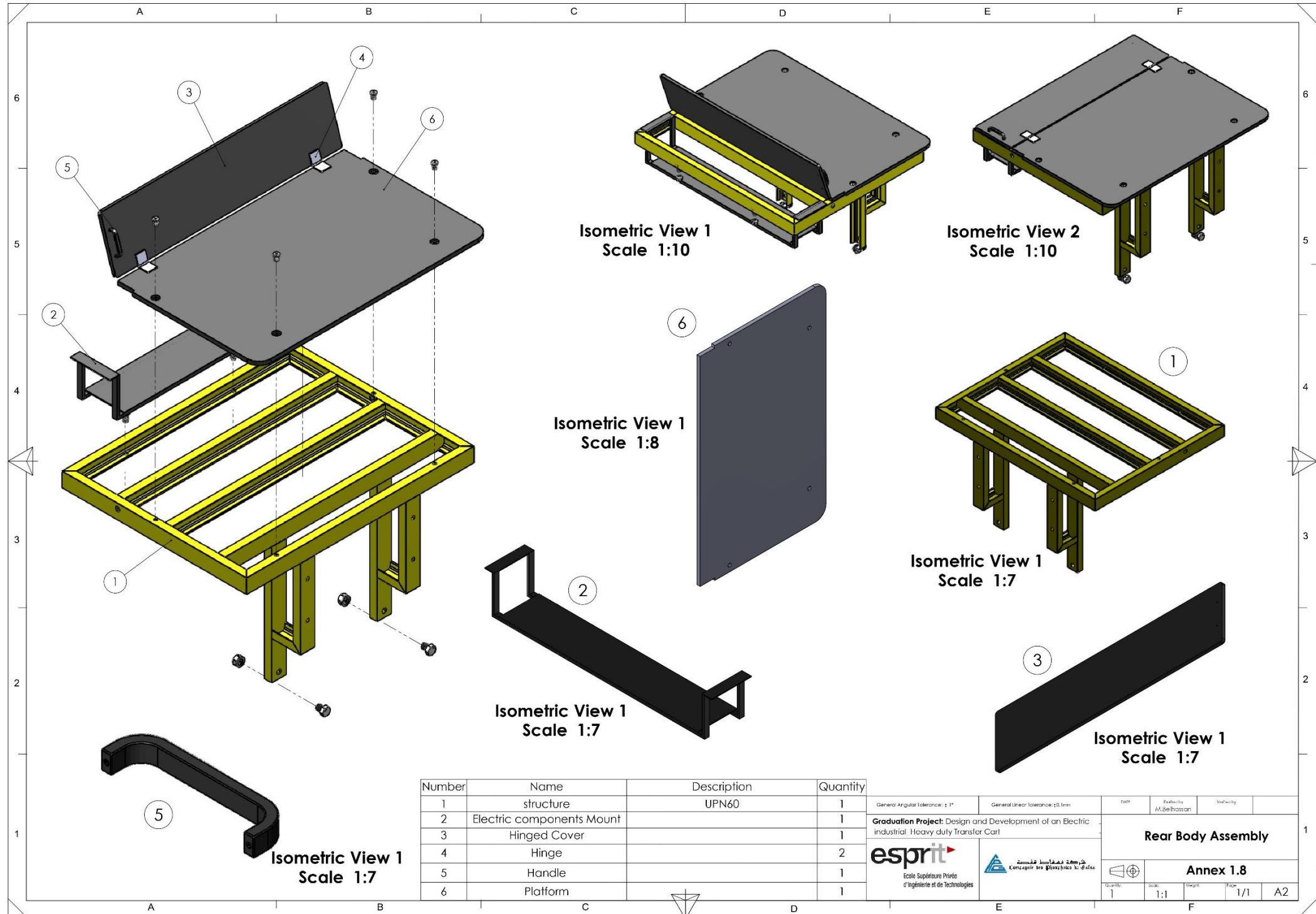


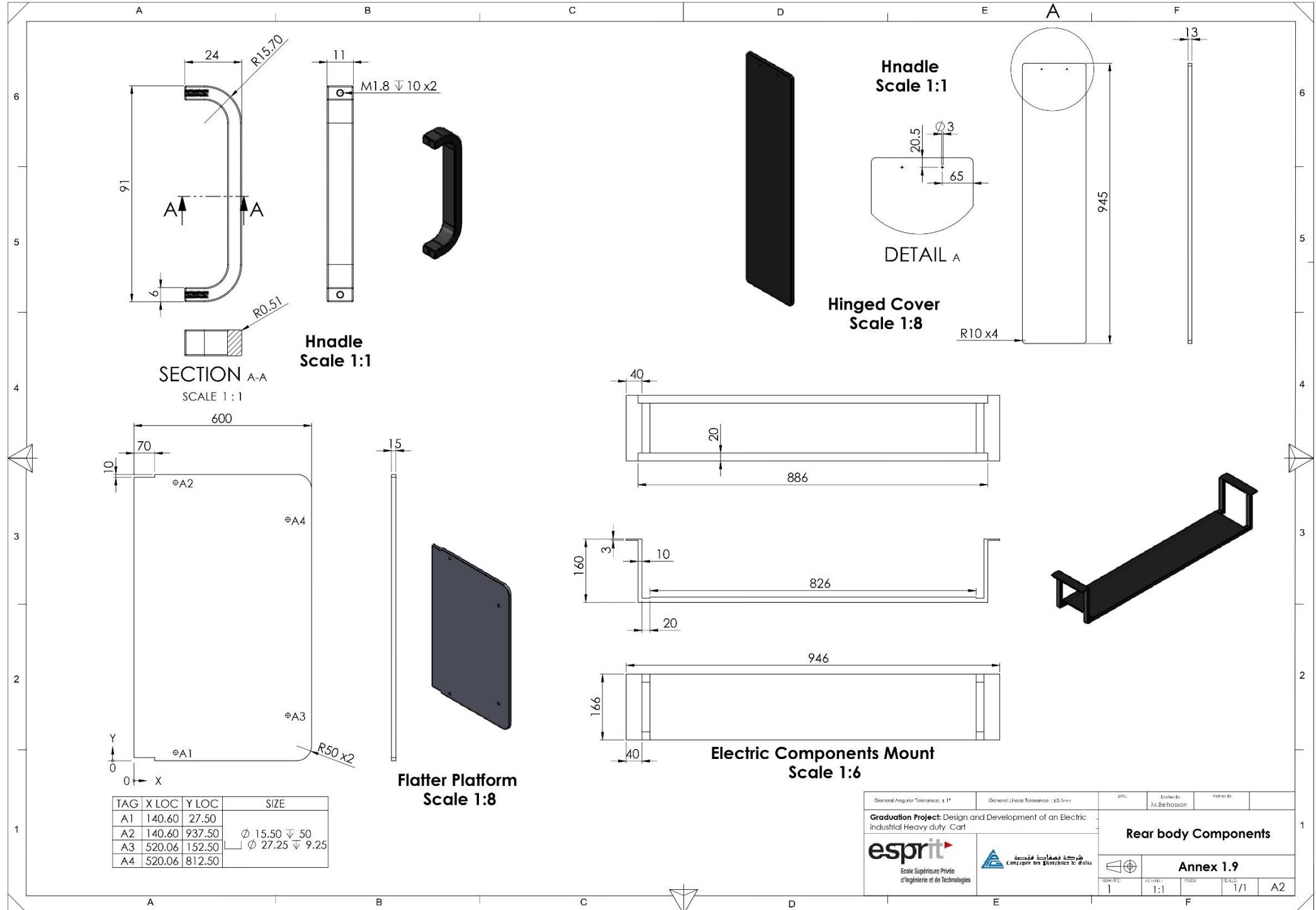


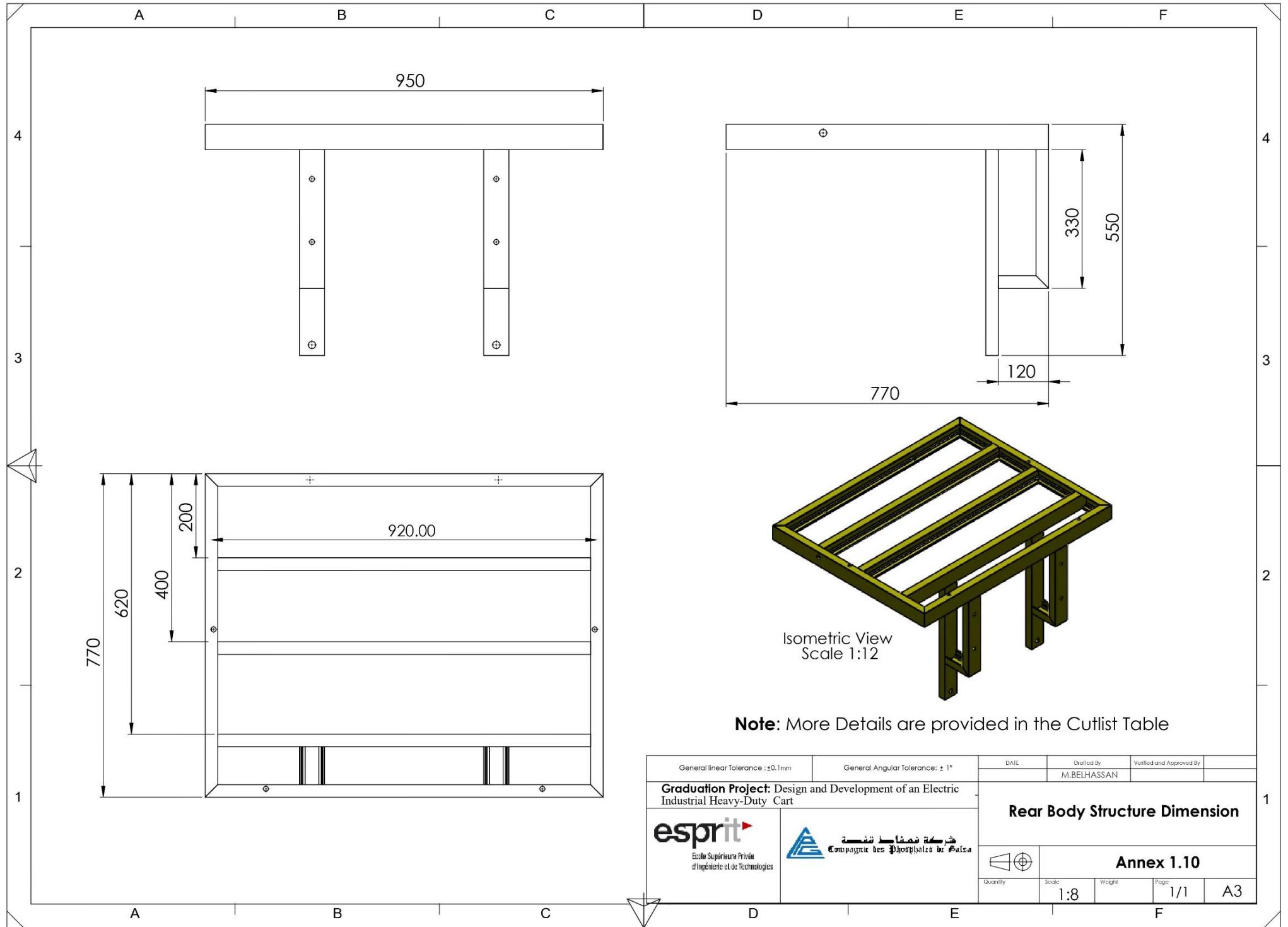
Note: The subsequent drawings include only the beam that have had fixation Points added to it

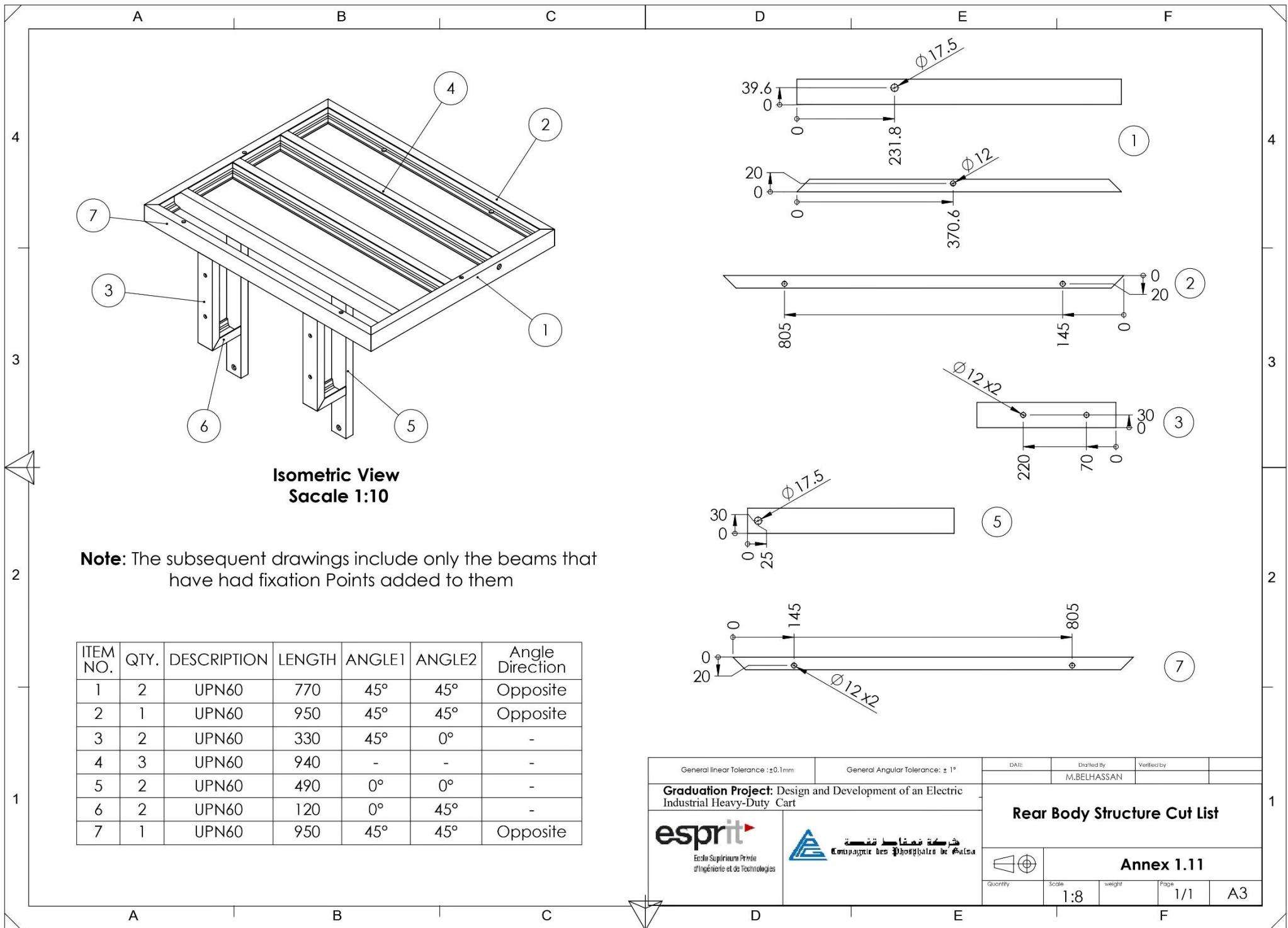
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2	2	Hollow beam 40x80	964.106158	10°	10°	Same
3	4	Hollow beam 40x80	107.053079	10°	0°	-

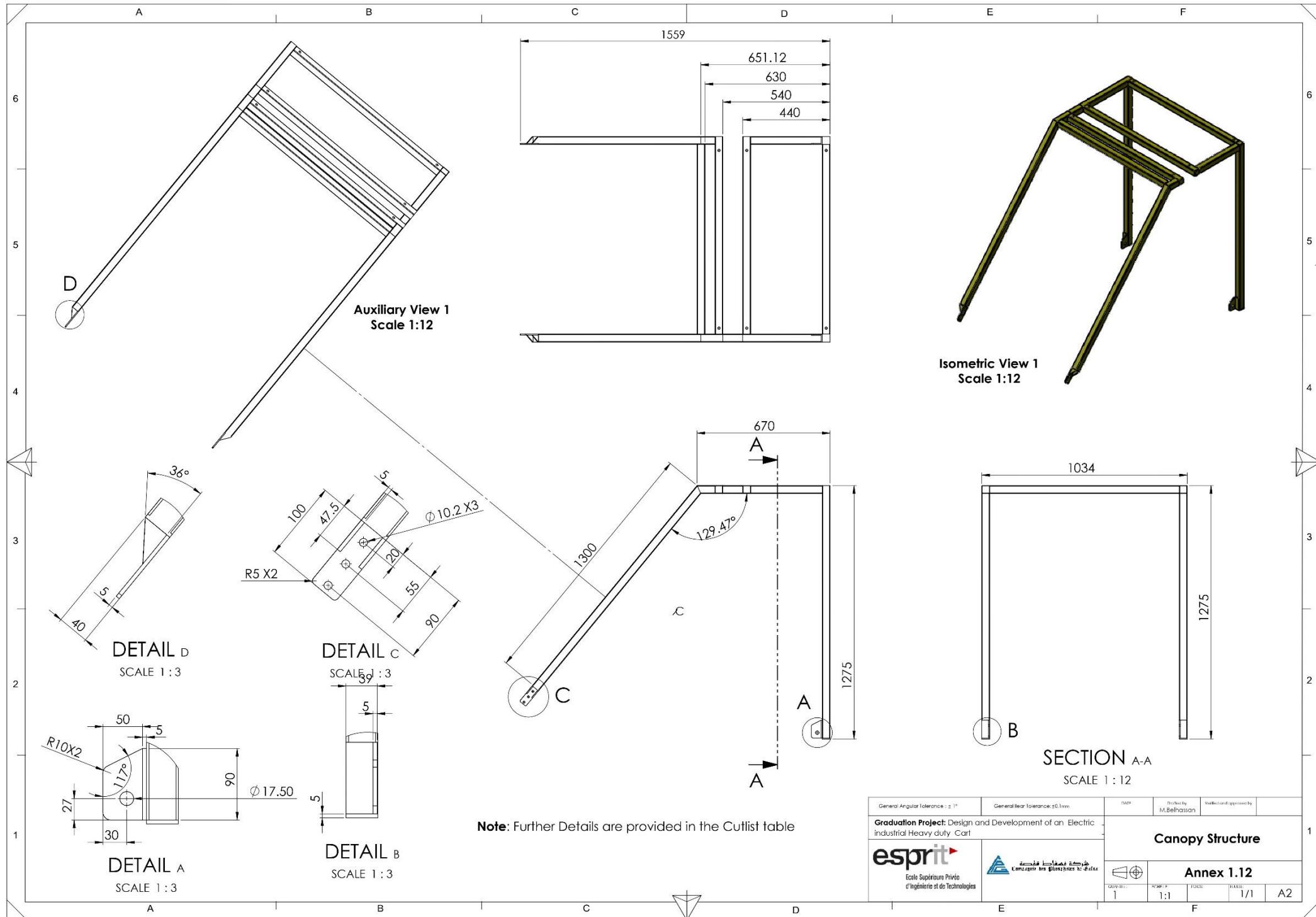
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			M.BELHASSAN	
Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart		Bumper Cut list		
 Ecole Supérieure Privée d'Ingénierie et de Technologies		 شركة فسفاط قفصة		
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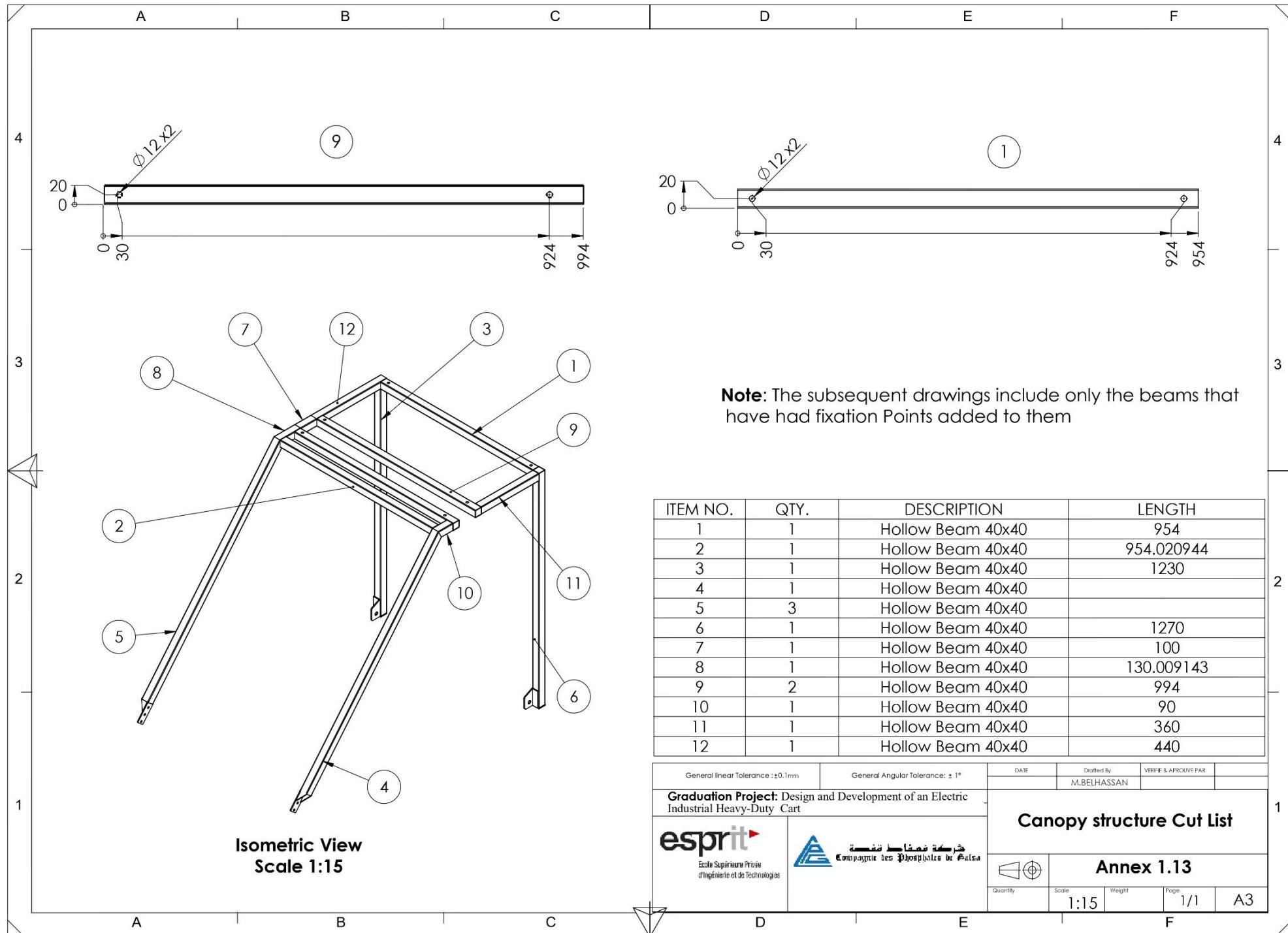






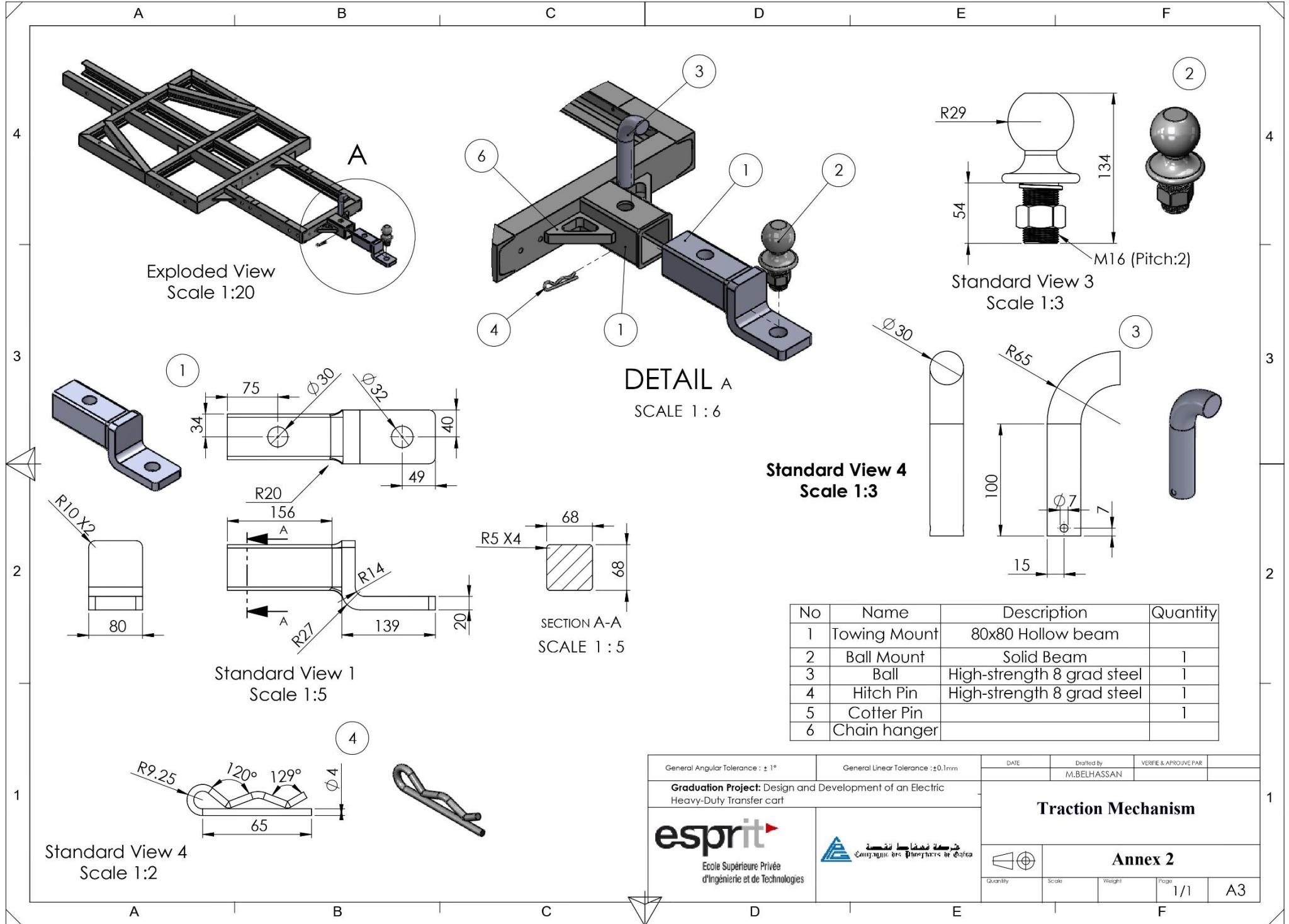






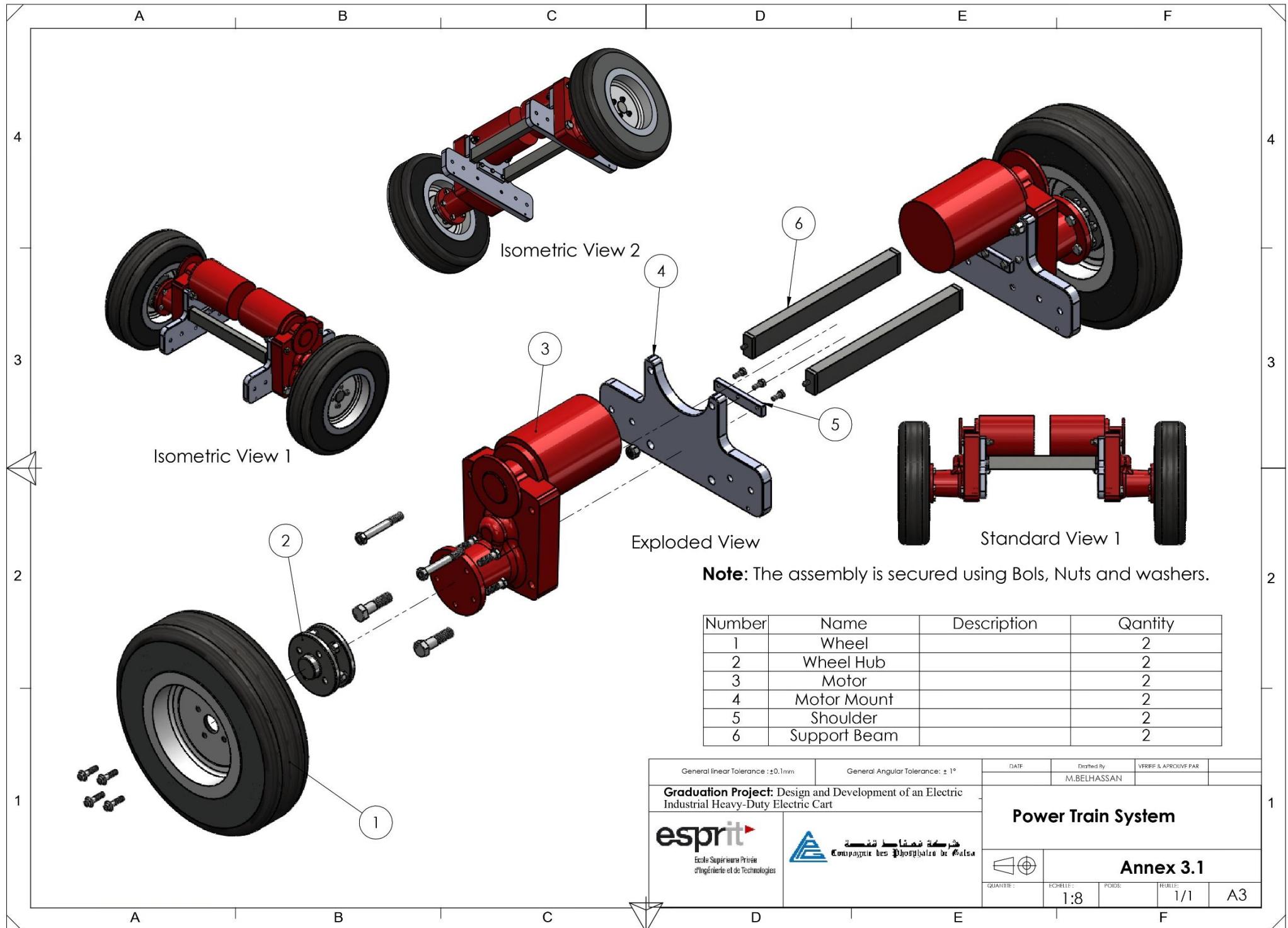
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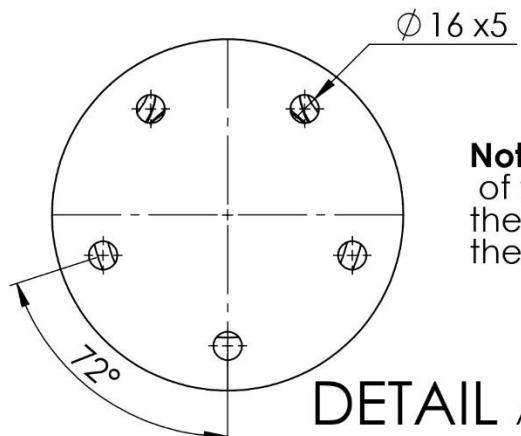
1. Traction Mechanism [Annex 2.1]



[Annex 3]

1. Power Train Assembly [Annex 3.1]
2. Motor [Annex 3.2]
3. Motor Mount [Annex 3.3]
4. Position Pin [Annex 3.4]
5. Shoulder [Annex 3.5]
6. Support Beam [Annex 3.6]
7. Wheel Hub[Annex 3.7]
8. Wheel [Annex 3.8]

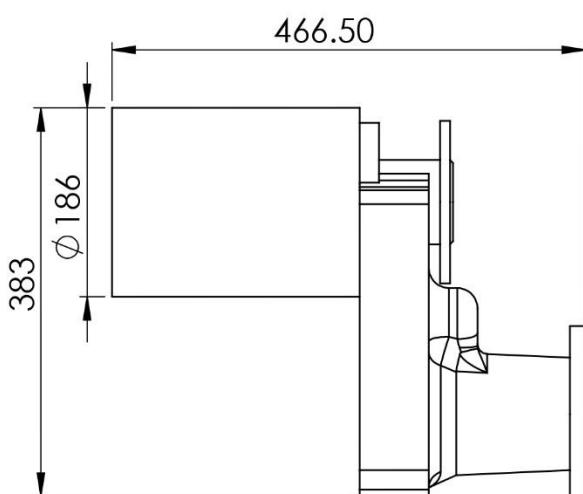
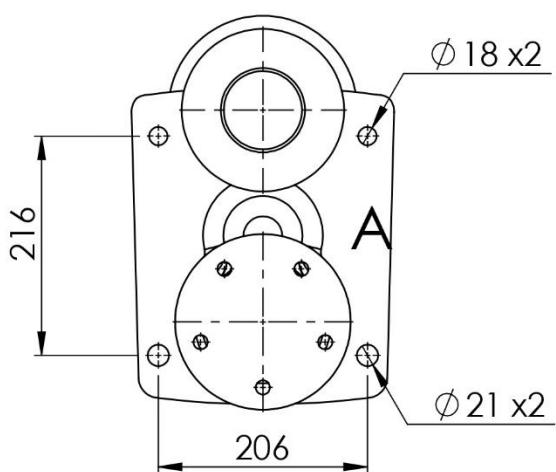




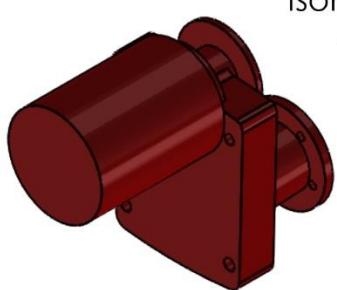
Note: The motor design is an approximation of the electric DC motor, considering only the essential measurements and ignoring the external appearance of the actual motor.

DETAIL A

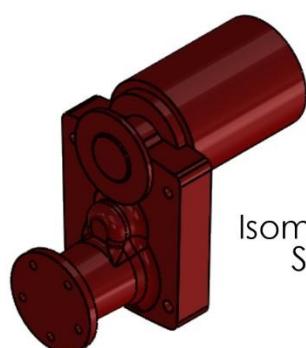
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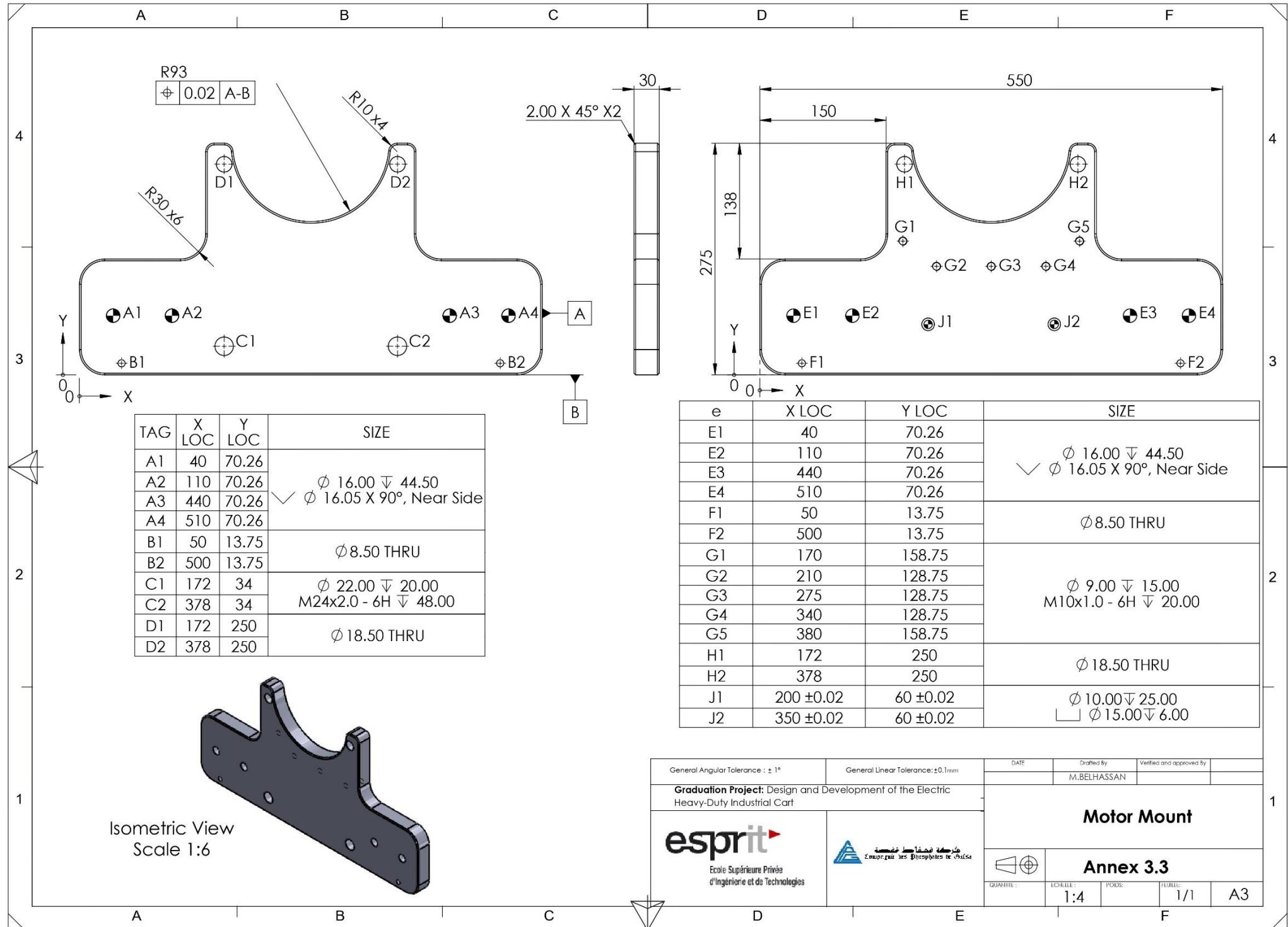
Isometric View 2
Scale 1:11

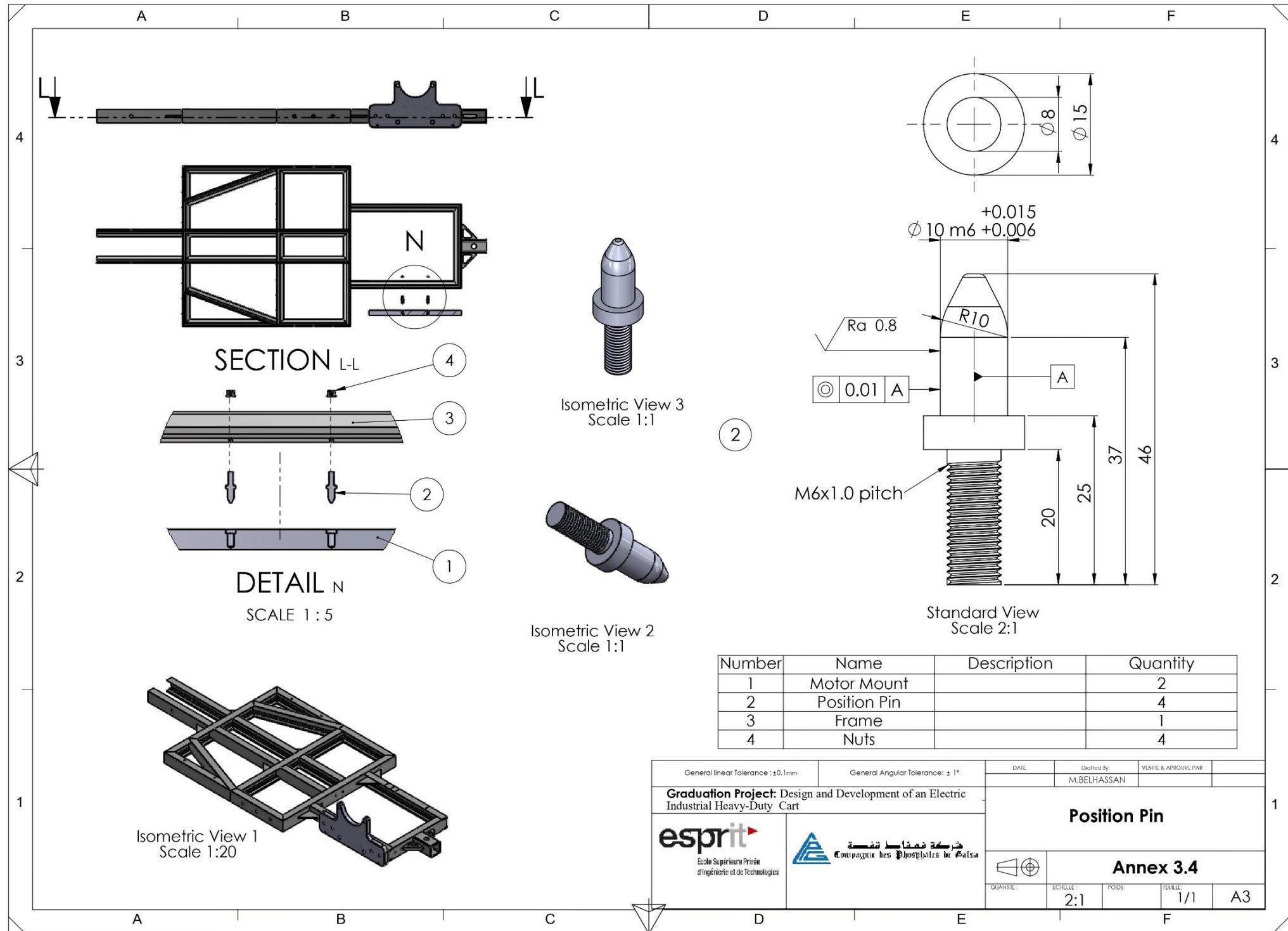


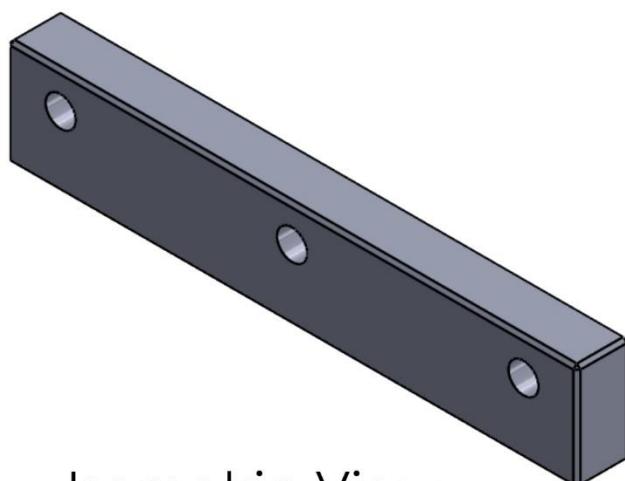
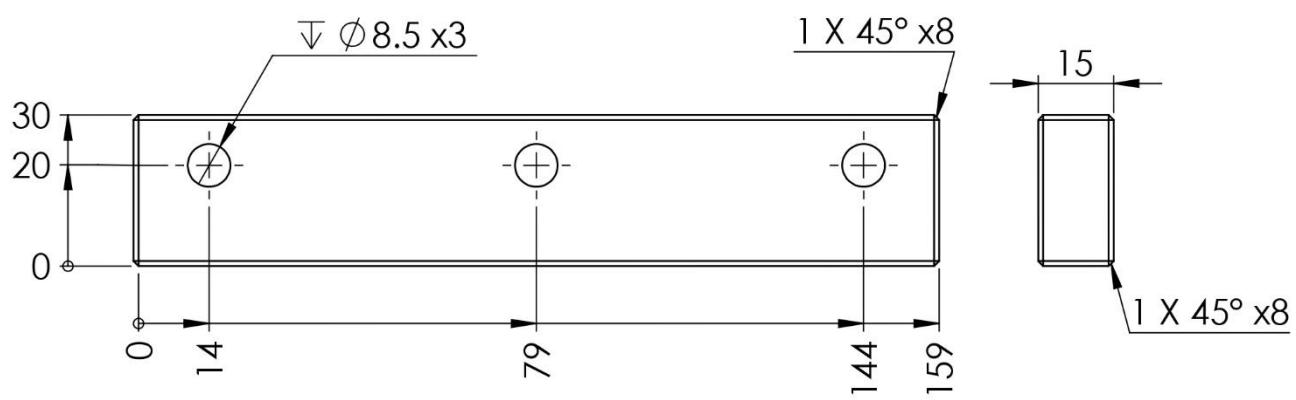
Isometric View 1
Scale 1:11



General Angular Tolerances: $\pm 1^\circ$	General Linear Tolerances: $\pm 0.1\text{mm}$	DATE	Drafted By	Verified And approved By
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Graduation Project: Design and Development of an Electric Heavy-Duty Traction Cart		Electric Motor		
 Ecole Supérieure Privée d'Ingénierie et de Technologies		 Annex 3.2		
Quantity	Scale	Wight	Page	Superficie (mm²) :
1:7			1/1	A4







Isometric View
Scale (1:2)

Tolérance générale angulaire: $\pm 1^\circ$

Tolérance générale linéaire: $\pm 0.1\text{mm}$

DATE

Drafted By

Verified By

M.BELHASSAN

Graduation Project: Design and Development of an Electric Heavy Duty Transfer Cart

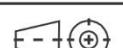
Shoulders

esprit

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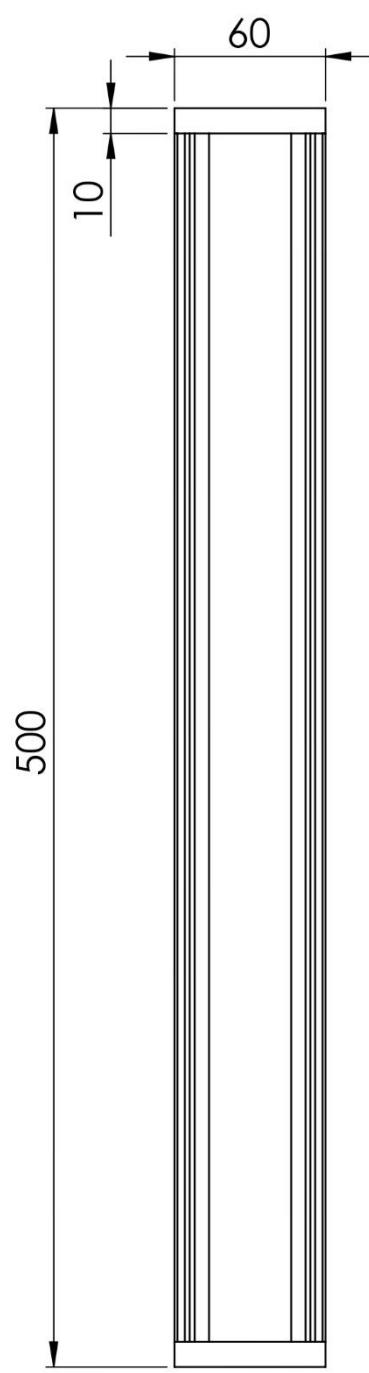
ال Companion des Prospects de Design



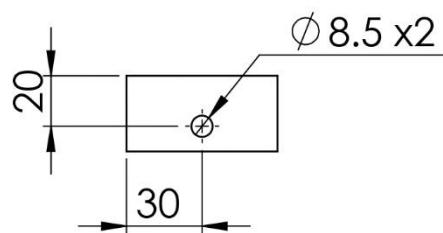
Annex 3.5

Superficie (mm²):

Quantity	Scale	Weight	Page	A4
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UPN60



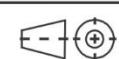
Tolérance générale angulaire: $\pm 1^\circ$

Tolérance générale linéaire: $\pm 0.1\text{mm}$

DATE	Drafted By	Verified and approved
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Graduation Project: Design and Development of an industrial
Heavy-Duty Electric Cart

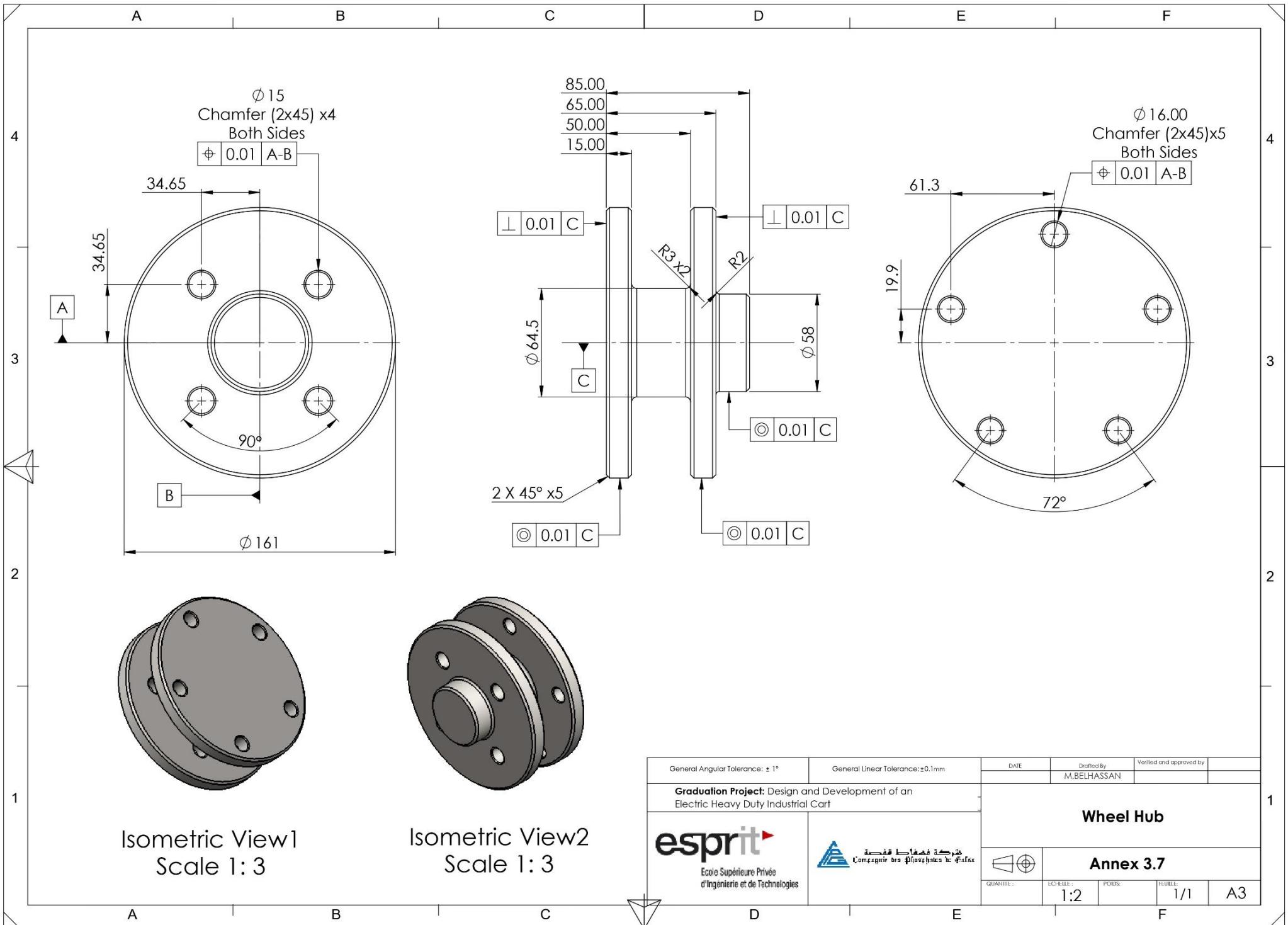
Support Beam

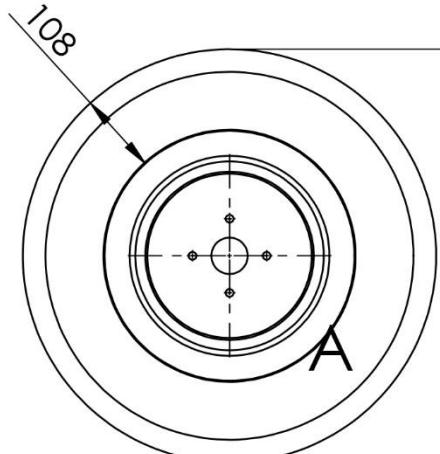


Annex 3.6

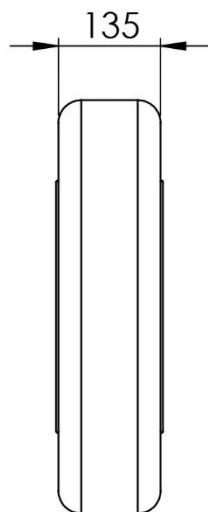
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QUANTITE:	ECHELLE:	POIDS:	FEUILLE:
2	1:5		1/1 A4

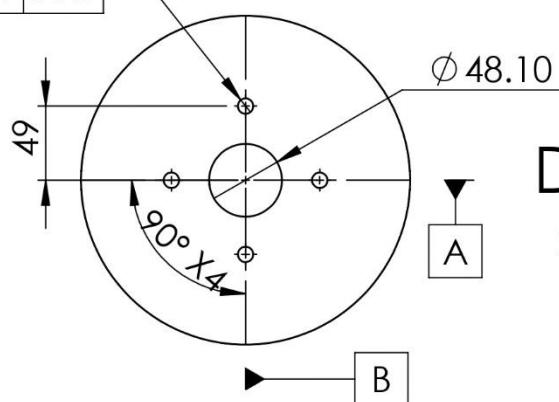




$\phi 546.20$



$\phi 10.25 \times 4$
⊕ 0.01 A-B



DETAIL A
SCALE 1:5



Note: The design of this wheel is essentially an approximation of a FIAT UNO wheel. Only the basic measurements were considered, without taking into account the external appearance of the actual wheel.

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance: $\pm 0.1\text{mm}$

DATE

Drafted By

Verified and approved

M.BELHASSAN

Graduation Project : Design and Development of an Electric Heavy-Duty Industrial Cart

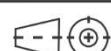
Wheel

esprit

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Compagnie des phosphates de Guelmim



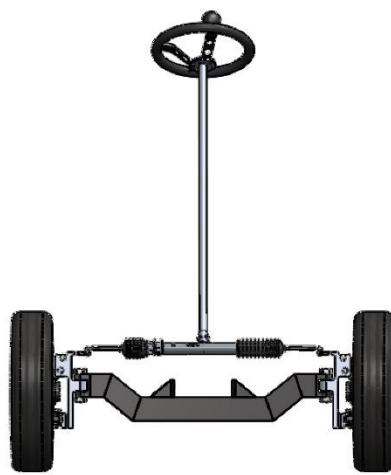
Annex 3.8

Superficie (mm²) :

Quantity	Scale	Weight	Page	A4
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[Annex 4]

1. Steering System Assembly [Annex 4.1]
2. Steering System Sub-Assembly [Annex 4.2]
3. Steering Knuckle Support [Annex 4.3]
4. Bushings [Annex 4.4]
5. Steering Knuckle [Annex 4.5]
6. Bearings [Annex 4.6]
7. Steering Frame Dimensions [Annex 4.7]
8. Steering Frame Cut List [Annex 4.8]



Standard View 2



Isometric View 1

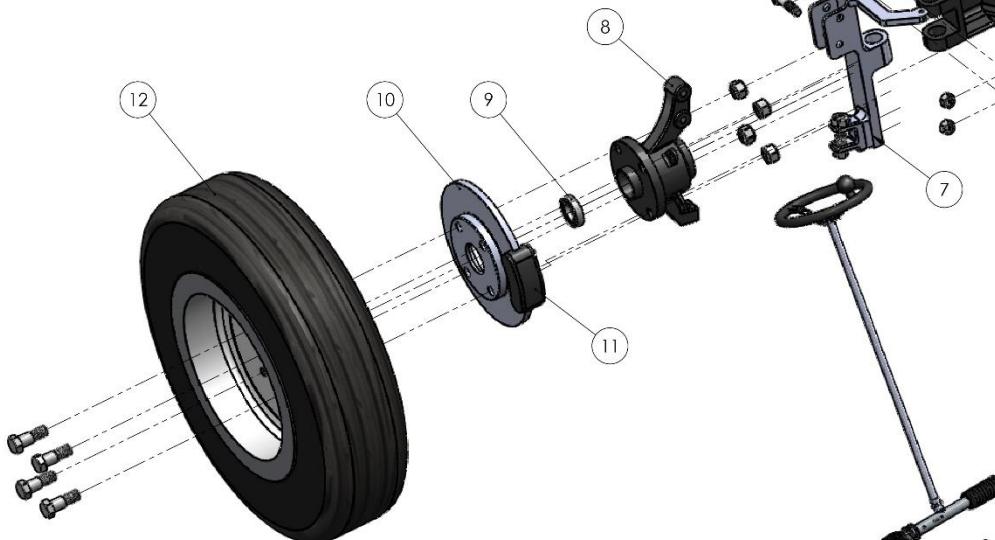


Isometric View 2

Note: The assembly is secured Using Bolts, Nuts and Washers

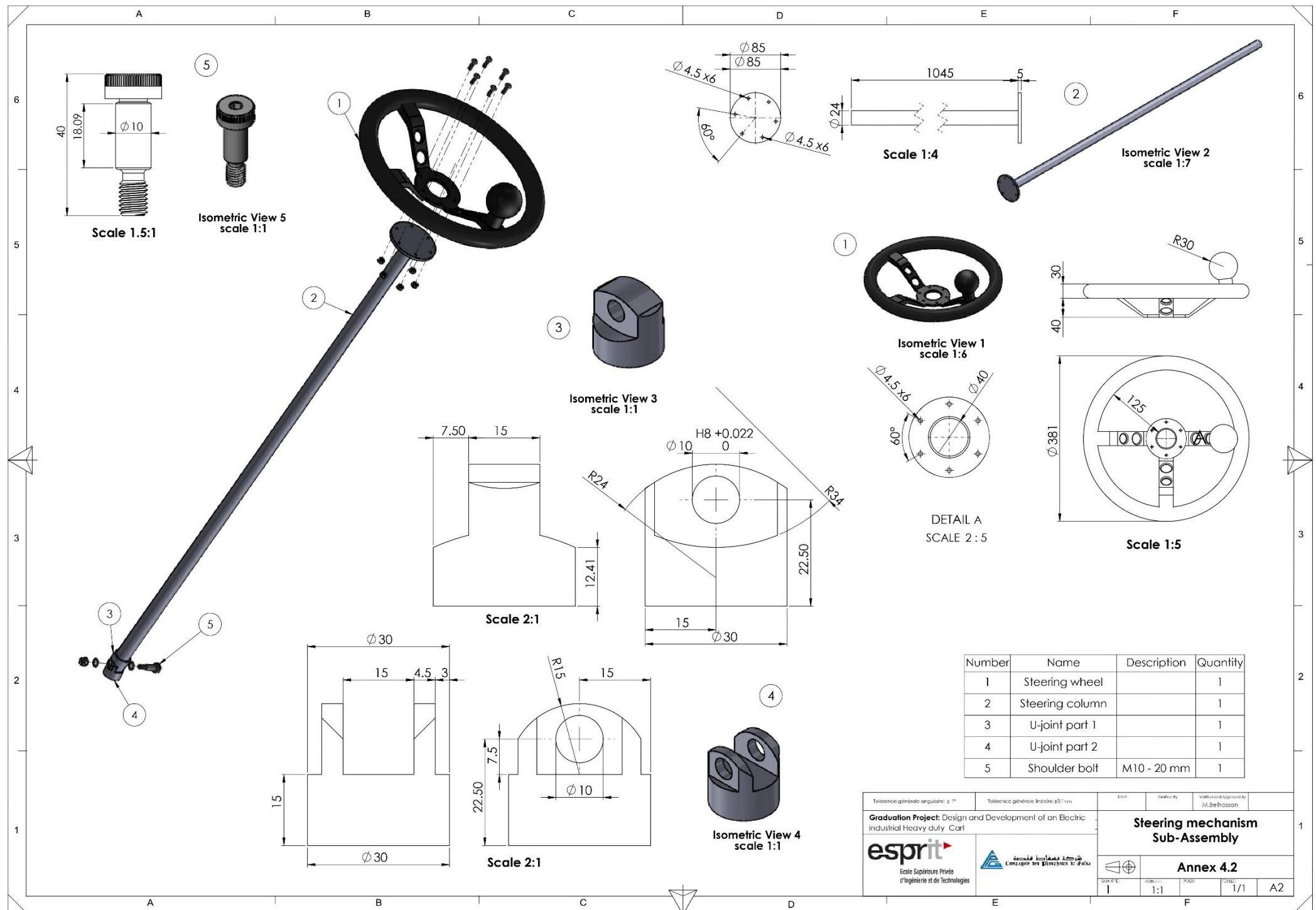


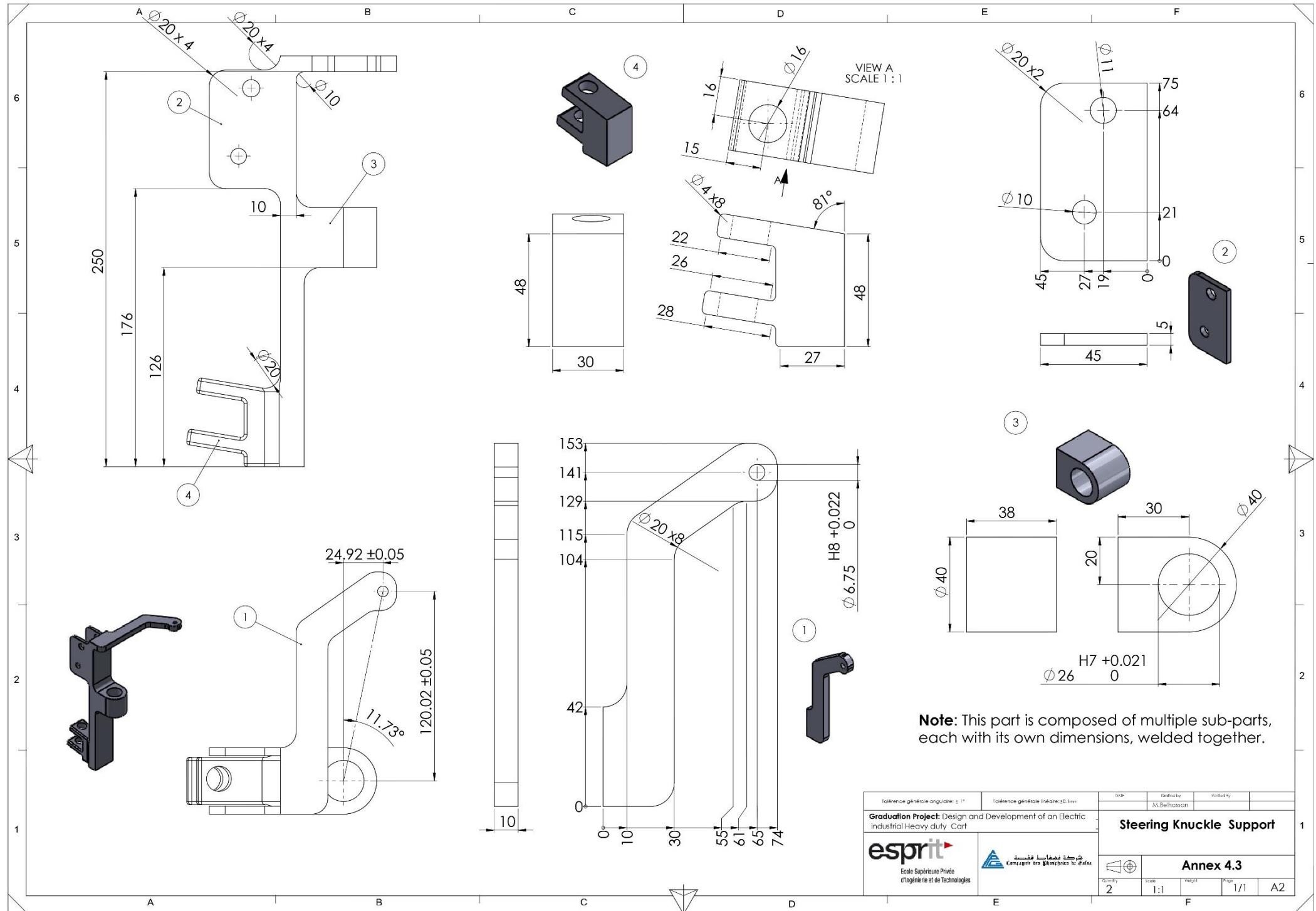
Exploded View 1

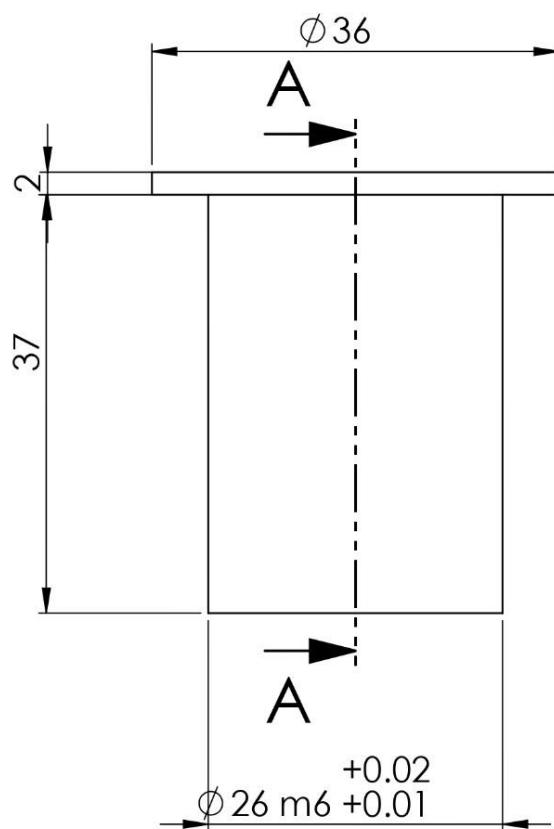


Number	Name	Description	Quantity
1	steering wheel		1
2	steering column		1
3	U-joint		1
4	Rack-pinion		1
5	Axle		2
6	Bushing		2
7	steering knuckle support		2
8	Steering Knuckle		2
9	Bearing	**	2
10	Brake disc		2
11	Brake caliper		2
12	Wheel		2
13	Steering Frame	UPN80	1

Tolérance générale angulaire: $\pm 1^\circ$	Tolérance générale linéaire: 10 mm	DUR	MTR PAR	VISAGE & APPAREIL PAR
Graduation Project: Design and Development of an Electric Industrial Heavy duty Cart				
Steering Mechanism   Annex 4.1				
1	1:5.5	1/1	1/1	A2

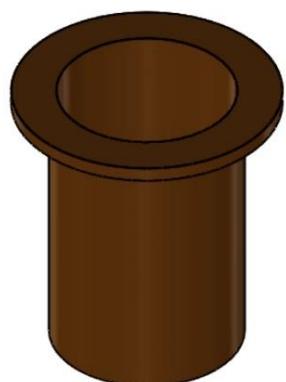
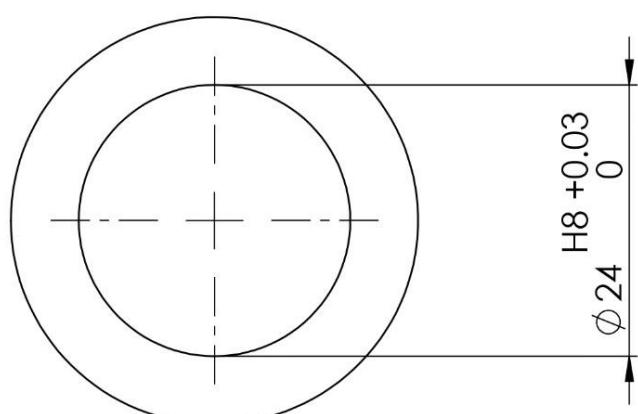






SECTION A-A

SCALE 1.5 : 1



General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance: $\pm 0.1\text{mm}$

DATE

Drafted By

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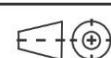
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 **Compagnie des Phosphates de Gafsa**

Bushing



Annex 4.4

Superficie (mm^2):

QUANTITE:

ECHELLE:

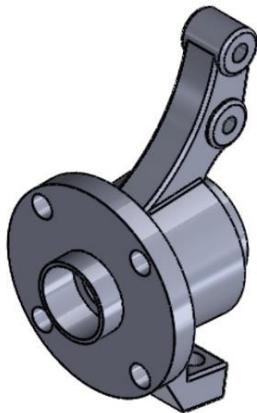
POIDS:

FEUILLE:

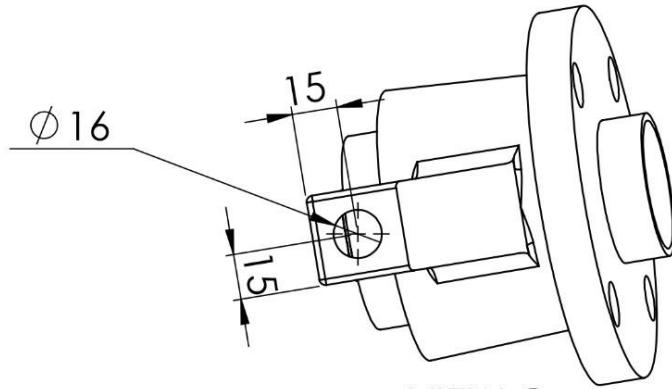
1.5:1

1/1

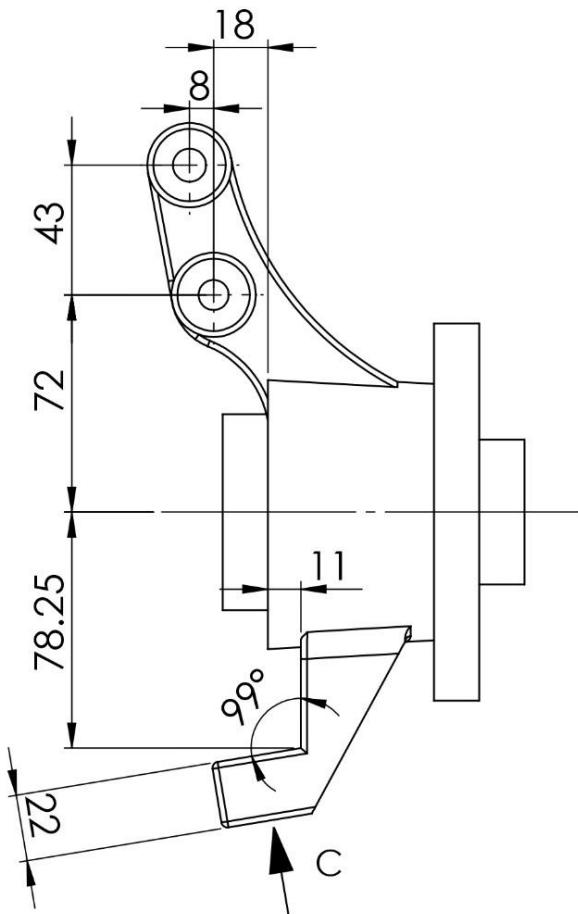
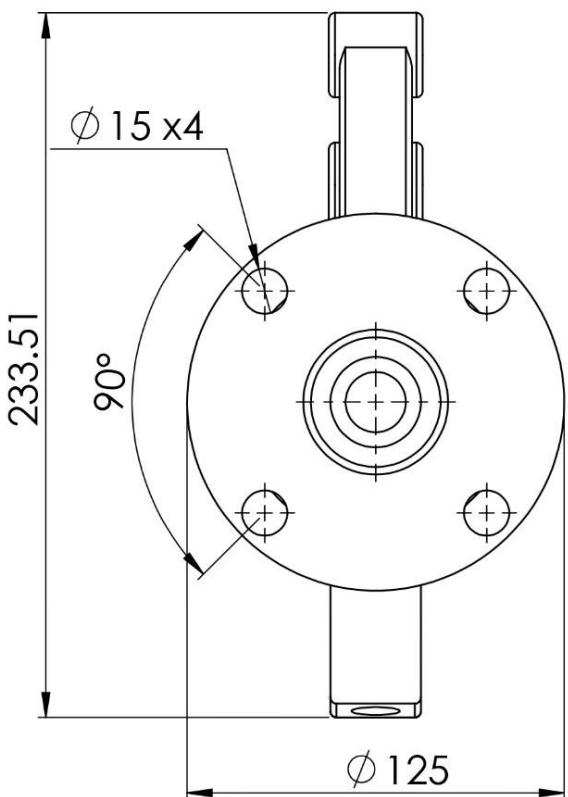
A4



Isometric view
scale 1:4



VIEW C
SCALE 1 : 2.5



Note: The design of the steering knuckle is an approximation of a recovered FIAT UNO steering knuckle. Only the basic measurements were considered.

Tolérance générale angulaire: $\pm 1^\circ$

Tolérance générale linéaire: $\pm 0.1\text{mm}$

DATE

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Steering Knuckle

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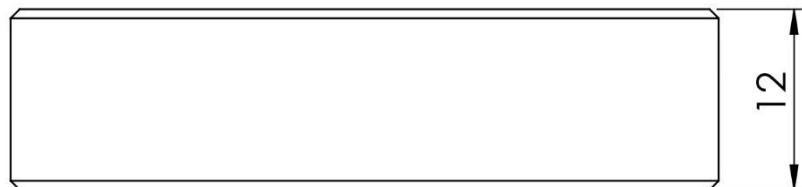
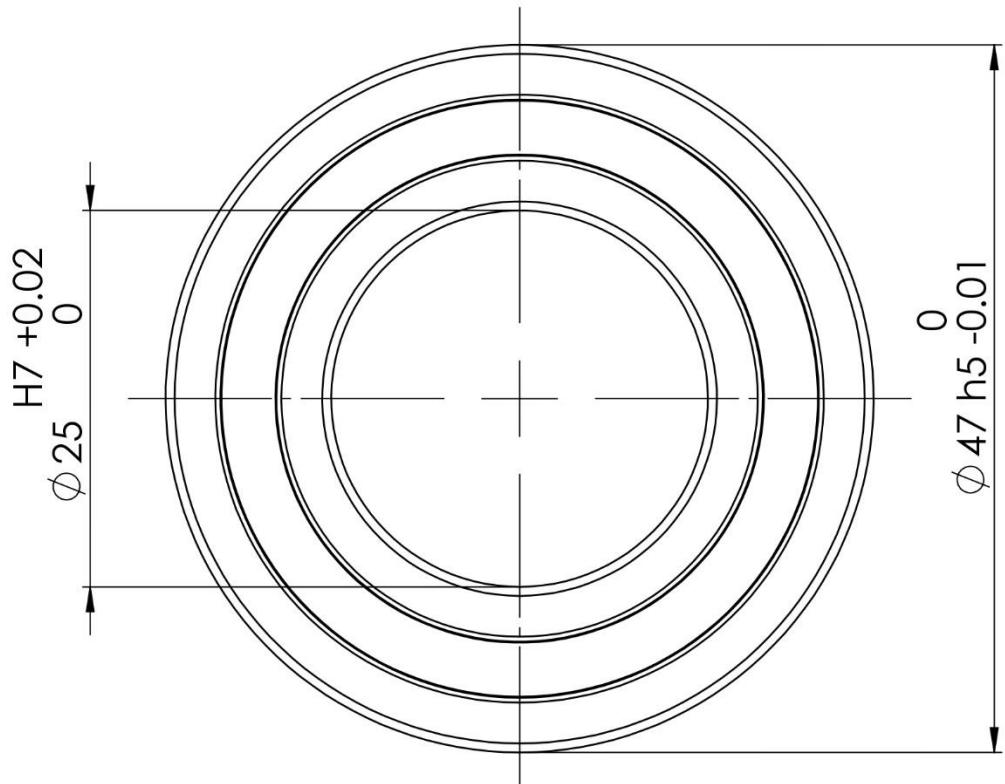
شركة فسفاط قفصة
Compagnie des Phosphates de Gafsa

Annex 4.5

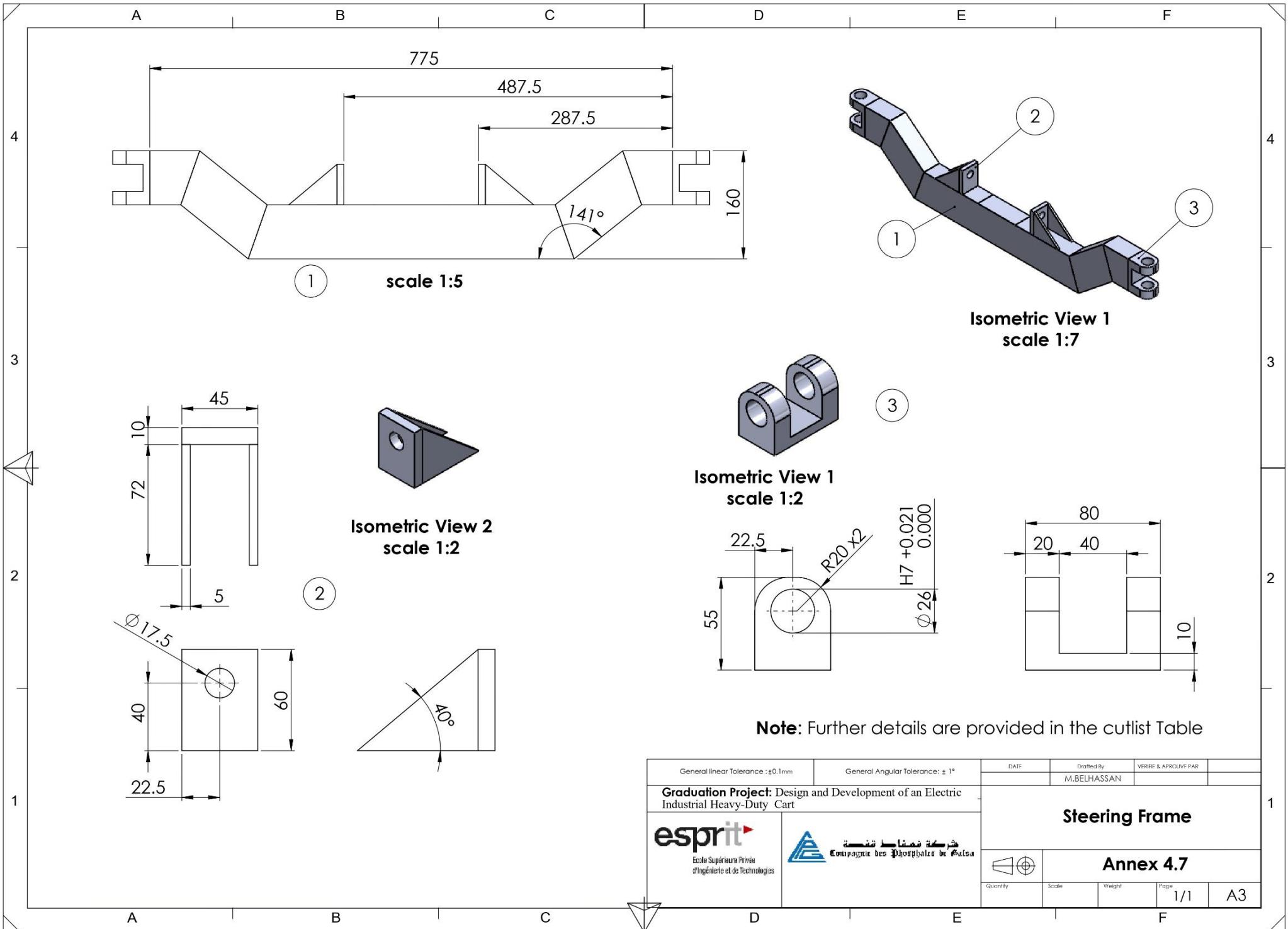
Superficie (mm²):

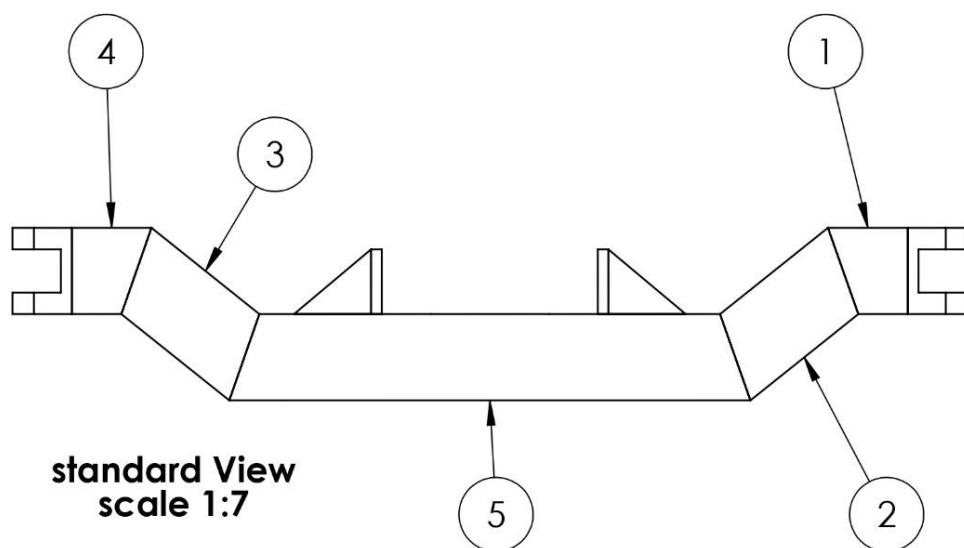
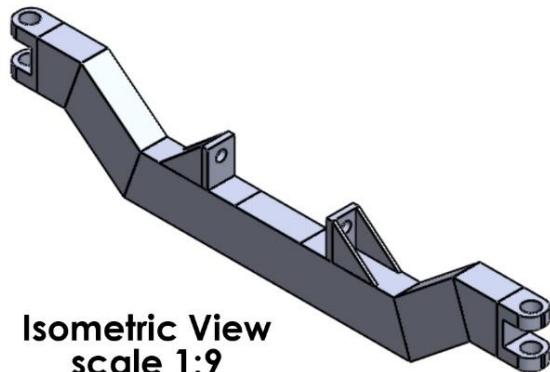


Quantity	Scale	Weight	Page	A4
	1:2.5		1/1	



General Angular Tolerance: $\pm 1^\circ$	General Linear Tolerance: $\pm 0.1\text{mm}$	DATE	Drafted By	Verified and approved
			M.BELHASSAN	
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 Ecole Supérieure Privée d'Ingénierie et de Technologies		 الشركة المغذية للنفط Compagnie des Phosphates de Gafsa	Annex 4.6	
Quantity	Scale	Weight	Page	Superfice (mm^2):
	1:1		1/1	A4





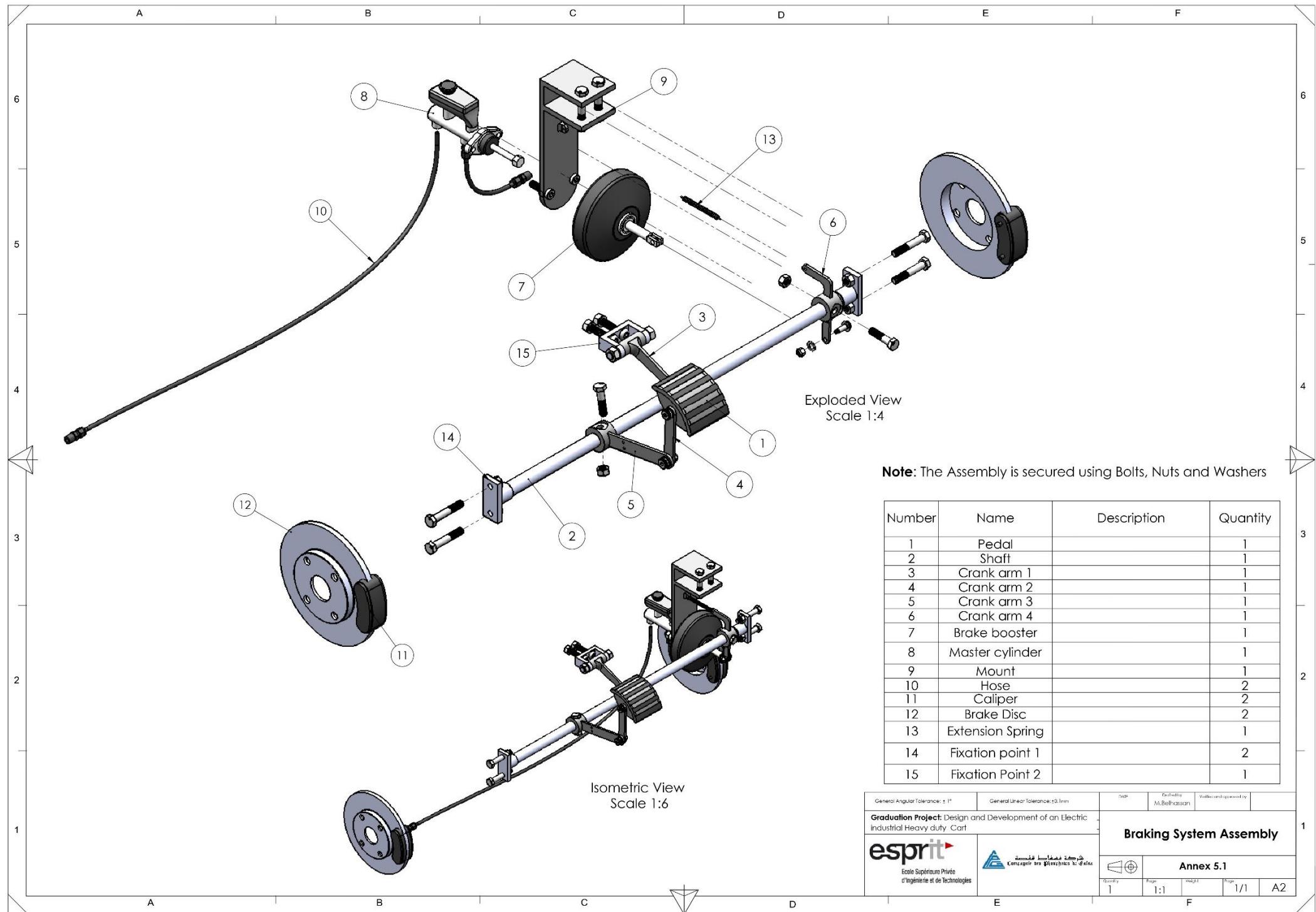
Cut list Table

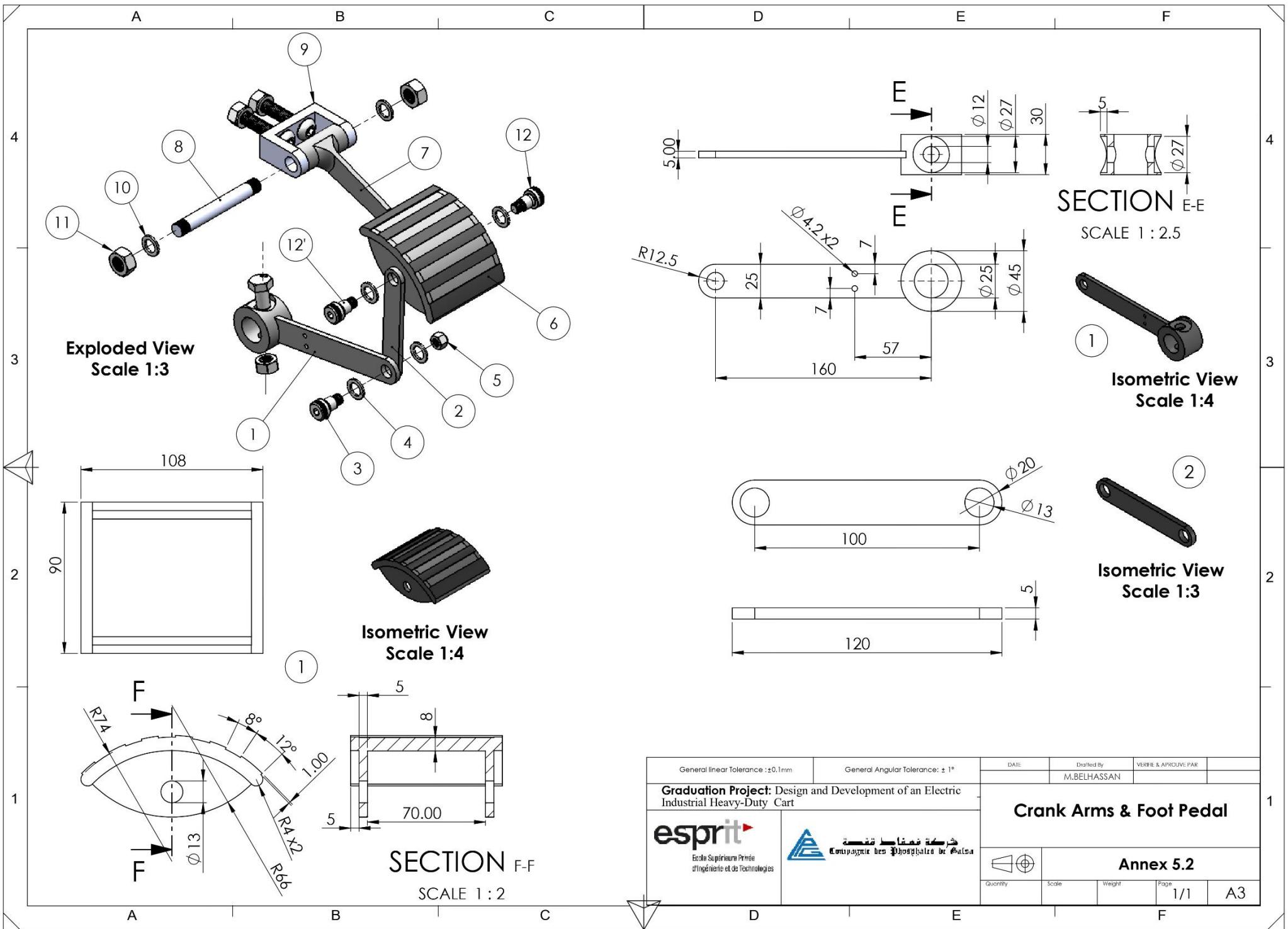
ITEM NO.	QTY.	DESCRIPTION	LENGTH	ANGLE1	ANGLE2	Angle Direction
1	1	UPN80	74.031242	19.33°	0°	-
2	1	UPN80	156.12497	19.33°	19.33°	Same
3	1	UPN80	156.12497	19.33°	19.33°	Same
4	1	UPN80	74.031242	0°	19.33°	-
5	1	UPN80	483.062485	19.33°	19.33°	Same

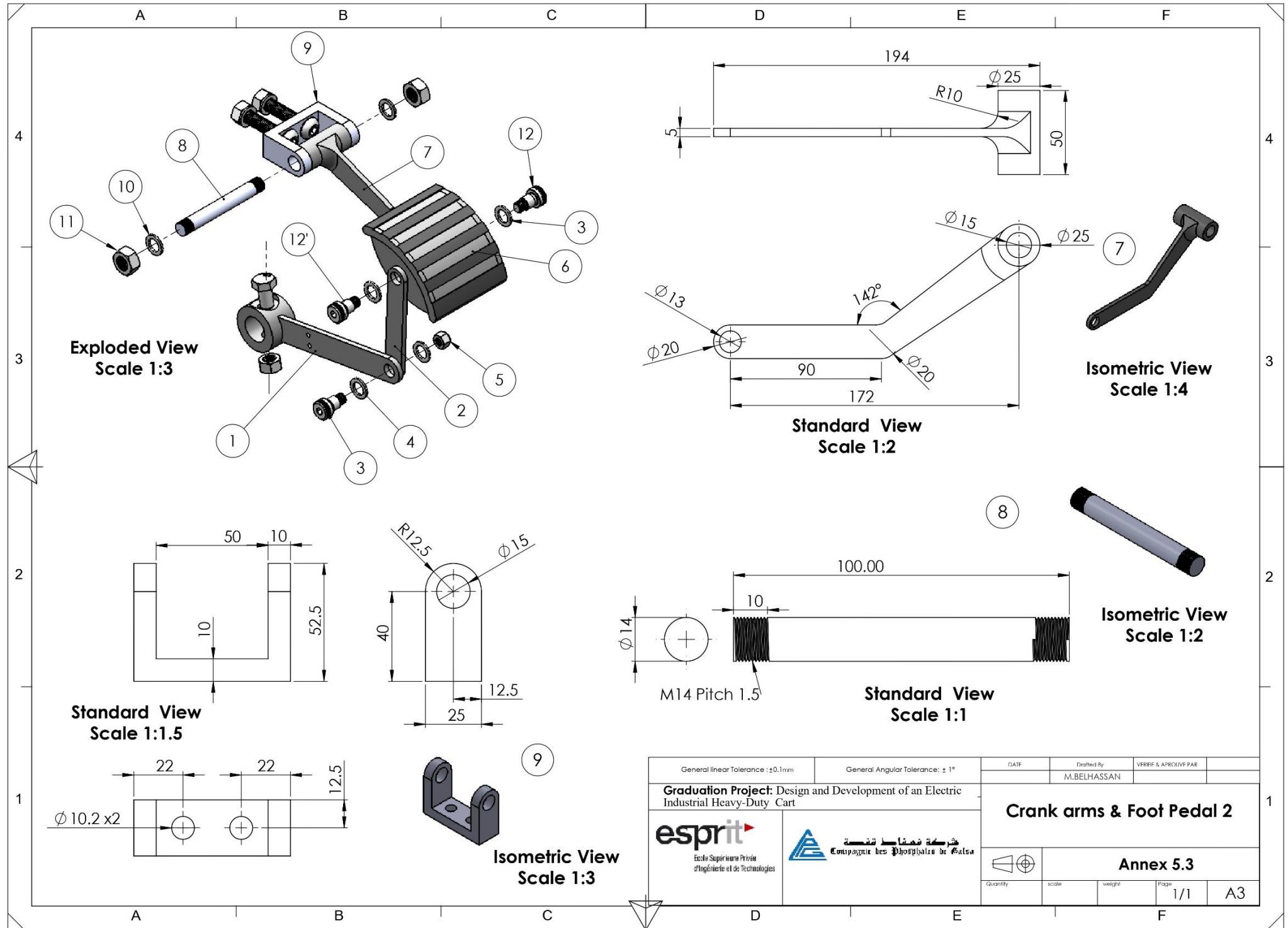
General Angular Tolerance: $\pm 1^\circ$	General Linear Tolerance: $\pm 0.1\text{mm}$	DATE	Drafted By	Verified and approved
			M.BELHASSAN	
Graduation Project: Design and Development of an Electric industrial Heavy-Duty Cart		Steering frame cut list		
 Ecole Supérieure Privée d'Ingénierie et de Technologies		 شركة فسفاط قفصة		
QUANTITE:	ECHELLE:	POIDS:	FEUILLE:	Superficie (mm²):
	1:7		1/1	A4

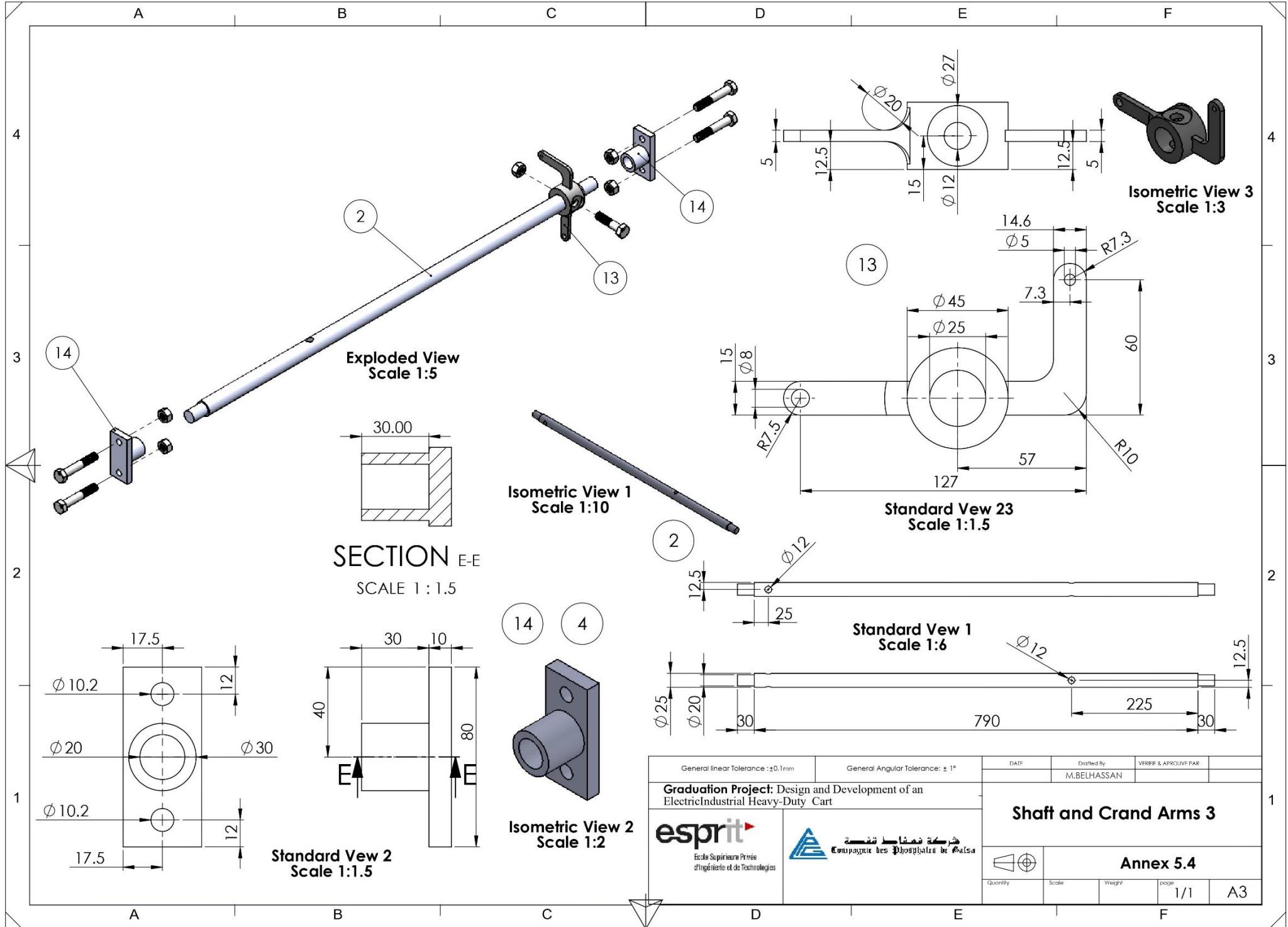
[Annex 5]

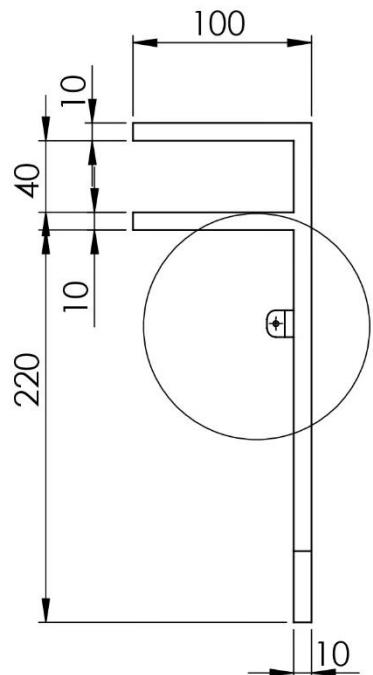
1. Braking System Assembly [Annex 5.1]
2. Braking System Sub-Assembly 1 [Annex 5.2]
3. Crank arms and Foot Pedal [Annex 5.3]
4. Crank arms and Foot Pedal 2 [Annex 5.4]
5. Crank arms and Shaft [Annex 5.5]
6. Master Cylinder Mount [Annex 5.6]



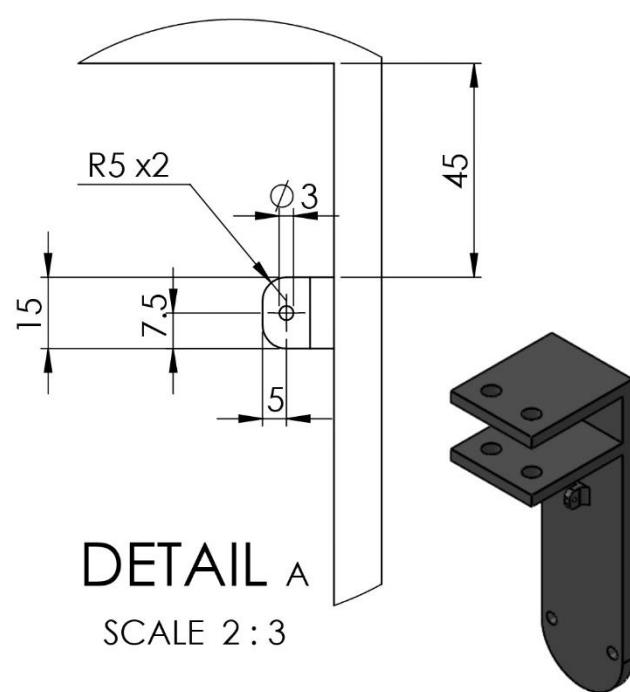
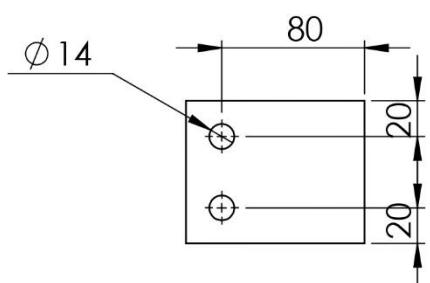
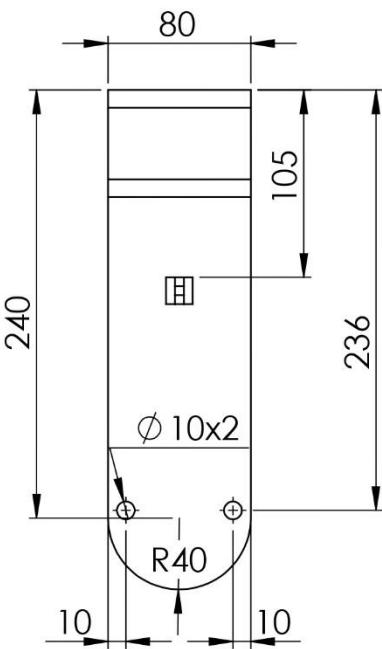








A



DETAIL A

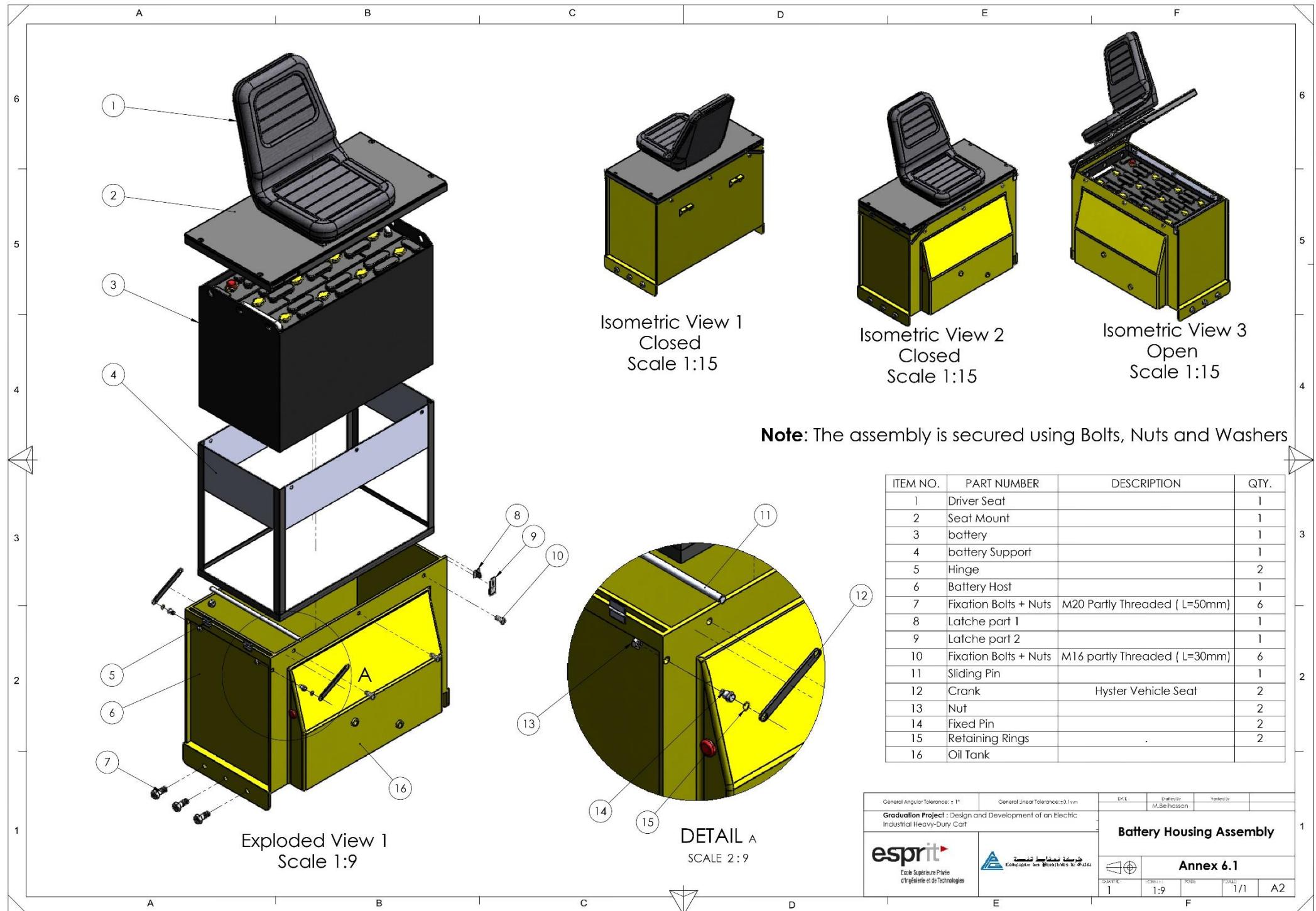
SCALE 2 : 3

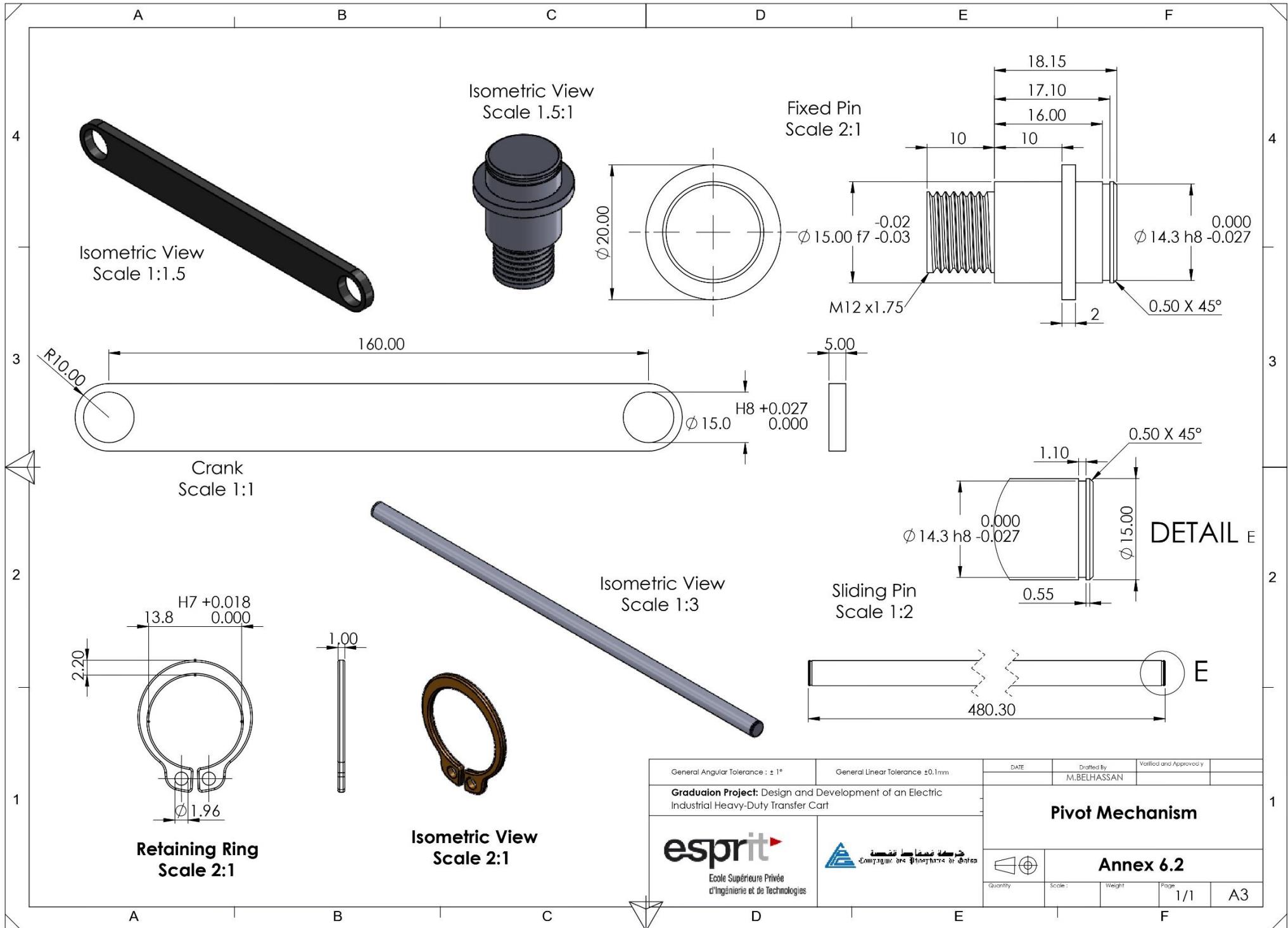
**Isometric View
Scale 1:5**

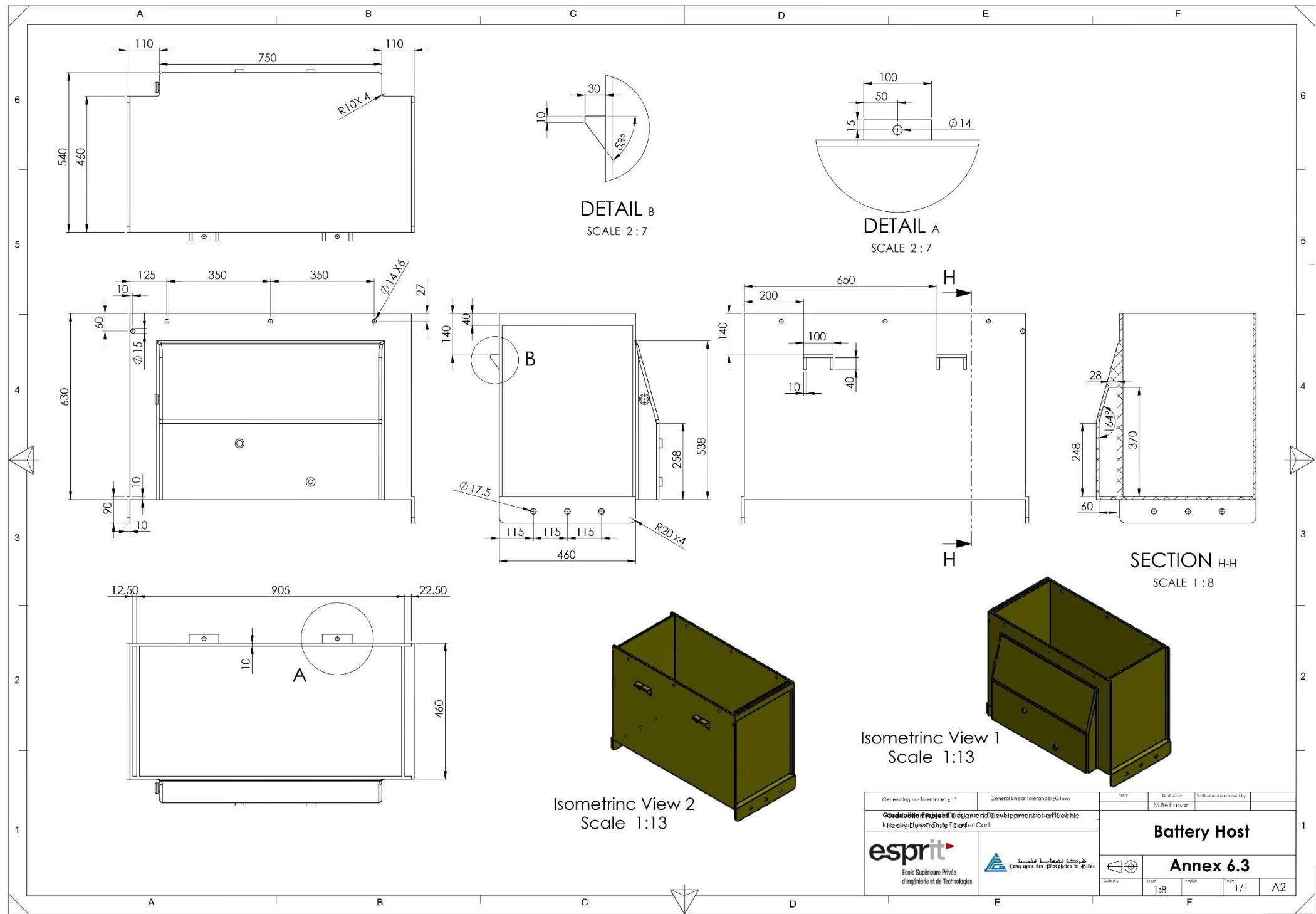
General Angular Tolerance: $\pm 1^\circ$	General Linear Tolerance: $\pm 0.1\text{mm}$	DATE	Drafted By	Verified and approved	
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Graduation Project: Design and Development of an Electric industrial Heavy-Duty Cart		Master cylinder Mount			
esprit Ecole Supérieure Privée d'Ingénierie et de Technologies	 Compagnie des Phosphates de Gafsa		Annex 5.5		Superficie (mm ²):
Quantity	scale	Weight	Page	1/1	A4
	1:3				

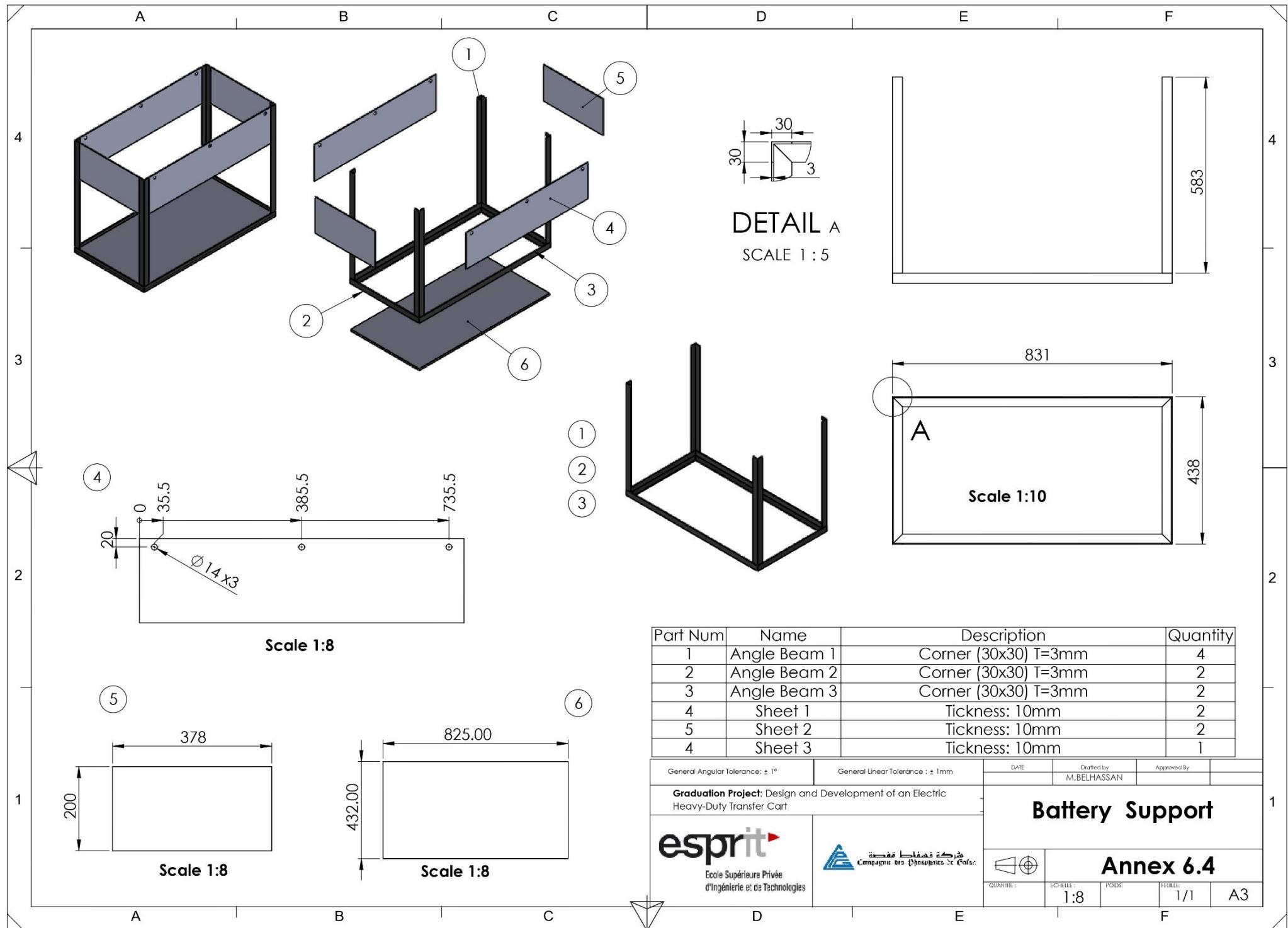
[Annex 6]

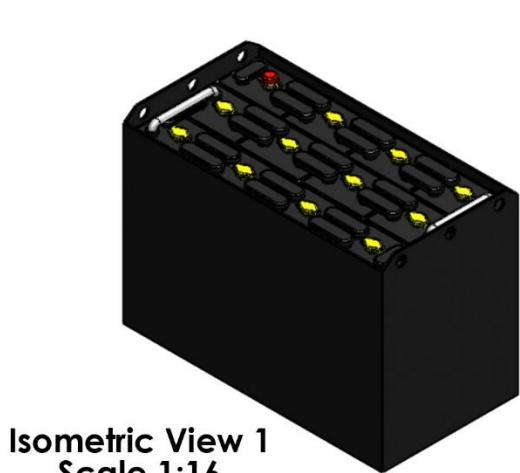
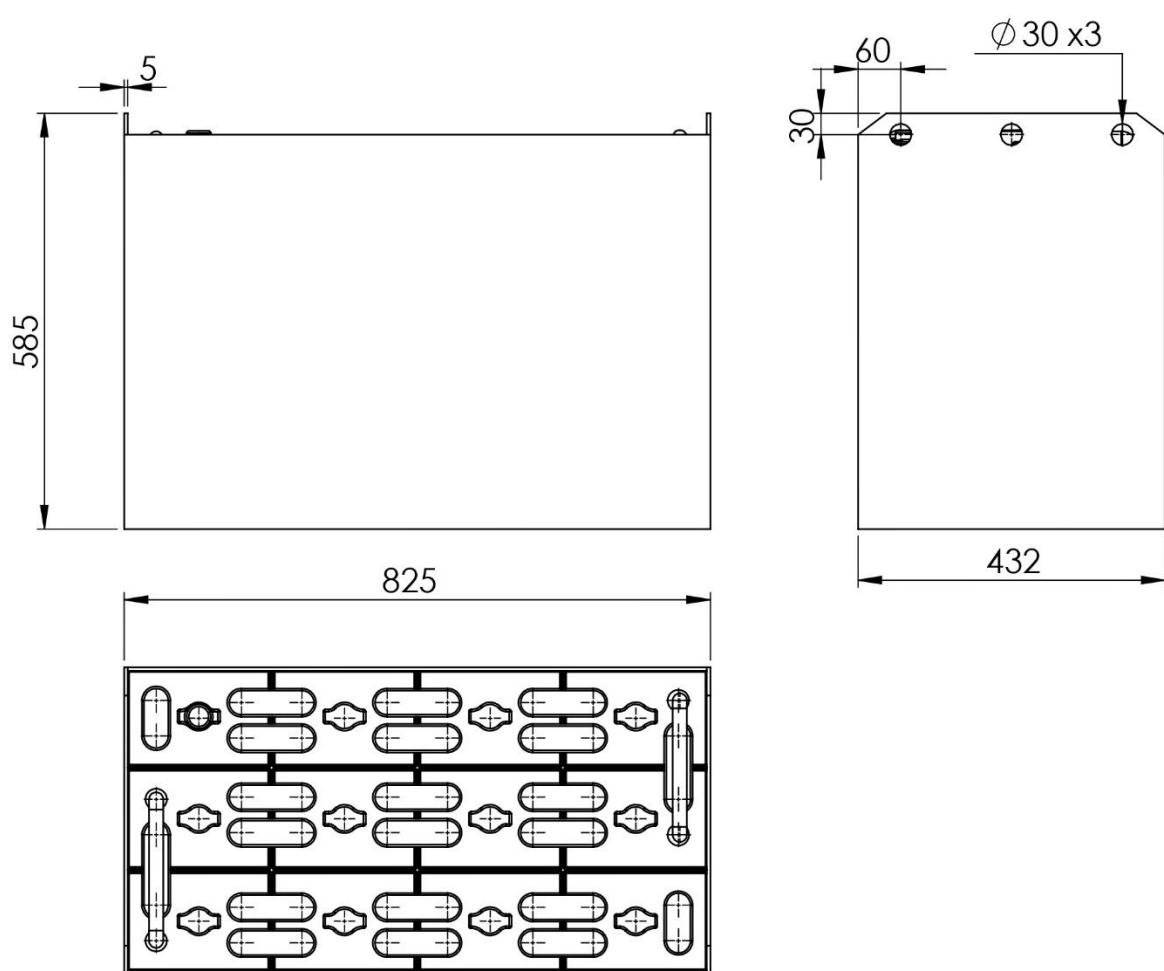
1. Battery Housing Assembly [Annex 6.1]
2. Pivot Mechanism [Annex 6.2]
3. Battery Host [Annex 6.3]
4. Battery Support [Annex 6.4]
5. Battery [Annex 6.5]
6. Seat Mount [Annex 6.6]
7. Seat [Annex 6.7]
8. Latches [Annex 6.8]



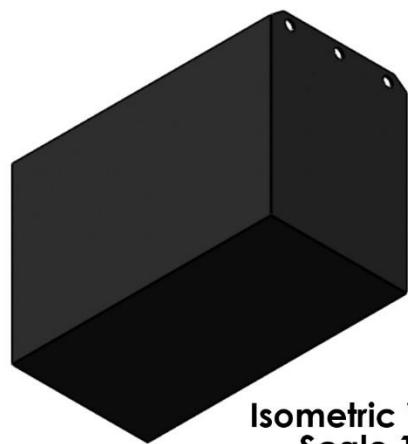








Isometric View 1
Scale 1:16



Isometric View 2
Scale 1:16

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance : ± 0.1 mm

DATE

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Battery

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d'Ingénierie et de Technologies



شركة فسفاط قفصة
Compagnie des Phosphates de Gafsa



Annex 6.5

Superficie (mm²)

Quantity

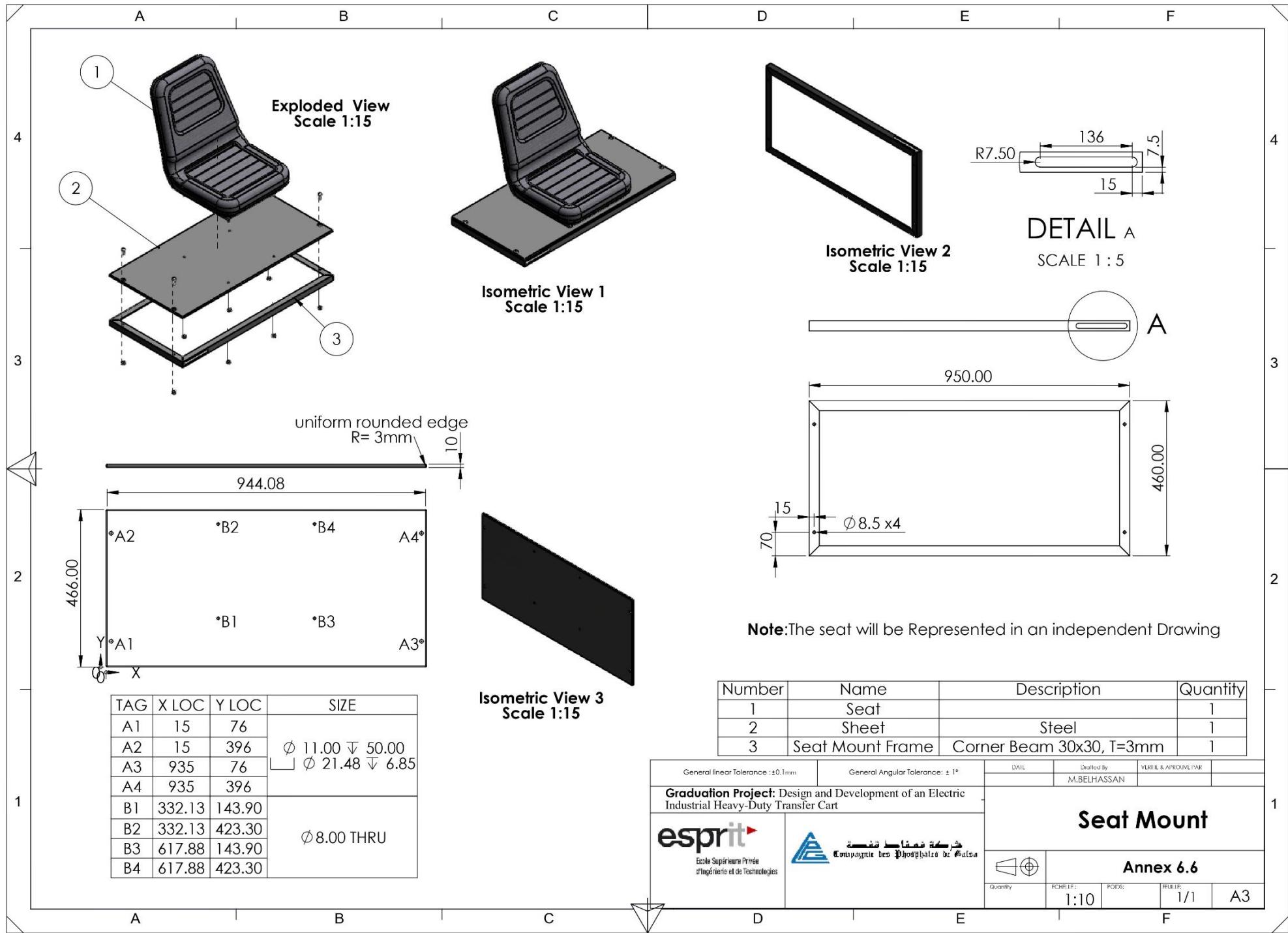
Scale

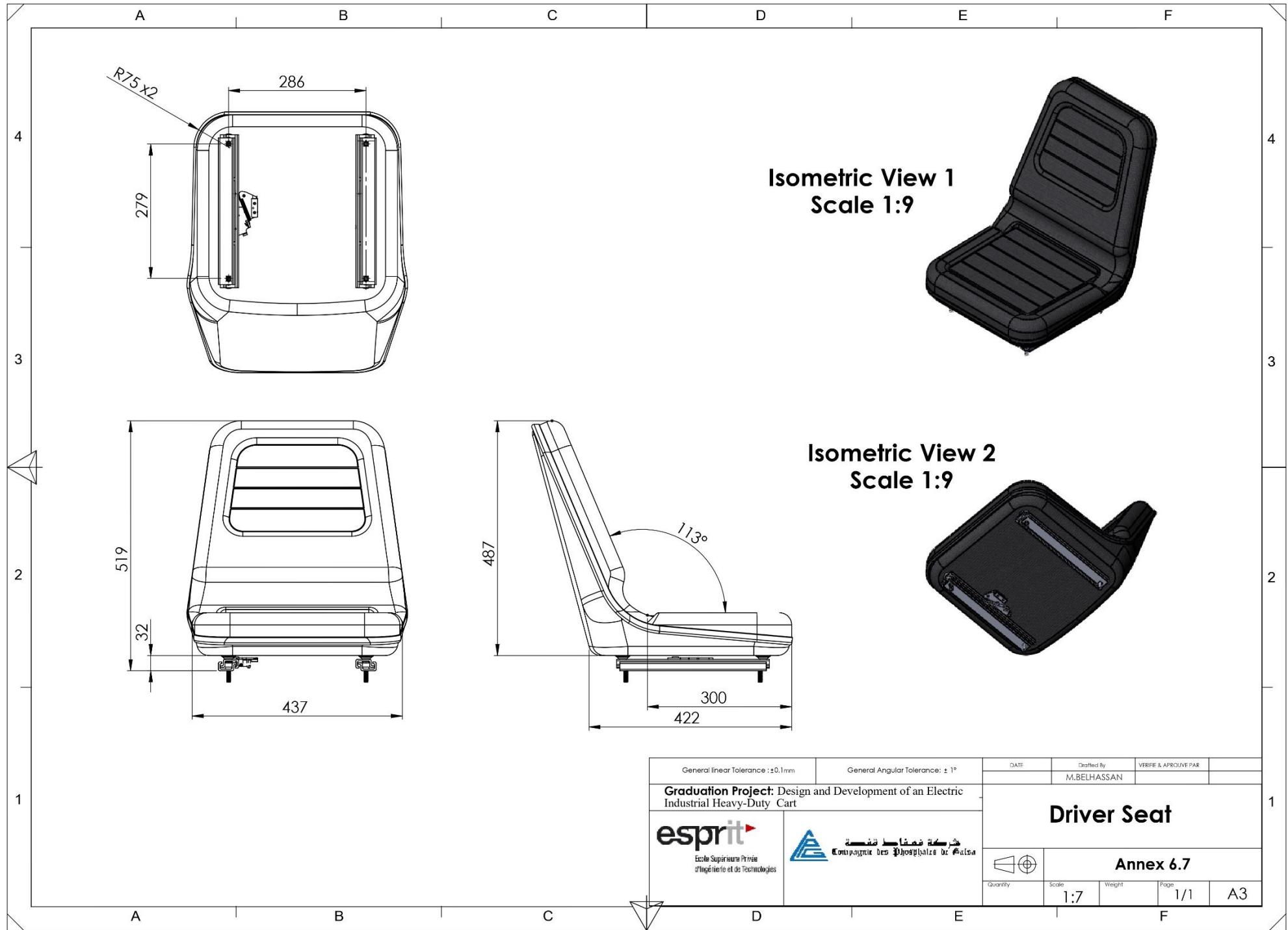
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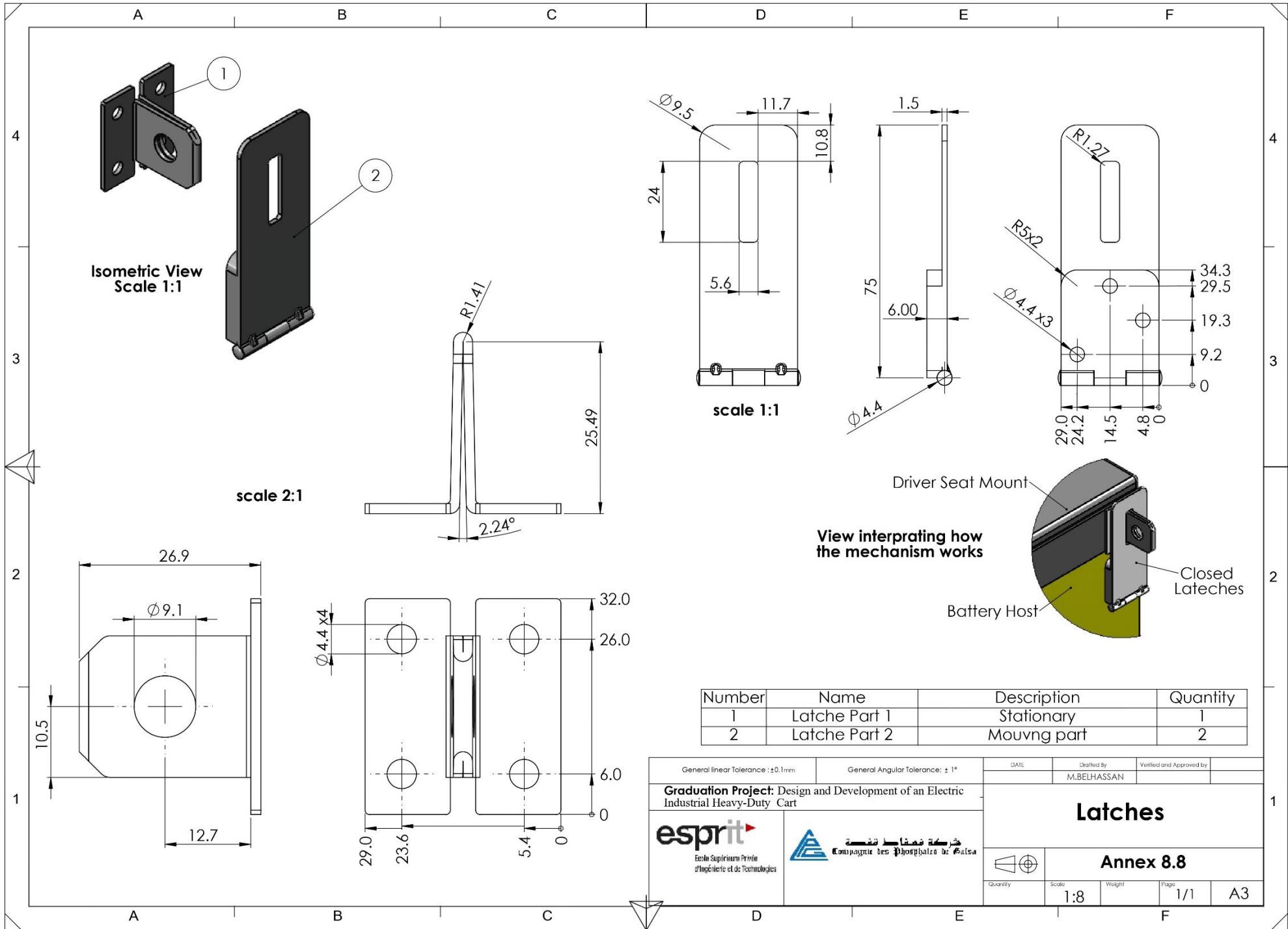
Weight

Page 1/1

A4

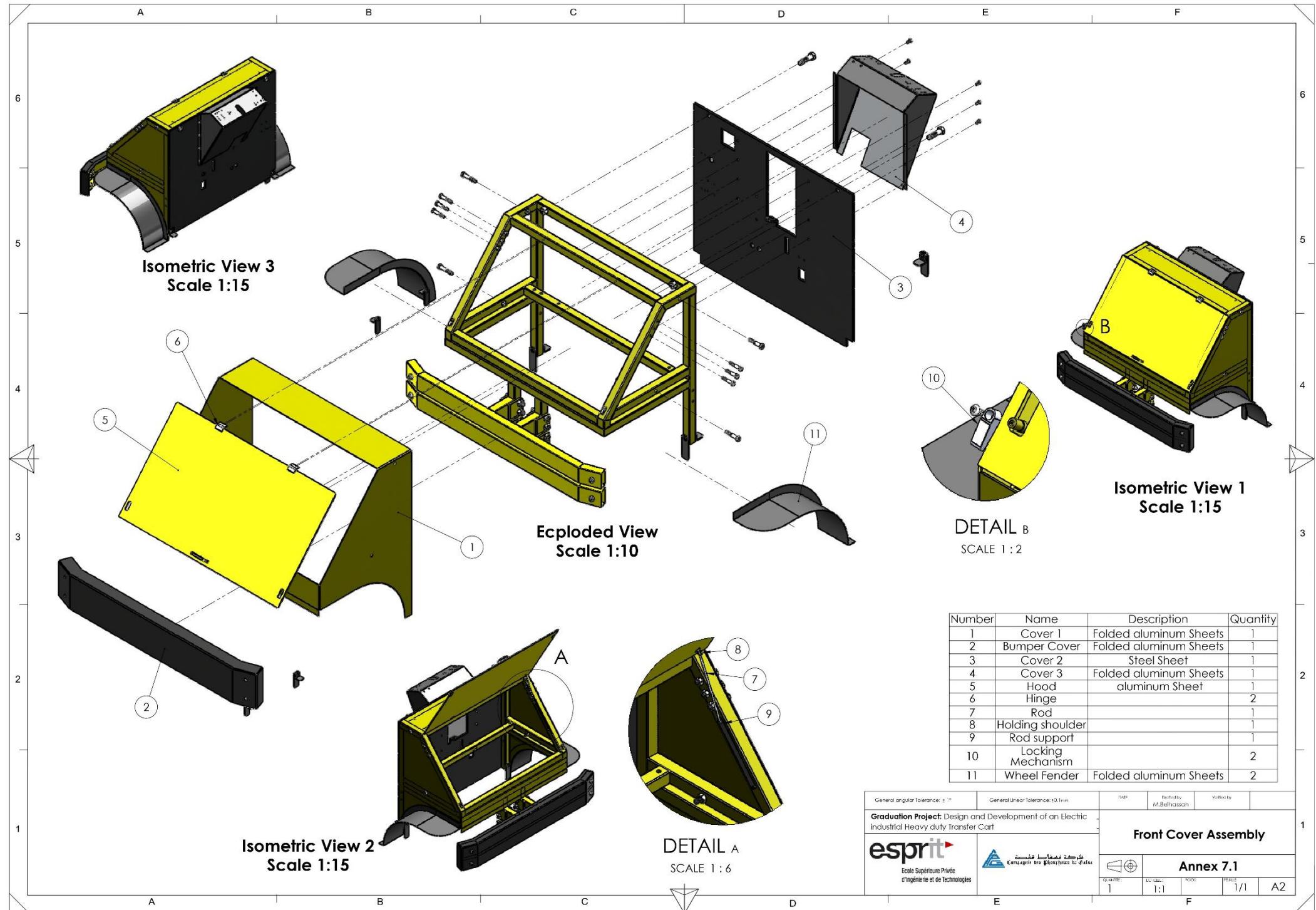


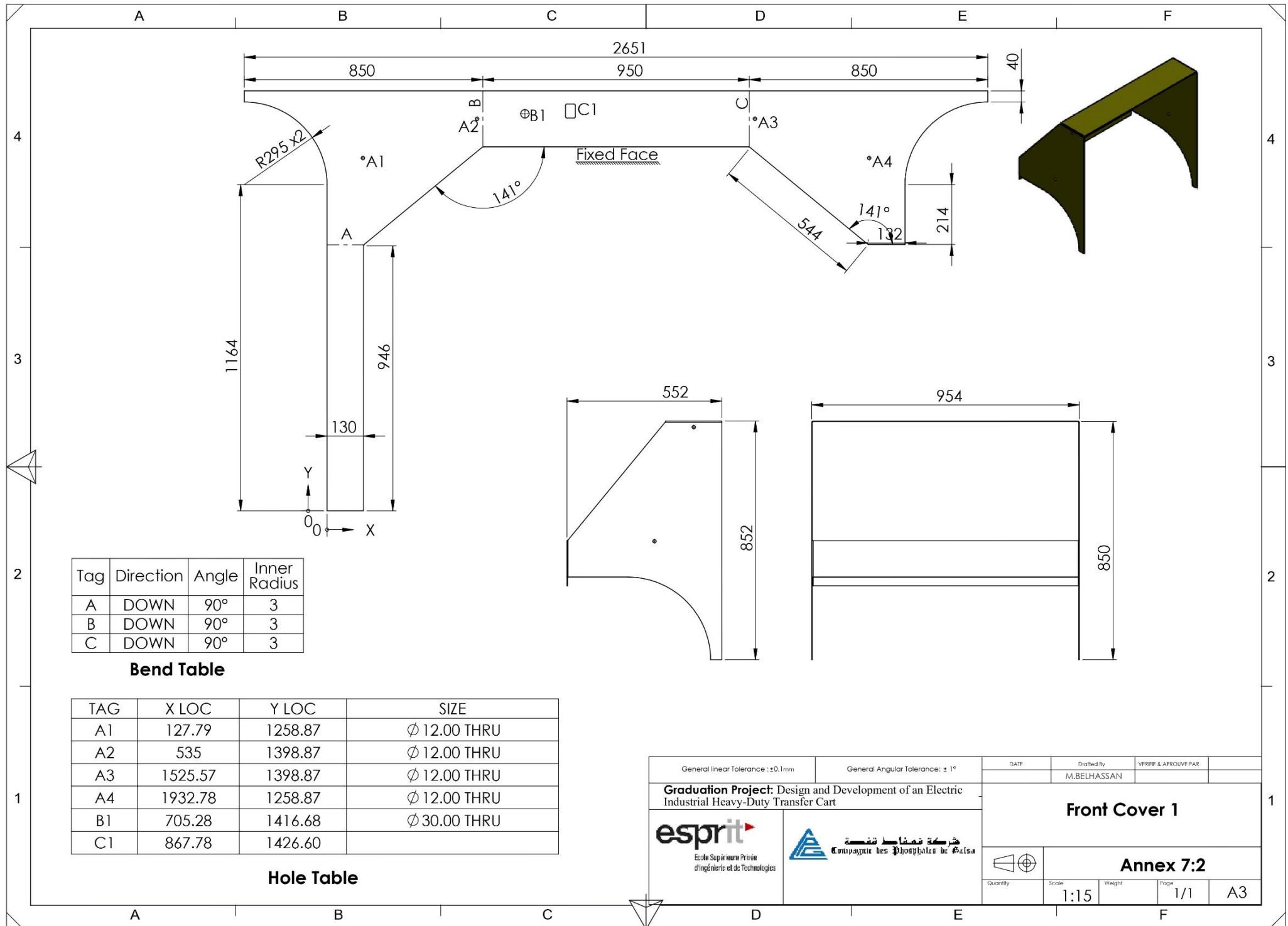


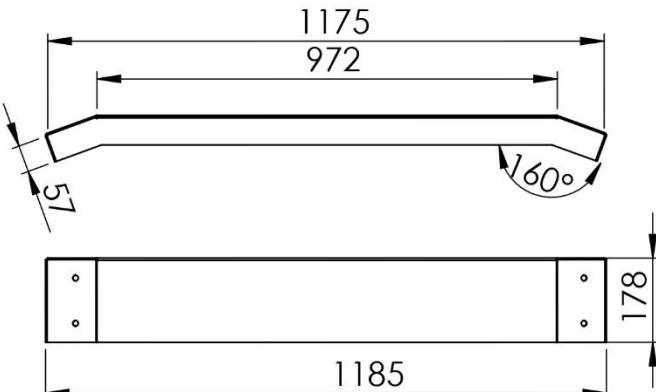


[Annex 7]

1. Front Cover Assembly [Annex 7.1]
2. Front Cover [Annex 7.2]
3. Bumper Cover [Annex 7.3]
4. Front Cover 2 [Annex 7.4]
5. Front Cover 3 [Annex 7.5]
6. Hood [Annex 7.6]
7. Hood Attachments [Annex 7.7]
8. Wheel Fender [Annex 7.8]
9. Rear Cover Assembly [Annex 7.9]
10. Rear Cover [Annex 7.10]
11. Rear Wheel Fender [Annex 7.11]
12. Canopy Cover [Annex 7.12]
13. Foor Pan Assembly [Annex 7.13]
14. Base [Annex 7.14]
15. Foot Platform [Annex 7.15]
16. Lower Cover [Annex 7.16]



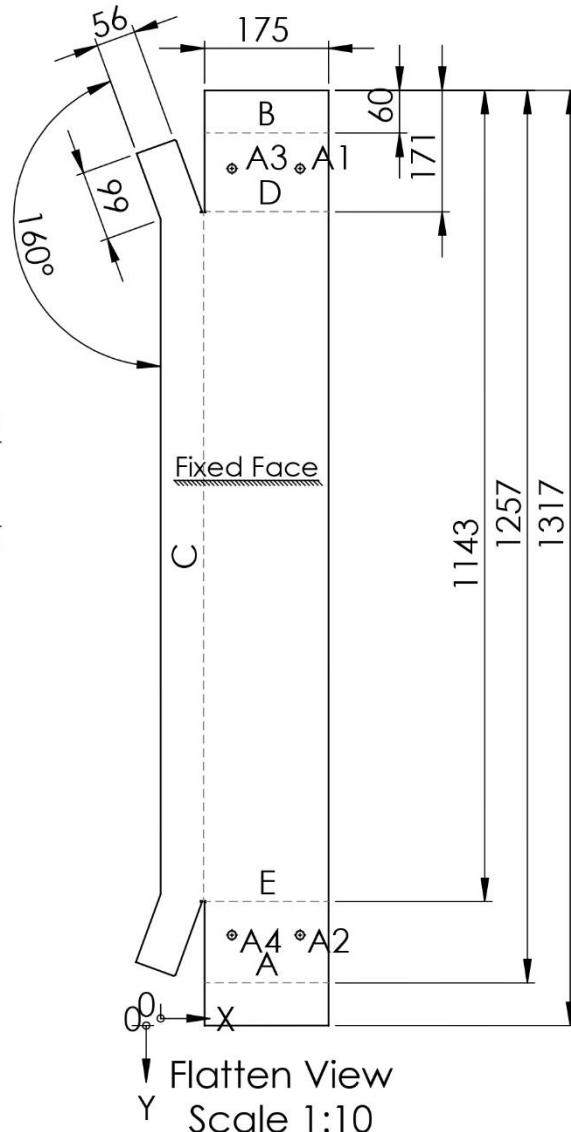




Scale 1:15



Scale 1:15



Tag	Direction	Angle	Inner Radius
A	DOWN	90°	3
B	DOWN	90°	3
C	DOWN	90°	3
D	DOWN	20°	3
E	DOWN	20°	3

Bend Table

TAG	X LOC	Y LOC	SIZE
A1	196.12	-1206.77	$\emptyset 12$ THRU
A2	196.12	-127.46	
A3	100.28	-1206.77	
A4	100.28	-127.46	

Hole Table

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance: $\pm 0.1\text{mm}$

DATE	Drafted By	Verified and approved
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Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart

Bumper Cover

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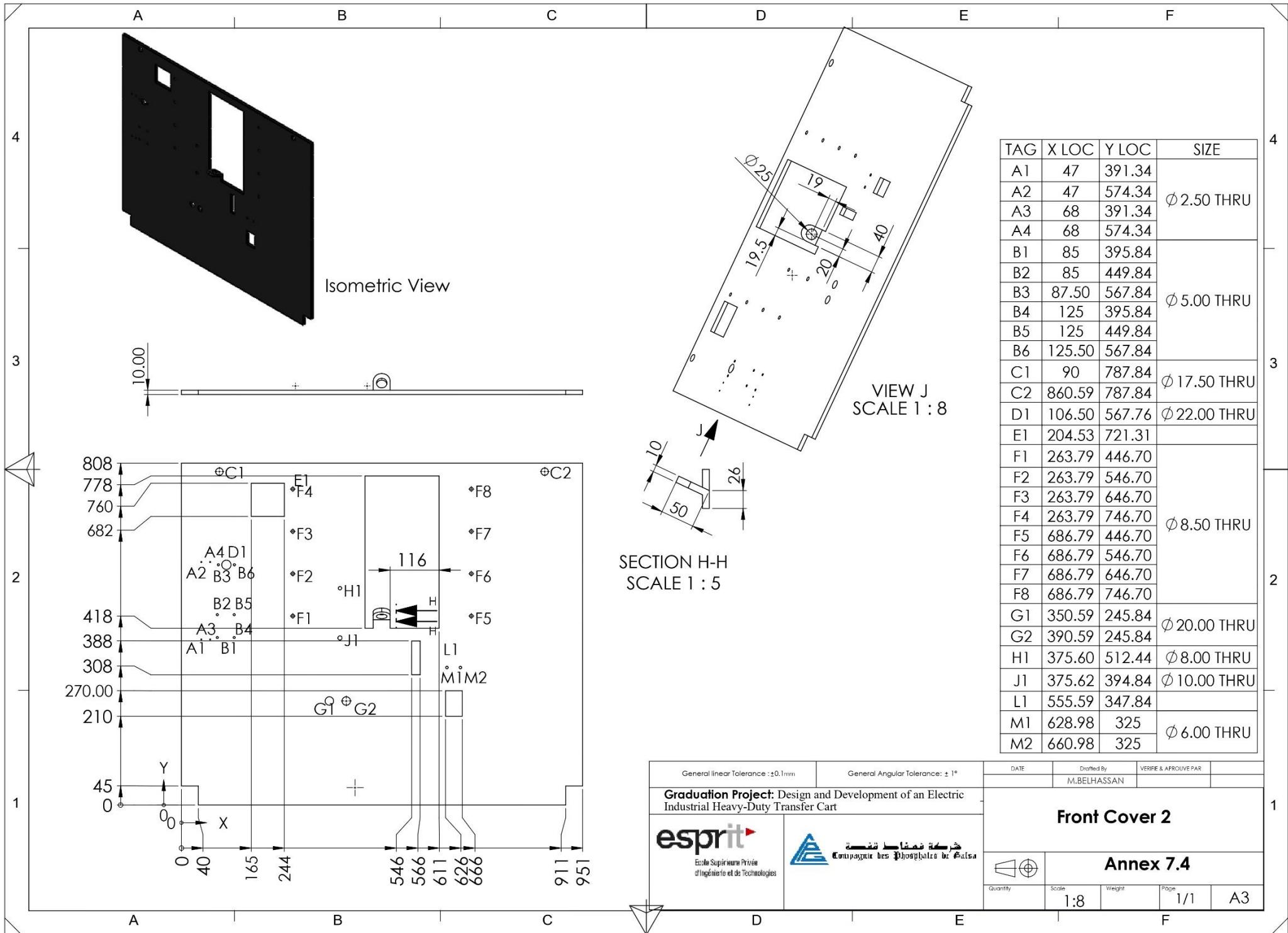
الشركة الوطنية للفوسفات

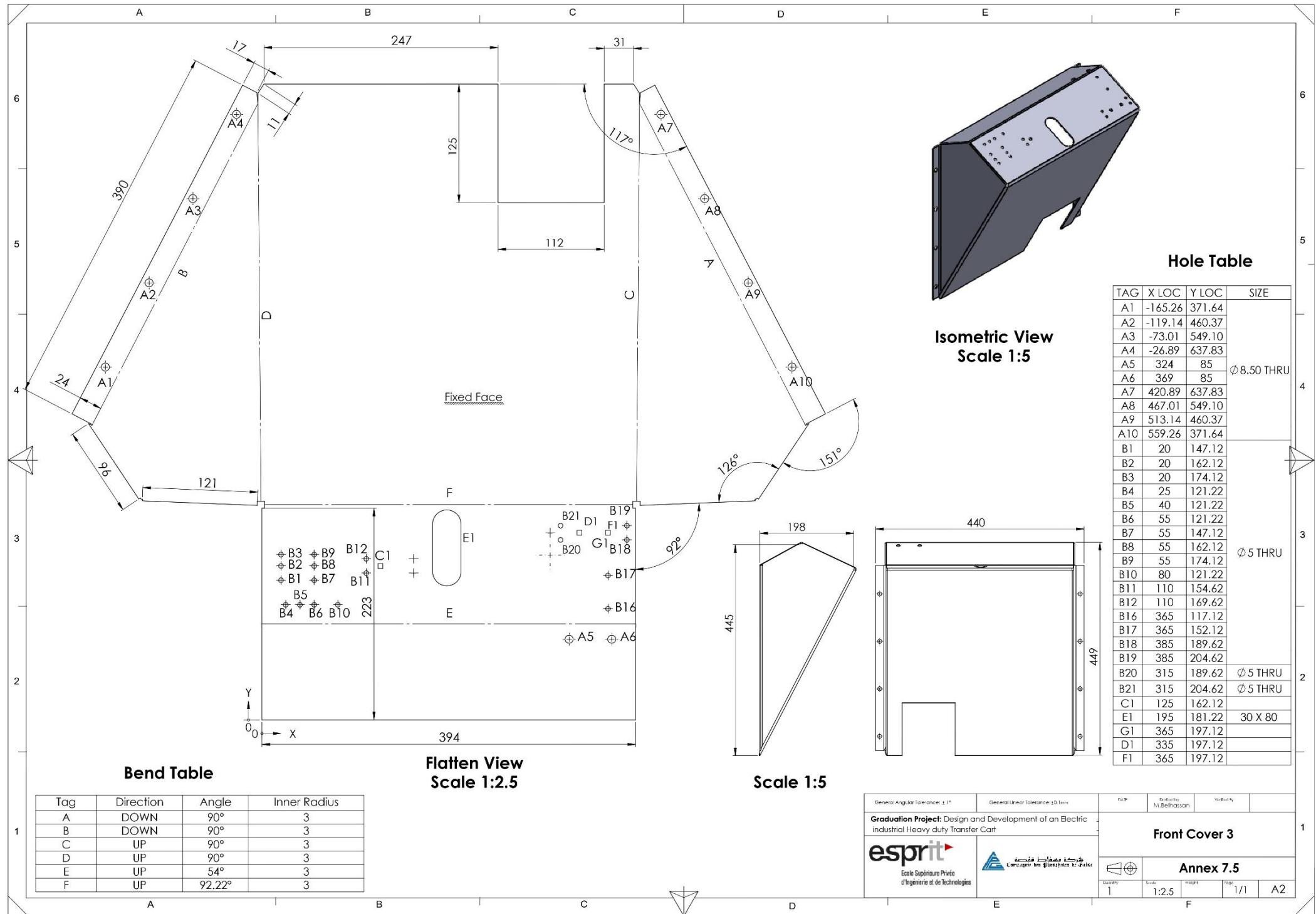


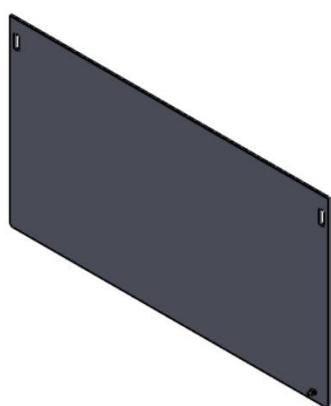
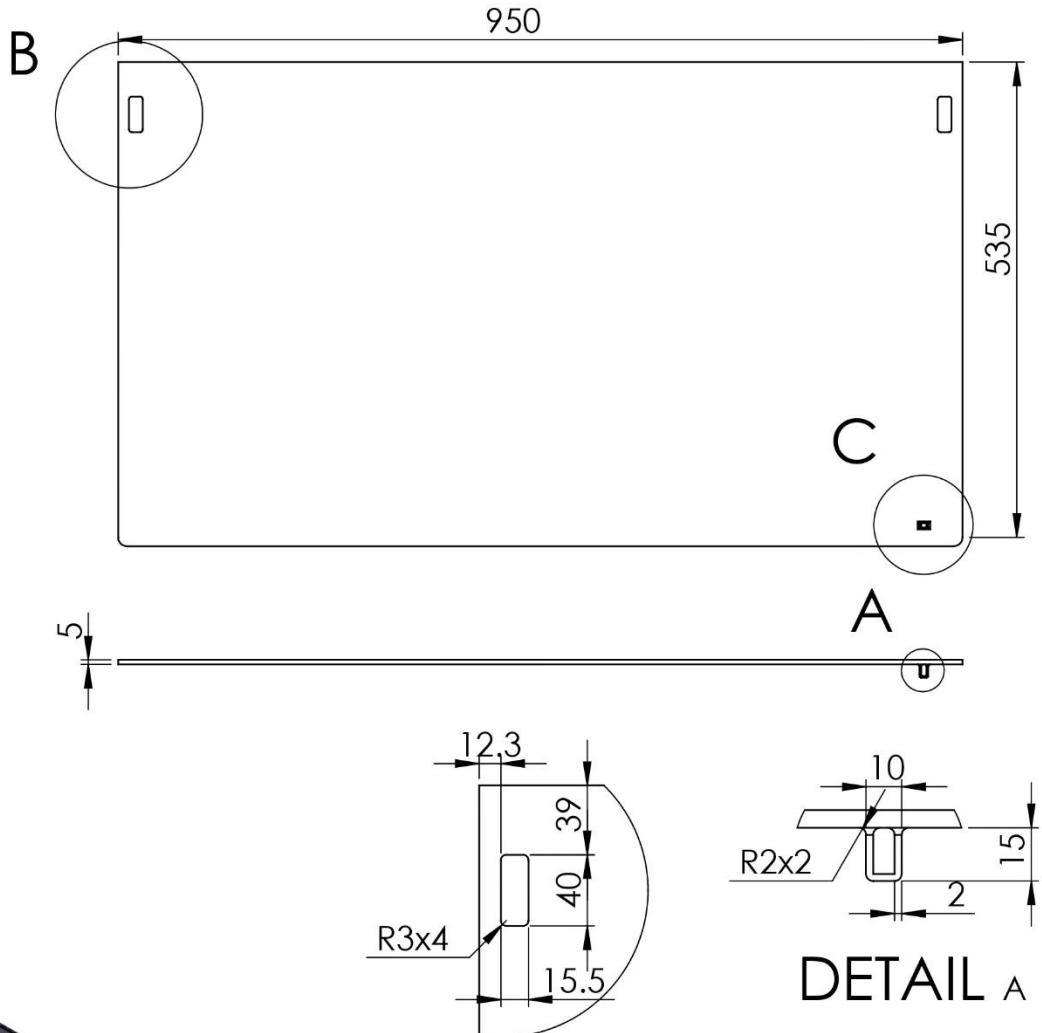
Annex 7.3

Superficie (mm^2) :

Quantity	Scale	Weight	Page	1/1	A4
	1:10				

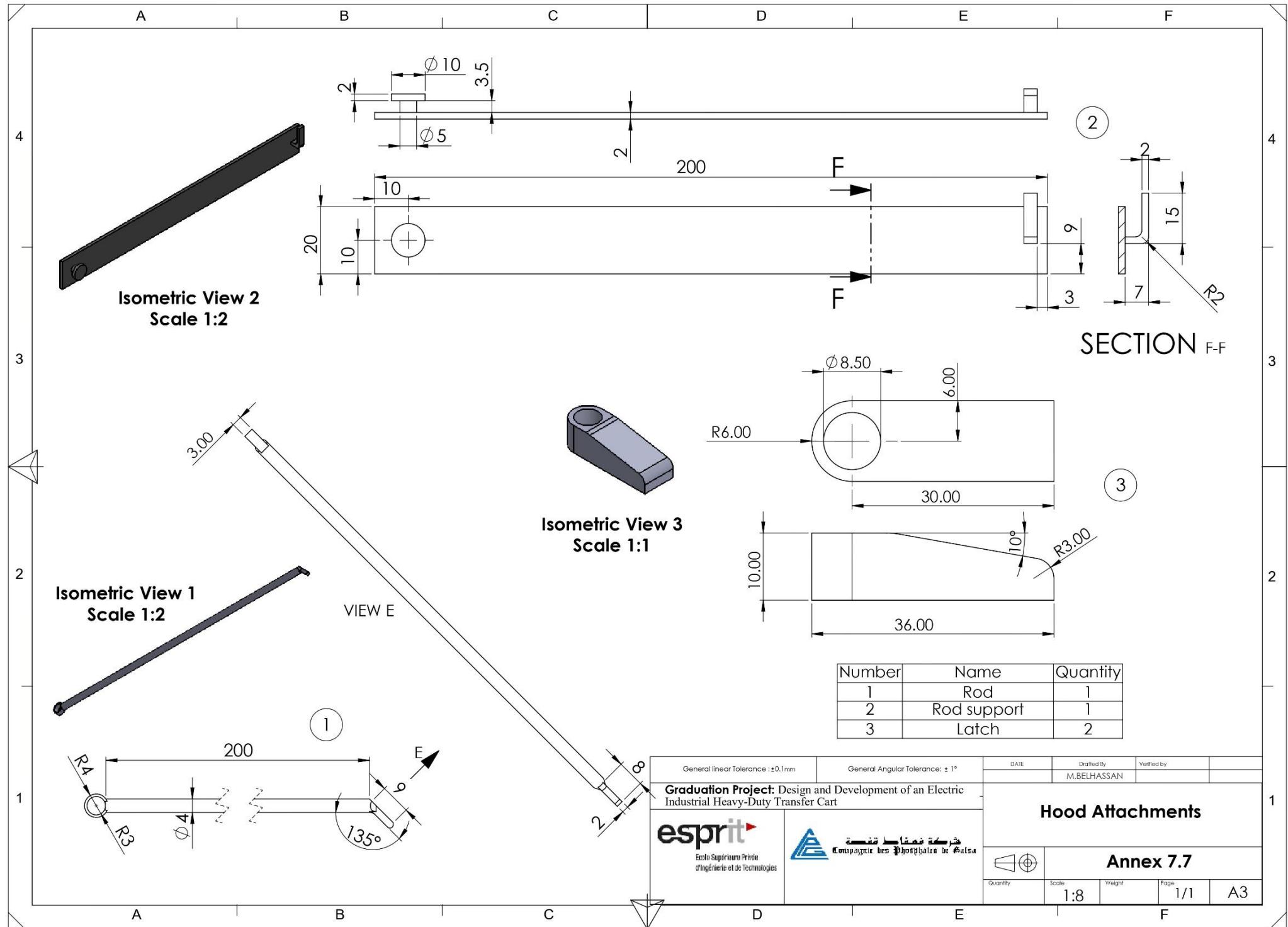


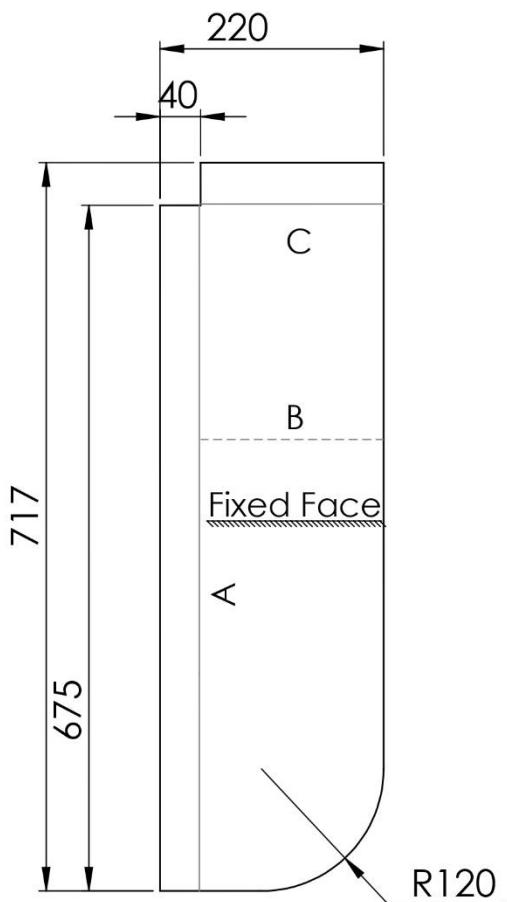




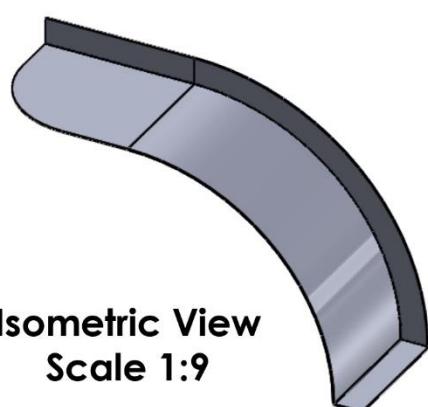
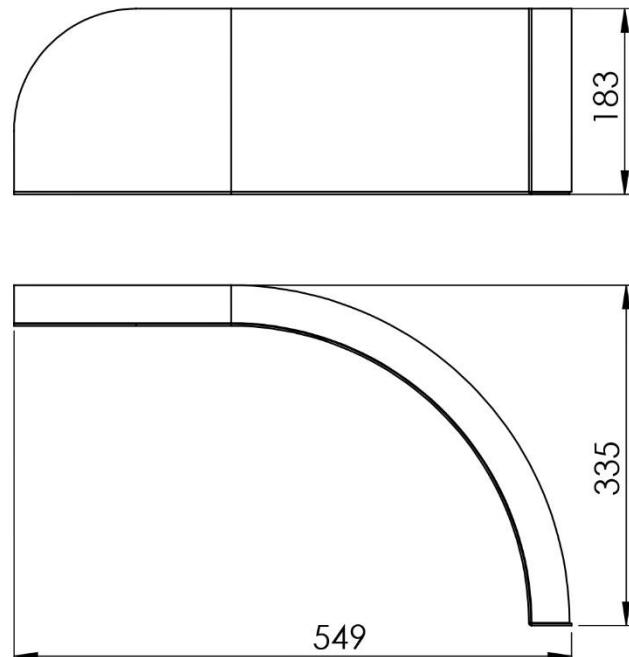
Isometric View
Scale 1:15

General angular Tolerance: $\pm 1^\circ$	General Linear Tolerance : $\pm 0.1\text{mm}$	DATE	Drafted By	Verified and approved
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 Ecole Supérieure Privée d'Ingénierie et de Technologies		 Compagnie des Phosphates de Gafsa		
Quantity	Scale	Weight:	Page	Superficie (mm²) :
1:8			1/1	A4





Flatten View



Bend Table

Tag	Direction	Angle	Inner Radius
A	UP	90°	0.74
B	DOWN	89.86°	293
C	UP	89.86°	0.74

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance : $\pm 0.1\text{mm}$

DATE Drafted By Verified and approved

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Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart

Wheel Fender



Annex 7.8

Quantity :	Scale	Weight	Page	Superficie (mm²) :
	1:7		1/1	A4

A

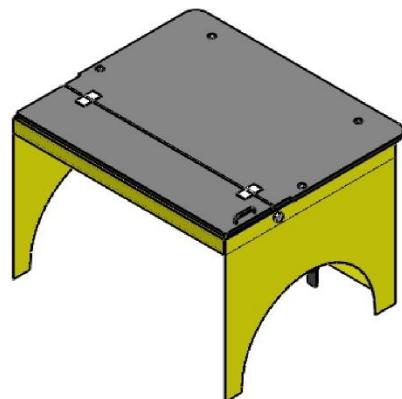
B

C

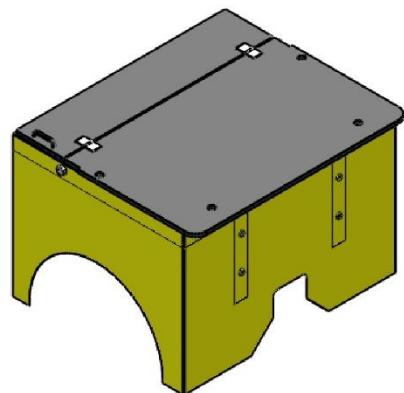
D

E

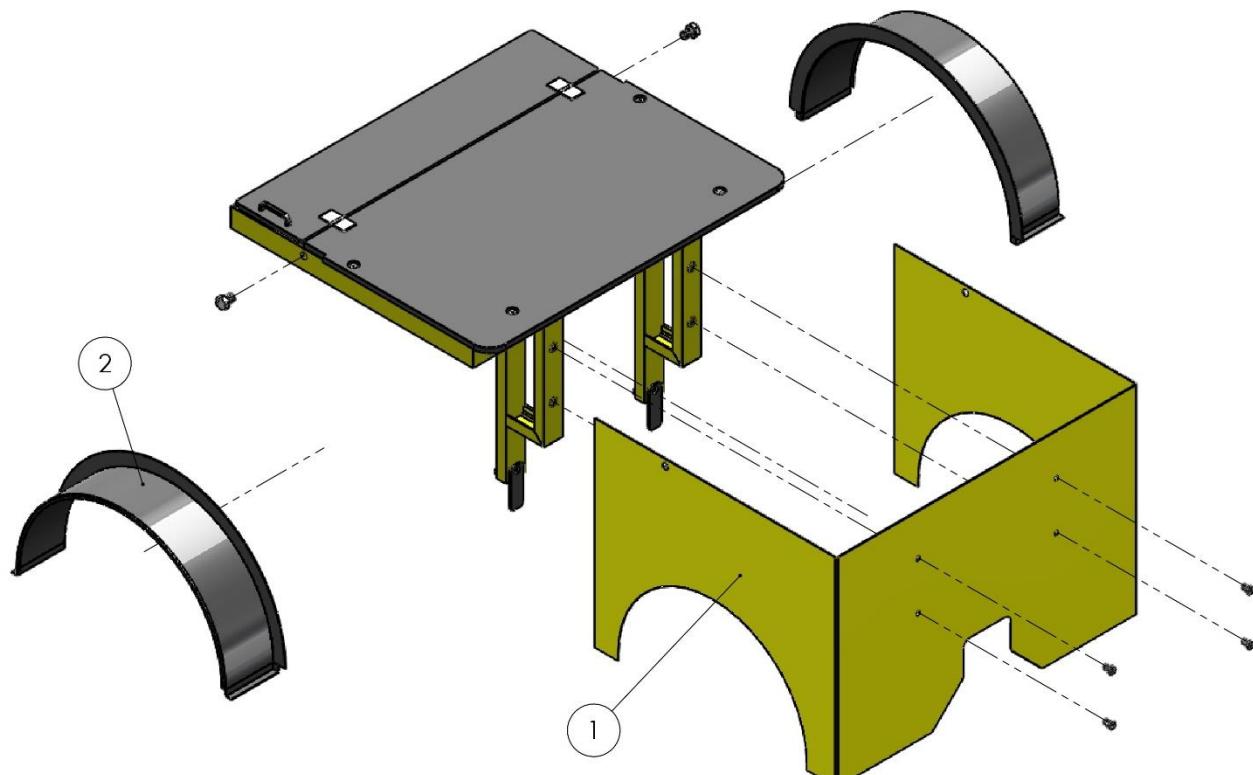
F



Isometric View 1
Scale 1:17



Isometric View 2
Scale 1:17



Exploded View
Scale 1:12

Number	Name	Description	Quantity
1	Rear Cover	Folded Aluminum sheets	1
2	Rear wheel fenders	Folded Aluminum sheets	2

General linear Tolerance : $\pm 0.1\text{mm}$ General Angular Tolerance: $\pm 1^\circ$

DATE _____ Drafted By _____

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Compagnie des Phosphates de Gafsa

Rear protective Cover Assembly

Annex 7.9

Quantity	Scale	Weight	Page	A3
1:12			1/1	

A

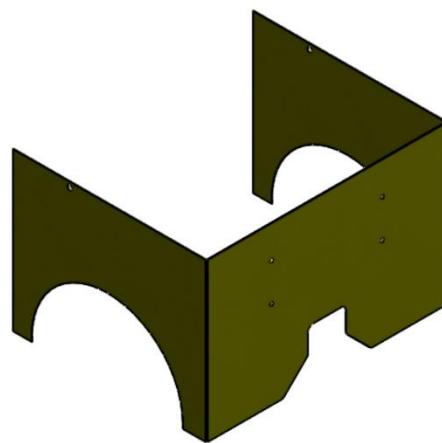
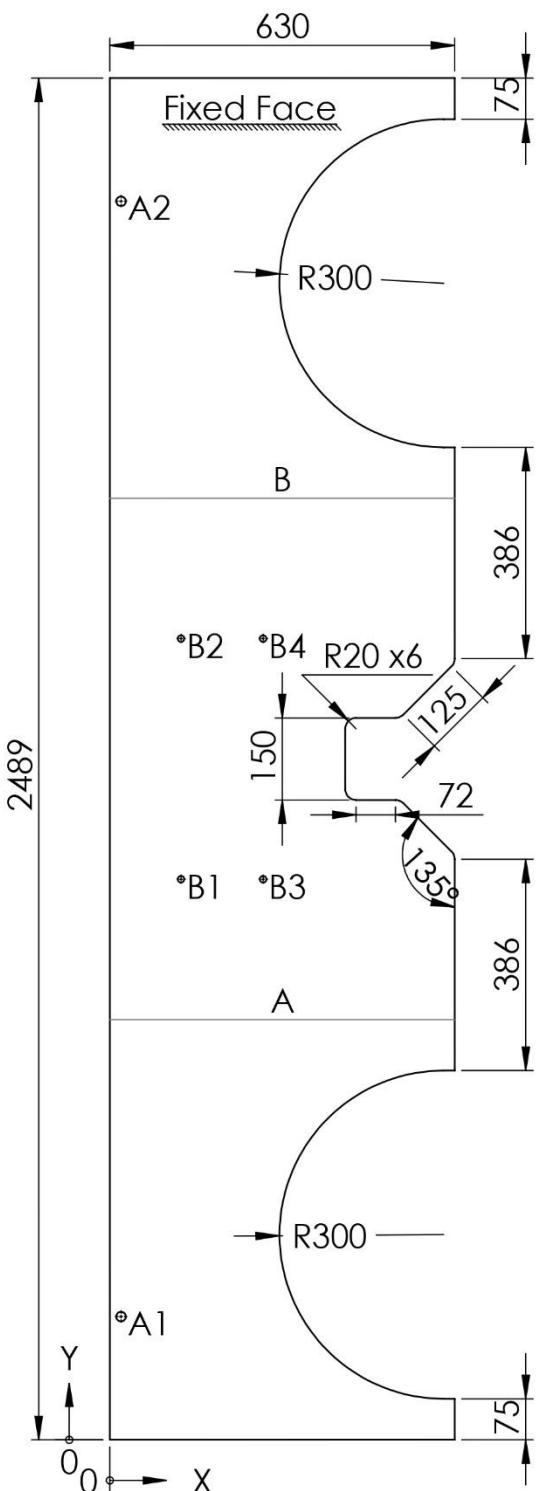
B

C

D

E

F



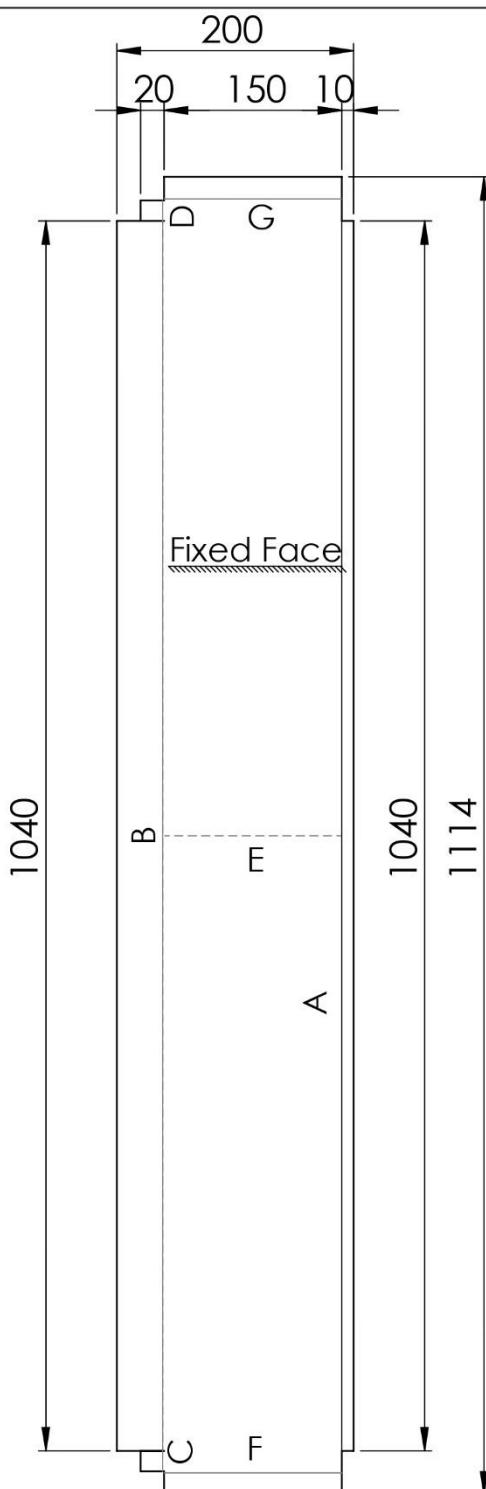
Hole Table

Tag	X LOC	Y LOC	SIZE
A1	20.40	225.21	$\emptyset 17.50$ THRU
A2	20.40	2264.22	
B1	130	1024.71	
B2	130	1464.71	
B3	280	1024.71	$\emptyset 12$ THRU
B4	280	1464.71	

Bend Table

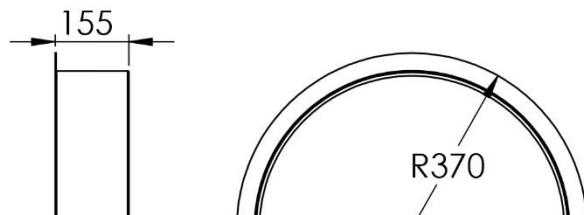
Tag	Direction	Angle	Inner Radius
A	UP	90°	2
B	UP	90°	2

Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart	DATE	Drafted By	Verified and approved
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Rear Cover			
Annex 7.10			Superficie (mm ²):
esprit Ecole Supérieure Privée d'Ingénierie et de Technologies	QUANTITE:	ECHELLE: 1:13	POIDS: 1/1
	FEUILLE: A4		



Flatten View
Scale 1:6

Isometric View
Scale 1:10



Standard View
Scale 1:15

Bend Table

Tag	Direction	Angle	Inner Radius
A	DOWN	90°	0.74
B	UP	90°	0.74
C	UP	90°	0.74
D	UP	90°	0.74
E	DOWN	180°	330
F	UP	90°	0.74
G	UP	90°	0.74

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance: $\pm 0.1\text{mm}$

DATE

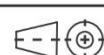
Drafted By

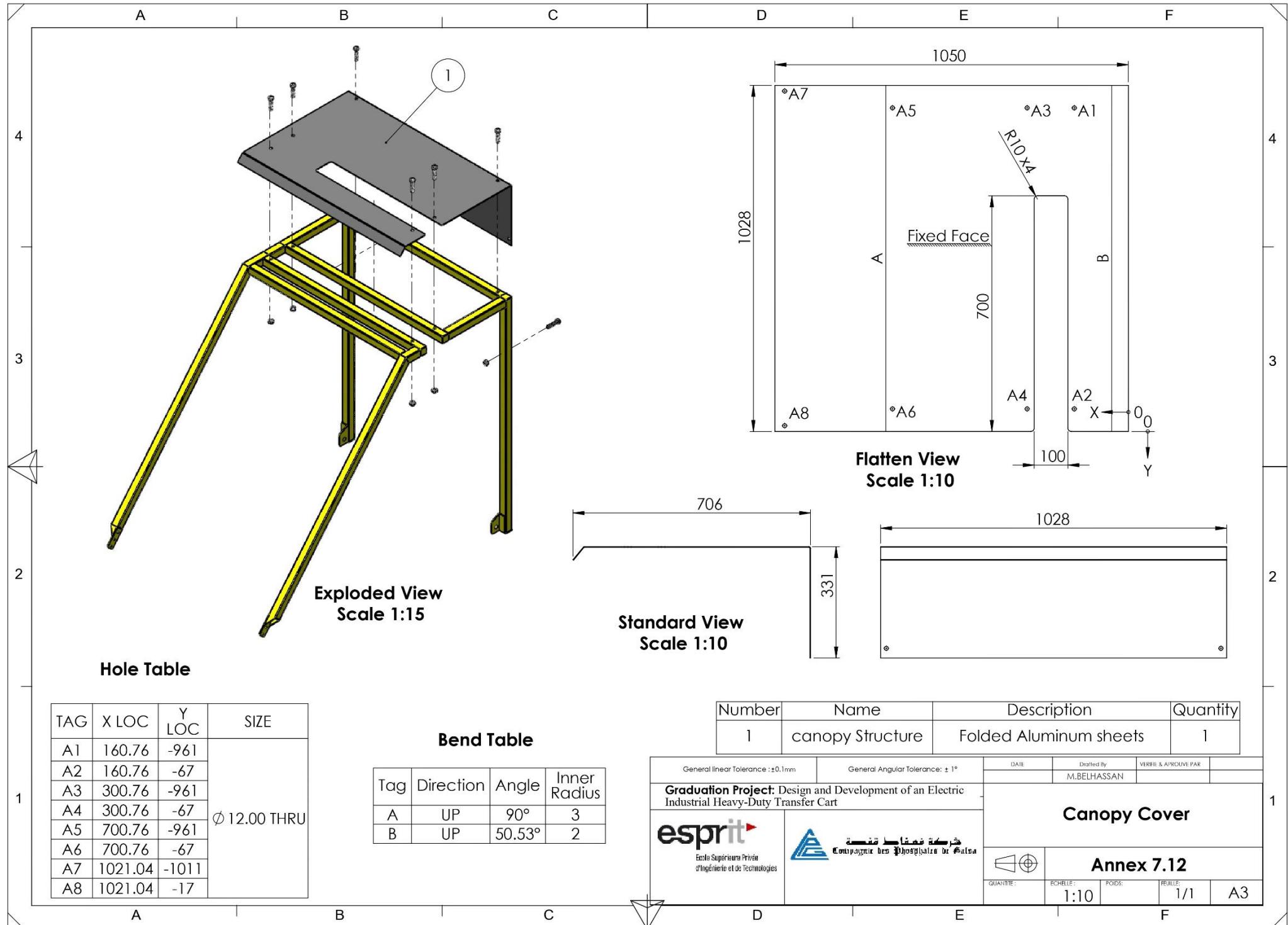
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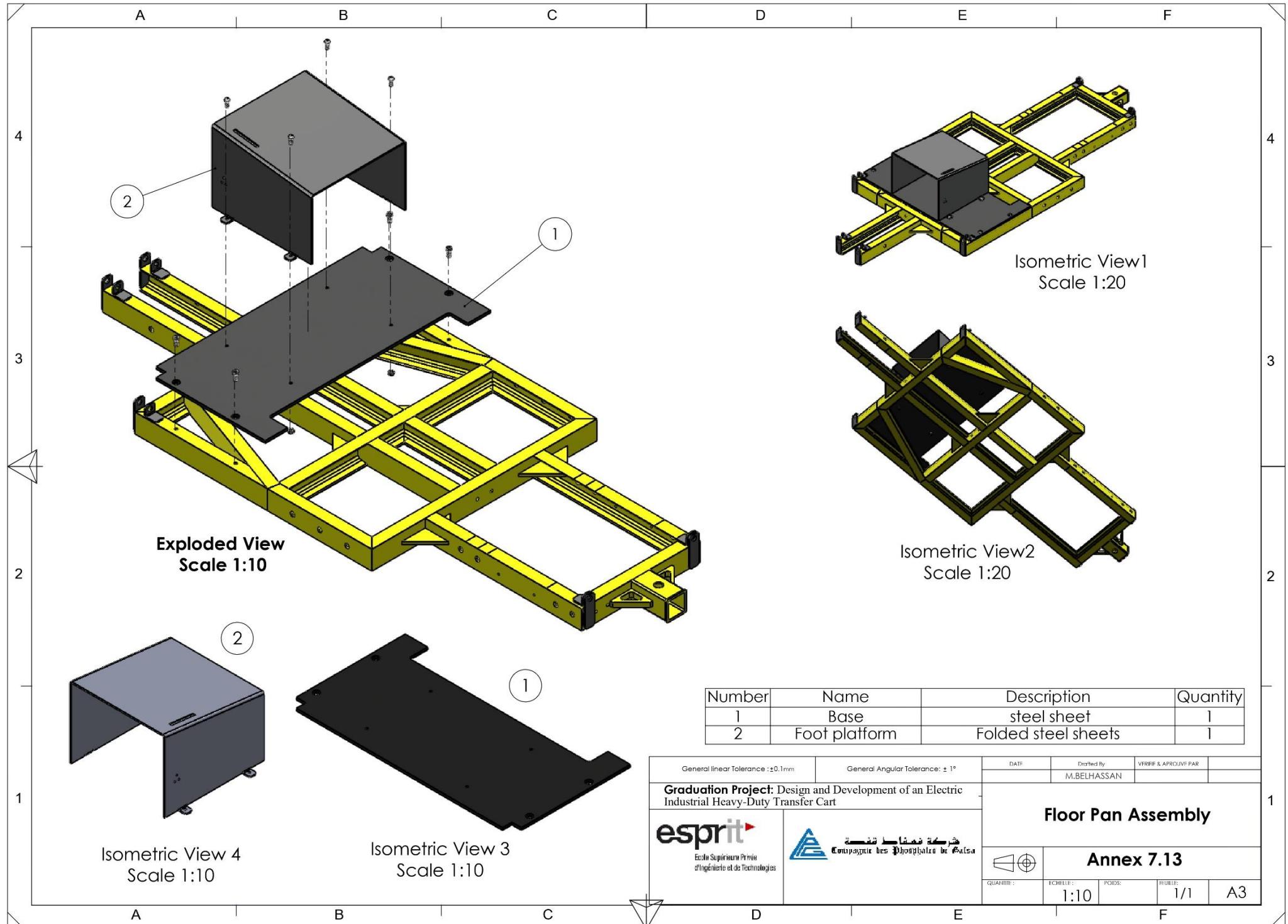
M.BELHASSAN

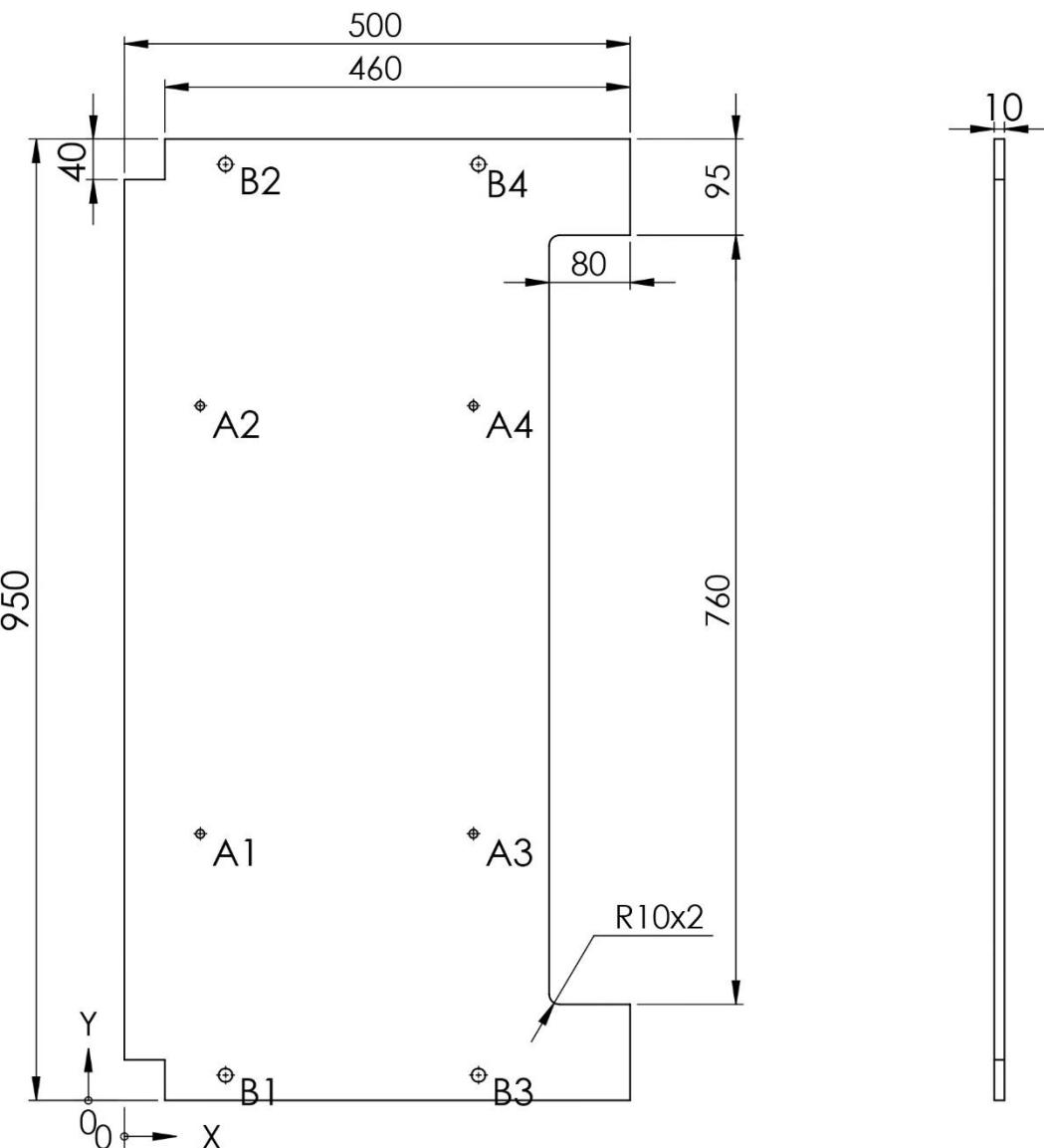
Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart

Rear Wheel Fender









**Isometric View
Scale 1:15**

TAG	X LOC	Y LOC	SIZE
A1	75	263.50	$\odot 8.50$ THRU
A2	75	686.50	
A3	345	263.50	
A4	345	686.50	
B1	100	25	$\odot 13.50 \pm 50$ $\square \odot 23.78 \pm 7.95$
B2	100	925	
B3	350	25	
B4	350	925	

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance: $\pm 0.1\text{mm}$

DATE

Drafted By

Verified and approved

M.BELHASSAN

Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart

Base

esprit

Ecole Supérieure Privée
d'Ingénierie et de Technologies



الشركة الوطنية للفوسفات
Compagnie des Phosphates de Gafsa



Annex 7.14

Superficie (mm^2):

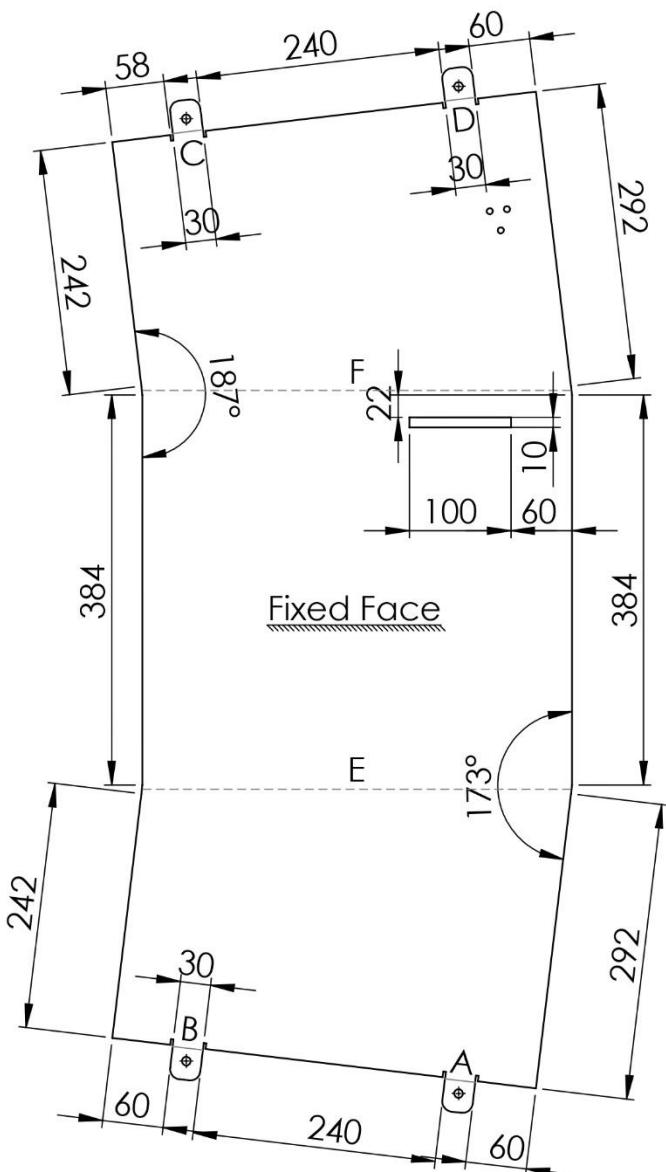
QUANTITE :

ECHELLE :

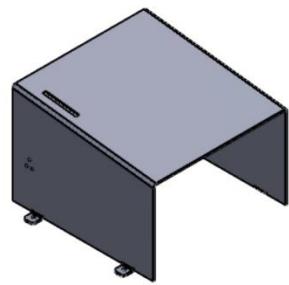
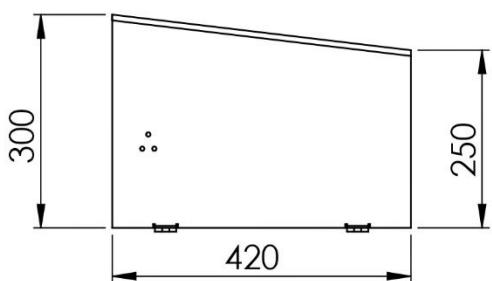
POIDS:

FEUILLE:

1:7 1/1 A4



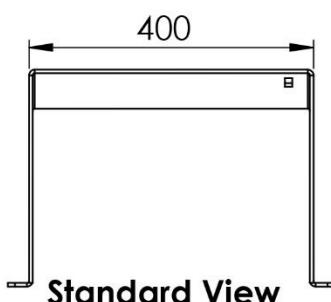
**Flatten View
Scalee 1:7**



**ISOMETRIC View
Scalee 1:15**

Bend Table

Tag	Direction	Angle	Inner Radius
A	UP	90°	3
B	UP	90°	3
C	UP	90°	3
D	UP	90°	3
E	DOWN	90°	3
F	DOWN	90°	3



**Standard View
Scalee 1:10**

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance: $\pm 0.1\text{mm}$

DATE	Drafted By	Verified and approved
	M.BELHASSAN	

Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart

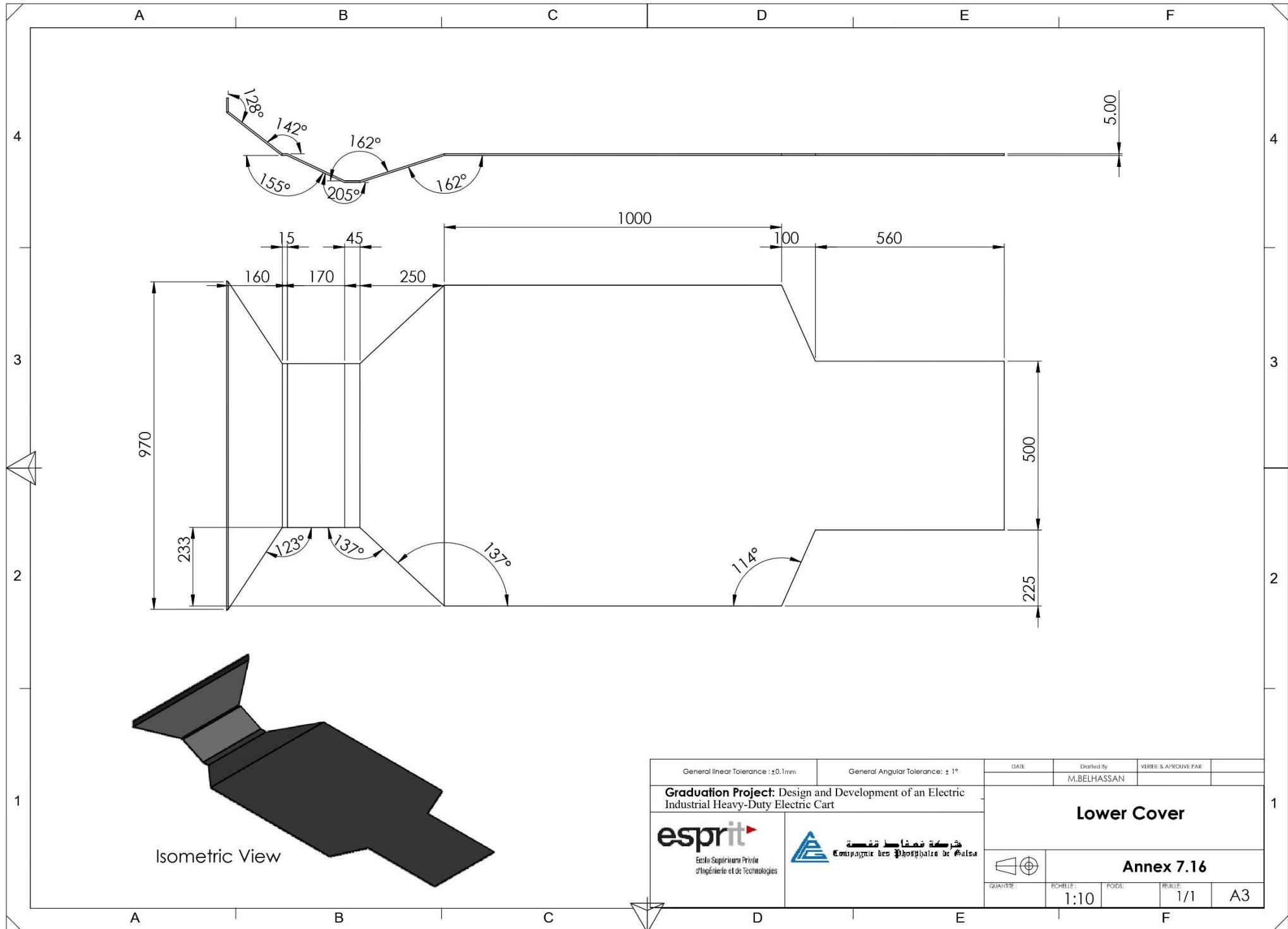
Foot Platform



Annex 7.15

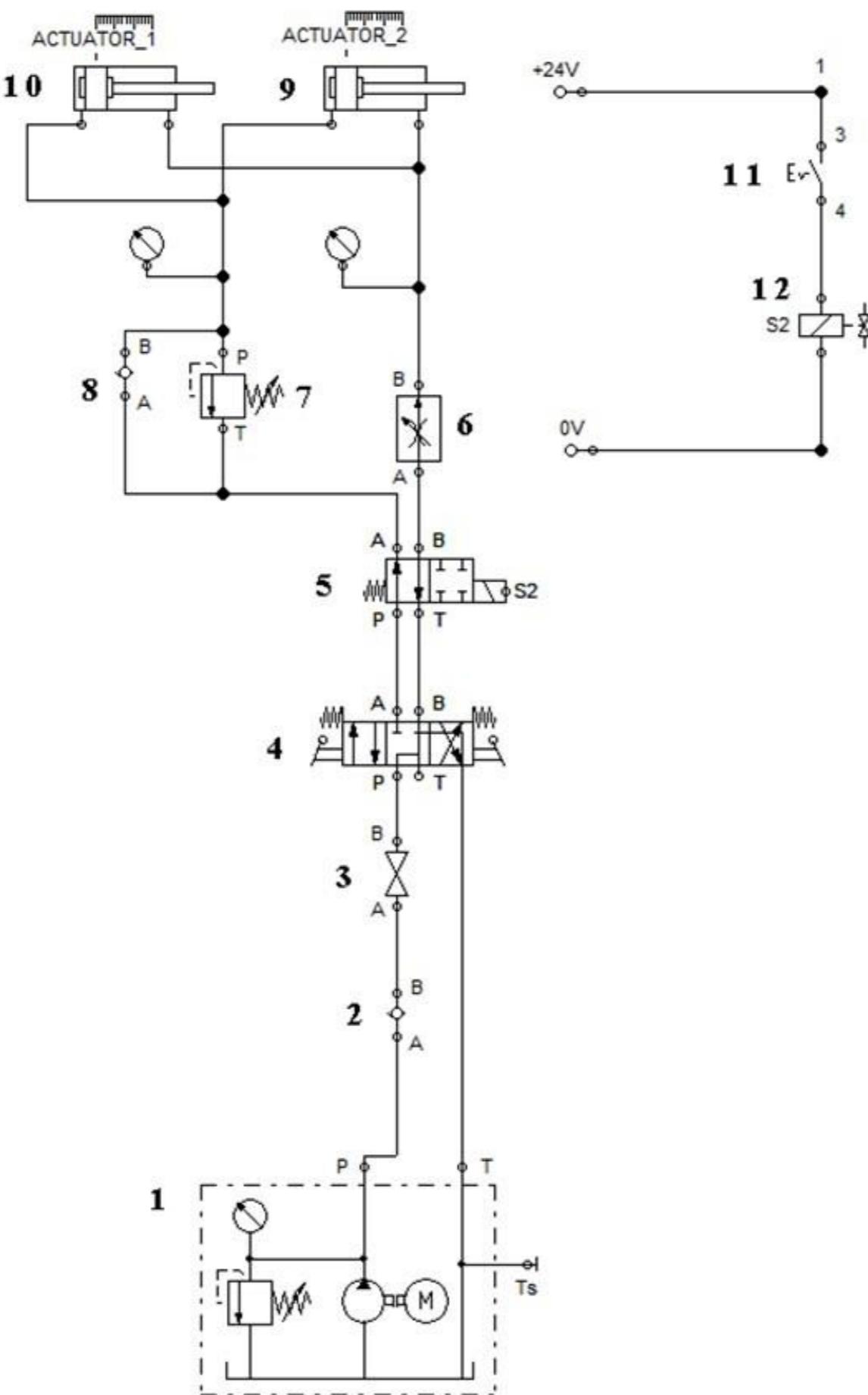
Superficie (mm^2) :

QUANTITÉ:	ECHELLE:	POIDS:	FEUILLE:	
	1:7		1/1	A4



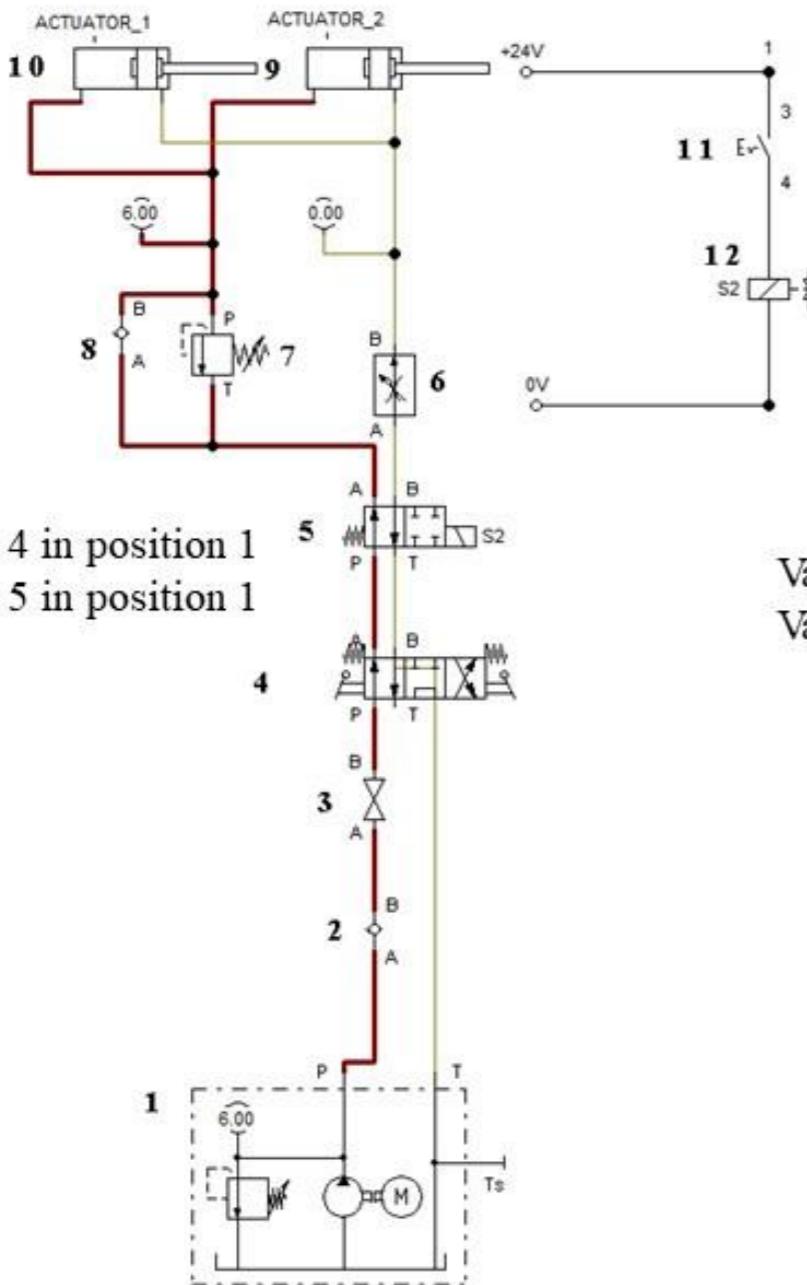
[Annex 8]

1. Hydraulic System Diagram [Annex 8.1]
2. Hydraulic System Simulation [Annex 8.2]
3. Hydraulic System Mechanical Design [Annex 8.3]

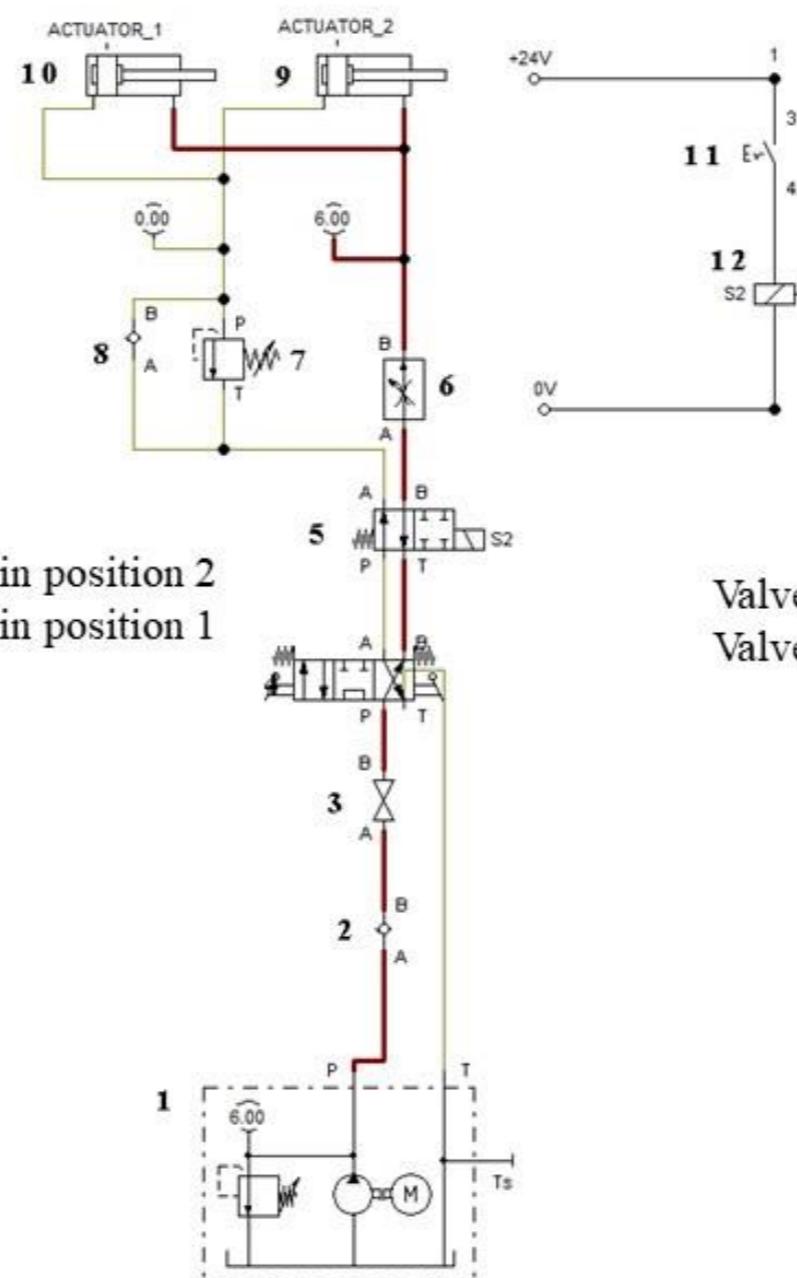


Number	Description
1	2-way flow control valve
1	4/2-way hand-lever valve
1	4/3-way hand-lever valve with shutoff position
1	Cylinder 1
1	Cylinder 2
1	Detent switch (make)
1	Electrical connection 0V
1	Electrical connection 24V
1	Pressure relief valve
1	Pump unit
1	Shutoff valve
1	Valve solenoid
2	Check valve
2	Distance rule
2	Manometer

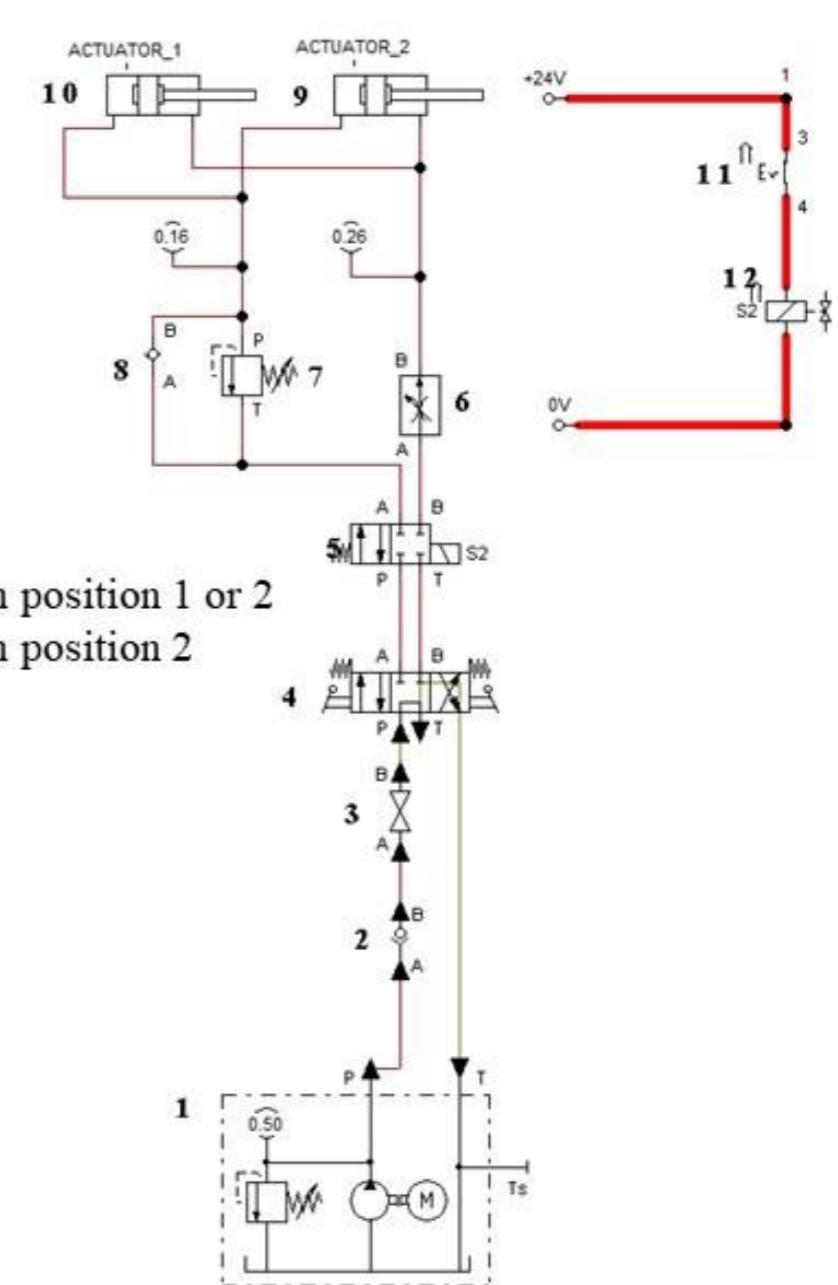




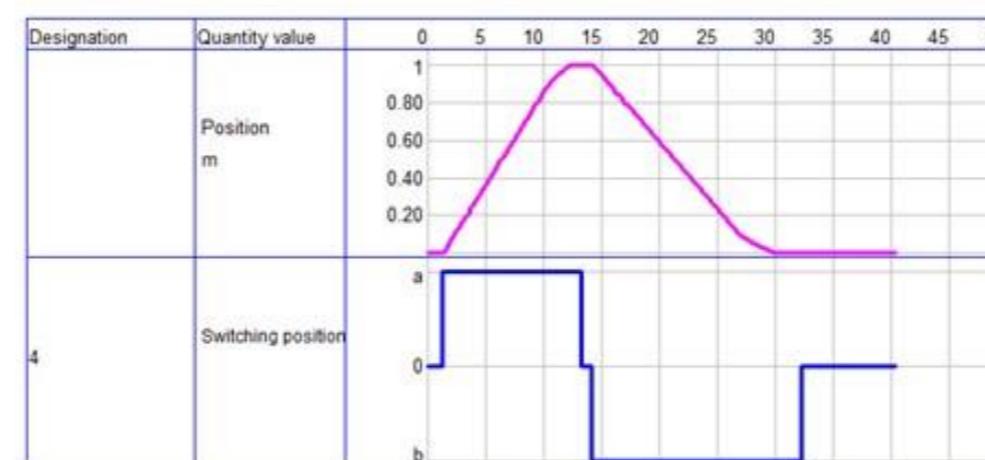
Valve 4 in position 1
Valve 5 in position 1



Valve 4 in position 2
Valve 5 in position 1



Valve 4 in position 1 or 2
Valve 5 in position 2



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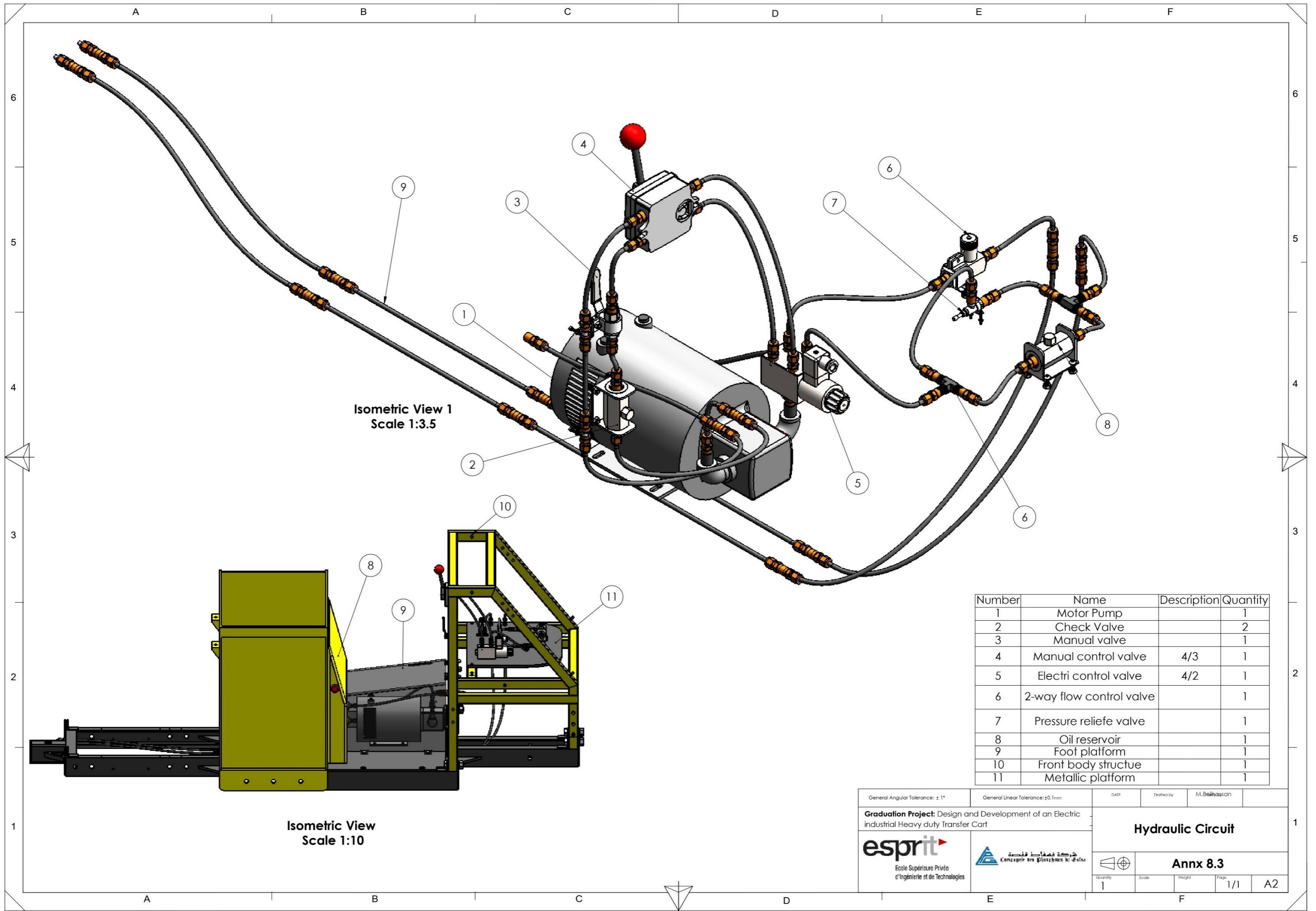
Hydraulic Circuit

Annex 8.2



Mohamed
Belhassan

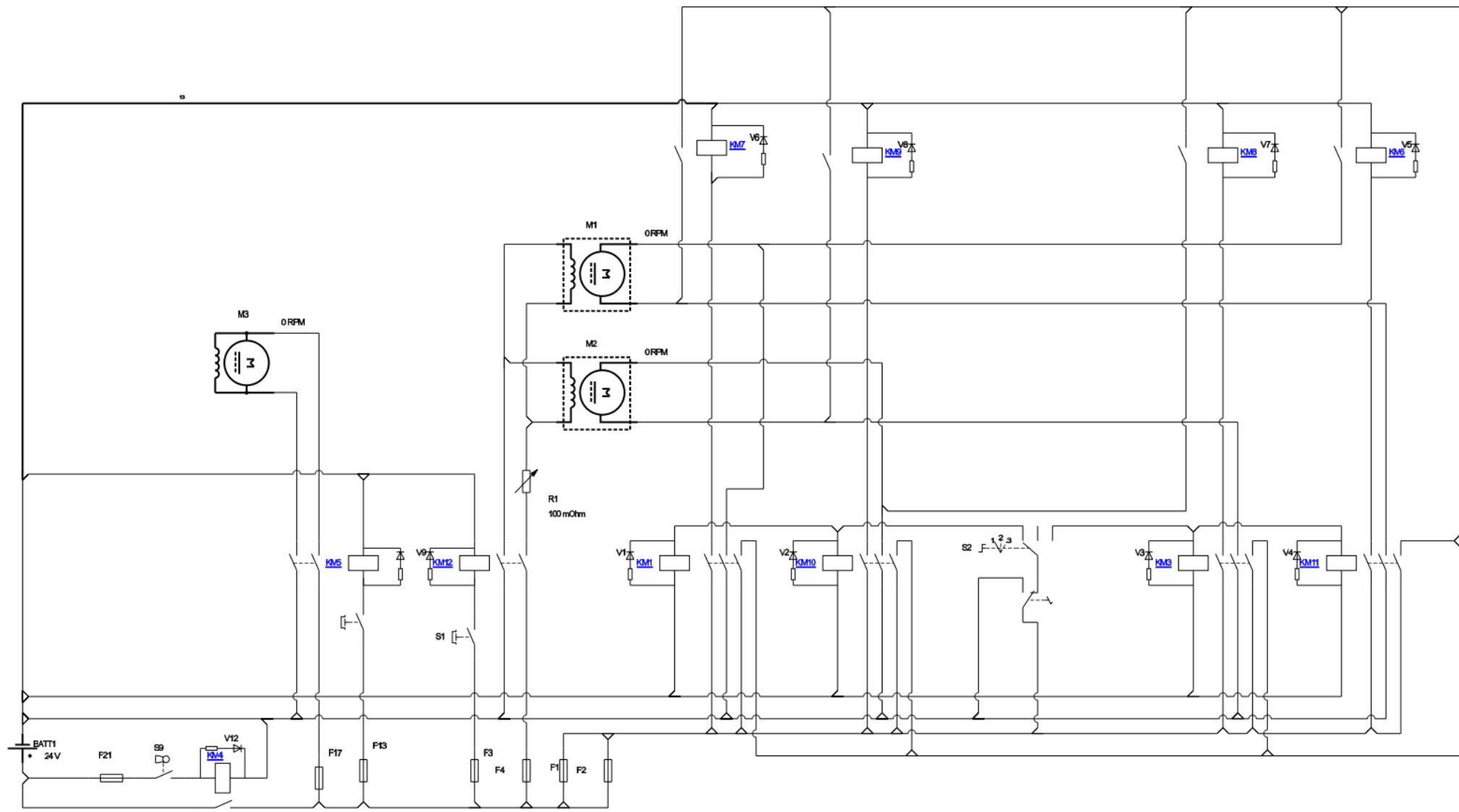
A3

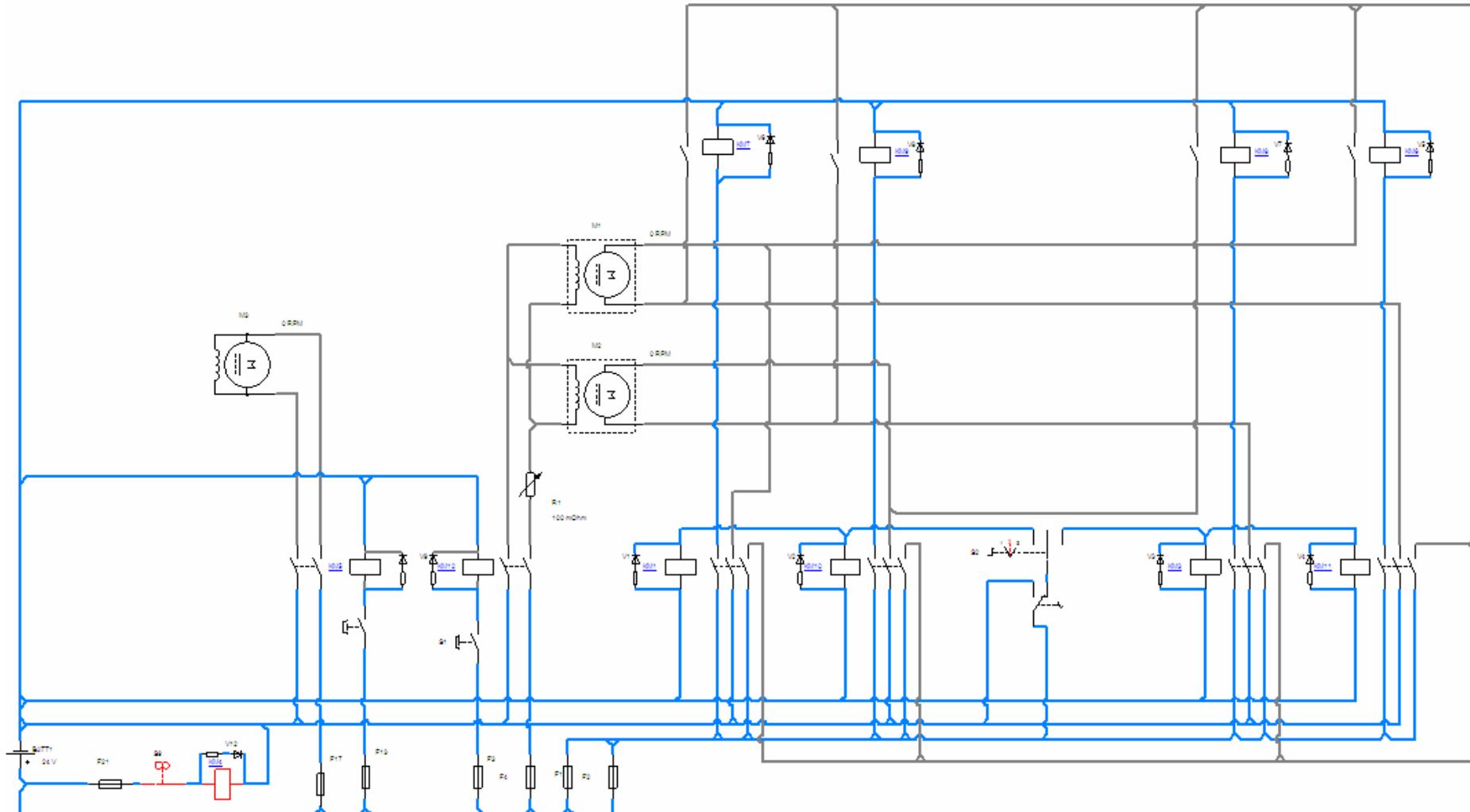


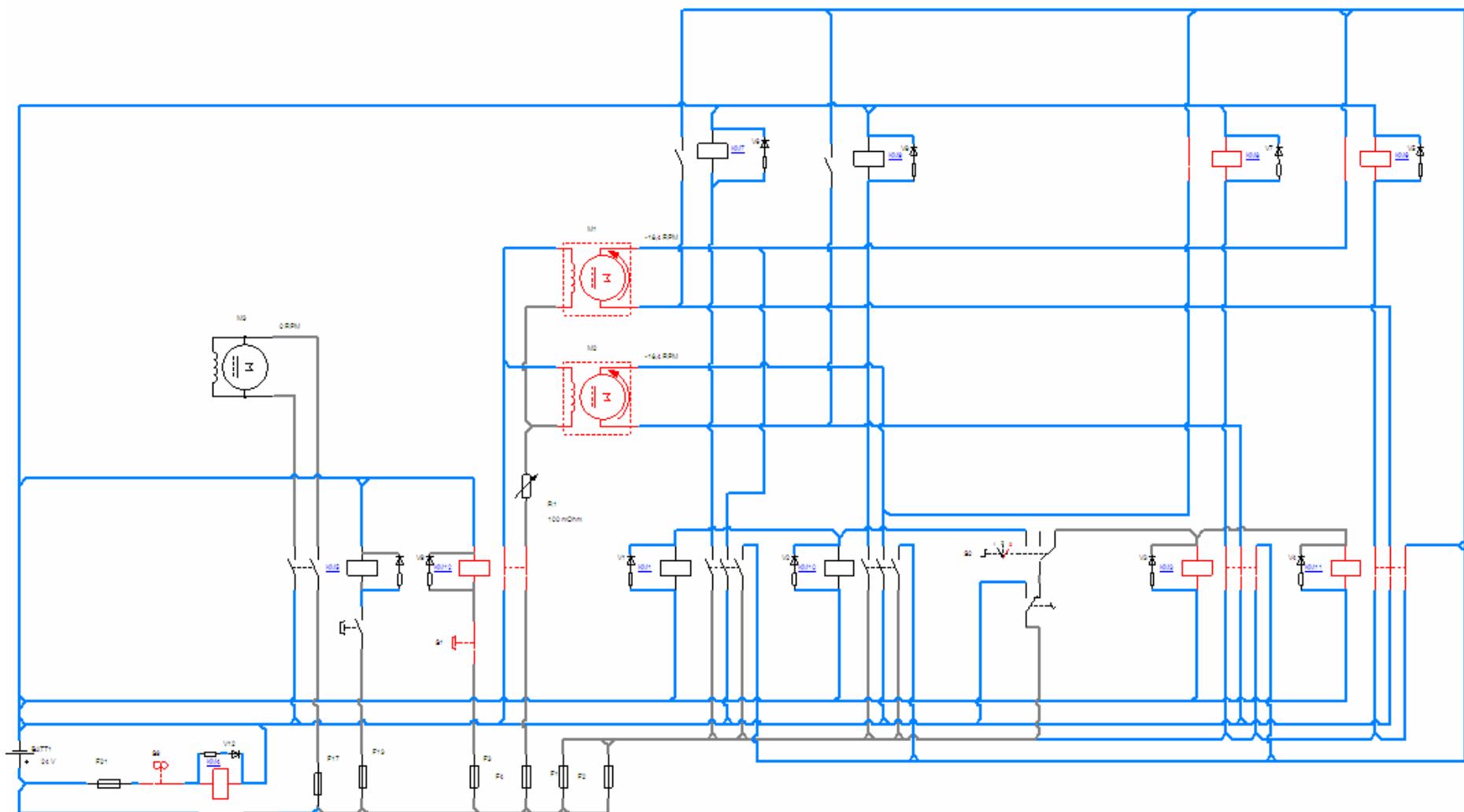
[Annex 9]

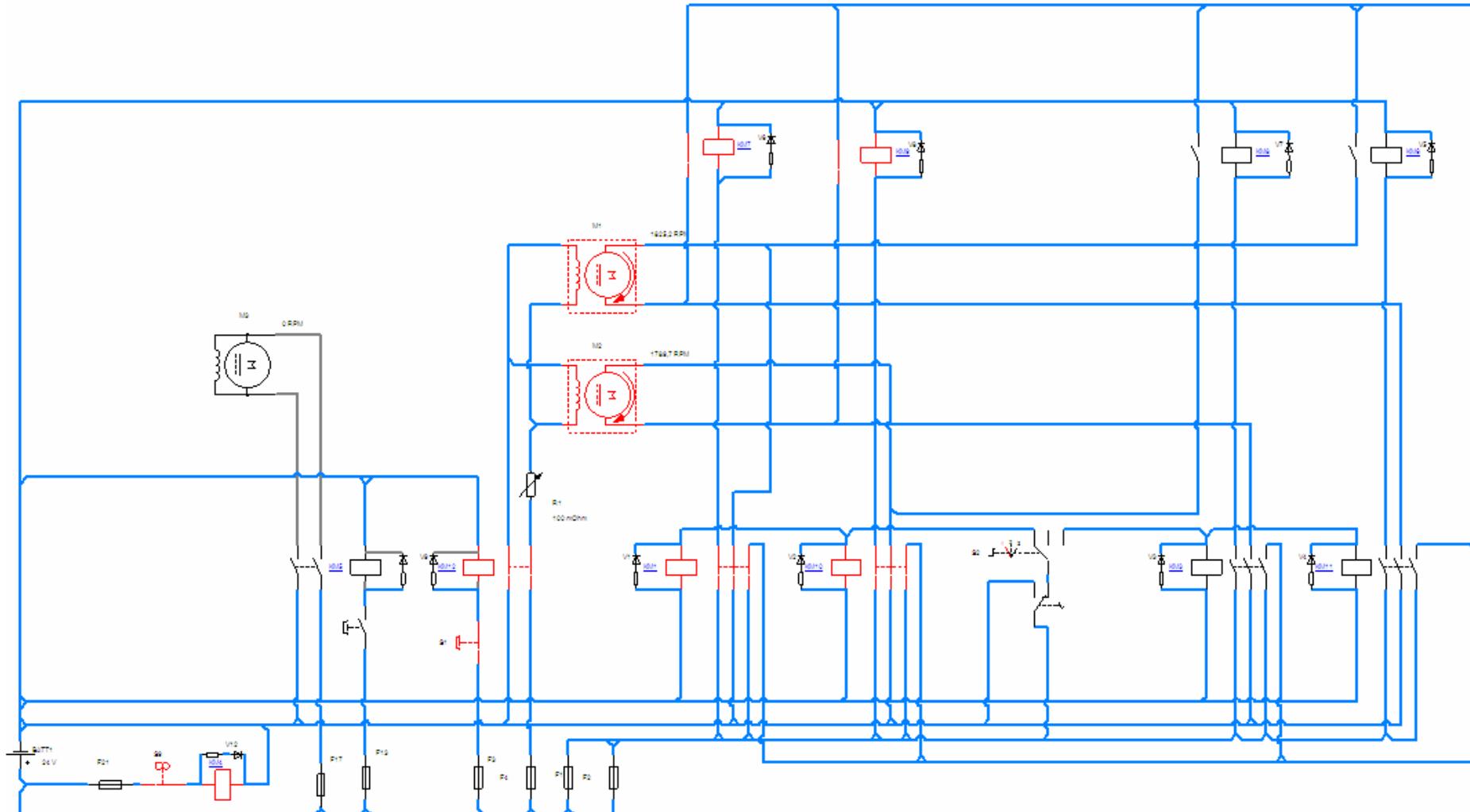
Power Circuit

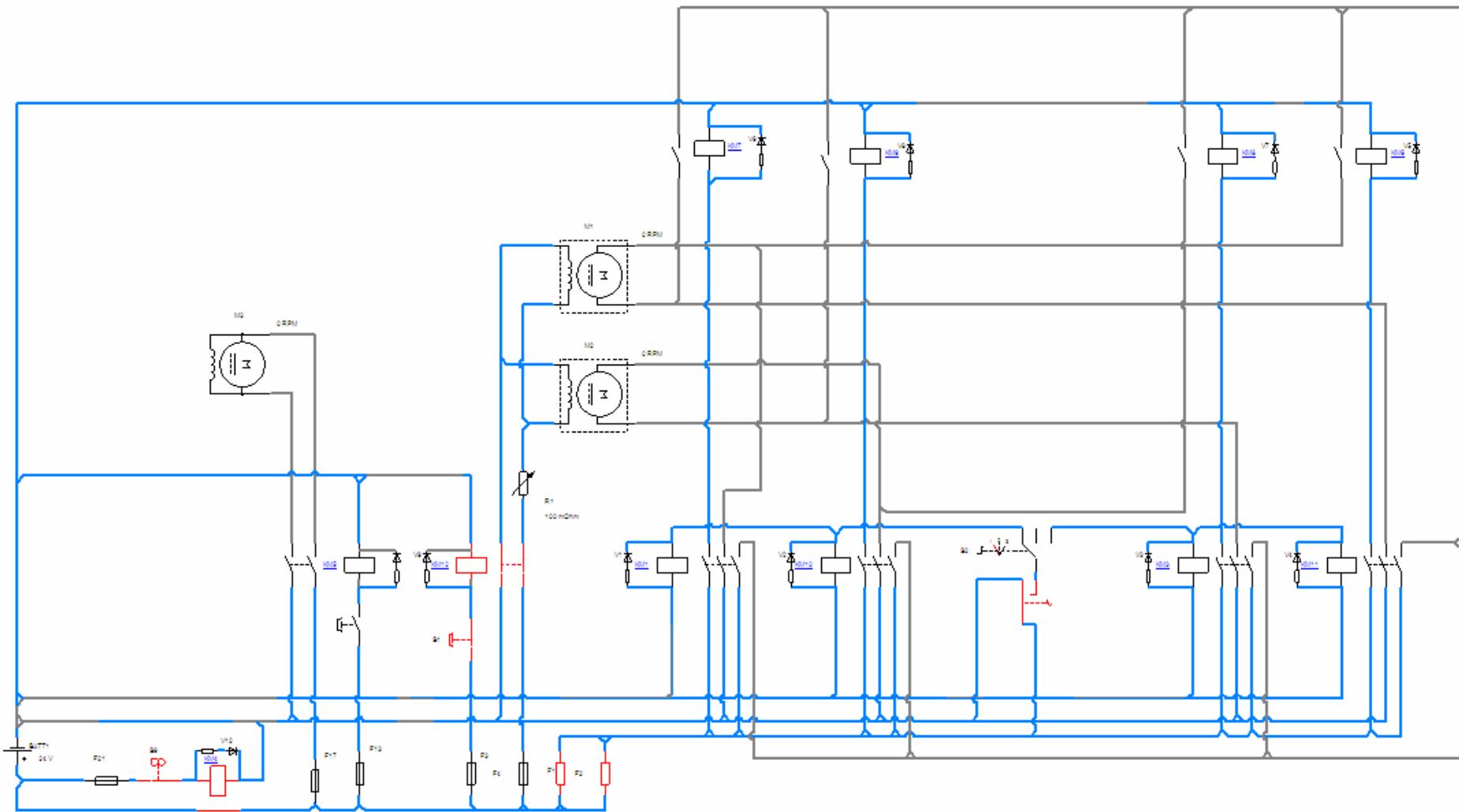
1. Power Circuit Design [Annex 9.1]
2. ON-OFF Circuit Design [Annex 9.2]
3. Motor Control Direction 1 [Annex 9.3]
4. Motor Control Direction 2 [Annex 9.4]
5. Motor Pump Circuit [Annex 10.5]

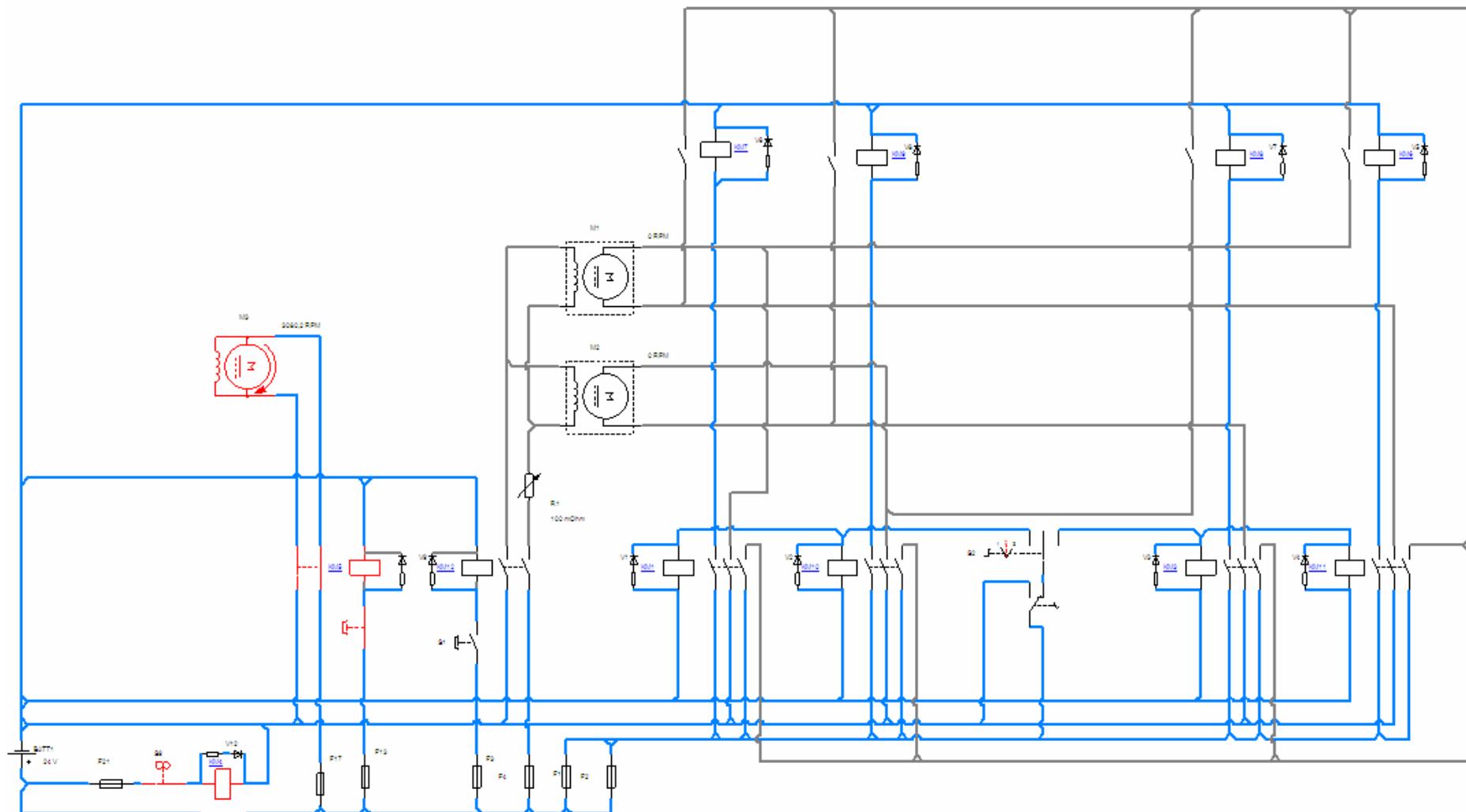












[Annex 10]

Auxiliary Circuit

1. Pvsyst Results [Annex 10.1]
2. Auxiliary Circuit Design [Annex 10.2]
3. Micro Controller Code [Annex 10.3]



PVsyst V7.2.6

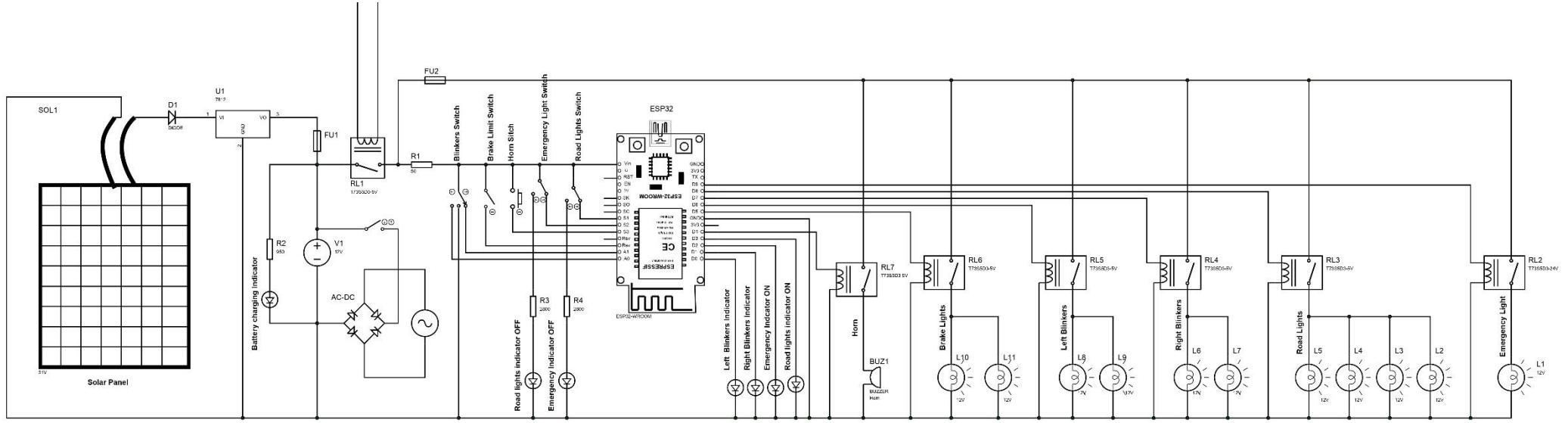
VC0, Simulation date:
13/06/24 12:04
with v7.2.6

Annex 10.1

Main results																																																																									
System Production			Battery aging (State of Wear)																																																																						
Available Energy	553.8 kWh/year		Specific production	1457 kWh/kWp/year																																																																					
Used Energy	226.9 kWh/year		Performance Ratio PR	32.87 %																																																																					
Excess (unused)	317.4 kWh/year		Solar Fraction SF	99.88 %																																																																					
Loss of Load			Battery aging (State of Wear)																																																																						
Time Fraction	0.0 %		Cycles SOW	82.7 %																																																																					
Missing Energy	0.3 kWh/year		Static SOW	80.0 %																																																																					
Normalized productions (per installed kWp)																																																																									
<table border="1"> <caption>Data for Normalized productions (per installed kWp)</caption> <thead> <tr> <th>Month</th> <th>Lu (Unused energy)</th> <th>Lc (Collection Loss)</th> <th>Ls (System losses)</th> <th>Yf (Energy supplied to the user)</th> </tr> </thead> <tbody> <tr><td>Jan</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Feb</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Mar</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Apr</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>May</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Jun</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Jul</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Aug</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Sep</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Oct</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Nov</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> <tr><td>Dec</td><td>~2.29</td><td>~0.89</td><td>~0.16</td><td>~1.64</td></tr> </tbody> </table>									Month	Lu (Unused energy)	Lc (Collection Loss)	Ls (System losses)	Yf (Energy supplied to the user)	Jan	~2.29	~0.89	~0.16	~1.64	Feb	~2.29	~0.89	~0.16	~1.64	Mar	~2.29	~0.89	~0.16	~1.64	Apr	~2.29	~0.89	~0.16	~1.64	May	~2.29	~0.89	~0.16	~1.64	Jun	~2.29	~0.89	~0.16	~1.64	Jul	~2.29	~0.89	~0.16	~1.64	Aug	~2.29	~0.89	~0.16	~1.64	Sep	~2.29	~0.89	~0.16	~1.64	Oct	~2.29	~0.89	~0.16	~1.64	Nov	~2.29	~0.89	~0.16	~1.64	Dec	~2.29	~0.89	~0.16	~1.64
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Sep	0.32	0.999																																																																							
Oct	0.41	0.999																																																																							
Nov	0.51	0.999																																																																							
Dec	0.62	0.999																																																																							
Balances and main results																																																																									
	GlobHor kWh/m ²	GlobEff kWh/m ²	E_Avail kWh	EUnused kWh	E_Miss kWh	E_User kWh	E_Load kWh	SolFrac ratio																																																																	
January	86.9	81.5	27.74	7.15	0.270	19.03	19.30	0.986																																																																	
February	100.0	95.3	32.16	13.77	0.000	17.43	17.43	1.000																																																																	
March	146.3	140.9	46.38	26.24	0.000	19.30	19.30	1.000																																																																	
April	176.9	171.9	54.99	35.79	0.000	18.68	18.68	1.000																																																																	
May	204.4	199.0	62.24	42.31	0.000	19.30	19.30	1.000																																																																	
June	210.2	205.0	62.49	43.17	0.000	18.68	18.68	1.000																																																																	
July	221.5	216.1	64.30	44.43	0.000	19.30	19.30	1.000																																																																	
August	200.7	195.4	58.68	38.98	0.000	19.30	19.30	1.000																																																																	
September	161.1	155.9	48.44	29.29	0.000	18.68	18.68	1.000																																																																	
October	131.6	126.0	40.46	20.29	0.000	19.30	19.30	1.000																																																																	
November	97.1	91.5	30.42	10.74	0.000	18.68	18.68	1.000																																																																	
December	81.0	75.5	25.47	5.21	0.000	19.30	19.30	1.000																																																																	
Year	1817.8	1754.0	553.77	317.37	0.270	226.94	227.21	0.999																																																																	

Legends

GlobHor	Global horizontal irradiation	E_User	Energy supplied to the user
GlobEff	Effective Global, corr. for IAM and shadings	E_Load	Energy need of the user (Load)
E_Avail	Available Solar Energy	SolFrac	Solar fraction (EUsed / ELoad)
EUnused	Unused energy (battery full)		
E_Miss	Missing energy		



Annex 10.3

```
// Assign output variables to GPIO pins
int Emergency_Light = 9;
int Road_light = 8;
int Blinkers_Light_R = 7;
int Blinkers_Light_L = 6;
int Brake_Light = 5;
int Horn = 4;
int Emergency_Indicator = 3;
int Road_light_Indicator = 2;
int Blinkers_Indicator_R = 1;
int Blinkers_Indicator_L = 0;

// Assign Input variables to GPIO pins
int Road_Light_Switch = 15;
int Emergency_Light_Switch = 14;
int Horn_Switch = 13;
int Blinkers_R_Switch = 10;
int Blinkers_L_Switch = 11;
int Brake_Light_Switch = 12;

void setup()
{
    // Initialize the output variables as outputs
    pinMode(Emergency_Light, OUTPUT);
    pinMode(Road_light, OUTPUT);
    pinMode(Blinkers_Light_R, OUTPUT);
    pinMode(Blinkers_Light_L, OUTPUT);
    pinMode(Brake_Light, OUTPUT);
    pinMode(Horn, OUTPUT);
    pinMode(Emergency_Indicator, OUTPUT);
    pinMode(Blinkers_Indicator_R, OUTPUT);
    pinMode(Blinkers_Indicator_L, OUTPUT);
    pinMode(Road_light_Indicator, OUTPUT);

    // Initialize the output variables as outputs
    pinMode(Road_Light_Switch, INPUT);
    pinMode(Emergency_Light_Switch, INPUT);
    pinMode(Horn_Switch, INPUT);
    pinMode(Blinkers_R_Switch, INPUT);
    pinMode(Blinkers_L_Switch, INPUT);
    pinMode(Brake_Light_Switch, INPUT);

    // Set outputs to low
    digitalWrite(Emergency_Light, LOW);
    digitalWrite(Road_light, LOW);
    digitalWrite(Blinkers_Light_R, LOW);
    digitalWrite(Blinkers_Light_L, LOW);
    digitalWrite(Brake_Light, LOW);

    // Initialize the output variables as outputs
    digitalWrite(Horn, LOW);
    digitalWrite(Emergency_Indicator, LOW);
    digitalWrite(Blinkers_Indicator_R, LOW);
    digitalWrite(Blinkers_Indicator_L, LOW);
}

void loop()
{
    // turns Emergency Lights ON
    if (Emergency_Light_Switch = HIGH){
        digitalWrite(Emergency_Indicator, HIGH);
        digitalWrite(Emergency_Light, HIGH);
    }
    else {
        digitalWrite(Emergency_Indicator, LOW);
        digitalWrite(Emergency_Light, LOW);
    }

    // turns Road Lights ON
    if (Road_Light_Switch = HIGH){
        digitalWrite(Road_light, HIGH);
        digitalWrite(Road_light_Indicator, HIGH);
    }
    else {
        digitalWrite(Road_light, LOW);
        digitalWrite(Road_light_Indicator, LOW);
    }

    // turns Right Blinkers
    if (Blinkers_R_Switch = HIGH){
        digitalWrite(Blinkers_Indicator_R, HIGH);
        digitalWrite(Blinkers_Light_R, HIGH);
        digitalWrite(Blinkers_Indicator_L, LOW);
        digitalWrite(Blinkers_Light_L, LOW);
    }
    else {
        digitalWrite(Blinkers_Indicator_R, LOW);
        digitalWrite(Blinkers_Light_R, LOW);
    }

    // turns Left Blinkers
    if (Blinkers_L_Switch = HIGH){
        digitalWrite(Blinkers_Indicator_L, HIGH);
        digitalWrite(Blinkers_Light_L, HIGH);
        digitalWrite(Blinkers_Indicator_R, LOW);
        digitalWrite(Blinkers_Light_R, LOW);
    }
    else {

        // turns Brake Lights
        if (Brake_Light_Switch = HIGH)
        {
            digitalWrite(Brake_Light, HIGH);
        }
        else {
            digitalWrite(Brake_Light, LOW);
        }

        // turns Horn ON
        if (Horn_Switch = HIGH)
        {
            digitalWrite(Horn, HIGH);
        }
        else {
            digitalWrite(Horn, LOW);
        }
    }
}
```

Data sheets

[Annex 11]

Motors Data sheet [Annex 11.1]

2. Technical data for electric motors to be installed in E12/15 and E15S (Type 324) lift trucks.

E12/15 operating voltage $U_B = 24 \text{ V}$

2.1 Traction motor:

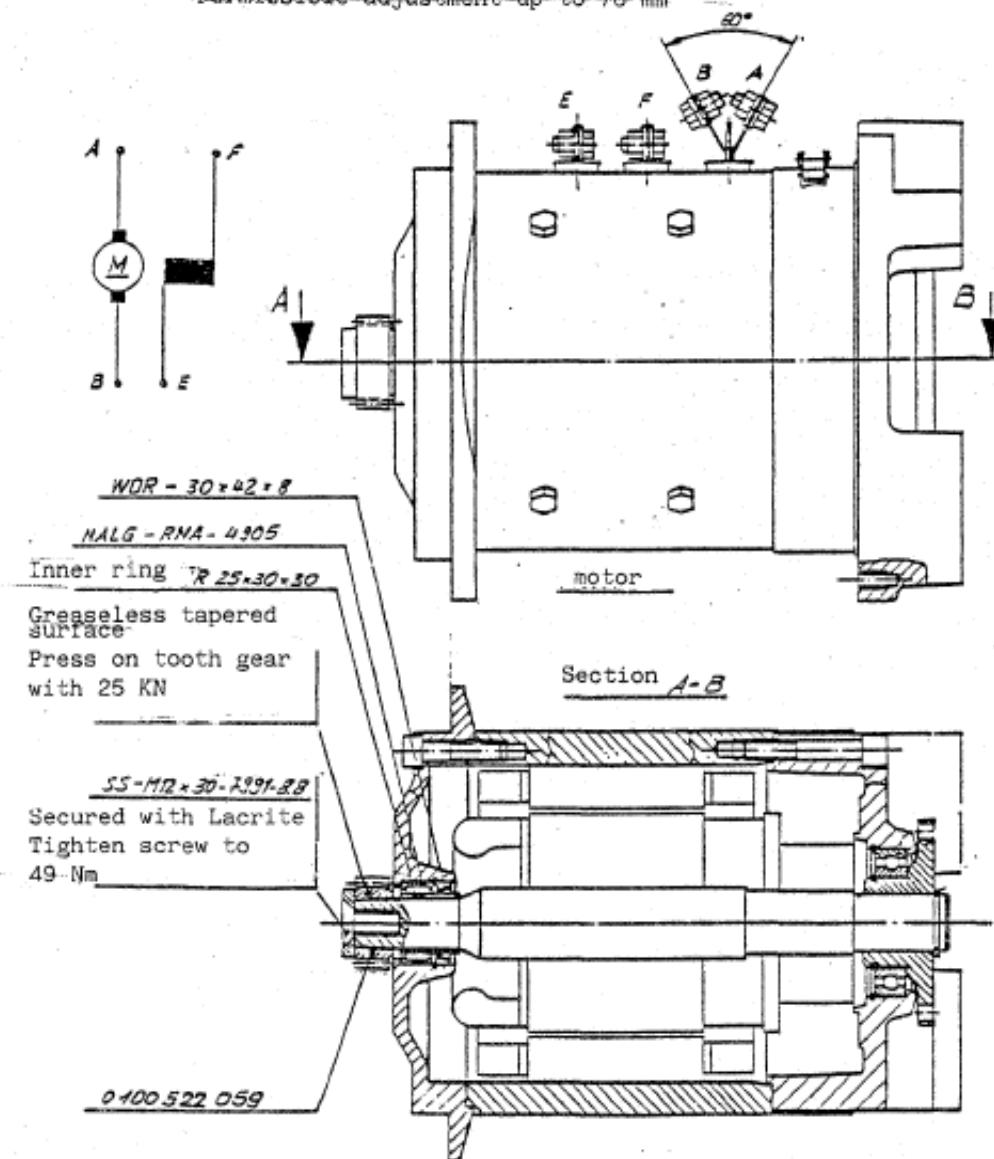
2 D.C. motors with armature reversing
Type GF114-14/1.1, ET-No. 324 350 05 05 RE
05 05 LI

24 V, 104 A at 2150 rpm
Rating 2 KW S2 (60 min)

Type of protection: JP00/JP22, DIN 40 050
Carbon brushes KK1 12.5x25x32 with dust groove
min. length of worn brushes 15 mm
Collector diameter new 82 mm

Permissible adjustment up to 73 mm

24 Volt
2 x 2 = 4 kW (= 2 kW S 2:60 min)
104 A
S ₂ - 60
2150 min ⁻¹
40 Nm
JP 00/ JP 22
12.5 x 25 x 32 mm
15 mm
i = 20,07



Motor Pump Data Sheet [Annex 11.2]

L. Best. Nr. 000 976 1118			Typ GP 116-14/5.5	
Best. Nr. 267 410				
24 V	260 A	2500 min ⁻¹	5.0 kw	15 %
KL. B/F	IP 44 kle .00			
0525		Baujahr		

Battery Data sheet [Annex 11.3]

Utilisation :	-
Type de l'élément :	8 PzV 1120
Type de la batterie :	12 x 8 PzV 1120
Tension en V :	24
Capacité (AH) en 5 H :	1120
Dimensions d'un élément en mm :	137 x 198 x 541
Dimensions du coffre métallique en mm avec peinture époxy :	x x
Poids d'un élément en ordre de marche en Kg :	41,800
Coffre fourni par :	ASSAD INDUSTRIAL
Délai de livraison :	<u>Disponible sauf vente entre temps</u>

Rim & Tire Data sheet [Annex 11.4]

Number of Bolts	4
Bolt Distance	98
Nut/Bolt Dimensions	M12x1.25
Central Bore (CB)	58.1
Fastening Type	Lug Bolts
Anti-Theft Locking Lug Nuts/Bolts	Optional 
Rim Type	Disc Wheel
Spare Wheel	Full-size (Steel)

Steel-S355J2G3 Data sheet [Annex 11.5]



Data Sheet

Steel 1.0570 / S355J2G3

Alternative Designations

St52-3; S355J2G3 (ISO) | 1024 (AISI/SAE) | G10240 (UNS) | E36-3 (AFNOR) | 50D (BS) | AE355D (UNE) | 2135-01 (SIS) | Fe510 (UNI) | SM490 (JIS)

Key Features

High tensile strength • Low thermal conductivity • Good weldability • Low ductility

Description

This steel is composed of different chemical elements that give it specific properties. For instance, steel st52 is known for its high strength and durability. It is also resistant to corrosion and can be easily welded. These properties make it an ideal choice for many applications. This unalloyed structural steel has a tensile strength of 630Mpa. Compared to other carbon steels, it has high electrical conductivity but low thermal conductivity and low ductility.

Mechanical Properties

Yield strength	315 – 355 MPa	Al	0.02%	N	-
Tensile strength	490 – 630 MPa	Bi	-	Nb	-
Elongation at break	22%	C	0.22%	Ni	0.3%
Hardness	217	Cd	-	O	-
Module of elasticity	210 GPa	Co	-	P	0.035%
		Cr	0.3%	Pb	-
		Cu	-	S	0.035%

Physical Properties

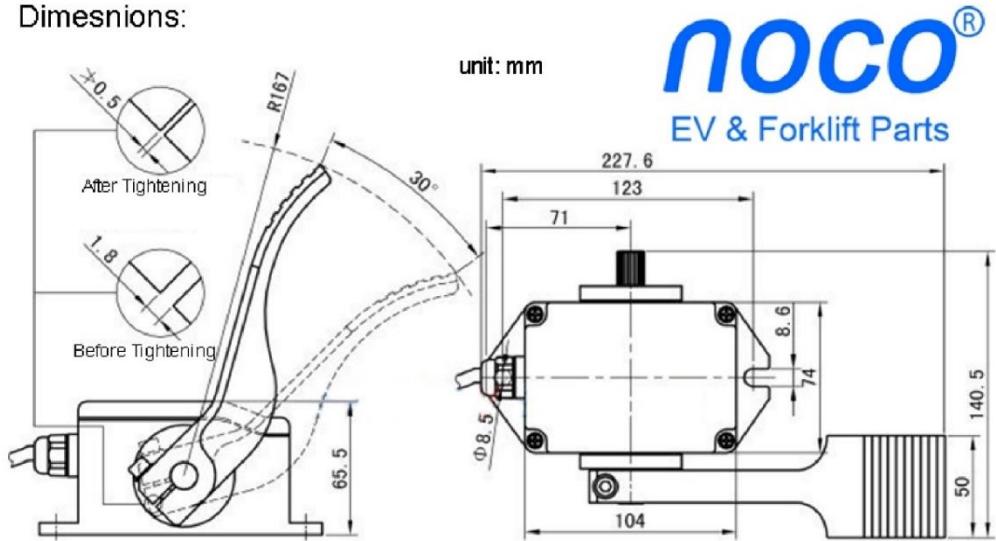
Density	7.85 g/cm ³	Fe	-	Si	0.55%
Electrical conductivity	6.67 m/Ω · mm ²	H	-	Sn	-
Coefficient of thermal expansion	11.1 K-1 · 10-6	Mg	-	Ti	-
Thermal conductivity	54 W/m · K	Mn	1.6%	V	-
Specific heat capacity	461 J/kg · K	Mo	0.08%	Zn	-

Reference

Datasheets provided by Xometry contain materials sourced through trusted OEMs, material distributors, and databases. Please visit Materialdatacenter.com for further information on this material.

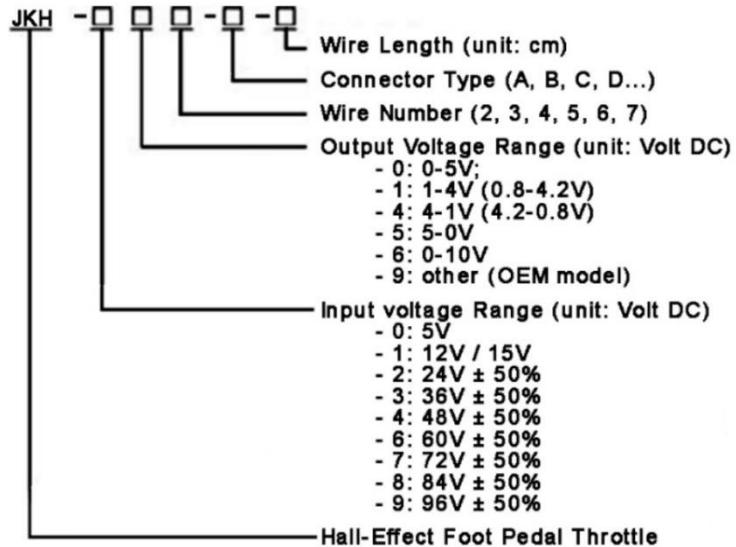
Potentiometer Data sheet [Annex 11.6]

Dimensions:

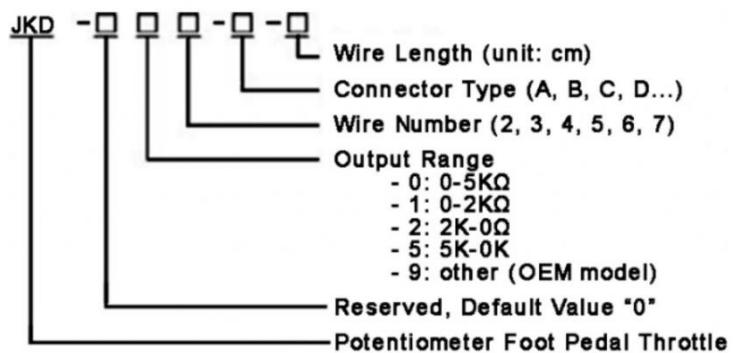


noco®
EV & Forklift Parts

Voltage Throttle Codification:



Potentiometer Throttle Codification:



Technical drawing title block.

A4 – A3 – A2

General Angular Tolerance: $\pm 1^\circ$

General Linear Tolerance: $\pm 0.1\text{mm}$

DATE

Drafted By

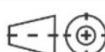
Verified and approved

M.BELHASSAN

Graduation Project: Design and Development of an Electric industrial Heavy-Duty Transfer Cart

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XXXXX

Superficie (mm²):

Quantity	Scale	Weight	Page	A4
	1:1		1/1	

A

B

C

D

E

F

4

4

3

3



2

2

1

1

General linear Tolerance : $\pm 0.1\text{mm}$		General Angular Tolerance: $\pm 1^\circ$	DATE	Drafted By	Verified and Approved by
				M.BELHASSAN	
Graduation Project: Design and Development of an Electric Industrial Heavy-Duty Electric Cart					XXXXXXX
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	Quantity	Scale	Weight	Page	
X:X				1/1	A3

A

B

C

D

E

F



A

B

C

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6

6

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4

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2

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1

A

B

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D

E

F

General Angular Tolerance: $\pm 1^\circ$	General Linear Tolerance: $\pm 0.1\text{mm}$	DATE	Drafted By M.Belhassan	Verified and Approved By
Graduation Project: Design and Development of an Electric industrial Heavy duty Cart		XXXXXXX		
 Ecole Supérieure Privée d'Ingénierie et de Technologies		 XXXXX		
Quantity	Scale X:X	Weight	Page 1/1	A2

