Steensby Inlet Marine Structures

Steensby Island Link – Design Criteria

Mary River Project

21-Nov-2011	E	Approved for Use – FEL3 Report	V. Lake	R. MacCrimmon	S. Perry	
09-Nov-2011	D	Approved for Use-Environmental Permit	R. MacCrimmon	K. Skebo	J. Casson	
22-Sept-2011	C	Internal/Client Review	R. MacCrimmon	K. Skebo	J. Casson	
12-Sept-2011	B	Internal/Client Review	R. MacCrimmon	K. Skebo	J. Casson	
09-Aug-2011	A	Client Review	R. MacCrimmon	K. Skebo	J. Casson	
DATE	**REV.**	**STATUS**	**PREPARED BY**	**CHECKED BY**	**APPROVED BY**	**APPROVED BY**
			HATCH			**CLIENT**

Table of Contents

Appendices

1. Introduction

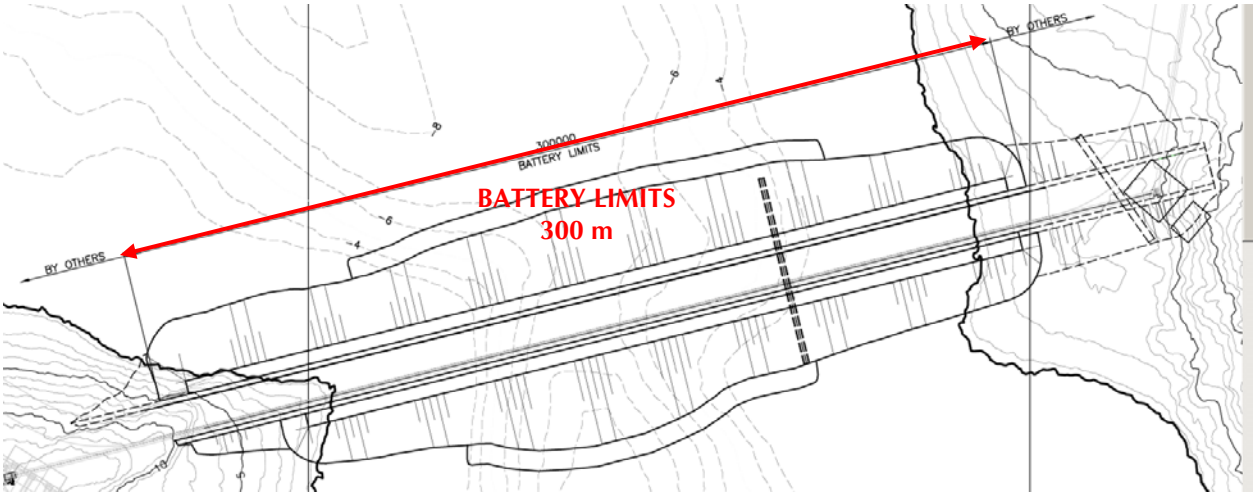
Baffinland Iron Mines (BIM) plans to ship up to 18 million tonnes of iron ore per year from a new port at Steensby Inlet, Baffin Island, Canada. The shipping operation will be year round, using ice breaking ore carriers. The ore loading dock will be located on Steensby Island.

The new port will require a link from the main land to Steensby Island will be a rock fill causeway.

The function of the facility will be to:

- provide transportation of construction materials and equipment during the construction of the Mary River Project
- provide a link for conveying systems, vehicular traffic, materials and goods for the Steensby Island operations of 25 year life of the Mary River Project
- provision for navigation is not required.

Table 1-1 Baseline Link Location



2. Project Objectives

The key objectives for this project are:

- provide a new link from the main land to Steensby Island
- provide a link that can accommodate routing of conveying systems and vehicular transportation
- provide designs that are appropriate for challenging Arctic conditions.

At the end of the project life all components of the link except for rockfill must be removable.

3. Link Layout

In accordance with decisions from trade off studies:

3.1 Link Length

The total link length is approximately 350 m.

3.2 Link Width

Sized adequately to allow for one conveyor and one lane for other forms of traffic.

3.3 Link Height

Pending further study of effects of waves and ice, the surface of the deck will be at not lower than elevation +8.20 m CD (+5.26 m CGD).

3.4 Water Depth

The existing maximum water depth is approximately 13 m at high tide.

3.5 Link Surface

The surface for causeway construction will be gravel.

3.6 Grades

The surface of the causeway shall not exceed a grade of 7%.

Note: The transporter, example shown in Appendix A, is not particularly sensitive to grades but sags or humps in excess of 600 mm in the length of the transporter cannot be accommodated.

3.7 Power/Lighting

Lighting will be provided by others.

Navigational lighting will not be provided.

3.8 Provision for Water Passage

At the time of issue of this document, a culvert has been proposed to allow a measure of flow through the causeway in addition to through the pervious rock fill. This could permit passage of marine life – to be confirmed.

3.9 Provision for Expansion

No provision will be made for future expansion.

3.10 Provision for Removal

Design and construction methods must account for removable of all components except rock fill at the completion of the Mary River mining project.

4. Design Proposal

4.1 Causeway

Revision 1 of the Steensby Island Link Trade-off Study showed that a causeway is the preferred option and is environmentally acceptable.

4.2 Spill Protection

No specific measures for spill protection into the water during loading operations will be provided in the design; see the cost estimates by others.

4.3 Sound Control

Refer to Environmental Impact Study (EIS).

4.4 Marine Siltation Control

Adequate measures for construction of all components of the link construction will be taken to minimize turbidity effects such as the use of a siltation curtain placed from surface to harbour bottom.

5. Design Criteria

The following design criteria will be followed for the design and construction of the link.

5.1 Codes and Standards

Codes and Standards will include:

- The Canadian Geotechnical Manual
- U.S. Army Corps of Engineers, Shore Protection Manual

Note: Design and construction of this type of facility is not explicitly covered by any Canadian Standard. Designers must use judgment and follow accepted practice for similar structures. Therefore the Codes and Standards listed will be referenced as deemed appropriate by the designers.

5.2 Datum

Canadian Geodetic Datum (CGD) 0.0 has been calculated to be 2.94 m above Chart Datum (CD) 0.0.

5.3 Units

The SI (metric) system will be used.

5.4 Climatic Data

Taken from Aker Kvaerner DFS, Appendix A unless noted otherwise.

5.4.1 Temperature

- Minimum temperature: -50°C
- Maximum temperature: +21°C

5.4.2 Rainfall

- Maximum (1 in 10 yrs) 15 minutes rainfall: 4 mm
- Maximum (1 in 30 yrs) 24 hours rainfall: 45 mm
- Total annual precipitation: 251 mm

5.4.3 Snow

- Ss: 1.7 kPa
- Sr: 0.2 kPa

5.4.4 Harbour Ice

- Thickness (level ice): 2.0 m
- Uniaxial crushing strength: 5 MPa

5.4.5 Ice Accretion

Taken from CAN/CSA-S6:

- 12 mm

5.4.6 Wind

Hourly wind pressure:

- 1/10 probability of exceeding in a year: undefined
- 1/50 probability of exceeding in a year: 0.66 kPa

5.4.7 Earthquake

Taken from CAN/CSA-S6:

- Peak Ground acceleration, 500 years return period: 0.08
- V: 0.10
- Za: 2
- Zv: 2

5.4.8 Water Characteristics, Steensby Inlet

- Water: saline
- Tides: yes, semi-diurnal
- Higher High Water Large Tide: elevation +4.8 m CD
- High Tide Level: elevation +4.3 m CD
- Mean Sea Level: +2.26 m CD
- Low Tide Level: elevation. +0.2 m CD (estimated)
- Lower Low Water Large Tide: elevation +0.0 m CD
- Current: Predominantly tidal, see separate report H337697-3100-12-124-0002
- Waves: see separate report H337697-3100-12-124-0003

5.5 Geotechnical

5.5.1 Site Conditions

Geotechnical conditions as of the time of issue of this report are contained in Thurber Reports:

- Mary River Project, Steensby Inlet and Milne Inlet Port Offshore Geotechnical Investigation Summary of Results , File 19-1605-126, November 9, 2011;
- Mary River Project, Initial Geotechnical Recommendations Offshore Structures at Port Steensby, File 19-1605-126, November 11, 2011.

5.5.2 Slope Protection Criteria

Refer to Report H337697-3100-12-124-0007.

5.6 Design Loads

5.6.1 Dead Loads

- Reinforced concrete: 24 kN/m^3
- Steel: 77 kN/m^3

5.6.2 Operating Loads

On the deck:

- Refer to Appendix A

5.6.3 Ice Loads

Refer to Document No. H337697-3100-12-124-0004.

5.7 Load Combinations

The loads show in Appendix A will be considered in isolation with no multiple loadings – to be confirmed.

5.8 Life Expectancy

All components of the link will be designed for a life expectancy of 25 years.

5.9 Technical Specifications

Refer to H337697-3240-12-123-0001 for Island Link Technical Specifications.

5.10 Construction Procedures

To be considered as it affects the design:

- Settlement;

- Dredging – geotechnically unstable material and dredged material placement on land or by sidecasting - to be confirmed;
- Schedule – Summer open water construction period mid July to mid October.

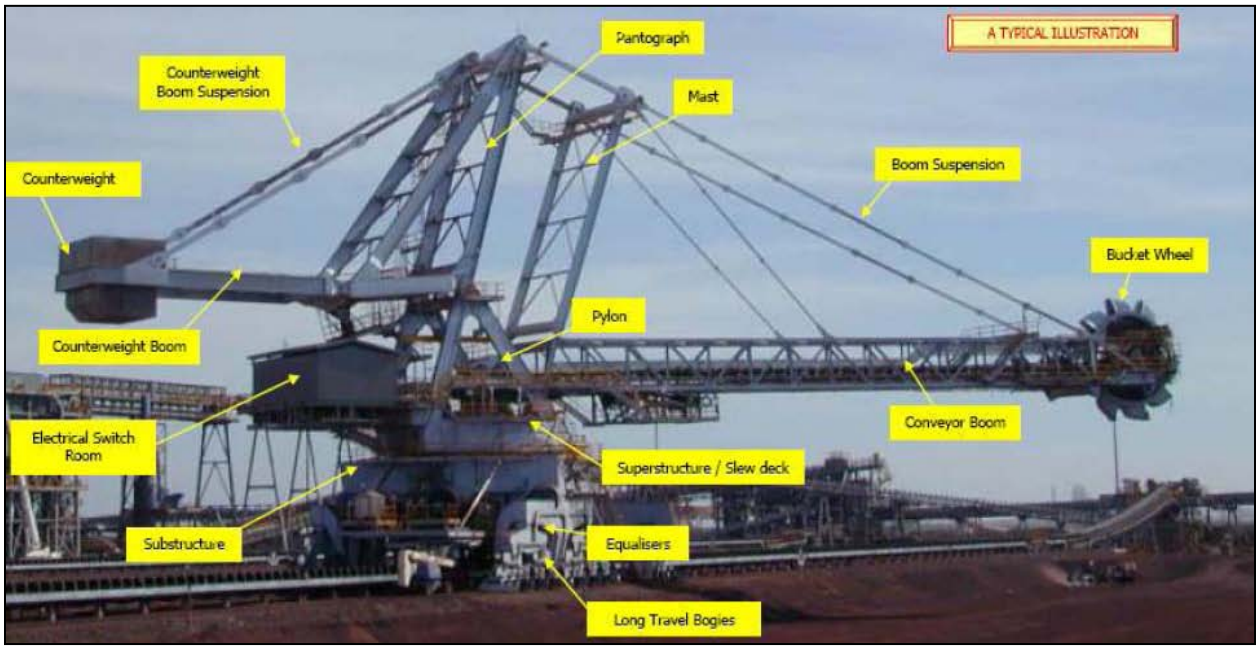
Appendix A:
Equipment Required to Pass Over the Mainland and Island Access

Table A-1: Largest piece of equipment passing over mainland to island access

Equipment Description	Number	Dimensions (m)			Weight	Year				Comments
PM503	of Units	L	W	H	(kg)	2012	2013	2014	2015	
Material Handling Equipment										
Reclaimer Undercarriage, complete with bogies wheels and equalizers	2	30	16	9	522,000			X		See Figure 2, Figure 3
Stacker cwt boom section	3	30	14	7	280,000				X	See Figure 5
Reclaimer boom with mechanicals	2	60	6.4	3.8	180,000				X	See Figure 5
Stacker Boom with mechanicals	5	50	6.4	3.2	140,000				X	See Figure 5
Stacker Tripper Car gallery c/w mechanicals	4	60	3.5	2.3	120,000				X	See Figure 5
Bucket Wheel Complete	2	11.5	11.5	11.5	85,000				X	See Figure 4
Construction Equipment										
777 Rock/Haul Truck	-	10.53	5.22	5.2	163,293	X	X			See Figure 7-9
DEMAG 400t (440 US ton) crane (exc. Counterweight)	-	10.25	8.45	3	133,000	X	X			See Figure 10-12
Transporter	-	21.00	5.0	8.0	161,400			X	X	See Figure 13-15

As shown in **Figure A-1**, there are many components to the Bucket Wheel Reclaimer. The main components include; Bucket Wheel, Superstructure (undercarriage), Counterweight and Conveyor boom. These components are shown below in images and drawings.

Figure A-1: Bucket Wheel Reclaimer



The Undercarriage for the Bucket Wheel Reclaimer is shown in **Figure A-2** with the bogies, wheels and equalizers attached. **Figure A-3** shows the bogie assembly.

Figure A-2: Bucket wheel Reclaimer Under Carriage with bogies, wheels and equalizers

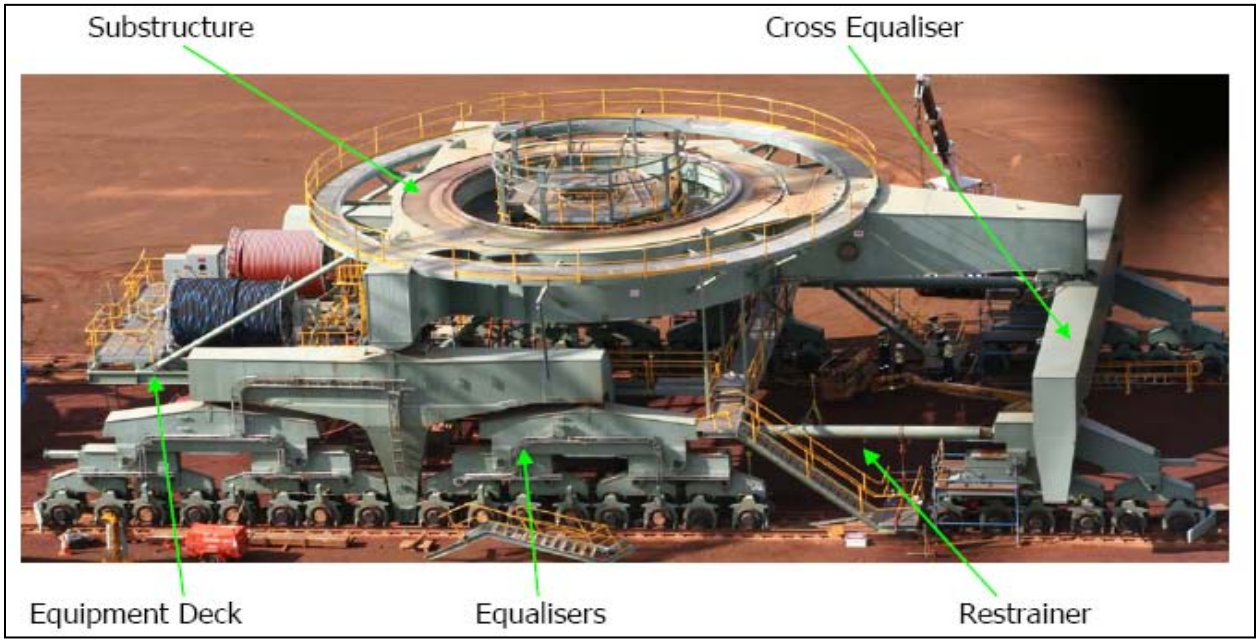
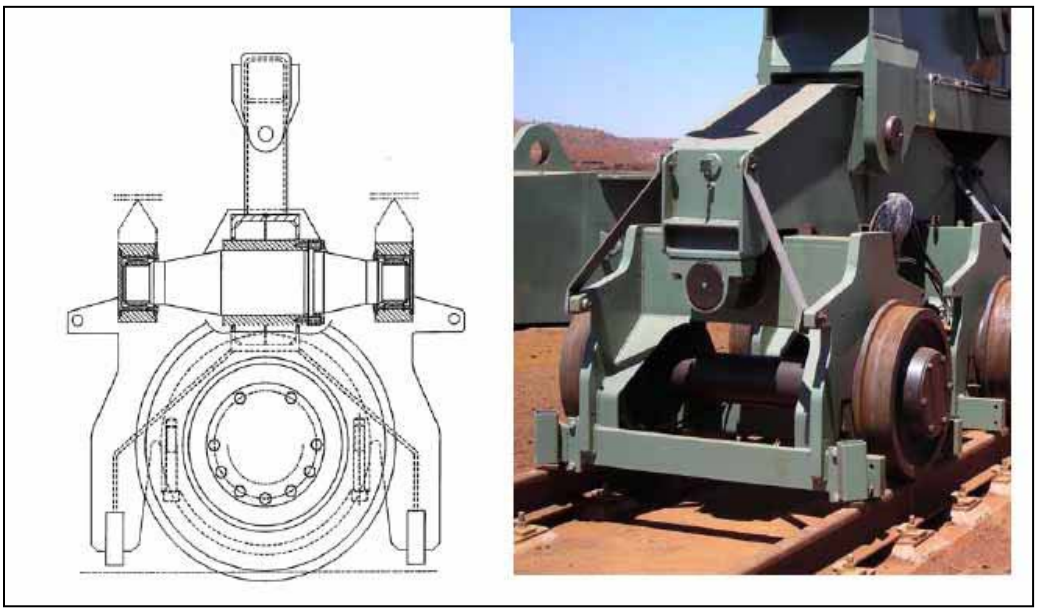
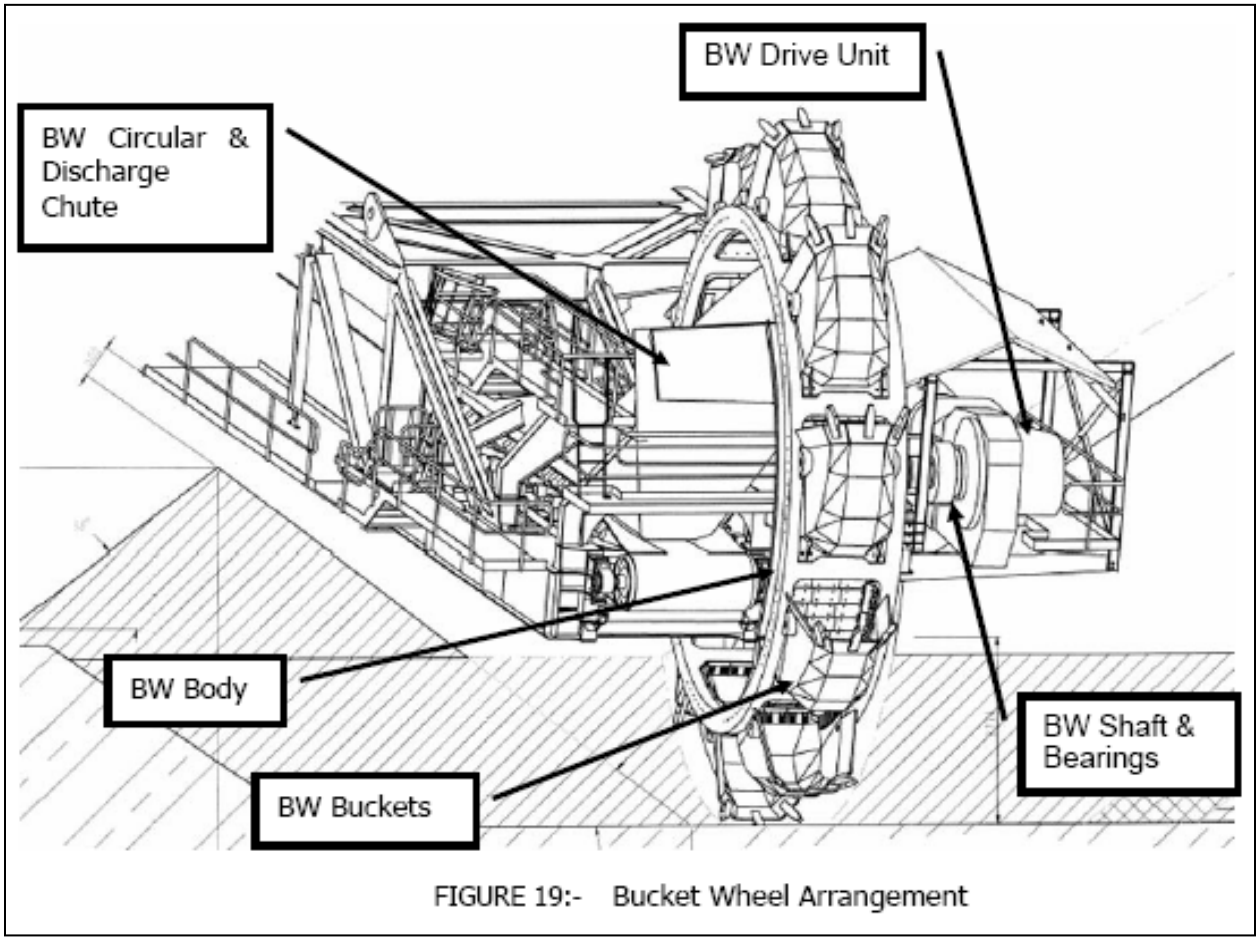


Figure A-3: Bogie Assembly



Shown in **Figure A-4**, is the Bucket Wheel Assembly which is one of the main components on the Bucket Wheel Reclaimer.

Figure A-4: Bucket Wheel Assembly

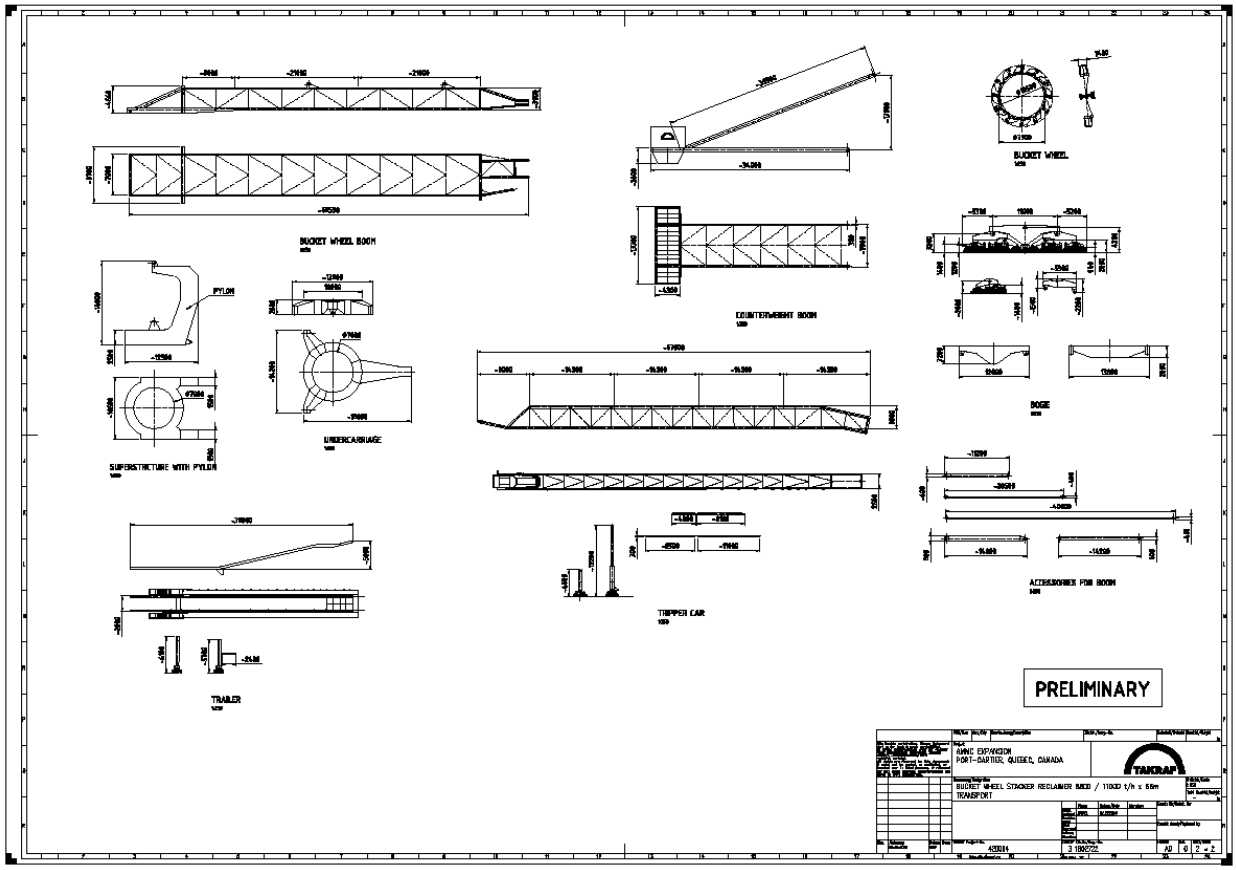


All of the components mentioned in Table A-1, are shown below in **Figure A-5**.

Figure A-5 includes which corresponds with Table A-1:

1. Bogie
2. Counterweight Boom
3. Bucket Wheel with Boom
4. Bucket Wheel without Boom
5. Trailer and Tripper Car
6. Bucket Wheel

Figure A-5: Bucket Wheel Stacker Reclaimer 8800 / 11000 t/h x 66m Transport, page 2



In Figure 6, are the components that are mentioned in **Figure A-5**and complied together to form the Bucket Wheel Reclaimer, also shown in **Figure A-1**.

Figure A-6: Bucket Wheel Stacker Reclaimer 8800 / 11000 t/h x 66m Transport, page 1

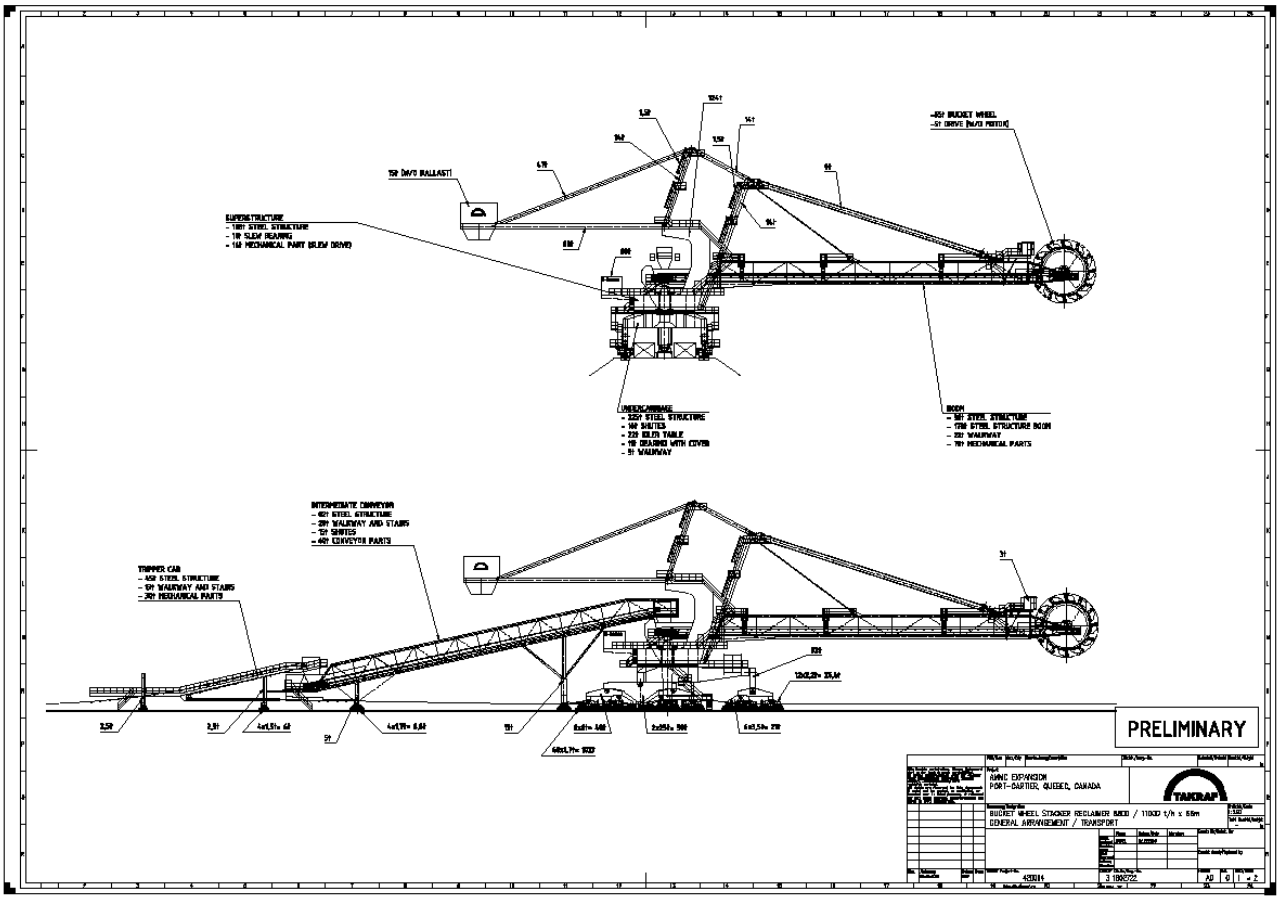
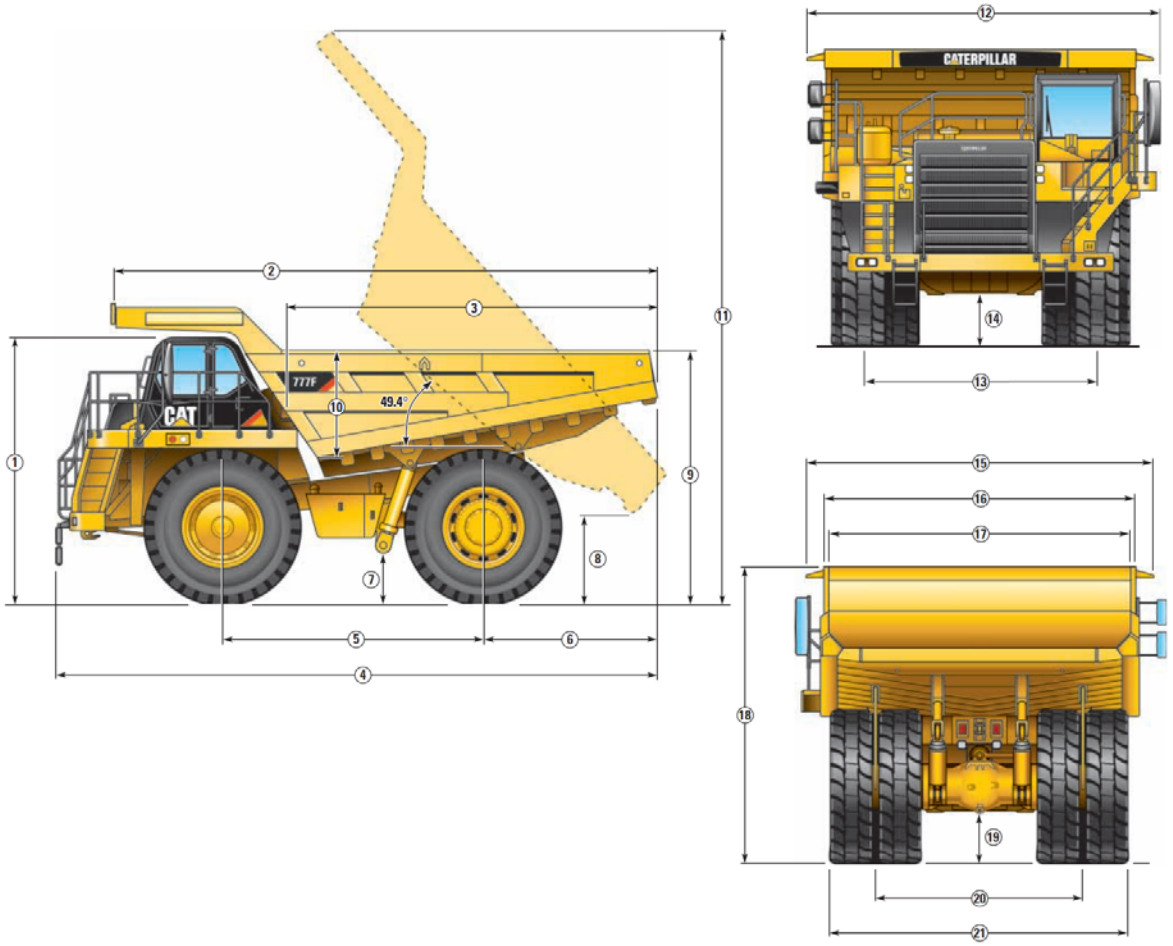


Figure A-7: 777F Off-Highway Truck, page 1

Dimensions

All dimensions are approximate.



1	Height to top of ROPS	4715 mm	15 ft 6 in
2	Overall Body Length	9830 mm	32 ft 3 in
3	Inside Body Length	6580 mm	21 ft 7 in
4	Overall Length	10 535 mm	34 ft 7 in
5	Wheelbase	4560 mm	15 ft
6	Rear Axle to Tail	3062 mm	10 ft 1 in
7	Ground Clearance	896 mm	2 ft 11 in
8	Dump Clearance	965 mm	3 ft 2 in
9	Loading Height – Empty	4380 mm	14 ft 4 in
10	Inside Body Depth – Max	1895 mm	6 ft 3 in
11	Overall Height – Body Raised	10 325 mm	33 ft 11 in

12	Operating Width	6494 mm	21 ft 4 in
13	Centerline Front Tire Width	4050 mm	13 ft 3 in
14	Engine Guard Clearance	864 mm	2 ft 10 in
15	Overall Canopy Width	6050 mm	19 ft 10 in
16	Outside Body Width	5524 mm	18 ft 2 in
17	Inside Body Width	5200 mm	17 ft 1 in
18	Front Canopy Height	5170 mm	17 ft
19	Rear Axle Clearance	880 mm	2 ft 11 in
20	Centerline Rear Dual Tire Width	3576 mm	11 ft 9 in
21	Overall Tire Width	5223 mm	17 ft 2 in

Figure A-8: 777F Off-Highway Truck, page 2

Weight/Payload Calculation

(Example)

	Dual Slope					
	No Liner		Steel Liner (16 mm)		Rubber Liner (102 mm)	
Target Gross Machine Weight*	163 293 kg	360,000 lb	163 293 kg	360,000 lb	163 293 kg	360,000 lb
Empty Chassis Weight*	48 008 kg	105,839 lb	48 008 kg	105,839 lb	48 008 kg	105,839 lb
Body Weight	16 420 kg	36,200 lb	16 420 kg	36,200 lb	16 420 kg	36,200 lb
Body Liner	—	—	5767 kg	12,714 lb	6766 kg	14,914 lb
Empty Machine Weight	64 428 kg	142,039 lb	70 195 kg	154,753 lb	71 194 kg	156,953 lb
Attachments**	—	—	—	—	—	—
Fuel Tank Size	1136 L	300 gal	1136 L	300 gal	1136 L	300 gal
Fuel Tank – 90% fill	861 kg	1,898 lb	861 kg	1,898 lb	861 kg	1,898 lb
Debris Allowance	1921 kg	4,234 lb	1921 kg	4,234 lb	1921 kg	4,234 lb
Empty Operating Weight**	67 210 kg	148,173 lb	72 977 kg	160,885 lb	73 976 kg	163,085 lb
Target Payload*	96 083 kg	211,827 lb	90 316 kg	199,115 lb	89 317 kg	196,915 lb
Target Payload*	**96.1 tonnes**	**105.9 tons**	**90.3 tonnes**	**99.5 tons**	**89.3 tonnes**	**98.5 tons**

* Refer to the Caterpillar 10/10/20 overload policy
** Includes weight of all attachments

Figure A-9: 777F Off-Highway Truck, page 3

Gradeability/Speed/Rimpull

To determine gradeability performance: Read from gross weight down to the percent of total resistance. Total resistance equals actual percent grade plus 1% for each 10 kg/t (20 lb/ton) of rolling resistance. From this weight-resistance point, read horizontally to the curve with the highest obtainable gear, then down to maximum speed. Usable rimpull will depend upon traction available and weight on drive wheels.

Direct Drive
Torque Converter Drive
E – Typical Field Empty Weight
L – Target Gross Machine Operating Weight 163 293 kg (360,000 lb)

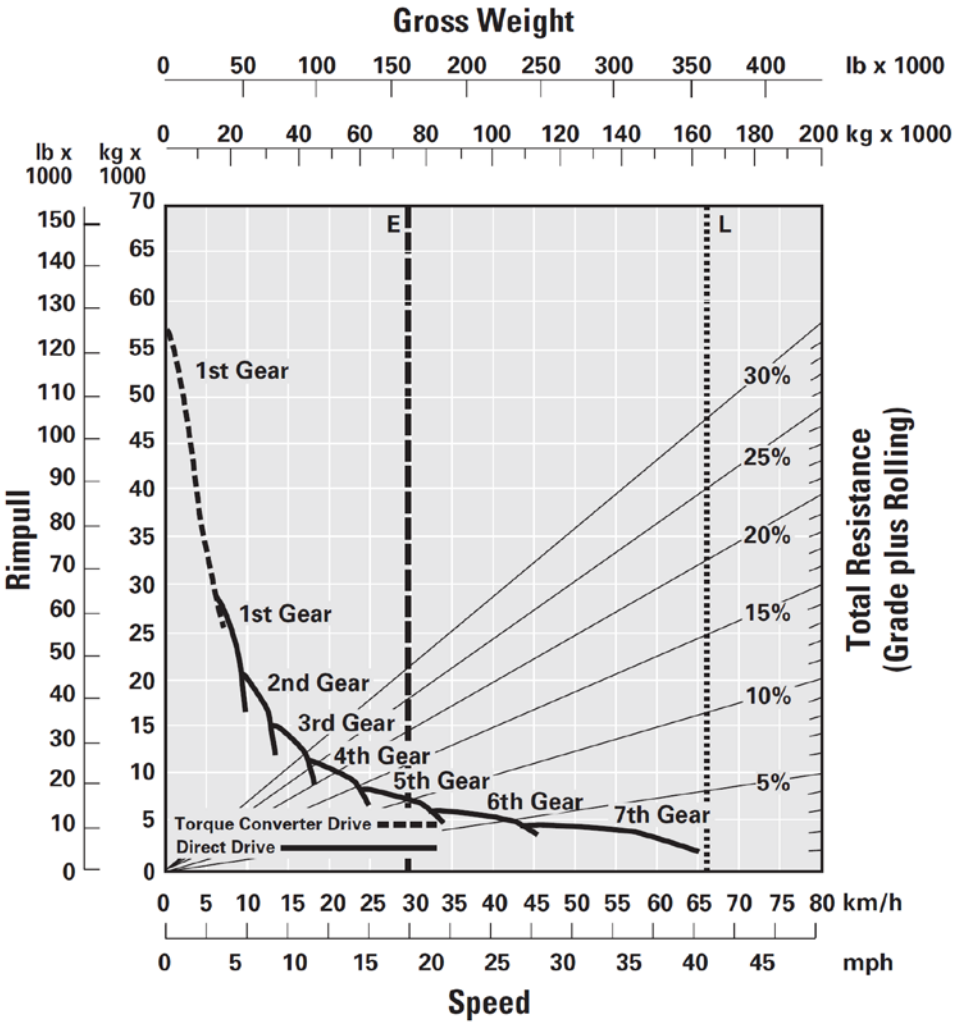


Figure A-10: DEMAG 400t (440 US ton) crane

SPECIFICATIONS · TECHNISCHE DATEN · CARACTÉRISTIQUES	
WEIGHTS · GEWICHTE · POIDS	
Total weight incl. 100 t counterweight, 24 m boom and hook block Gesamtgewicht einschl. 100 t Gegengewicht, 24 m Hauptausleger und Unterflasche Poids avec 100 t de contrepoids, flèche de 24 m et crochet	233 t
Superstructure (with 3 winches, A-frame, carbody, self-assembly equipment) Oberwagen (mit 3 Winden, A-Bock, Mittelstück, Selbstmontageausrüstung) Partie supérieure (avec 3 tambours, chevalet, partie centrale, équipement automontage)	59,6 t
Superstructure (with 3 winches, A-frame and quick-connection) Oberwagen (mit 3 Winden, A-Bock und Schnellverbindung) Partie supérieure (avec 3 tambours, chevalet et connexion rapide)	39,6 t
Carbody with jacks and quick-connection Mittelstück mit Abstützung und Schnellverbindung Partie centrale avec appuis et connexion rapide	21,9 t
Crawlers with track shoes (1200 mm) Raupen mit Bodenplatten (1200 mm) Chenilles avec patins (1200 mm)	2 x 23,4 t
Counterweight Gegengewicht Contrepoids	100 t

Figure A-11: DEMAG 400t (440 US ton) crane

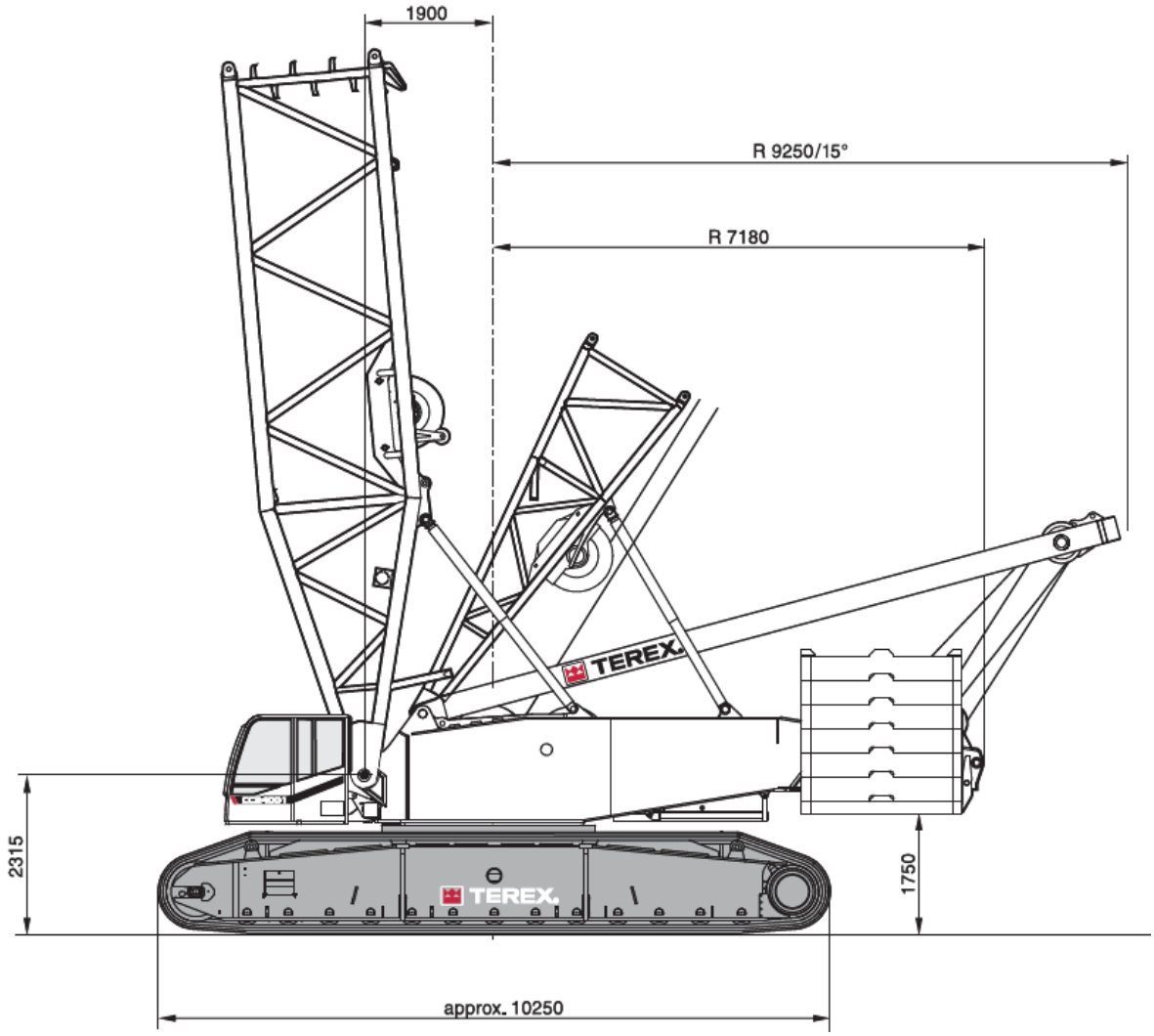


Figure A-12: DEMAG 400t (440 US ton) crane

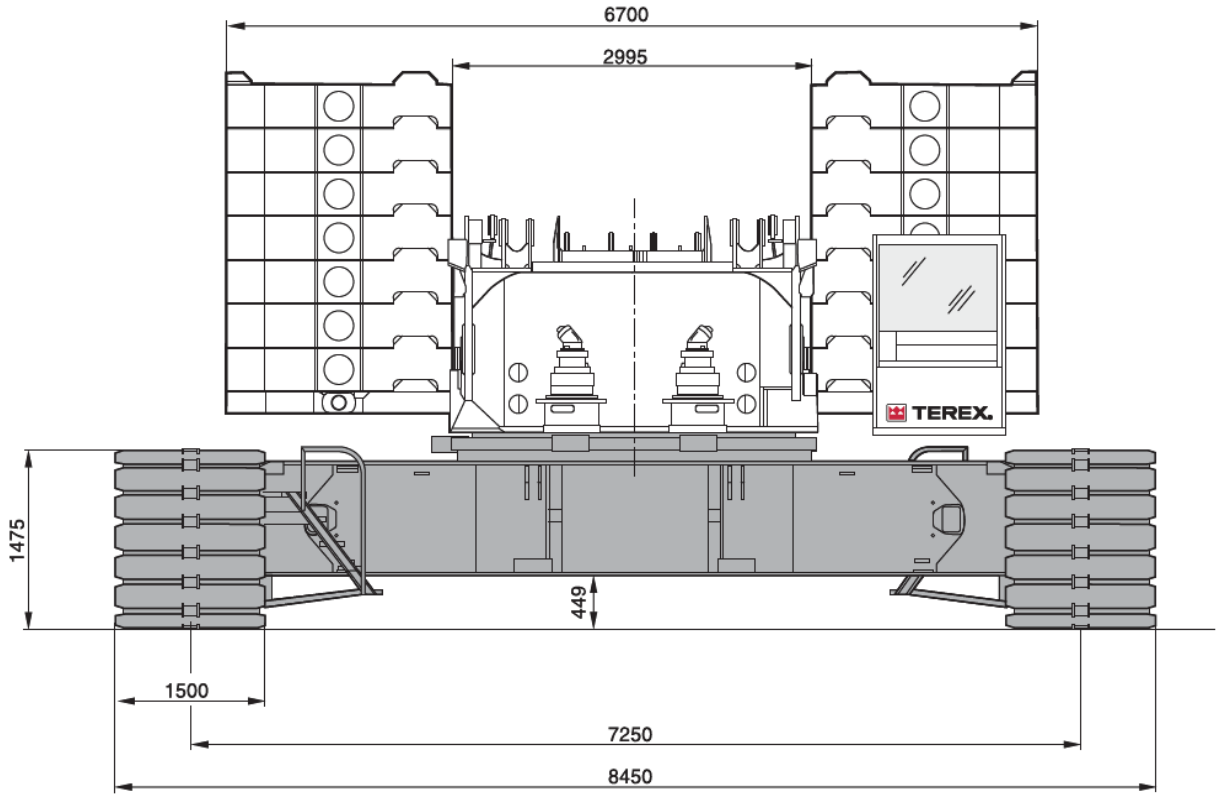


Figure A-13: Typical Transporter

OVERALL WEIGHTS:

TRAILER AND EQUIPMENT:		
TRAILER TARE WEIGHT:	141 400 KGS	311,734 LBS
EQUIPMENT WEIGHT:	20 000 KGS	44,092 LBS
CARGO:		
STACKER WEIGHT:	522 000 KGS	1,150,813 LBS
TOTAL WEIGHT:	683 400 KGS	1,506,639 LBS

Figure A-14: Typical Transporter, Plan

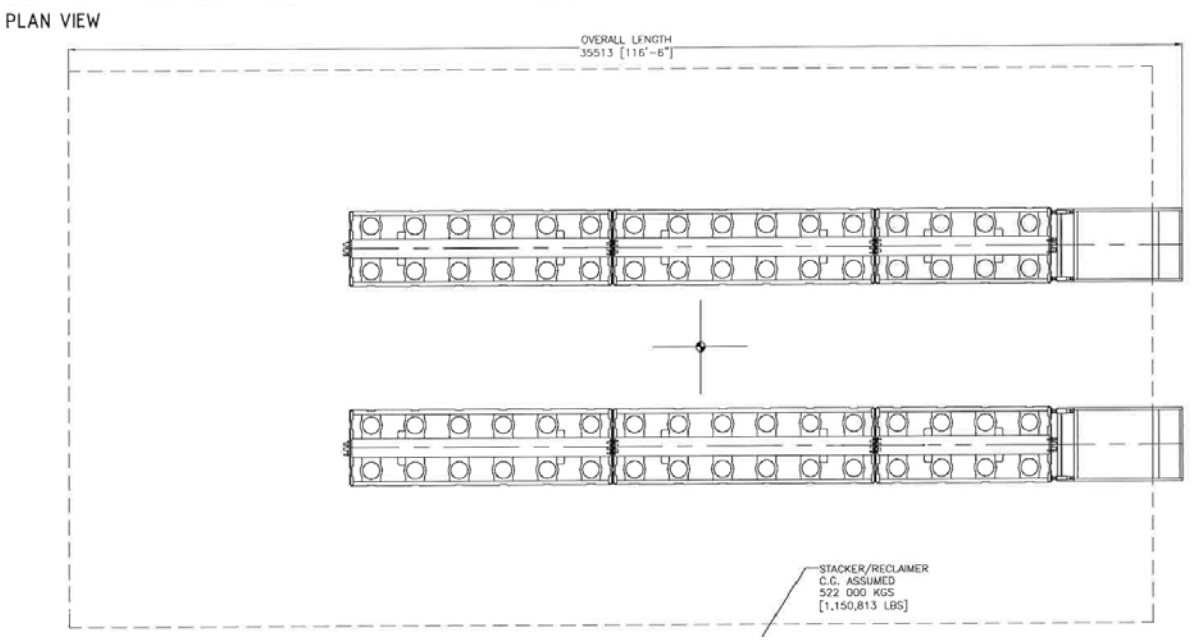


Figure A-15: Typical Transporter, Elevation and Loadings