

**Precast Ballast Block Delivery and Installation
Wallingford Renewable Energy Project
25 Pent Road, Wallingford CT**

Ballast Procurement:

- Target NTP - Mid March
- 3-4 weeks to build forms
- Target Start for Fabricating Ballasts – Mid April
 - o 40ea Type B per day (56 total production days)
 - o 40ea Type C per day (56 total production days)
- Target Start for Delivering Ballasts – Mid May
 - o 6 trucks of ballasts delivered per day (108 ballasts per calendar day)
 - Each truck would have 9ea Type B's and 9ea Type C's per truck (48,600 lbs)
 - 41 delivery days

Ballast Prep; Survey / Gravel Pads:

- Target NTP – Mid March
- Target Start For Surveying – Early May
 - o Survey all end of rows and each ballast location
 - o Determine if each ballast location will require gravel pads, i.e. if slope on ballast will be more than 10% slope.
 - Place 1 ½" gravel and compact as specified. Finer gravel may be used to top off gravel pads to help create a level pad.
 - Taper gravel pads as specified

Ballast Logistics and Installation:

- Precast concrete ballast will be delivered to the site on 40 foot flatbed trailers. The tractor trailers will enter the site via Pent Road and will be unloaded in a temporary staging area. Proposed staging areas are identified in the attached marked up Google Earth shot; Areas shown in blue, red, and purple show the proposed temporary ballast staging areas.
- Ballasts will be unloaded off flat-bed delivery trucks with either a wheeled telehandler (LULL) or a wheeled skid steer (BOBCAT) by picking up the blocks from underneath with forks.



- Ballasts will be transported from staging area to the approximation permanent location.
 - o Ballasts will have to be transported on the landfill proper with low ground pressure tracked equipment (1000 psf or less). They will be moved from the purple temporary ballast laydown area to the approximate permanent location with either a tracked dump truck (MOROOKA) or a track BOBCAT. Either a BOBCAT or medium-sized excavator (Komatsu PC160 Excavator or similar) will be used to set the blocks in final permanent location.

Ballasts will be set by hooking (2) two straps to pre-set lifting inserts in the tops or sides of the ballasts



Attachments:

- Proposed laydown Area Locations (Google Earth)
- Morooka Crawler Carrier Specifications
- Komatsu PC160 LC-8 Hydraulic Excavator Specifications



MOROOKA

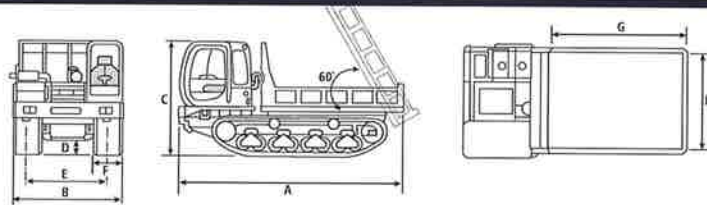


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MOROOKA

Crawler Carriers



Specifications

MODEL		MST-300VD		MST-300VDR		MST-600VD/L		MST-800VD/L		MST-1500VD		MST-2200VD		MST-3000VD	
LENGTH	A	10'4"	3150 MM	10'4"	3150 MM	12'6"/15'	3810/4572 MM	14'9"/17'9"	4496/5410 MM	17'11"	5461 MM	20'2"	6147 MM	20'2"	6147 MM
WIDTH	B	5'4"	1626 MM	5'4"	1626 MM	6'5"	1956 MM	8"	2438 MM	8'6"	2591 MM	9'7"	2921 MM	10'5"	3175 MM
HEIGHT	C	7'6"	2318 MM	7'6"	2318 MM	7'6"	2286 MM	8'3"	2515 MM	9'6"	2896 MM	10'5"	3175 MM	10'4"	3150 MM
MIN. GROUND CLEARANCE	D	11"	280 MM	11"	280 MM	14"	356 MM	18"	457 MM	20"	508 MM	15"	381 MM	20"	508 MM
GAUGE	E	4'1"	1245 MM	4'1"	1245 MM	4'9"	1448 MM	5'7"	1702 MM	5'11"	1803 MM	6'9"	2057 MM	7'4"	2235 MM
TRACK WIDTH	F	14"	350 MM	14"	350 MM	20"	500 MM	24"	600 MM	28"	700 MM	30"	750 MM	31.5"	800 MM
LENGTH OF DUMP BED	G	4'10"	1474 MM	6'5"	2000 MM	7'4"/9'7"	2235/2921 MM	8'8"/11'11"	2642/3632 MM	10'2"	3099 MM	11'10"	3607 MM	12'	3658 MM
WIDTH OF DUMP BED	H	4'7"	1397 MM	4'7"	1397 MM	5'10"	1778 MM	6'8"	2032 MM	7'3"	2210 MM	8'7"	2617 MM	8'2"	2489 MM
WEIGHT		4,850 LBS	2200 KG	5,291 LBS	2400 KG	8,800 LBS	3992 KG	14,140 LBS	6414 KG	22,040 LBS	9998 KG	31,820 LBS	14,434 KG	33,140 LBS	15,032 KG
FUEL CAPACITY		13.7 GAL	51 L	13.7 GAL	51 L	22 GAL	83 L	27.7 GAL	105 L	39.6 GAL	150 L	65 GAL	247 L	75 GAL	284 L
ENGINE MFG / MODEL		KUBOTA / V2203		KUBOTA / V2203		KUBOTA / V3307		CATERPILLAR / C4.4		CATERPILLAR 7.1		CATERPILLAR 7.1		Cummins QSL9	
HORSE POWER		46		46		76		129		225		250		325	
TRANSMISSION		HST		HST		HST		HST		HST		HST		HST	
MAXIMUM LOAD		5,000 LBS	2268 KG	5,000 LBS	2268 KG	8378 LBS	3800 KG	10,584 LBS	4800 KG	15,435 LBS	7000 KG	24,255 LBS	11,000 KG	33,016 LBS	14,975 KG
TRAVEL SPEED (LOW-HIGH)		3.7-5.6 MPH	6-9 KM/H	3.7-5.6 MPH	6-9 KM/H	4.7-7.5 MPH	7.6-12 KM/H	5.1-7.5 MPH	8.2-12 KM/H	4.7-6.8 MPH	7.6-11 KM/H	8 MPH	12.8 KM/H	5-7.5 MPH	8-12 KM/H
GRND PRESSURE ~ EMPTY		2.4 PSI	0.17 KG/CM ²	2.4 PSI	0.17 KG/CM ²	3.6 PSI	0.25 KG/CM ²	2.3 PSI	0.16 KG/CM ²	2.4 PSI	0.17 KG/CM ²	3.1 PSI	0.22 KG/CM ²	2.6 PSI	0.18 KG/CM ²
GRND PRESSURE ~ LOADED		4.6 PSI	0.32 KG/CM ²	4.6 PSI	0.32 KG/CM ²	7.2 PSI	0.50 KG/CM ²	3.8 PSI	0.27 KG/CM ²	3.9 PSI	0.28 KG/CM ²	5.7 PSI	0.40 KG/CM ²	4.8 PSI	0.33 KG/CM ²

MOROOKA

11191 Air Park Road, Ashland, VA 23005
Phone: 1-877-667-6652 | Fax: 1-804-752-7523
www.morookacarriers.com

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Dealer

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REV 03-2016

KOMATSU®

PC160LC-8

NET HORSEPOWER

86 kW **115 HP** @ 2200 rpm

OPERATING WEIGHT

16680–17120 kg **36,770–37,740 lb**

BUCKET CAPACITY

0.37–0.95 m³ **0.48–1.24 yd³**

PC
160
LC

HYDRAULIC EXCAVATOR



Photo may include optional equipment.

WALK-AROUND

Ecology and Economy Features

- **Low Emission Engine**

A powerful turbocharged and air-to-air aftercooled Komatsu SAA4D107E-1 engine provides 86 kW **115 HP** (net). This engine is EPA Tier 3 and EU Stage 3A emissions certified, without sacrificing power or machine productivity.

- **Low Operational Noise**

The dynamic noise is reduced providing low noise operation

- **Selectable Working Modes**

Match performance to the application and minimize fuel consumption with E mode

- **Extended Idling Caution**

- **Eco-gauge**

Assists energy saving operation

- **Low Fuel Consumption**

Additional Features

- Innovative cab design
- Slip-resistant plates to improve foot grip
- Large side-view and sidewise mirrors
- Rear view monitoring system
- Operator Protective Guard (OPG) top guard Level 2 capable



Large TFT LCD Monitor

- Easy-to-see and use large 7" multi-function color monitor
- Can be displayed in 12 languages

TFT : Thin Film Transistor
LCD : Liquid Crystal Display

- Easy hydraulic flow adjustment

KOMTRAX®

KOMTRAX equipped machines can send location, SMR and operation maps to a secure website utilizing wireless technology. Machines also relay error codes, cautions, maintenance items, fuel levels, and much more.

NET HORSEPOWER
86 kW 115 HP @ 2200 rpm

OPERATING WEIGHT
16680 – 17120 kg
36,770 – 37,740 lb

BUCKET CAPACITY
0.37 – 0.95 m³
0.48 – 1.24 yd³

Maintenance Features

- Long replacement interval of engine oil, engine oil filter, hydraulic oil and hydraulic filter
- Fuel pre-filter with water separator as standard equipment
- Side-by-side cooling concept enables servicing of individual cooling modules
- Easy access to engine oil filter, fuel filter and fuel drain valve
- Fuel filter is remotely mounted to improve accessibility
- Self-diagnostic monitor

Large Comfortable Cab

- Low-noise cab design
- Low vibration with viscous cab damper mounting
- Highly pressurized cab with automatic air conditioner
- Operator seat and console with armrest that enables ergonomic operational posture
- Automatic air conditioner

Reliability Features

- High rigidity work equipment
- Sturdy frame structure
- Reliable Komatsu manufactured major components
- Reliable electronic devices
- In-line hydraulic filters



Photo may include optional equipment.

SPECIFICATIONS



*EPA Tier 3 and EU Stage 3A emissions certified.



Hydraulic cylinders:
(Number of cylinders – bore x stroke x rod diameter)

Boom	2–110 mm x 1175 mm x 75 mm	4.3" x 46.3" x 3.0"
Arm	1–120 mm x 1342 mm x 85 mm	4.7" x 52.8" x 3.3"
Bucket	1–105 mm x 1027 mm x 70 mm	4.1" x 40.4" x 2.8"



DRIVES AND BRAKES

UNDERCARRIAGE

SERVICE REFILL CAPACITIES

OPERATING WEIGHT (APPROXIMATE)

Shoes		Operating Weight		Ground Pressure		
mm	in	kg	lb	kPa	kg/cm²	psi
600	24"	16900	37,260	40.3	0.41	5.84
700	28"	17120	37,740	35.0	0.36	5.08
800	31.5"	17420	38,400	31.0	0.32	4.49

subtract bucket
weight of 1,100lbs

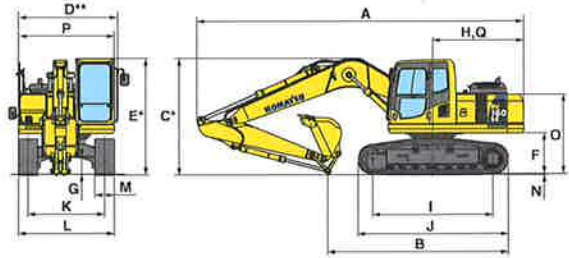


DIMENSIONS

	Arm Length	2610 mm	8'7"	2900 mm	9'6"
A	Overall length	8565 mm	28'1"	8565 mm	28'1"
B	Length on ground (transport)	4760 mm	15'7"	4565 mm	15'0"
C	Overall height (to top of boom)*	3025 mm	9'11"	3125 mm	10'3"

D	Overall width**	2590 mm	8'6"
E	Overall height (to top of cab)*	3030 mm	9'10"
F	Ground clearance, counterweight	1055 mm	3'6"
G	Ground clearance (minimum)	440 mm	1'5"
H	Tail swing radius	2435 mm	8'0"
I	Track length on ground	3170 mm	10'5"
J	Track length	3965 mm	13'0"
K	Track gauge	1990 mm	6'6"
L	Width of crawler	2590 mm	8'6"
M	Shoe width	600 mm	24"
N	Grouser height	26 mm	1.0"
O	Machine cab height	2065 mm	6'9"
P	Machine cab width	2490 mm	8'2"
Q	Distance, swing center to rear end	2390 mm	7'10"

* Including grouser height ** Including handrail



BACKHOE BUCKET AND ARM COMBINATION

Bucket Type	Bucket			Arms	
	Capacity	Width	Weight	2.6 m 8'7"	2.9 m 9'6"
Komatsu TL	0.47 m ³	610 mm	506 kg	V	V
	0.62 m ³	762 mm	568 kg	V	V
	0.78 m ³	914 mm	660 kg	W	X
	0.95 m ³	1067 mm	705 kg	X	Y
Komatsu HP	0.37 m ³	508 mm	511 kg	V	V
	0.47 m ³	610 mm	572 kg	V	V
	0.62 m ³	762 mm	649 kg	V	V
	0.78 m ³	914 mm	735 kg	W	X
	0.95 m ³	1067 mm	806 kg	Y	Y
Komatsu HPS	0.37 m ³	508 mm	563 kg	V	V
	0.47 m ³	610 mm	635 kg	V	V
	0.62 m ³	762 mm	729 kg	V	W
	0.78 m ³	914 mm	831 kg	X	X
	0.95 m ³	1067 mm	919 kg	Y	Z

V – Used with densities up to 3,500 lb/yd³, W – Used with densities up to 3,000 lb/yd³

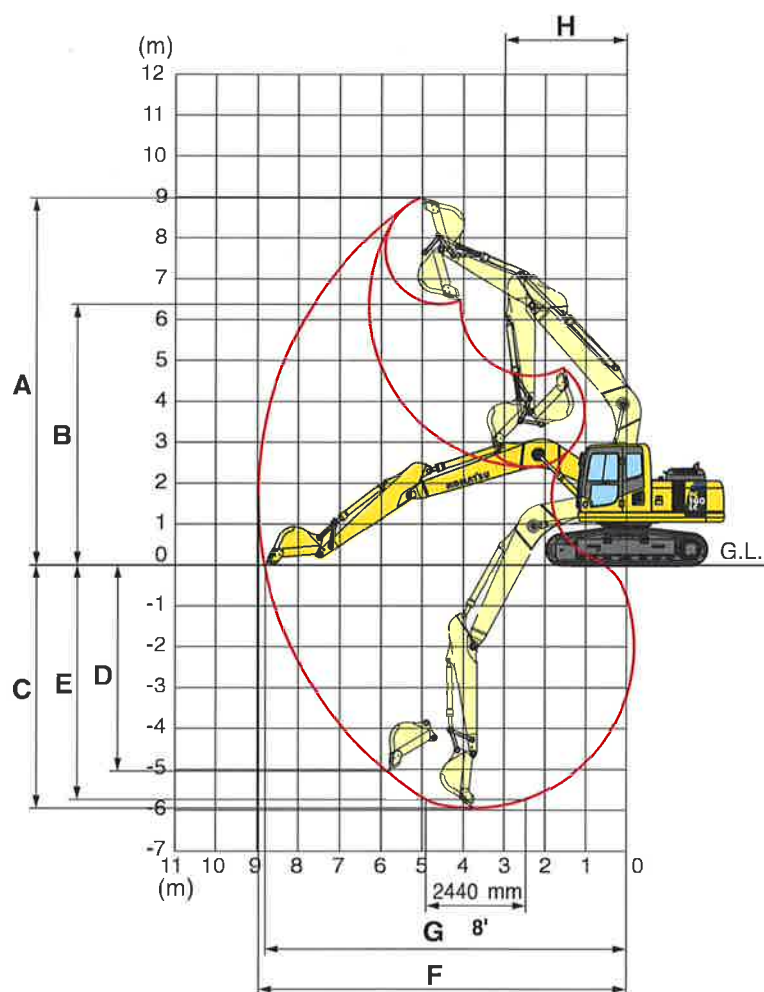
X – Used with densities up to 2,500 lb/yd³, Y – Used with densities up to 2,000 lb/yd³, Z – Not useable

COMMENTS: When using any quick coupler or other attachment equipment, there is an increased risk of the bucket hitting the cab.

*See the Operation & Maintenance Manual for detailed bucket installation instructions.



WORKING RANGE



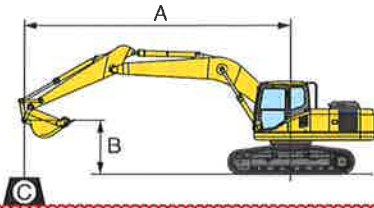
	Arm	2610 mm 8'7"	2900 mm 9'6"
A	Max. digging height	8980 mm 29'6"	9130 mm 29'11"
B	Max. dumping height	6370 mm 20'11"	6525 mm 21'5"
C	Max. digging depth	5960 mm 19'6"	6250 mm 20'6"
D	Max. vertical wall digging depth	5040 mm 16'6"	5320 mm 17'5"
E	Max. digging depth of cut for 8' level bottom	5740 mm 18'10"	6050 mm 19'10"
F	Max. digging reach	8960 mm 29'5"	9235 mm 30'4"
G	Max. digging reach at ground level	8800 mm 28'10"	9075 mm 29'9"
H	Min. swing radius	2990 mm 9'10"	2995 mm 9'10"
SAE rating	Bucket digging force at power max.	109 kN 11100 kgf/24,470 lb	109 kN 11100 kgf/24,470 lb
	Arm crowd force at power max.	83.4 kN 8500 kgf/18,740 lb	77.5 kN 7900 kgf/17,420 lb
ISO rating	Bucket digging force at power max.	123 kN 12500 kgf/27,560 lb	123 kN 12500 kgf/27,560 lb
	Arm crowd force at power max.	86.3 kN 8800 kgf/19,400 lb	79.4 kN 8100 kgf/17,860 lb

PC160LC-8 HYDRAULIC EXCAVATOR

LIFTING CAPACITIES



LIFTING CAPACITY



- A: Reach from swing center
 B: Bucket hook height
 C: Lifting capacity
 Cf: Rating over front
 Cs: Rating over side
 ⊗: Rating at maximum reach

Conditions:

- Arm: 2610 mm 8'7"
- Boom length 5150 mm 16'11"
- Bucket 0.65 m³ 0.85 yd³ (SAE heaped)
 –Bucket weight: 500 kg 1,100 lb.
- Lifting mode: On

PC160LC-8 Shoe 800 mm 31.5"												Unit: kg/lb	
B \ A	1.5 m 5'		3.0 m 10'		4.6 m 15'		6.1 m 20'		7.6 m 25'		MAX		
	Cf	Cs	Cf	Cs	Cf	Cs	Cf	Cs	Cf	Cs	Cf	Cs	
7.6 m 25'											*2250 5,000	*2250 5,000	
6.1 m 20'							*3050 6,800	2950 6,500			*2000 4,400	*2000 4,400	
4.6 m 15'							*4150 9,100	3900 8,600			*2000 4,400	*2000 4,400	
3.0 m 10'			*8450 18,600	*8450 18,600	*5750 12,700	4450 9,800	4550 10,100	2750 6,100	2750 6,100	1850 4,100	*2050 4,600	1750 3,900	
1.5 m 5'			*8500 18,800	7500 16,500	7000 15,500	4100 9,000	4400 9,700	2500 5,500	3050 6,700	1800 3,900	*2250 5,000	1650 3,700	
0 m 0'			*7650 16,900	7100 15,600	6700 14,800	3850 8,500	4250 9,400	2500 5,500	3000 6,600	1750 3,800	*2650 5,900	1700 3,700	
1.5 m -5'	*5900 13,000	*5900 13,000	*10500 23,200	7050 15,500	6600 14,600	3750 8,200	4200 9,200	2400 5,300			*2250 7,100	1850 4,100	
3.0 m -10'	*9400 20,700	*9400 20,700	*10900 24,100	7150 15,800	6650 14,600	3750 8,300	4200 9,300	2450 5,400			4000 8,900	2350 5,200	
4.6 m -15'			*17,400	7450 16,500	*5,500 11,500	3950 8,700					*4950 10,900	3750 8,300	

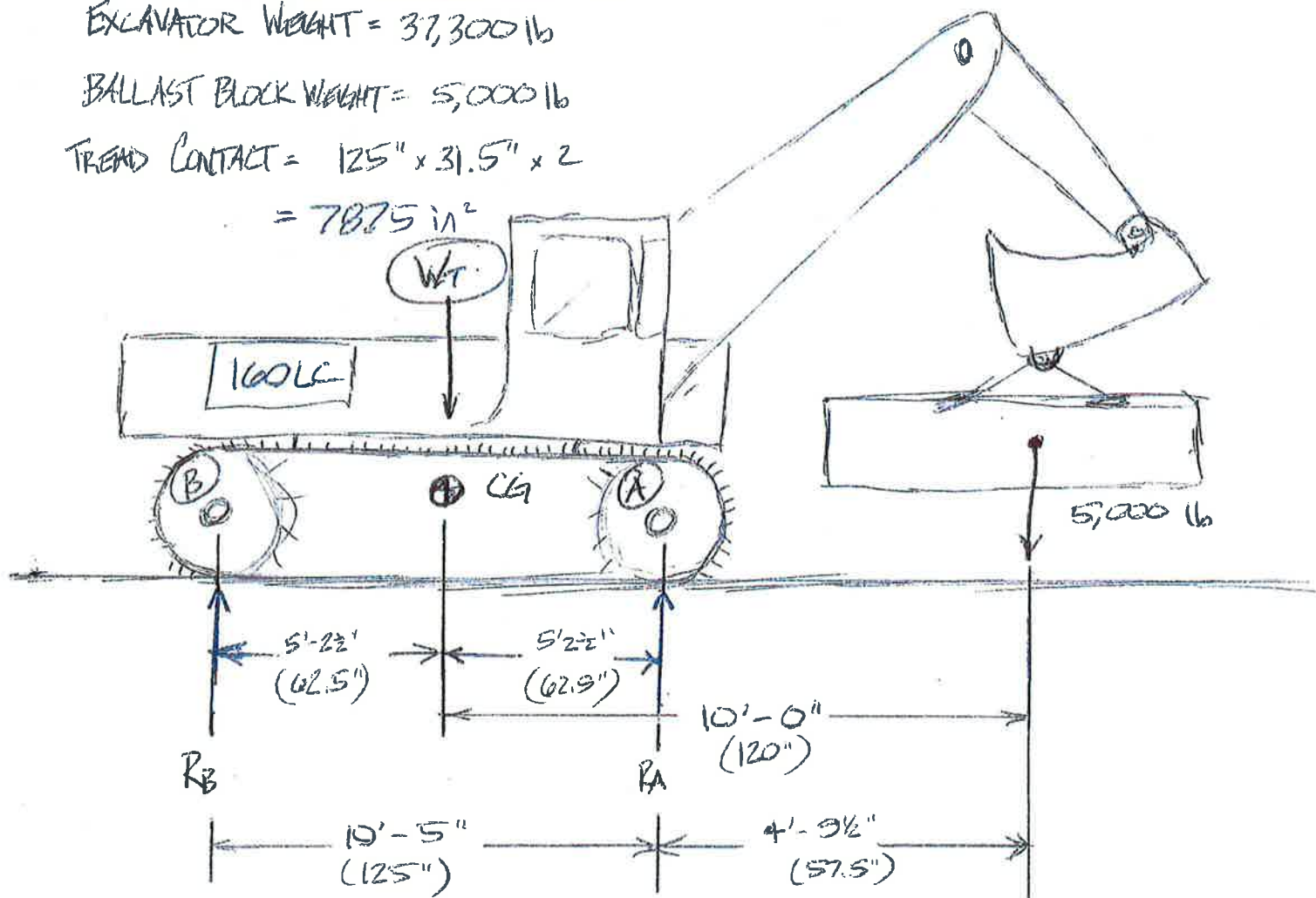
*Load is limited by hydraulic capacity rather than tipping. Ratings are based on SAE standard No. J1097. Rated loads do not exceed 87% of hydraulic lift capacity or 75% of tipping load.

KOMATSU PC160LC-8

EXCAVATOR WEIGHT = 37,300 lb

BALLAST BLOCK WEIGHT = 5,000 lb

TREAD CONTACT = 125" x 31.5" x 2
= 7875 in²

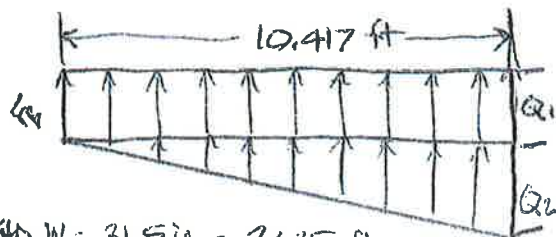


$$\sum F_y = 0 \therefore R_A + R_B - 37,300 - 5,000 = 0 \Rightarrow R_A + R_B = 42,300 \text{ lb}$$

$$\sum M_A = 0 \therefore W_t (62.5 \text{ in}) - R_B (125 \text{ in}) - 5,000 (57.5 \text{ in}) = 0$$

$$(37,300)(62.5 \text{ in}) - 5,000(57.5 \text{ in}) = R_B (125 \text{ in}) \Rightarrow R_B = 16,350 \text{ lb}$$

$$R_A = 42,300 \text{ lb} - 16,350 \text{ lb} \Rightarrow R_A = 25,950 \text{ lb}$$



$$Q_1 = \frac{2R_B}{10.417} = \frac{2(16,350 \text{ lb})}{10.417 \text{ ft}} = 3139 \frac{\text{lb}}{\text{ft}} \quad Q_1$$

$$\frac{1}{2} Q_2 (10.417) = (25,950 - 16,350)$$

$$\therefore Q_2 = 1843 \frac{\text{lb}}{\text{ft}} \quad Q_2$$

$$\text{TREAD } W = 31.5 \text{ in} = 2.625 \text{ ft}$$

$$Q_1 + Q_2 = 3139 + 1843 \Rightarrow 4,982 \frac{\text{lb}}{\text{ft}}$$

$$\frac{\frac{1}{2}(4,982 \frac{\text{lb}}{\text{ft}})}{2.625 \text{ ft}} = 949 \frac{\text{lb}}{\text{ft}^2} \left(\frac{1 \text{ ft}}{12 \text{ in}} \right)^2 = 6.6 \text{ psi}$$

AVG
TREAD
PRESSURE