

## *A Guide to Biomass Installation*

*Things you should consider before you install  
& the equipment best suited to your needs*



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# PERRY BIOMASS ENGINEERING

Perry Engineering is a family run business founded in the 1947 by Tom Perry, a Farmers Son, then was later taken over by Nigel Perry, who in turn handed the business down to the current Managing Director, David Perry.

Being a family business it embodies that perfect combination of “every customer is important” coupled with “we don’t stop until the job is done” which has resulted in our excellent reputation for reliable and well-engineered storage, handling & drying machinery.



The business continually invests in its people, its technology and its buildings which has led to Perry’s becoming one of the biggest businesses in the area.

Perry Biomass Engineering has over 60 years of experience of handling granular products and 35 years of experience with handling woodchip, and over the years we have encountered all sorts of logistical issues and found a different solution for each of them.



When installing a Biomass heating system often some of the last things to be considered are actually the most important aspects of a Biomass system. This guide is designed to help you make informed decisions & help to make sure you have considered all aspects of installing a Biomass system before you make the decision to invest.

It is quite common for the decision to invest in a biomass boiler to be made, and the position of the boiler decided before considering the logistics of handling the fuel. This can lead to problems when the storage and delivery of the fuel is assessed.

? 1) *Is there enough room for a lorry to tip & turn where the delivery needs to be made*



If the space is not adequate for a delivery to be made then the only solution is to move the delivery space, but this in its self can cause further issues. The decision will then need to be made as to whether you move the boiler along with the woodchip store or bunker, and then pipe the heat to where

it needs to go, or do you move the bunker and transport the fuel to the boiler using a system of conveyors.

Not only should you consider the turning space of the lorry, but you should also carefully consider the position of the intake to ensure that the lorry can tip its

goods without fear of the top of the trailer colliding with a wall or another object.

? 2) *When building your woodchip store or using an existing building, and allocating a required storage capacity have you considered the angle of repose of woodchip*

There is an angle of repose associated with woodchip because it does not flow well.



This means that when a store is filled there is an angle of 45 degrees which the edge of the pile of woodchip makes and this reduces the storage capacity of a given space. The usable capacity of the store should also be considered, for example if the chip cannot be removed from the square corners of a bunker by the discharge system then these areas will fill up once and never empty. There are methods to improve the filling of woodchip stores including full length centre augers or levelling conveyors.

Later on in this booklet there are calculators that have been designed to aid you with calculating the usable storage capacity of a new or existing building.

? 3) *Will the system fit in with the area aesthetically*

Sometimes Biomass systems can be a little unsightly, but there are options available to help reduce the impact. For example Perry Biomass Engineering produces the BIO Bin. This galvanised steel woodchip storage bin can be clad in timber or box profile sheeting to blend in with it's surroundings.



? 4) *Using systems with blowers can be noisy, will this become a nuisance*



One particular client put a woodchip blower system in place that was producing about 120db of noise. During the early periods of operation local residents complained about the noise and dust generated during delivery. Eventually the client had to replace the system with a Perry Biomass handling BIO Intake which reduced the noise generated during the delivery to less than 60db.

# BIOINTAKE

*Designed and manufactured in the UK by bulk handling specialists Perry Engineering, this range of pre-galvanised equipment can be supplied to bespoke requirements or modular built on-site.*

## *For fast intake of Biomass fuels.*

### *The challenge:*

The delivery of biomass fuels has traditionally been serviced by noisy specialist delivery trucks which have proved to be unpopular due to their expense, noise pollution and the slowness to the actual delivery process. The biomass boiler systems run smoothly once the fuel is in the storage area so our challenge was to engineer a delivery solution that would take the effort, expense and noise out of the fuel delivery process.

### *The solution:*

The Perry BIO Intake combines a reception hopper with a vertical auger to seamlessly move the biomass fuel from the point of delivery by a standard tipper truck into the Biomass storage area, at the push of a button. The hopper comes fitted with an easy to operate winched lid, which when open acts as a splash back to minimise the spill of the fuel during the tipper truck delivery. Any blockages during the delivery can be easily remedied as the construction of the BIO Intake is tubular allowing for the removal of side panels. It has been designed to require 2 hand operation of the safety switch to ensure the operator is in the view of the tipping pit at all times. The BIO Intake has been designed to operate at less than **60db**, making it one of the quietest Biomass delivery systems available on the market.



# BIOINTAKE

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## *For fast intake of Biomass fuels.*

- Designed for fast intake of Biomass fuels from a tipping truck, delivering direct to your storage bin or bunker.
- Only requires a flat concrete pad for installation so saves the cost of complicated concrete work.
- All galvanised construction for a long outside life.
- Operates at less than 60db.
- Suitable G30 and G50 W30 woodchip.
- Capacity of **60m<sup>3</sup>** per hour in G50 forestry woodchips.
- Winched lid and control switch lid can be padlocked shut to prevent unauthorised use or vandalism.
- Single outlet to fill to one point in a bin, or long length open bottom auger to spread the woodchip along a rectangular store.



# BIOINTAKE

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## *Twin Auger Intake*

- Designed for fast intake of Biomass fuels from a walking floor lorry, delivering direct to your storage bin.
- Brief: To design a fast intake system to convey G50 & G30 wood chip from a walking floor lorry into a 120m<sup>3</sup> BIO Bin at a rate of 120m<sup>3</sup>/h.
- Description: There is a twin intake system that consists of two 3m long intake hoppers with screw conveyors, these feed the wood chip into the bottom of centre-less vertical screw conveyors which then feed the wood chip into a pair of 5° inclined screw conveyors to fill the BIO Bin. The inclined conveyors have been fitted due to the additional height of the large Bio Bin. The augers have no case once inside the BIO Bin to distribute the wood chip as evenly as possible.
- The twin 60m<sup>3</sup>/h intakes allow a full artic walking floor lorry to be emptied within an hour.
- An existing pathway needed to be maintained between the intake pit and the Bio Bin, so longer augers were needed.
- Access is not easily available at the side of the BIO Bin, so an access platform with ladder and a hatch have been fitted to the roof of the BIO Bin to allow for maintenance.
- The cable operated ventilation system has been installed on the bin to allow for maximum control of ventilation rate.
- The customer has fitted hydrolic lids to the intake augers to reduce the amount of labour with each delivery of woodchip.



# BIOINTAKE

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## *Economy Auger Intake System*

This intake has been designed to receive a controlled feed & offers a lower cost alternative to our full BioIntake system.

- 3m long intake hopper
- 3m long discharge auger with option to extend to 6m overall length
- Auger can be inclined up to 45°
- Capacity of 60 cubic meters per hour in G50 W30 forestry chip
- All galvanised construction
- 5.5kW & 3kW drive motors
- Fully pre-wired option available with operation station
- Supplied with auto cut off safety control switch to satisfy EU Machinery Directive
- Optional splashback & side extensions



# BIOBUNKER

*Designed and manufactured in the UK by bulk handling specialists Perry Engineering, this range of pre-galvanised equipment can be supplied to bespoke requirements or modular built on-site.*

## *For localised storage of Biomass fuels.*

### *The challenge:*

To use a biomass boiler you need a place to store your biomass fuel and a mechanism to consistently deliver the fuel into your boiler system. This has traditionally been provided by an existing storage area. We challenged ourselves to design a storage solution for those buildings without the throughput of biomass fuel to necessitate a dedicated biomass store.

### *The solution:*

The Perry BIO Bunker combines a reception hopper and biomass feeder mechanism into one unit making it a perfect solution for smaller commercial premises or large residential properties. The biomass fuel can be emptied into it from dumpy bags using a forklift, by a loader bucket or by hand. The auger mechanism delivers the biofuel directly into the boiler buffer hopper.



# BIOBUNKER

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## *For localised storage of Biomass fuels.*

- This is a modular storage bunker with a chisel shaped discharge hopper with an integral discharge auger.
- Storage volumes are from 3 to 9.5m<sup>3</sup>. It can be used to store and discharge G30 and G50 forestry wood chip, sawdust, wood pellets or waste grains and chaff from farm cleaners.
- It is available with either a hinged or lift off lid or tarpaulin cover.
- There is an optional agitator to ensure that products such as sawdust flow from the hopper.
- It can be filled from dumpy bags from a forklift or by a loader bucket or by hand.
- The discharge auger is inverter controlled to enable an accurate feed to a boiler system.
- Only requires a flat concrete pad for installation so saves the cost of complicated concrete work.
- All galvanised construction for a long outside life.
- Capacity of 1m<sup>3</sup> per hour in G50 forestry woodchip.
- Suitable for filling by a blower truck.
- Hinged lid to allow filling by loader bucket or dumpy bag.



# BIOBIN

*Designed and manufactured in the UK by bulk handling specialists Perry Engineering, this range of pre-galvanised equipment can be supplied to bespoke requirements or modular built on-site.*

## *For bulk storage of all Biomass fuels.*

- 3m, 4m, 5m or 6m diameter versions maximum overall height 7.0m.
- All manufactured from pre-galvanised panels.
- No square corners means no “dead” space
- All bolted construction for quick and easy site assembly.
- Capacity up to 120m<sup>3</sup> of wood chip.
- Sight glasses.
- Access door into main area and low level door for access under discharge floor.
- Cladding kit available for cladding in timber or box profile sheeting.
- Roof vents.
- Can be filled by blower trucks using industry standard camlock connection.



### *The challenge:*

To use a biomass boiler you need a place to store your biomass fuel and a mechanism to consistently deliver the fuel into your boiler system. This has traditionally been provided by an existing storage area. We challenged ourselves to design a storage solution for those facilities that required bulk storage of biomass fuels but lacked an existing suitable storage area for them.

### *The solution:*

The Perry BIO Bin is a storage silo built from pre-galvanised panels that can be quickly and easily assembled to provide significant on-site biomass storage.



# PERRY BIOMASS

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# BIOHANDLING

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## *Augers & Screw Conveyors*

- Augers and screw conveyors capacities from 6 to 200m<sup>3</sup> per hour.
- Can be inclined, horizontal or vertical.
- Can be used as an intake for materials from trucks or walking floors as the speed can be controlled to provide a consistent feed into a plant or storage facility.
- Galvanised or painted construction.



## *Belt & Bucket Elevators*

- Belt and bucket elevators are designed to convey product vertically.
- These elevators have capacities from 6 to 200m<sup>3</sup> per hour
- Low energy consumption
- All galvanised construction
- Can be fed directly by an intake auger
- Full industrial specification elevators available for industrial applications.



## *Twin Trace Conveyors*

- Twin trace conveyors capacities from 6 to 290m<sup>3</sup> per hour
- Can be inclined, horizontal or curved from horizontal to 30 degree inclination.
- Slow speed means very gentle handling of wood pellets.
- Galvanised or painted construction.
- Can be used to fill a flat store building with product by having an open bottom to allow the discharge of product all the way along the length of the conveyor.



# BIOHANDLING

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## *Belt Conveyors*

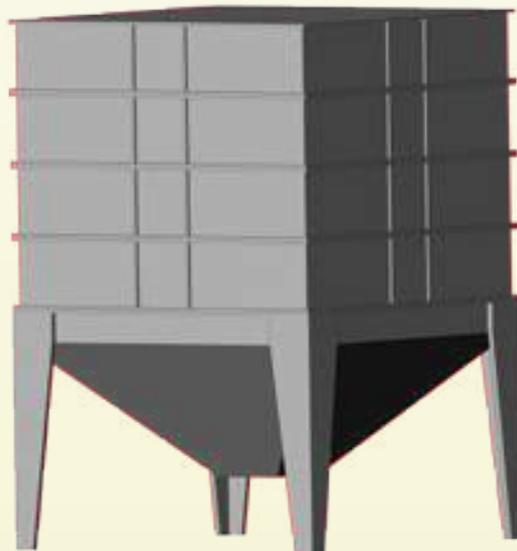
- These belt conveyors have capacities from 6 to 1000m<sup>3</sup> per hour
- Low energy consumption
- All galvanised construction
- Can be inclined or horizontal



## *Storage*

In addition to the Perry BIO Bin and BIO Bunker we also offer a complete range of square, tote and flat bottom storage silos that are suitable for biomass fuels.

- Our storage bins allow you to store 1 to 25 Tonnes of product. Ideal for all sizes of operations.
- Square, tote and flat bottom silos.
- All bins are in Galvanised construction.
- Suitable for outdoor use (lids extra).
- 45 degree & 60 degree hoppers available.
- Special bins made to customer requirements.
- All bins are self-assembly.
- Capacity 1.4 to 28m<sup>3</sup>.
- 1.4 cubic metre capacity tote bins can be stacked 2 high.
- Suitable for storage of all granular and free flowing products.
- Very heavy duty construction using 5mm and 3mm thick galvanised steel.
- Modular design allows capacity to be increased after purchase.



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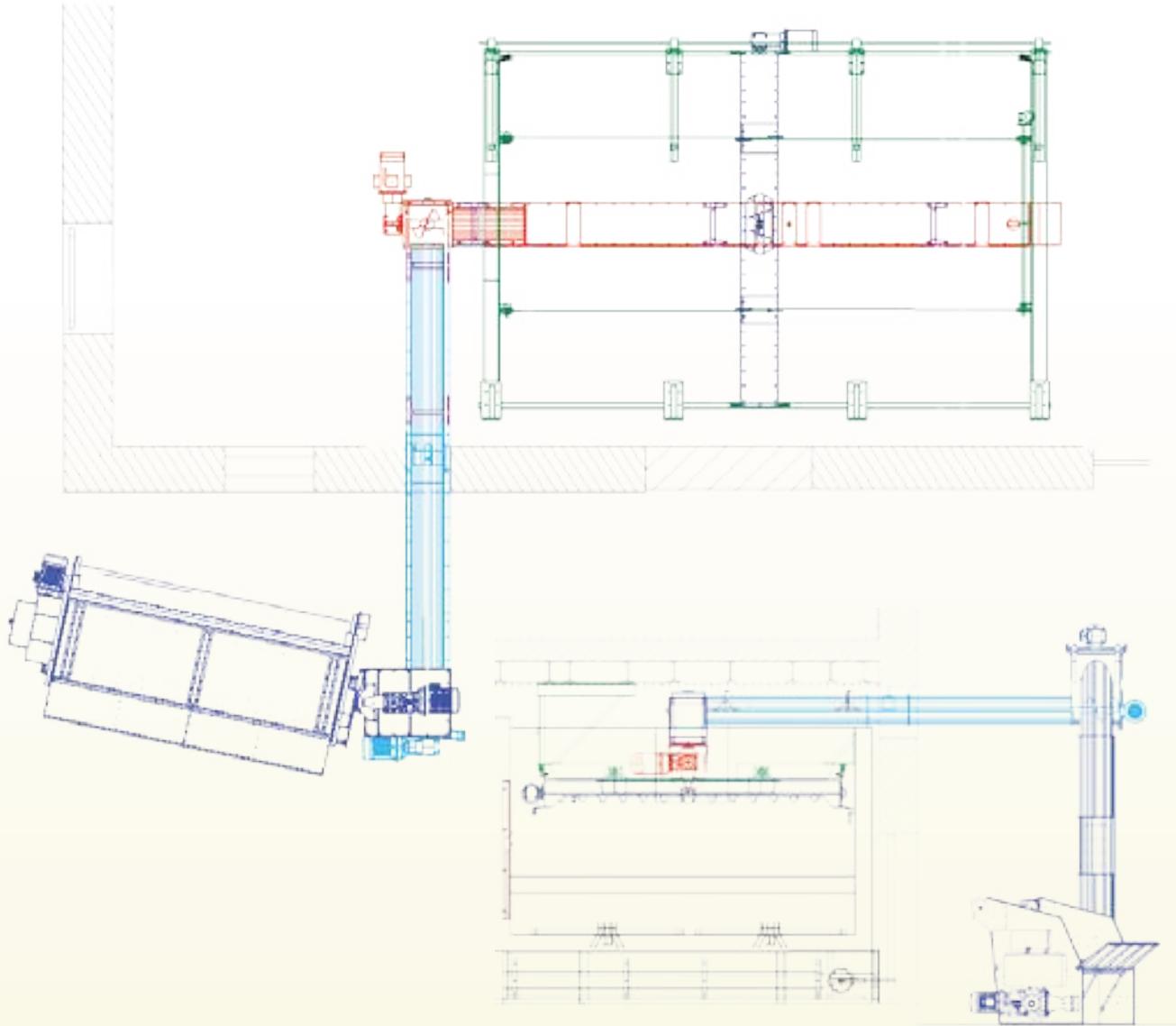
## *How to get the best capacity from your existing storage bunker*

- Ideal for existing bunkers that are difficult to fill, an abnormal shape or unable to be expanded.
- Levelling Augers help fill an existing bunker to its maximum capacity.
- The size and shape of a building (example: 6.03m long x 4.22m wide x 2.05m high) allows for a holding capacity of **12m<sup>3</sup>** using a standard chisel fill system. By adding a levelling auger Perry can increase the bunker holding capacity to **37m<sup>3</sup>**.
- The system is capable of handling both G50 virgin woodchip and shredded wood. On woodchip the intake rate is 60m<sup>3</sup>/h, on shredded wood the rate is 30m<sup>3</sup>/h.
- The double winch systemed levelling auger spreads the product and removes the angle of repose (between 20° and 55° depending on woodchip standard).
- The levelling auger travels up and down nearly the full length the bunker ensuring an even distribution of product.

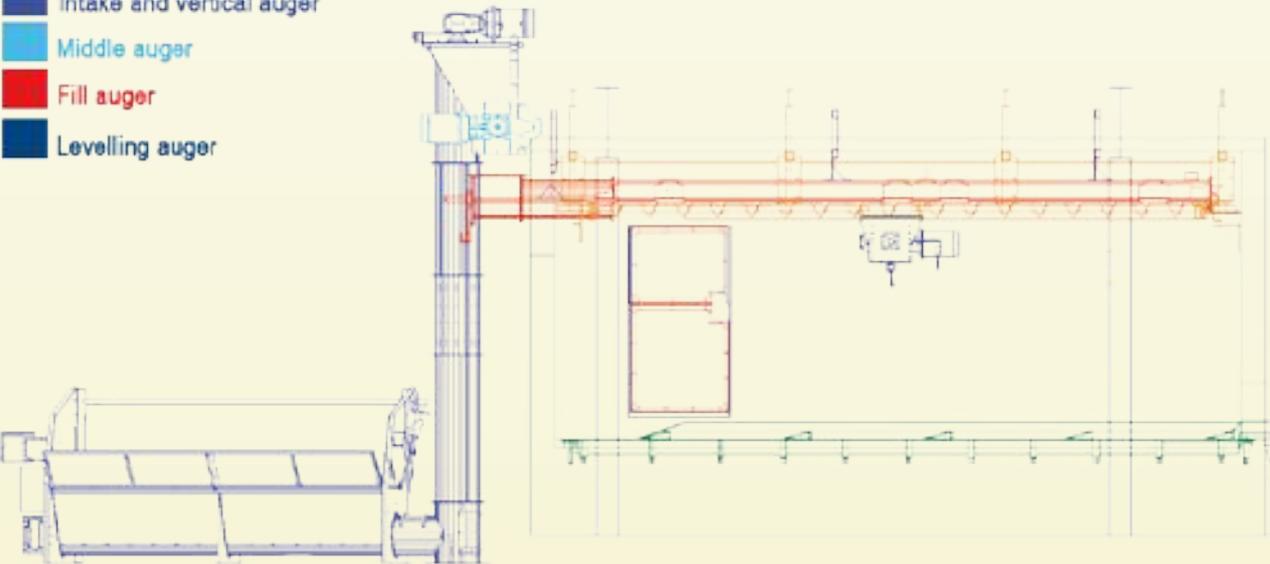


# PERRY BIOMASS

E N G I N E E R I N G



- Intake and vertical auger
- Middle auger
- Fill auger
- Levelling auger



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## BELT DRIER



- Fine mesh drying belt
- All galvanized construction. Stainless steel as an option.
- Multiple heat sources available including biomass, steam, oil, kerosene or gas.
- PLC touch screen panel with internet connectivity.
- Levelling device.
- Modular construction.
- Rotary brush to clean belt.
- Various widths up to 3m available.
- Designed and manufactured in house.



Wood chip  
Wood shavings  
Wood pellets  
Other feed pellets  
Saw dust  
Biomass straw  
Miscanthus and bagasse  
Herbs  
Combinable crops

Beans and soya beans  
Shredded recycled matter  
Sewerage sludge & digestate  
Flaked maize  
Nuts  
Fruit and fruit slices  
Compost  
Cotton rejects

Extruded pet foods  
Finely ground wet chips  
Grass  
Grass seed  
Orange peel  
Pulp granulates  
Solid shredded waste  
Granular & shredded plastic  
Poultry manure



FEED & BIOMASS

# mini PELLETER

- Quality European manufacturer.
- Plug in & go style operation.
- Continued support & after care.
- 15kW & 18.5kW motor options.
- Hard wood capacity 150kg/h - 200kg/h.
- Soft wood capacity 200kg/h - 250kg/h.
- Straw capacity 180kg/h to 200kg/h.



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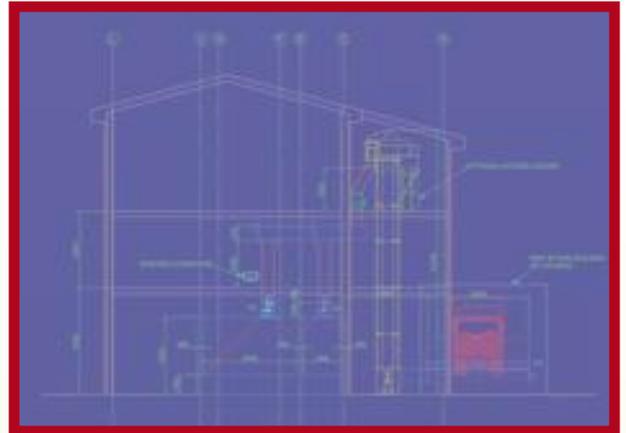
E N G I N E E R I N G

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## *Specialist Capabilities*

At Perry we offer a wide range of specialist services & machines to help make sure you get the Biomass system that is best suited for your needs. Some of these services include:

- Each customer will have a direct link to their area sales manager. The area sales manager will guide you through our range of products & help you decided which options are best suited to your needs.
- Bespoke machines to suit a whole range of needs are available for design. We can offer machines that are **capable of handling up to G100 grade wood chip & can transport capacities of up to 200m<sup>3</sup>** per hour for users with a need of very high through put.
- An in house design team can not only design your bespoke machine, but with the consultation of your area sales manager they can produce site layouts and schematics for you.
- Investments in buildings mean that we carry a large range of stock, helping to deliver your machine in the quickest possible time
- Staying up to date with technology & machinery allows us to stay at the top of the industry by making advancements quicker than our competitors. As standard all of our machines are designed using the latest CAD/CAM technology, then our in house manufacturing team build the machines to the exact measurements and calculations our experienced design team have given. We extensively test each of products to ensure they are of the high quality that is associated with the Perry name.
- We have a dedicated technical support line, allowing you direct contact with the manufacturer of your product.



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## *Kier Schools in Kent*

- Perry biomass Engineering supplied and installed 3 BIO Intake systems for Kier at schools in Kent.
- The installation was required to avoid the noise of blower deliveries of woodchip.
- The BIO Intake operates at less than 60db.
- Perry's staff carried out the site survey, the installation and the commissioning and the training of the Kier Facilities Management staff.
- Fully tailored solution to suit existing bunkers.
- High specification 10mm thick auger flighting.
- All galvanised construction.
- Full safety switch system.
- Bin full probes and blockage probes.
- Winch operated lid with braked operation to avoid the risk of injury due to the weight of the lid or high winds.



*Case Study*

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## *Crediton Leisure Centre*

- 199kw ETA boiler
- 60 cubic M capacity BIO Bin Woodchip storage silo
- 60 cubic M per hour BIO Intake Woodchip intake system.
- Fuel delivery by tipping trucks. One delivery every 2 weeks.
- BIO Bin is a fully galvanised flat bottomed storage silo. It comes in simple to erect kit form and can be plain galvanised finish or clad with timber or box profile sheeting. Sight glasses fitted and 2 access doors.
- BIO Intake operates less than 60db.
- Very high specification 10mm thick auger flighting.
- Full safety switch system.
- Bin full probes and blockage probes.
- Prewired “plug & play” to minimise site costs.



# PERRY BIOMASS

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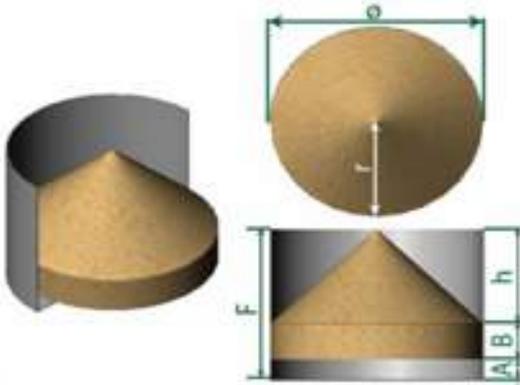
## *Saunton Sands Hotel, North Devon*

- 199kw Twin Heat boiler
- 60 cubic M per hour BIO Intake Woodchip intake system.
- Fuel delivery by tipping trucks.
- The BIO Intake operates at less than 60db.
- Fully tailored solution to suit the existing building size.
- Full safety switch system.
- Bin full probes and blockage probes.
- Prewired "plug & play" to minimise site costs.
- Probably the most durable system on the market.
- The intake feeds an open bottom auger inside the bunker fuel store. This provides a consistent fill along the full length of the long but narrow store.
- The woodchip is fed into 2 containerised walking floor containers which then discharges the chip into a PERRY feed auger system to deliver the chip to the boiler buffer hopper when the level probes call for it.



*Case Study*

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Calculating the **ESTIMATED** storage capacity of a *round building from a centre fill point*.

All calculations are based on a 45° angle of repose.

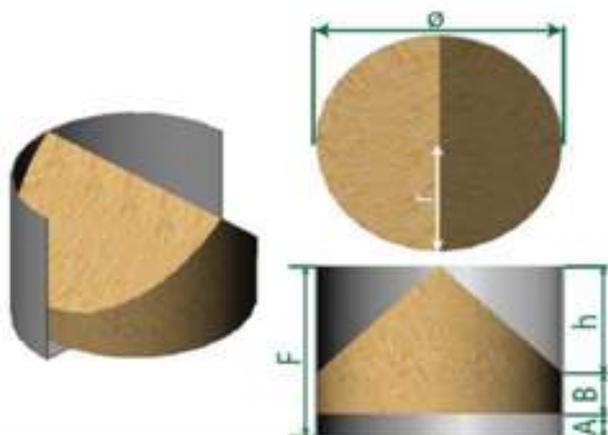
To use this calculator fill in the boxes marked in red. Start from the top box then work down.

Please fill in the boxes with a **RED** background in the table below. Read all descriptions before entering values.

Symbol	Description	Formula	Value
$\phi$	Building Diameter (m)	= $\phi$	
F	Height from building base to bottom of auger (m)	= F	
A	Discharge Auger (0.55m)	= 0.55	0.55
$\pi$	Pi (3.142)	= 3.142	3.142
Y	Max Radius ( $\frac{1}{2}$ of $\phi$ )	= $\phi \div 2$	
X	Formula: <b>F - A</b>	= F - A	
h	Peak height - If <b>X</b> is smaller than <b>Y</b> then use <b>X</b> , otherwise use <b>Y</b> .	= Y or X	
r	Radius is equal to peak height	= h	
r <sup>2</sup>	radius x radius	= r x r	
B	Cylinder height (Zero if negative number)	= F - h - A	

Please fill in the boxes with a **RED** background in the table below. The column above will tell you which figure to enter.

Calculations							
	$\pi r^2 h$	$\pi$	x	r <sup>2</sup>	x	h	Result
Step 1		3.142	x		x		
	$\frac{\pi r^2 h}{3}$	<b>Result Step 1</b>	÷	<b>3</b>			
Step 2			÷	<b>3</b>			
Step 3 result will be 0 (Zero) if B equals 0 (Zero)							
	$\pi r^2 B$	$\pi$	x	r <sup>2</sup>	x	B	
Step 3		3.142	x		x		
	Total	<b>Result Step 2</b>	+	<b>Result Step 3</b>			
Result			+				<b>m<sup>3</sup></b>



Calculating the **ESTIMATED** storage capacity of a round building with a chisel fill.

All calculations are based on a 45° angle of repose.

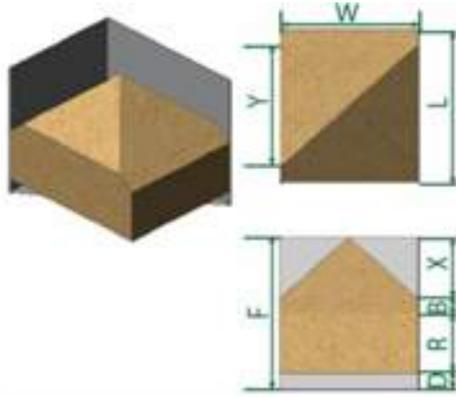
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Symbol	Description	Formula	Value
$\phi$	Building Diameter (m)	$= \phi$	
F	Height from building base to bottom of auger (m)	$= F$	
Y	Max Radius ( $\frac{1}{2}$ of $\phi$ )	$= \phi \div 2$	
A	Discharge Auger (0.55m)	$= 0.55$	0.55
X	Formula: $F - A$	$= F - A$	
h	Peak height - If X is smaller than Y then use X, otherwise use Y.	$= Y$ or $X$	
r	radius is equal to h	$= h$	
$r^2$	radius x radius	$= r \times r$	
$\pi$	Pi (3.142)	$= 3.142$	3.142
B	Cylinder height (Zero if negative number)	$= F - h - A$	

Please fill in the boxes with a **RED** background in the table below. The column above will tell you which figure to enter.

Calculations							
	$\pi r^2 h$	$\pi$	x	$r^2$	x	h	Result
Step 1		3.142	x		x		
	$\frac{\pi r^2 h}{2}$	Result Step 1	÷	2			
Step 2			÷	2			
If B equals 0 (Zero) then do not add 15.5%. Step 3 result will be equal to Step 2 result							
	$\frac{\pi r^2 h}{2} + 15.5\%$	Result Step 2	+	15.50%			
Step 3			+	15.50%			
Step 4 result will be 0 (Zero) if B equals 0 (Zero)							
	$\pi r^2 B$	$\pi$	x	$r^2$	x	B	
Step 4		3.142	x		x		
	Total	Result Step 3	+	Result Step 4			
Result	Your Data		+				$m^3$



Calculating the **ESTIMATED** storage capacity of a *square building from a centre fill point*.

All calculations are based on a 45° angle of repose.

To use this calculator fill in the boxes marked in red. Start from the top box then work down.

Please fill in the boxes with a **RED** background in the table below. Read all descriptions before entering values.

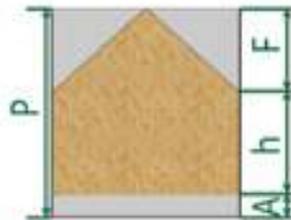
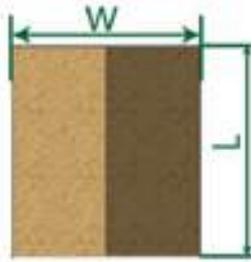
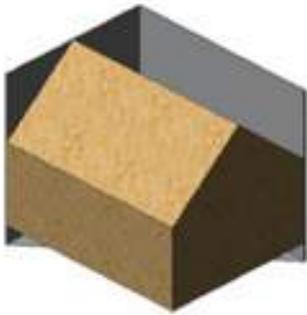
Symbol	Description	Formula	Value
L	Building Length (L) (m)	= L	
W	Building Width (W) (m)	= W	
F	Height from building base to bottom of auger (m)	= F	
D	Discharge Auger height (0.55m)	= 0.55	<b>0.55</b>
M	Max product height - height from base minus discharge auger	= F - D	
T	Smallest number out of L and W	= L or W	
U	Largest number out of L and W	= L or W	
P	Max Top peak height	= T ÷ 2	
X	Top Peak height to use - smallest number out of P or M	= P or M	
Y	Top Peak length & width to use	= X x 2	
B	Base peak length - If X is less than P then set to 0	= (U - T) ÷ 2 or 0	
D	Base peak length 2	= Y + B	
R	Remaining height (can be set to a minus number)	= M - X - B	

Please fill in the boxes with a **RED** background in the table below. The column above will tell you which figure to enter.

Calculations							
	YYX	Y	x	Y	x	X	Result
Step 1			x		x		
	$\frac{YYX}{3}$	Result Step 1	÷	3			
Step 2			÷	3			
	DBT	D	x	B	x	T	
Step 3			x		x		
	RWL	R	x	W	x	L	
Step 4			x		x		
	Total	Result Step 2	+	Result Step 3	+	Result Step 4	
Result	Your Data		+		+		<b>m<sup>3</sup></b>

# PERRY BIOMASS

E N G I N E E R I N G



Calculating the **ESTIMATED** storage capacity of a *square building with a chisel fill*.

All calculations are based on a 45° angle of repose.

To use this calculator fill in the boxes marked in red. Start from the top box then work down.

Please fill in the boxes with a **RED** background in the table below. Read all descriptions before entering values.

Symbol	Description	Formula	Value
W	Width of building - always the shortest length (m)	= W	
L	Length of building (m)	= L	
P	Overall height from base of building to bottom of auger	= P	
A	Discharge Auger (0.55m)	= A	0.55
X	Max Height of peak - width of building divided by 2		
F	Peak Height - use smallest number between P and X	= P or X	
h	Remaining height (can be a minus number) (m)	= P - A - F	

Please fill in the boxes with a **RED** background in the table below. The column above will tell you which figure to enter.

Calculations							
	WFL	W	x	F	x	L	Result
Step 1			x		x		
	$\frac{WFL}{2}$	Result Step 1	÷	2			
Step 2			÷	2			
	LWh	L	x	W	x	h	
Step 3			x		x		
	Total	Result Step 2	+	Result Step 3			
Result	Your Data		+				m <sup>3</sup>

# Capacity Calculator

Phone: +44 (0)1404 890 300

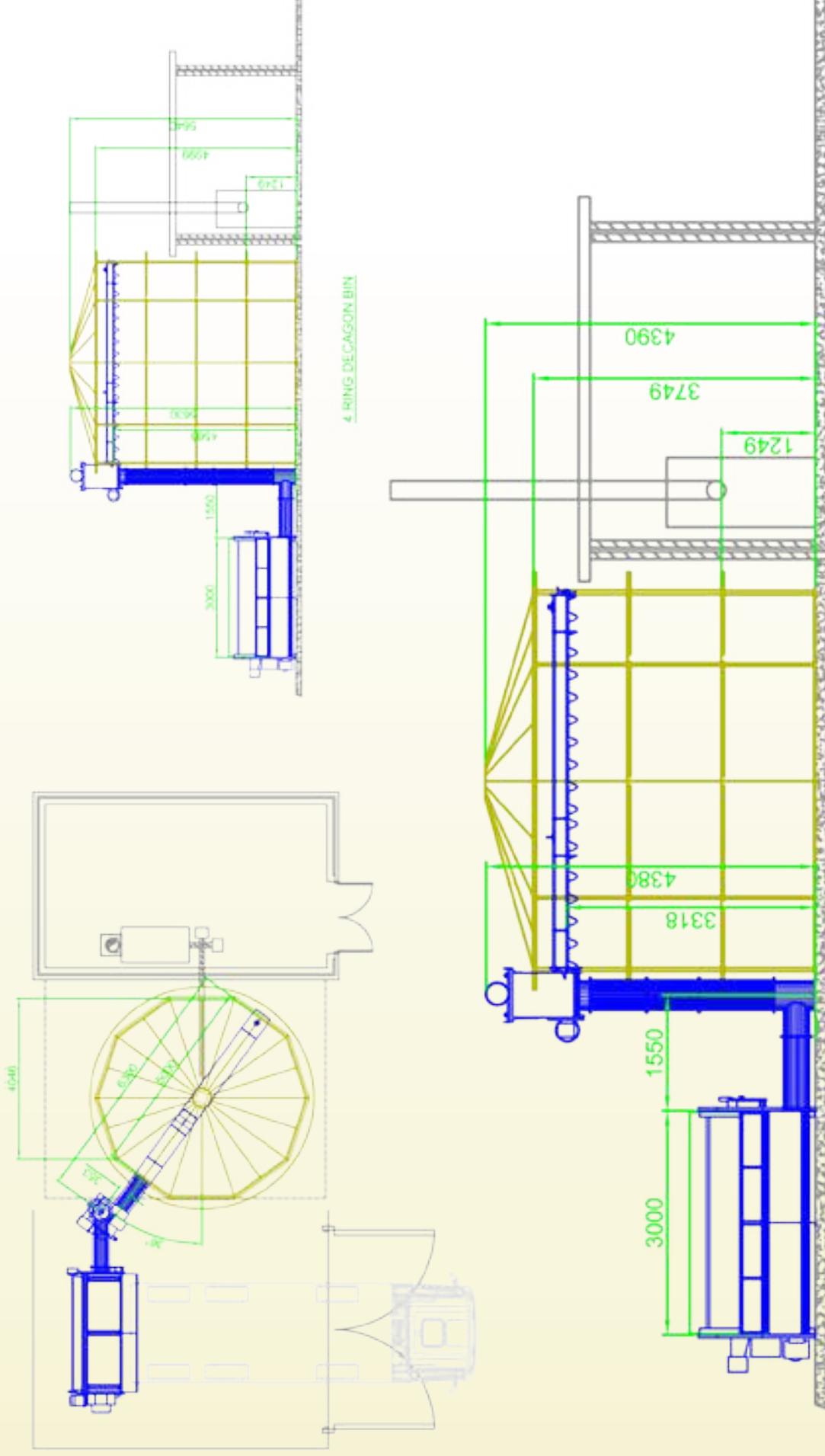
Email: [sales@perrybiomassengineering.co.uk](mailto:sales@perrybiomassengineering.co.uk)

[www.perrybiomassengineering.co.uk](http://www.perrybiomassengineering.co.uk)

# Site Layout

# PERRY BIOMASS

E N G I N E E R I N G



At Perry we have both 2D and 3D design capabilities. We offer a site layout service to help you visualise how our machines will interact with existing sites & machinery, or a completely new scheme.

*Designed and manufactured in the UK by bulk handling specialists Perry Engineering, this range of pre-galvanised equipment can be supplied to bespoke requirements or modular built on-site.*

## *Industry Standards for Wood Chip*

Standards for woodchips are generally more developed in countries with a longer history of biomass use. The UK's most commonly used standard is based on the Austrian system and covers four areas: Particle size and extremes, moisture content, material density & ash content.

Particle size relates to the area of the woodchip in square millimetres and ranges from a G30 small chip to a G150 large 'chunk' chip. The standard for moisture ranges from under 20% to a 40 to 50% moisture content, but it is generally accepted that all users need to know is whether material is below 35% or above; 35% moisture being where the line is drawn between "wet fuel" and "dry fuel".

### *Size classification*

Chip designation	<4% of particles	<20% of particles	60 - 100% of particles	<20% of particles	Max. Area cm <sup>2</sup>	Max. Length cm
G30	<1 mm	1 - 3 mm	3 - 16 mm	>16 mm	3	8.5
G50	<1 mm	1 - 6 mm	6 - 32 mm	>32 mm	5	12
G100	<1 mm	1 - 11 mm	11 - 63 mm	>63 mm	10	25
G120	<1 mm	1 - 63 mm	63 - 100 mm	>100 mm	12	30
G150	<1 mm	1 - 100 mm	100 - 130 mm	>130 mm	15	40

### *Moisture content classification*

Quality class designation	Moisture content (wet basis)	Description
W20	<20%	Air dry
W30	20% - 30%	Storable
W35	30% - 35%	Storable within limits
W40	35% - 40%	Wet
W50	40% - 50%	Green (freshly harvested)

### *Material density classification*

Chip designation	Material density in kg/m <sup>3</sup>	Density definition
S160	<160	Low
S200	160 - 250	Medium
S250	>250	High

### *Ash content classification*

Chip designation	Ash content as % of fuel weight	Ash content definition
A1	<1%	Low
A2	>1%	High

