

- ▶ *Easy access to the fuel reception area can reduce costs.*
- ▶ *The storage facility should have a capacity of at least 1.25 to 1.5 times the volume normally delivered.*
- ▶ *Chip storage should be separate from the rest of the building.*
- ▶ *When working in chip silos, it is important to wear a good dust mask or a fresh air supply.*

Delivery and storage of wood chip fuel

Pieter D. Kofman¹

Properly sourced, specified and graded wood chip is an excellent carbon-neutral fuel, particularly suited to large non-domestic buildings such as hotels and offices with year-round boiler capacity of 500 to 1000 kW. It is also a material that needs to be efficiently delivered, stored and combusted in order to avoid adding extra costs and creating logistic and other problems. Adherence to the simple rules and design principles outlined in this note will go a long way towards addressing such issues.

Layout

A wood burning boiler installation consists of the boiler room, a storage area or silo for the chips, and a reception area.

The reception area is usually a pit, below ground level, into which the chips can be tipped by the delivery vehicle.

For most applications envisaged in this country a walking floor system at the bottom of the reception pit moves the chips to the auger feeding the boiler. In such cases the reception pit also serves as a storage unit.

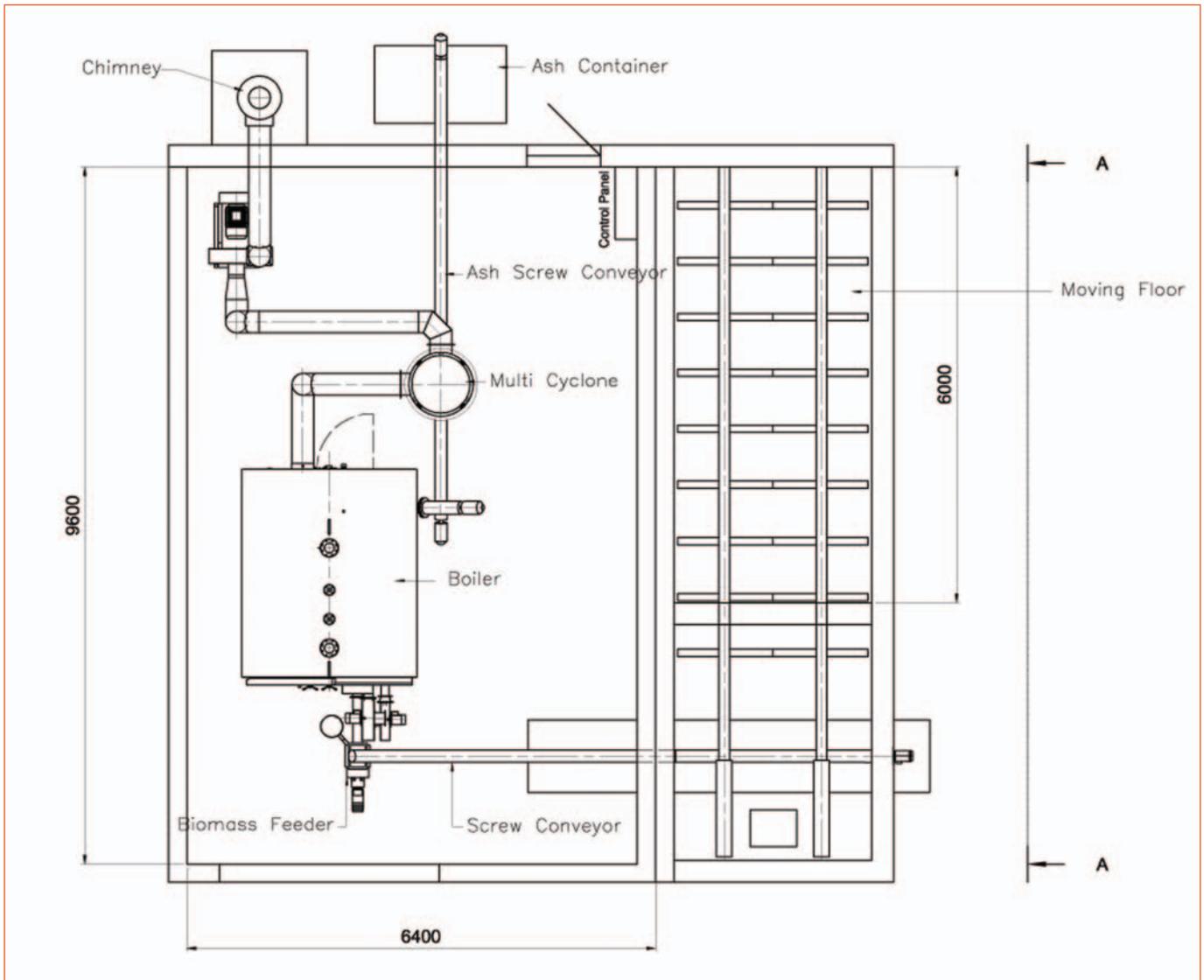
For larger systems, the fuel is usually moved with a crane. The chips are tipped into the reception pit and then transferred by crane to a silo for long term storage. The same crane will be used to feed the boiler.

How much chip?

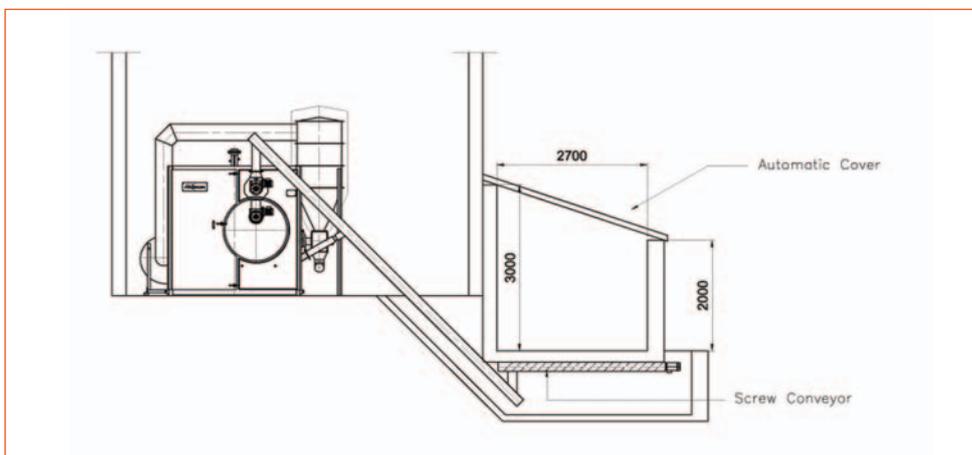
Before installing a wood burning boiler one needs to carefully consider how much fuel will be required, how it will be delivered and how it will be stored. Fuel quantities depend on the size of the boiler, its efficiency and level of usage. Usually a medium sized hotel (twenty rooms and more) would need a 500 kW boiler, while a large hotel would require a 1 MW boiler.

COFORD
Arena House, Arena Road, Sandyford, Dublin 18, Ireland
Telephone: +353 1 2130725
Email: info@coford.ie
<http://www.coford.ie>
© COFORD 2007

¹ Danish Forestry Extension, Senior Consultant Wood for Energy, Skovvej 25, 7182 Bredsten, Denmark. Email: woodenergy@gmail.com.



▲ Schematic drawing of a wood chip boiler installation, seen from above, with the walking floor reception pit outside the building.



◀ Schematic drawing of the installation, seen from the side. Note that the chip silo is below ground level and the chips are transported up by auger.

How much storage?

The size of the storage facility depends not only on the amount of fuel required, but also on what volume of chips will usually be delivered. The storage facility should be planned accordingly. Typically, a 500 kW boiler would consume 300 to 400 tonnes of fuel annually, which can be translated to 900 to 1200 m³ loose volume of chips. This means that 20 to 30 loads of fuel will be required in a typical year. During winter the loads will be required more frequently than during summer. In winter a load will probably be delivered every week, while during summer there might be up to 3 to 4 weeks between loads. For a larger boiler the frequency of the delivery will be higher.

Delivery systems

Wood chip can be delivered in a number of ways (with delivery capacity indicated as loose volume of chip):

1. a tractor-trailer combination (40-45 cubic metres),
2. tipping truck (40-60 cubic metres),
3. container truck with one container on the truck and one on a trailer (40 cubic metres by two containers, so 80 cubic metres in total) or
4. a walking-floor truck (80-100 cubic metres)

At delivery the chips will usually be tipped into a reception pit or onto the ground. In some exceptional cases chips may be blown into a silo, but this is a very expensive option.

Reception facility

The reception facility should be able to cope easily with the volume to be delivered, so that a new load can be tipped off without having to wait for the reception pit to be emptied or the chips to be moved.

If the reception pit is an integral part of the storage facility, then the storage facility should be at least 1.5 times the size of the maximum load which can be received. This obviously allows for fuel to be delivered before the silo is empty. If the reception facility does not have the required capacity, fuel delivery has to be delayed until the storage area is almost empty, which may lead to heat outages and



Container truck delivering chips to the chip reception pit of a large co-generation plant.

increased delivery costs. It is good practice, therefore, to have the reception pit 25-50% larger than the maximum load that can be received.

As the load tips out it will pile in the centre of the pit – again a well-sized pit will accommodate the pile and reduce spillage outside the perimeter of the storage area. To reduce this occurrence further, the width of the reception pit should be at least 60 cm wider than the maximum width of the vehicle that will deliver the chips. Since most vehicles that transport wood chips have a width of 2.4 m, the opening of the reception pit should be 3 m. If the opening is smaller, spillage will occur and the superstructure of the pit may be damaged.

The company delivering the fuel may clear up chips that have fallen outside the pit perimeter but this adds to cost and inconvenience, and is easily avoided if the reception pit is properly sized in the first place.

A kerb with a maximum height of 20 cm should be placed around the perimeter of the pit to allow the delivery vehicle to slowly back up to it until the rear wheels touch it. This ensures that the rear of the vehicle is as far over the reception pit as possible. The kerb also prevents rain water from entering the pit.

It is best to place the pit fully below ground level, with water-tight walls. It should be covered over and securely fastened at all times outside of fuel delivery. The walls should be perpendicular and joined at right angles to minimise the area that cannot be accessed by the crane or the walking floor feeding the boiler. Silos with a sloping bottom that feeds into a central outlet hole should be avoided for wood chips, since the risk of bridging over the central opening is too big.

If the reception pit is situated inside a building the room where it is situated needs to be designed in such a way that it will accommodate tipping trucks, if that is the preferred method of delivery. Most beds of tipping trucks extend to a height of 6 m. Entrances to such indoor storage areas should be closed off once delivery has taken place; this will reduce the risk of accidents and keep in dust. Fuel storage areas are best isolated from the rest of the building to avoid exposure to wood dust and fungal spores. Air for the combustion process should be taken through the fuel storage area. In this way a small under-pressure is created which keeps the dust inside the storage area, and carries it into the boiler where it will be burned.

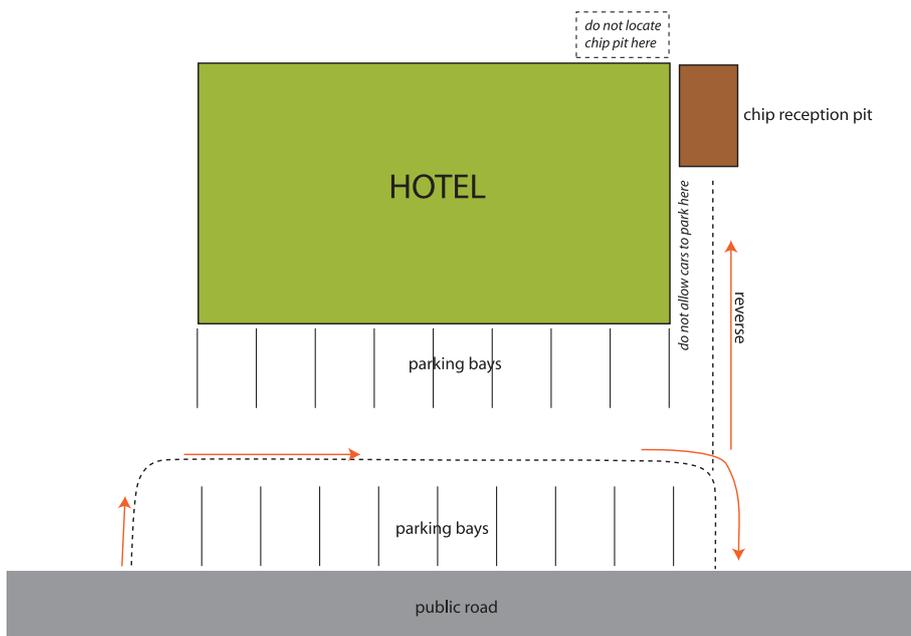
Planning the location of the fuel pit should also consider the type of delivery vehicles expected and their admission route. The road leading to the fuel reception pit should be as straight as possible, so that time is not wasted by having to manoeuvre around tight corners or other



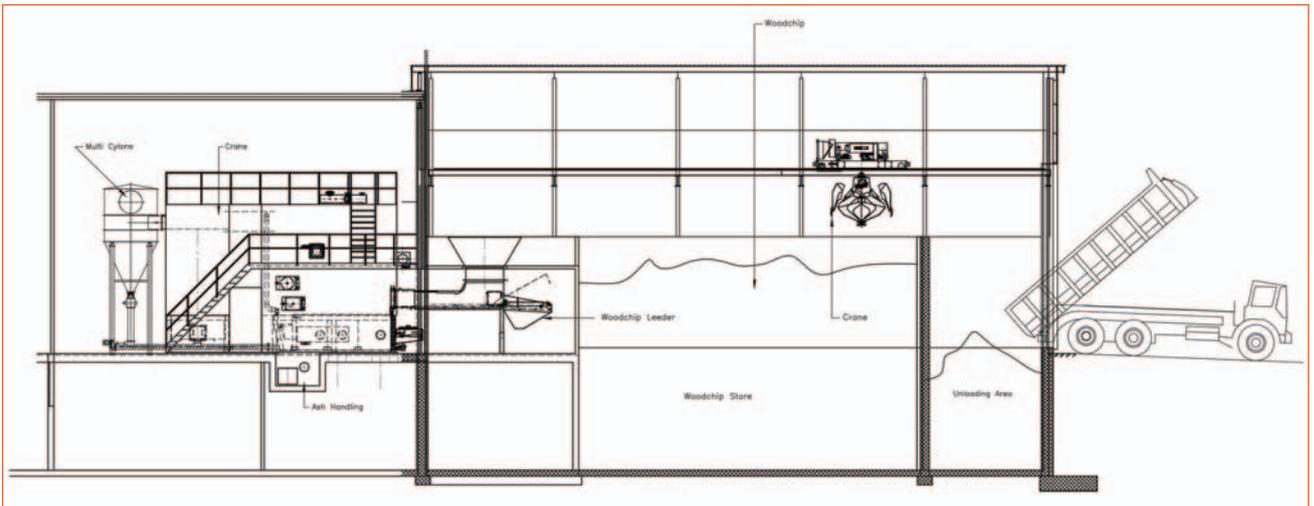
▲ Chip delivery to a reception pit inside a building - note the height of the gate.

obstacles. Ideally the delivery vehicle should be able to drive to the end of the pit, offload and then continue on to exit the site, or failing that there should be a sufficient turning table for the delivery vehicle to turn. Other vehicles should be moved from reception area before delivery.

A good solution for an admission route is to provide a U-shaped area where the truck enters the leg furthest away from the pit, passes it almost driving out of the second leg and then reverses to the pit. It is also possible to reverse from the public road to the reception pit.



◀ An ideal U-shaped entry system for a truck or tractor-trailer to deliver fuel. The truck could also reverse to the chip reception pit directly from the public road, where permissible.



- ▶ A cross section through a larger district heating plant with a reception pit and a crane system for emptying the reception silo and feeding the boiler.

Fuel storage facility

For crane fed systems, the fuel should be transported from the reception pit into a silo for longer term storage. It is recommended that the volume of the storage facility is at least equal to 10 days of maximum consumption. This means that sufficient fuel can be delivered to bridge periods such as between Christmas and New Year.

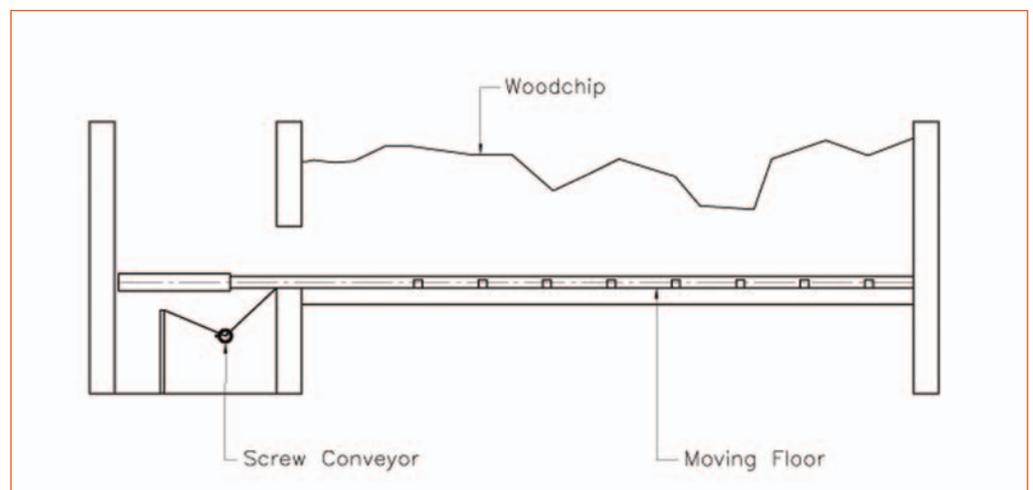
For walking floor systems, the required volume should ideally be 1.25 to 1.5 times the volume of the usual delivery, which should make it sufficient for the 10-day period.

Smaller storage facilities for medium-sized boilers are

usually equipped with a walking floor system or a scraper system that moves the chips to an auger for feeding into the boiler. In industrial systems, the chips are usually moved with an overhead crane, which also feeds the boiler.

Equipment that is buried under fuel will inevitably break down at some stage, and it is necessary to be prepared for that situation. If at all possible, the auger should not be placed under the fuel pile. A scraper or walking floor should deliver the chips onto the auger, which should be situated between the chip pile and boiler. If this configuration is used blockages, such as those caused by oversized chips, can be easily removed.

- ▶ Cross-section of the walking floor system showing that the auger is outside the chip storage facility.



Otherwise, digging down through the fuel to unblock the auger will be very time consuming.

In all configurations there should be ample space and access provided at the design stage to allow blockages to be removed. The preferred method is to use a crane or digger with a clamshell bucket. Manual digging to the auger should be done with a fork, as a shovel will not easily get down through the fuel. Forks with rounded tines are best; forks with sharp teeth tend to pick up chips and become difficult to work with.

Rotary scraper systems are only suitable for round silos. A rotary scraper at the bottom of a square silo will leave the corners of the room filled with fuel, where fines will accumulate which will be colonised by mould and other fungi.

Health and Safety

Chip silos and storage rooms should be cleaned out at the end of each heating season, to avoid accumulation of dust, bacteria and fungi. During this operations a good facemask with a particle filter (P3) must be worn, or if the cleaning is anticipated to take longer than an hour a mask connected to a fresh air supply is required.

Working in below-ground storage and reception facilities should not be done alone. Oxygen levels at the bottom of a silo can become low and pose a safety risk. Work should be carried out with a face mask with fresh air supply or the whole silo area should be forcibly ventilated for a longer period of time before work commences.

Chip reception pits should be equipped with a ladder (set into the wall) to facilitate entry and egress.

Acknowledgements

Drawings were provided by Focus Energy, Denmark.

For information and a free on-line advisory service on the wood energy supply chain, the quality of wood fuels and internal handling visit www.woodenergy.ie

Note: The use of trade, firm or corporation names in this publication is for the information of the reader. Such use does not constitute an official endorsement, or approval by COFORD of any product or service to the exclusion of others that may be suitable. Every effort is made to provide accurate and useful information. However, COFORD assumes no legal liability for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed herein or for any loss or damage howsoever arising as a result of use, or reliance, on this information.