BOSMIN® TOP NETS

IMPROVING DRAGLINE PRODUCTIVITY

BOSMIN TOPNETS are light mesh structures fitted to the top of a dragline bucket to eliminate payload spillage.

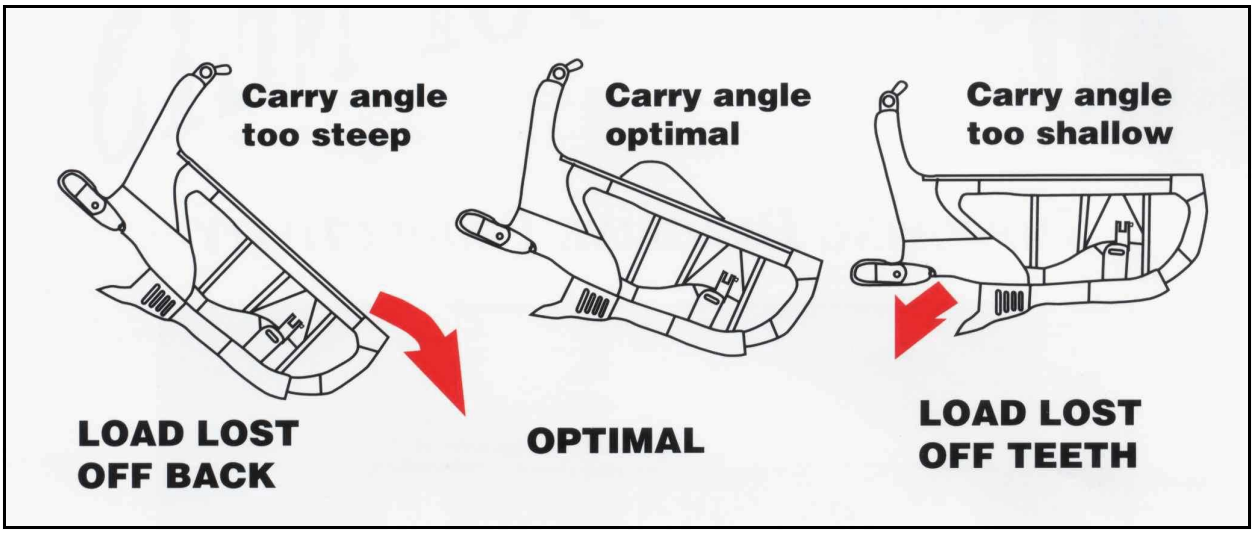
This **TOPNET** is operating on a cut down bucket with lowered sides.

Stacking material on top of the bucket reduces the tare weight and increases the payload to give the same gross load.

This **TOPNET** is fitted to a 45m^3 Reverse Spade Lip bucket. For dragline operations, fitting a **TOPNET** offers:

- ☐ Improved consistency in payload
- ☐ Reduction in cycle time
- ☐ Improved dragline operations

The Perfect Carry Angle



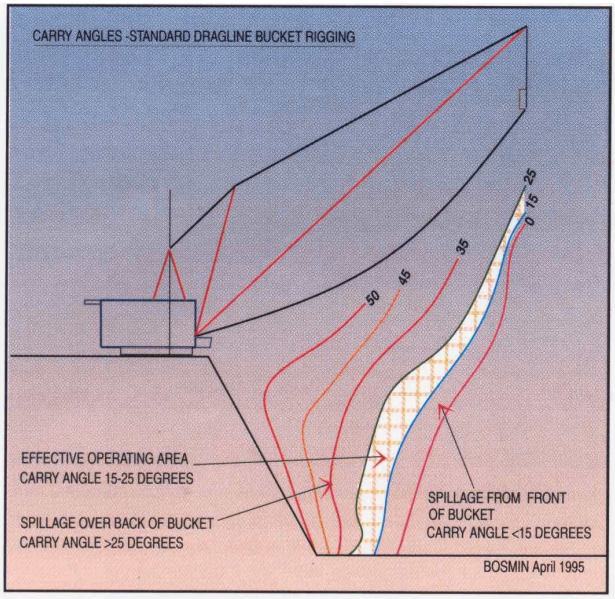
In a traditional dragline operation bucket payload is directly affected by the bucket carry angle. When the bucket is carried at a flat angle, material falls off the front of the load. When the carry angle is steep, material rills off the back. A generally acceptable carry angle between 15 degrees and 25 degrees, offers a compromise between these extremes.

Carry angle is fine tuned by adjusting dump rope and/or hoist chain lengths. The angle changes continuously as the bucket is dragged in and setting a high angle (to allow loads to be picked up near the boom point) generally results in too steep a carry angle when the bucket is dragged close in to the machine.

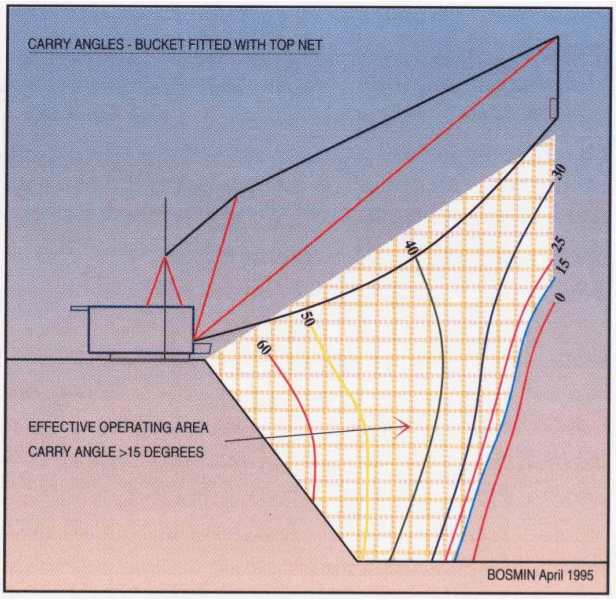
A normal dragline bucket shows a flat payload profile when operating in common low cohesive materials:

With a **TOPNET** fitted, the payload profile matches the profile seen when loading very cohesive payloads:

A **BOSMIN® TOPNET** retains material that would normally slump off the back of the bucket at steep carry angles and extends the effective operating range to a carry angle of over 50°. An optimal bucket carry-angle is no longer a compromise between wanting to improve the bucket load on the teeth and having the load slumping off the back of the bucket.



This diagram shows a dragline adjusted to operate effectively at around mid-boom point. The bucket only achieves a good load if it is picked up inside the shaded area and kept within the shaded area of the curve during the hoisting and swing cycles.

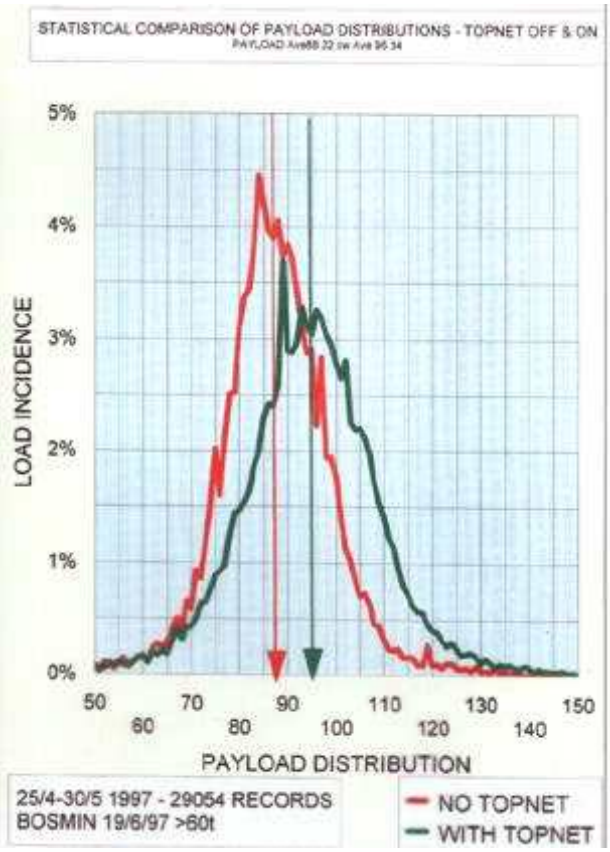


The optimal setting for a dragline equipped with a **TOPNET** is shown in the figure immediately above. In this case the bucket will operate effectively much closer to the boom point and the operator is given a much wider operating range. This dragline will achieve a more consistent payload.

The increased operating range when using a **TOPNET** provides the operator with greater freedom in positioning the bucket with reduced loss of material when the bucket is accidentally moved out of the"sweet spot". This is important when deep digging, where the optimal carry angle range can extend for less than a bucket length. In a traditional installation, bucket volume is sensitive to the disengaged carry-angle and cohesion of the spoil. Dragline owners have little opportunity to fine tune bucket volume. For a given bucket, payload mass will vary as the dragline moves around the pit. It is sensitive to cohesion, fragmentation and spoil composition. Often it is difficult to achieve a full load (especially in very shallow or very deep dig conditions) and occasionally the dragline is overloaded. Gross overloads can occur when particularly cohesive material is encountered, or when high density spoil is being removed, or just when a "good" operator achieves an optimally loaded bucket.

Controlling Overloads

While the **TOPNET** is designed to prevent material falling off the back of the load, it also effectively caps the peak volume that can be loaded. A bucket payload becomes less sensitive to cohesion and carry angle. The bucket is volume adjustable. Total suspended loads can be matched more precisely.



This exhibit shows the payload distribution carried by a BE1370W dragline, both with and without a **TOPNET** fitted to a 45m^3 RSL ESCO bucket. **While the maximum payload lifted by the dragline does not increase, the average payload lifts by 8.9% - a significant improvement to productivity without overloading the dragline.**

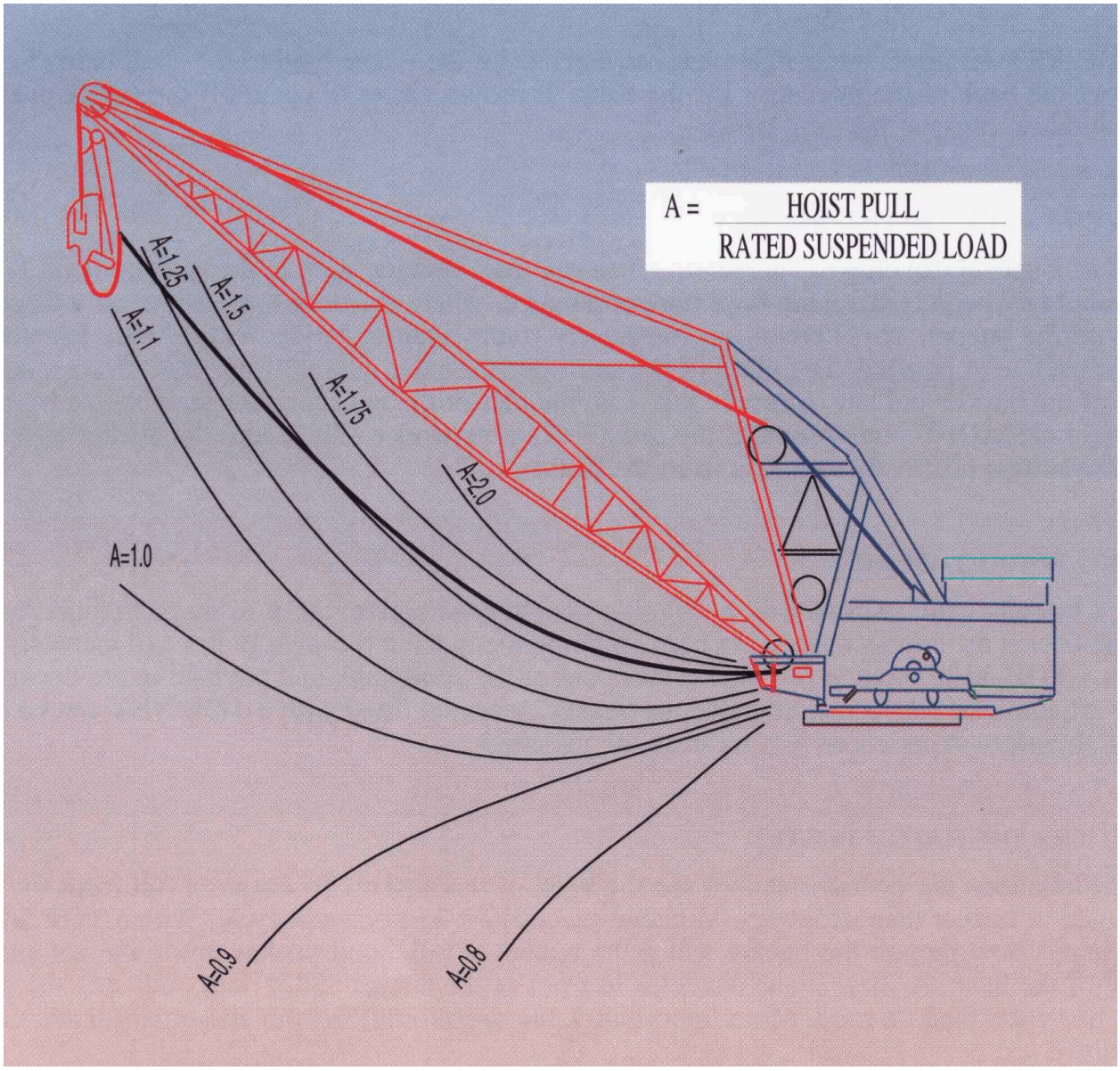
Reducing Dragline Cycle Time

In most operations the bucket is full well before rigging geometry allows it to be lifted without the payload falling out of the bucket mouth. The full bucket must be dragged further through the bank until the dump rope can operate. This wears out the bucket as well as costing valuable seconds on each cycle.

Cycle time observations for a large dragline digging in ideal conditions with a competent operator show a tendency to *overdrag*. Overdrag is defined as the interval from when the bucket is full to when the bucket leaves the bank. Even in a well-run operation an average of 4.6 seconds, or 6% of the cycle time can be spent in dragging a full bucket to the point where rigging geometry permits it to be picked up without losing the payload.

With a **TOPNET** fitted and the rigging adjusted for a steeper carry angle, an earlier pick up is possible. Recovering only half the overdrag time yields a 3% improvement in overall productivity.

Wise use of the hoist capacity



When a load is hoisted close to the fairleads, the hoist motor (and the boom) see a much greater load than if the same load is hoisted at the end of the boom, as shown in the attached figure. The hoist rope must provide a lifting component equal to the bucket mass, but is pulling at a less advantageous angle as well as working against the drag rope tension.

Relative hoist rope loads are shown to increase as the bucket nears the tight-line envelope. For a hoist limited system, in certain circumstances, the extra hoist motor load can affect cycle time. With a **TOPNET**, the rigging is adjusted to allow the load to be hoisted as far out as possible. Hoisting under the boom point reduces hoisting times.

Improved Dragline Operations

Maximising the Spoil Radius

Fitting a **TOPNET** allows a general steepening of the carry angle to achieve an earlier pick-up, and increased spoil radius, without compromising pick-up capabilities close to the fair leads. With too shallow a bucket carry angle, the payload drops off the teeth before reaching the intended spoil position. Draglines adjusted to the **BOSMIN®** configuration have a steeper carry angle than is possible prior to fitting a **TOPNET.** This holds the dirt on the front of the bucket until the last moment. The spoil has a peaked top rather than the usual rounded top. Effective spoil radius is increased and rehandle reduced.

Keeping the Working Area Clean

With a **TOPNET** installed, the bucket picks up and carries the whole load to the spoil bank. Less material spills out the back of the bucket or off the teeth. It proves easier to clean off the top of coal and less spoil is spilt back onto the working bench. Field experience shows time spent cleaning the coal surface can reduce toone third when using a **TOPNET.**

Improving the Geotechnical Handling of the Muck Pile

A **TOPNET** prevents spoil cascading through the loading bucket and rilling to the bottom of the muck pile. Cascading spoil effectively lowers the centroid of the muck pile and increases the hoisting requirements. A TOPNET effectively minimises this effect and increases the linear advance rate down the pit. When evaluating the productivity of a **TOPNET,** it is important to recognise this contribution and measure ***pit advance rate per work hour*** as well as volume per work hour.

Filling the Back of the Bucket

The throat of a bucket can clog up, preventing material from flowing right to the back corners. This occurs more commonly when (1) stripping on a horizontal slice, where the drag force is the only force pushing material into the bucket, or (2) when loading poorly fragmented material. With a steep carry angle, the bucket tips back as it is lifted. The mass of the spoil becomes the internal force that clears a blockage in the throat of the bucket and lets material "fall" into the rear of the bucket rather than be lost from the payload. In the **BOSMIN®** configuration, the dragline bucket works a little like the bucket of a front end loader in that it tips positively as it lifts from the bank.

Reducing Bucket Wear

Typically a bucket is full well before the rigging geometry is correct for it to be picked up. Spoil flows through the bucket as it drags though the bank, rubbing metal from the wear plates and increasing loading time. With a **TOPNET** fitted, a full bucket rides out of the spoil bank and payload in the bucket remains stationery. That means less abrasion inside the bucket. A bucket fitted with a **TOPNET** can be picked up earlier and therefore experiences less wear on the underside.

Keeping your Operator Posted

In many installations the operator cannot see the back of the bucket. To ensure a full load, the bucket is often dragged in further than necessary. Valuable seconds are lost on each cycle. With a TOPNET fitted, material cannot flow though the bucket. Once the bucket is full, spoil pushes up on the net and lifts the bucket out of the bank. A shear-plane develops in front of the bucket and it rises, reducing the drag force needed to move the load forward. More importantly, the operator knows the bucket is full and can hoist it immediately.

Helping the Dragline Operators

TOPNET installation is the perfect time to promote upgrade training as one facet of a continuous improvement program. Operators may appreciate guidance in making the most of the extra dragline flexibility provided by the **TOPNET**. Additional productivity boosts may be available if general dragline operating procedures are reviewed at this time.

Using a Smaller Bucket

Extensive scale model tests confirm that effective bucket volume can be varied between 80% and140% of a normal payload by fitting an appropriately designed **TOPNET**. On oneproductiondragline that had spare hoisting capacity, a TOPNET has been employed toincrease the load carrying capacity of a bucket by 15%. Further productivity improvementcomes from reduced fill and hoist times.

There is considerable scope for installing a smaller bucket with a loosely adjusted **TOPNET** to improve the ratio between payload and total suspended load. Consider a typical dragline fittedwith a 47 cubic metre bucket. Bucket and jewelry would weigh around 56 tonnes and carrya payload of about 84 tonnes for a total suspended load of 140 tonnes. If a 45 cubic metrebucket were employed, bucket and jewelry would weigh only 52 tonnes, allowing thepayload to increase by over 5% for the same total suspended load.

Adding It All Together

The potential productivity improvements noted above may be cumulative or in some cases,improvements in one part of the dig and swing cycle may impact performance in another part of the cycle. Field evidence indicates that an overall productivity improvement should be expected but each site requires careful assessment to identify the optimal **TOPNET** configuration.

As **TOPNETS** are field adjustable, there is a new opportunity to optimise dragline configurations,for each pass in the stripping cycle rather the current compromise. Installing a **TOPNET** on a dragline bucket, results in:

- Fewer under-loaded buckets and reduces the opportunity for overloads
- Reduced cycle time
- Increased spoil radius
- Improved geotechnical handling of the muck pile Easier operation

We can prepare a quote to instal a **TOPNET** suitable for your dragline bucket, if you send the **A**, **B**, **C**, & **D** dimensions, together with the bucket size and recommended suspended dragline load.

At the mine site **BOSMIN®** engineers adjust the hoist chains and/or the dump rope to achieve a steeper bucket carry angle. The bucket will then lift a full load when hoisted further out towards the boom point, and achieve improved performance close in near the fair leads. By adjusting net fullness, **BOSMIN®** tunes the bucket volume to exactly match dragline capacity. With a correctly adjusted **TOPNET** the dragline achieves close to the perfect payload on every cycle.

BOSMIN® is a regestered trade mark of;

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