# HOSE CO.2 WESTBURY FIRE DEPT.
TRAINING BULLETIN
MECHANICAL ADVANTAGE ROPE BAGS

The **Westbury Fire Department** currently has two (2) pre-rigged mechanical advantage rope systems, each in pre-packed rope bags stored on both ladder trucks (962 and 963) .

1. **2: 1 System** (YELLOW BAG) – made up of 200 feet of 9mm kernmantle rope, carabineers and a preset 2: 1 pulley system.

2. **High Point System** (RED BAG) – made up of 200 feet of 1/2" kernmantle rope, carabineers and a pre-set 3:1 pulley system.

Members should recognize the 2:1 System is designed to be a **Pulling** system where as the High Point System is more a **Lifting** or **Lowering** System. When members are unsure of which bag to utilize at an incident, members should recognize that although the 2 bags are the same physical size, the High Points Bag (**Red Bag**), its rope fills the bag more, weighs more and should prompt members to recognize, we'd rather use the heavier rope when we are suspending someone from a rope, so when doing so the high point bag is be the bag of choice.

In a 2: 1 system, we should recognize we use a mechanical advantage to dividing our load in half, with our anchor point supporting a portion of the weight (½) and we will be pulling the other portion (½) . We accomplish this by securing our Anchor (Anchor Carabineer on the figure 8 on a bite) to our Anchor and securing our Load (Load pulley with the load carabineer) to the load we will be hauling. We should also recognize, the distance pulled can't be more the ½ the distance of our 200 feet rope bag, so less than 100 feet.
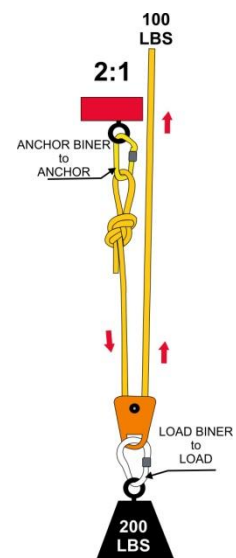
In our High Point system, we should recognize we will either be lowering a person from an elevated position like a window or platform or pulling a victim up from a below grade position such as a basement and this requires much more strength and energy. To combat this, instead of using our 2:1 system where we split out load in half, we'll use a 3:1 system where we'll split the load weigh in three. Since our Anchor will be elevated by either a Ground Ladder or Aerial devised and we will want to pull this weight from the safety of the ground, a simple 3:1 will not accomplish this because we'll be pulling the weight in the direction of the anchor. To combat this, our standard 3:1 will need a direction change, directing the rope back towards the ground. We should know with the rope going back and forth through these pulleys this limits our hauling distance of our 200' rope to a distance of about 50'.
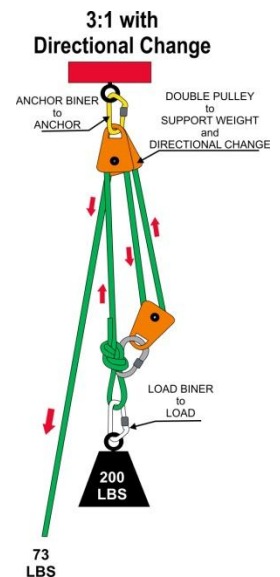
## Understanding Mechanical Advantages:

If we compare a **1:1** system to a **2:1** System –

We notice a few things:
- ✦ Both system have a carabineer on a 8 on a bite
- ✦ Both systems use a single pulley
- ✦ The components physically made look identical...

> *It's the placement of our carabineers that will determine*
> *if we gain a mechanical advantage.*

With the 1:1 – (**no mechanical advantage**) – is when we place our "Anchor carabineer" to our Load and our "Load carabineer" to our Anchor, this creates nothing more than a simple change of direction.
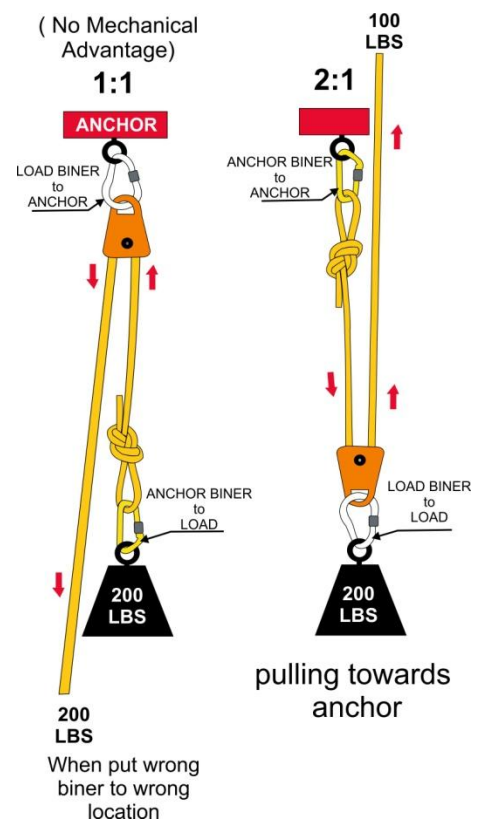
By switching the **Load carabineer - to the Load** and the **Anchor carabineer - to an Anchor**, we've now allowed the Anchor to support a portion of the weight, creating our 2:1, splitting our load weight in half.

With our 2:1 as is, we will be pulling our Load in the direction of our Anchor.

What if we wanted to pull the weight in the opposite direction and in the direction of the load? We accomplish this simply by adding a pulley to our anchor, placing a loop the rope in it and this change the ropes direction.

What if we took this same 2:1 with our directional change and reversed our Anchor and Load, now pulling in the direction of our anchor?
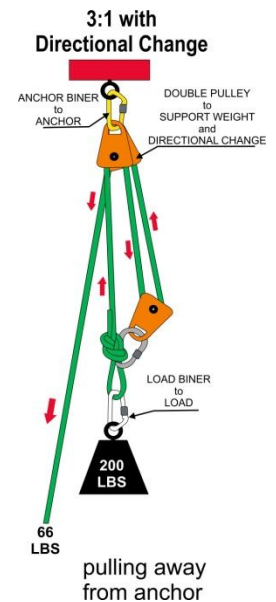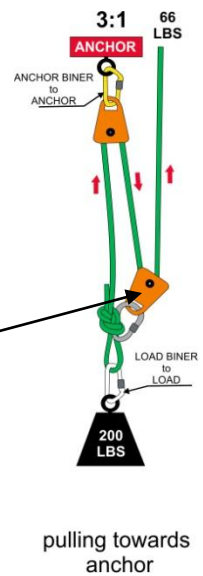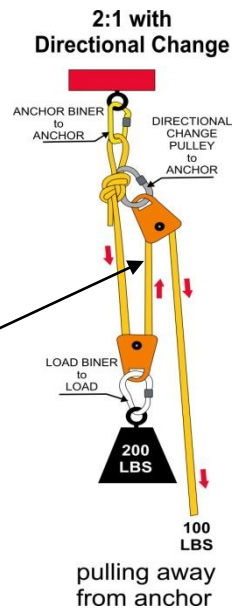
We've just created a 3:1 System

In the diagram to the right, you can see just by flipping the yellow carabineer from the Anchor Knot to the Load pulley, making it the Anchor and the white carabineer from the Load pulley to the Anchor Knot and connecting to our Load, it creates 2 points of support at our anchor. This now divides the load into 3 creating our 3:1
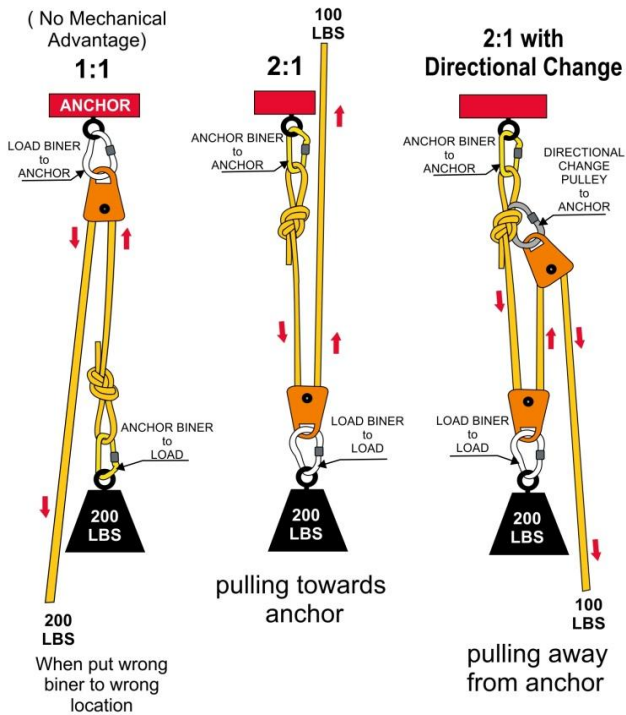
We basically just added a 2:1 system to or 1:1
Note our pull direction is back towards our anchor point.

What if we wanted to pull away from our anchor as would be the case in our high point system where our Anchor is up on a ladder (High Point) and we and to pull from the safety of the ground ?
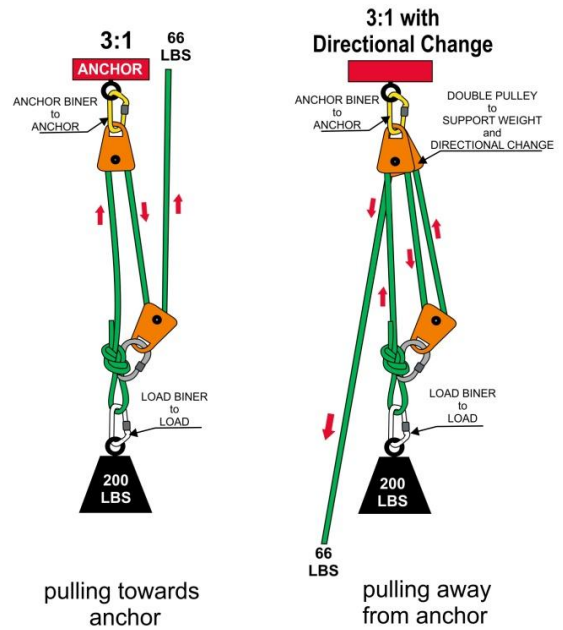
We could add a directional change to the anchor as we did with our 2:1 with a change of direction (adding another pulley to our anchor point) or in our case, since this will be a permanent set up, we'll use at **double sheave pulley** at our anchor to create this directional change.

MECHANICAL ADVANTAGES 2:1

MECHANICAL ADVANTAGES 3:1

(No Mechanical Advantage)
1:1

ANCHOR

LOAD BINER to ANCHOR

ANCHOR BINER to LOAD

200 LBS

200 LBS

When put wrong biner to wrong location

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100 LBS

2:1

ANCHOR BINER to ANCHOR

LOAD BINER to LOAD

200 LBS

pulling towards anchor

2:1 with Directional Change

ANCHOR BINER to ANCHOR

DIRECTIONAL CHANGE PULLEY to ANCHOR

LOAD BINER to LOAD

200 LBS

100 LBS

pulling away from anchor

3:1

66 LBS

ANCHOR BINER to ANCHOR

LOAD BINER to LOAD

200 LBS

pulling towards anchor

3:1 with Directional Change

ANCHOR BINER to ANCHOR

DOUBLE PULLEY to SUPPORT WEIGHT and DIRECTIONAL CHANGE

LOAD BINER to LOAD

200 LBS

66 LBS

pulling away from anchor

Packing our Yellow 2:1 Bag:

- Create a figure 8 knot on a bite with a overhand stop on a approximately 12" tail making your – ANCHOR KNOT

- Attached your Yellow ANCHOR CARABINEER to loop of the ANCHOR KNOT

- Install the LOAD CARABINEER to the LOAD PULLEY

- Clip the LOAD CARABINEER to the ANCHOR CARABINEER

- Clip the ANCHOR CARABINNER to the bag after placing the remaining rope into the bag
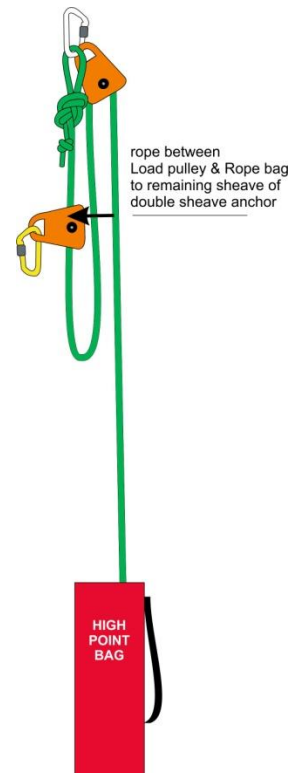
- Close the Bag

ANCHOR CARABINEER
(yellow)

ANCHOR KNOT
Single loop figure 8 overhand stop knot

LOAD PULLEY

LOAD CARABINEER
(white)

2:1 BAG
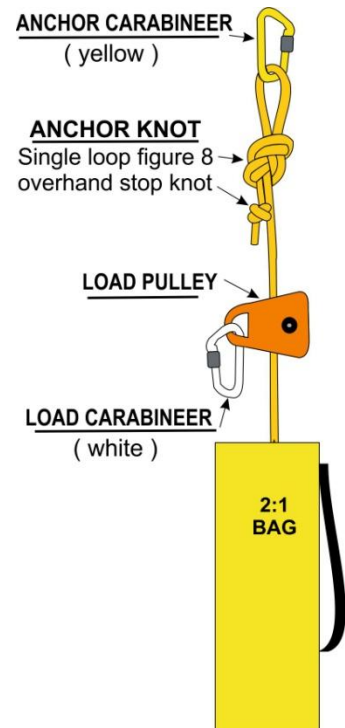
Packing our Red High Point Bag:

- Create a figure 8 knot on a bite with a overhand stop on a approximately 12" tail making your – ANCHOR KNOT

- Attach the LOAD CARABINEER to ANCHOR KNOT

- Install the single sheave LOAD PULLEY to the rope between the ANCHOR KNOT and the ROPE BAG

- Attach the ANCHOR CARABINEER to the DOUBLE SHEAVE ANCHOR PULLEY

- Install is DOUBLE SHEAVE ANCHOR PULLEY to the rope between the LOAD PULLEY and ANCHOR KNOT

- Put the LOAD CARABINEER to the LOAD PULLEY
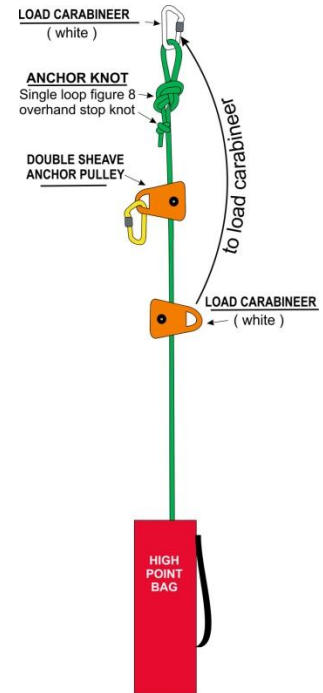
- Install the Remaining sheave of the DOUBLE SHEAVE ANCHOR PULLEY to the rope between LOAD PULLEY and ROPE BAG

- Attach the LOAD CARABINEER to the ANCHOR CARABINEER

- Attach the ANCHOR CARABINEER to the rope bag after placing the remaining rope into the bag

- Close the bag

LOAD CARABINEER
(white)

ANCHOR KNOT
Single loop figure 8
overhand stop knot

DOUBLE SHEAVE
ANCHOR PULLEY

to load carabineer

LOAD CARABINEER
(white)

HIGH
POINT
BAG

rope between
Load pulley & Rope bag
to remaining sheave of
double sheave anchor

HIGH
POINT
BAG

Deploying the 2:1 System:

- Find an anchor point that can support over the weigh you'll be pulling.

- Open the rope bag and detach the ANCHOR CARABINEER from the rope Bag

- Clip the ANCHOR CARABINEER to your anchor or create a tensionless hitch and clip the ANCHOR CARABINEER to the Rope itself.

Tensionless Hitch

- Detach the LOAD CARABINEER for the ANCHOR CARABINEER and proceed to the LOAD you'll be pulling.

- Attach the LOAD CARABINEER to the Load (firefighter or victim to be removed)

- Haul the Load to the anchor point using the 2:1 Mechanical Advantage System.

100
LBS

2:1

ANCHOR BINER
to
ANCHOR

LOAD BINER
to
LOAD

200
LBS
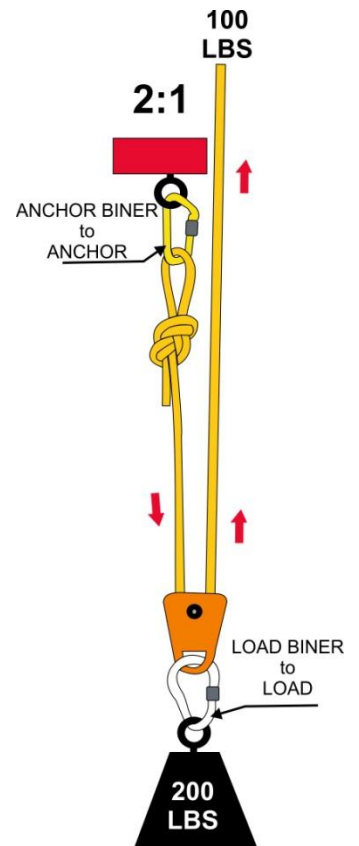
pulling towards
anchor

Deploying the HIGH POINT System:

3:1 with Directional Change

* Set a Ladder (Ground or Aerial) above the opening you'll be remove the firefighter or victim from

* Proceed to the base of the ladder placing the High Point Bag along side of the ladder

* Open the rope bag and detach the ANCHOR CARABINEER from the Bag and proceed up the ladder with the ANCHOR CARABINEER

* Attach the ANCHOR CARABINEER to a rung, on the building side on the ladder (Between ladder and building), and a few rungs above the opening you'll be removing the firefighter or victim from

* Detach the LOAD CARABINEER from the ANCHOR CARABINEER and hand it inside to the firefighters inside preparing the firefighter/victim for removal, these firefighters will attached the LOAD CARABINEER to the LOAD (firefighter/Victim)

* Proceed down the ladder

* Place rope bag with the rope inside from inside the ladder to outside the ladder through 1st and 2nd rung up ⟶

* Place rope bag with rope from outside the ladder to inside of ladder between 2nd and 3rd rung up ⟵

* Place rope bag with rope from inside the ladder back outside the ladder between 3rd and 4th rung up ⟶ and deploy some rope from the bag, this rope will be used to support the weight of the hauling or lowering of the load, assisted by the friction created by looping the rungs. When using an aerial device, you'll weave through a couple of rungs before sending bag to the ground, where firefighter will be hauling or lowering from.

* Before a load is place on any ground ladder, **it is imperative a firefighter stands on bottom rung of the ladder preventing it from being kicked out !**