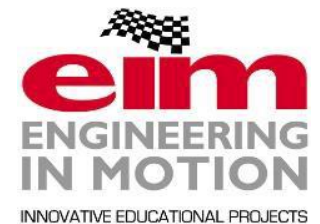




Expert Tips and Hints

# Off-Road Performance – Tyres & Suspension

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# Off Road Performance

There are 2 Main Chassis Systems That Affect a 4x4 Off Road Performance

## 1. Tyres



## 2. Suspension



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# Tyres

## What's important

### Diameter

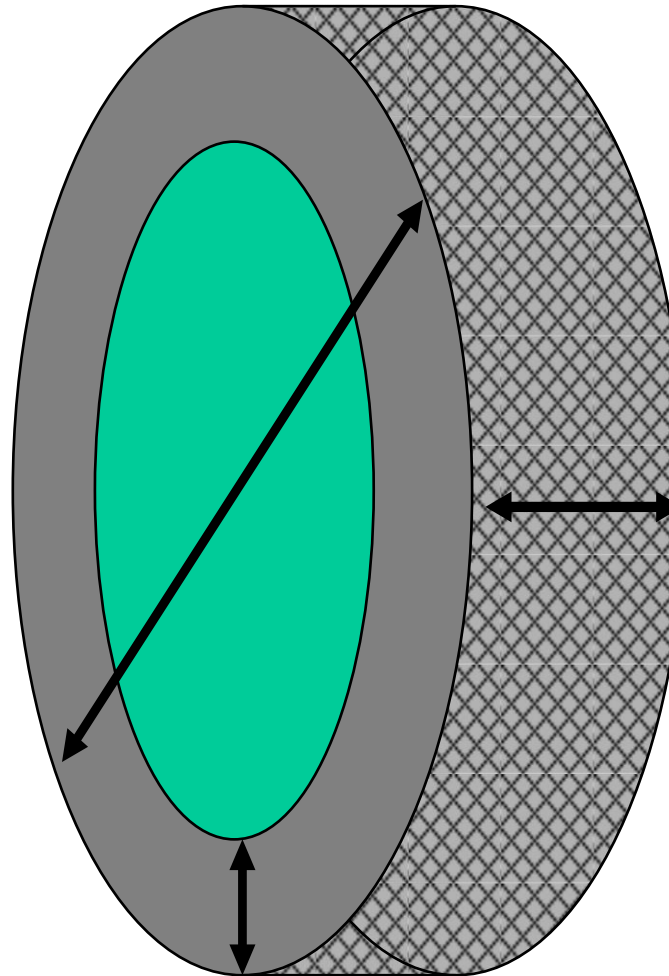
Rolling resistance

Ability to climb obstacles Contact patch length

### Profile / Sidewall height

Resistance to rim damage

Contact patch length at lower pressures



### Tread Pattern

Grip 'Digging'

### Width

Sinkage

Rolling resistance

### Pressure

Sinkage

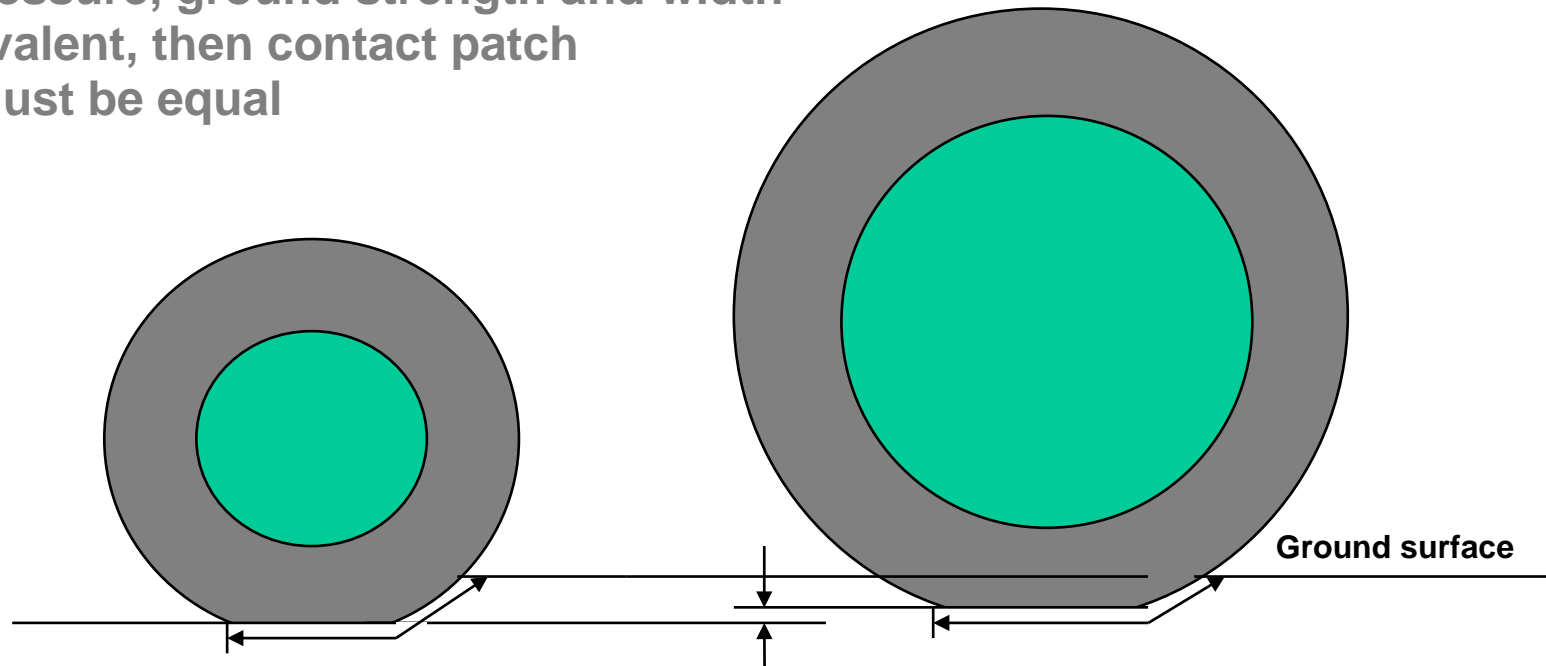
Rolling resistance

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# Tyres

## Diameter

If tyre pressure, ground strength and width are equivalent, then contact patch length must be equal



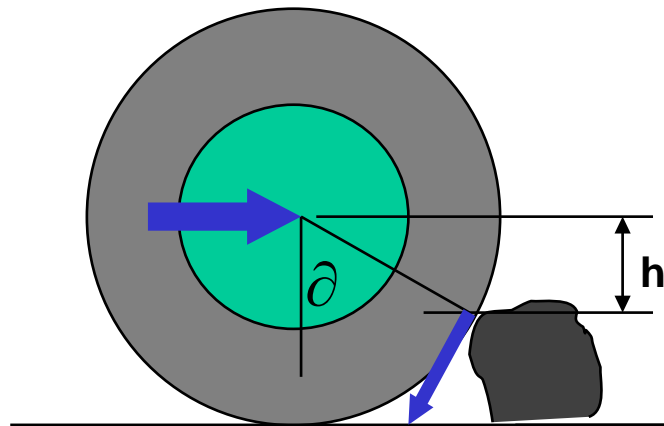
For equivalent contact patch lengths, there is more sinkage on the smaller wheel, therefore it has more rolling resistance

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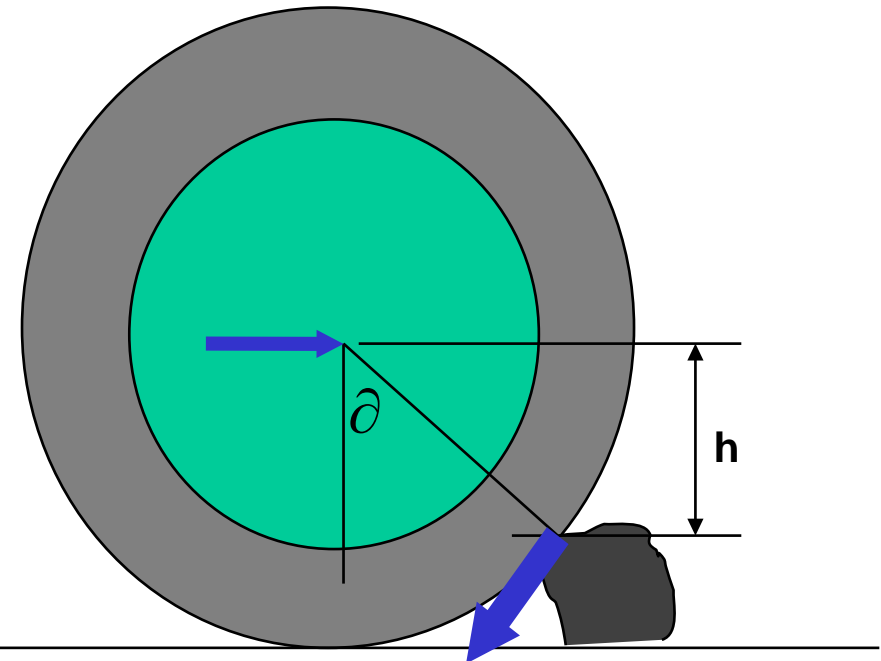
# Tyres

## Diameter

If  $\tan \theta$  is greater than the contact patch friction level then the wheel will not be able to generate sufficient self traction to climb over the obstacle and so will slip



If there is insufficient self-traction, then excess traction from the other wheels is required to help push the wheel onto the obstacle to generate more traction, and help push the wheel over the obstacle

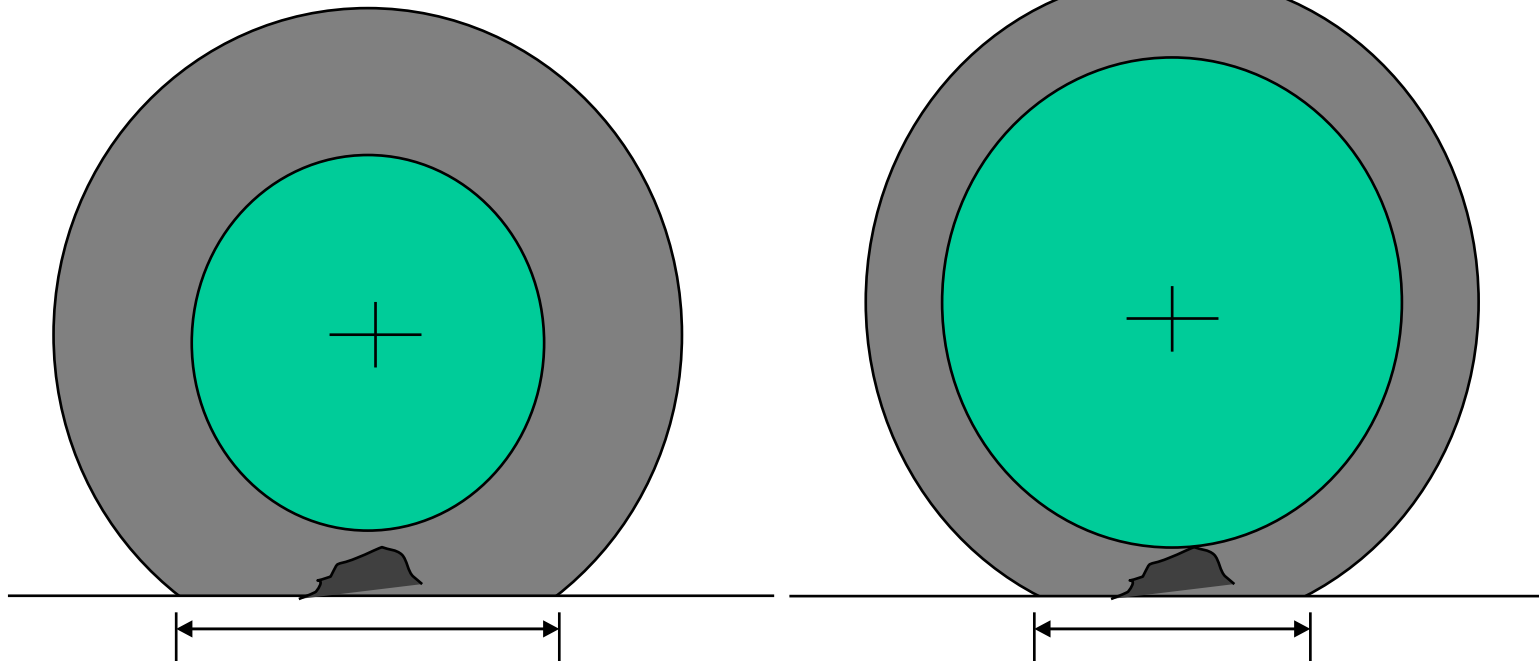


The larger 'h' is the more effective any pushing force is at pushing the wheel over the obstacle

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# Tyres

## Profile / sidewall height



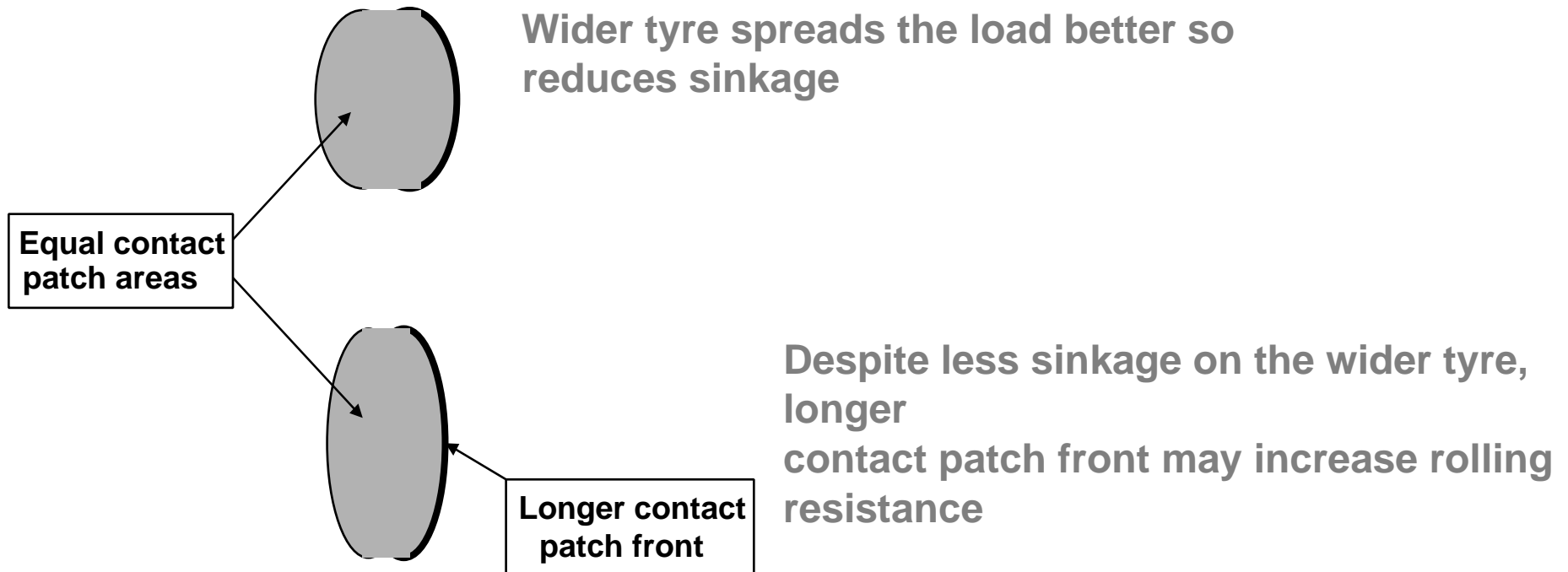
Higher sidewall tyre has more capacity to squash at lower tyre pressures so contact patch length increase is greater

Greater chance of rim stone / rock damage during dynamic tyre squash with smaller sidewall

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# Tyres

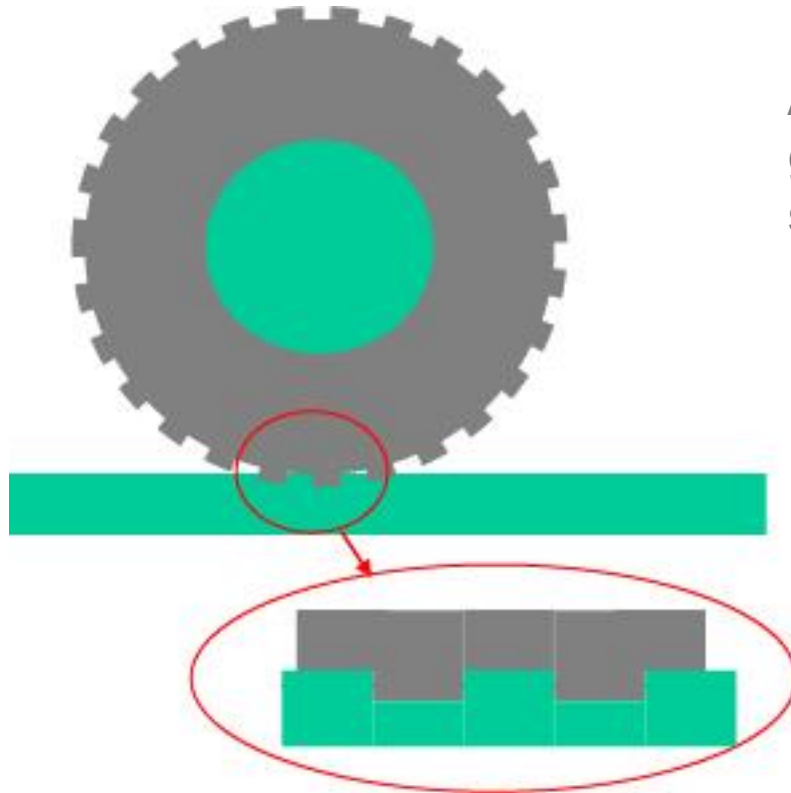
## Width



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# Tyres

## Tread Pattern



Aggressive tread pattern engages with the ground so grip is a function of ground strength not tyre to ground friction

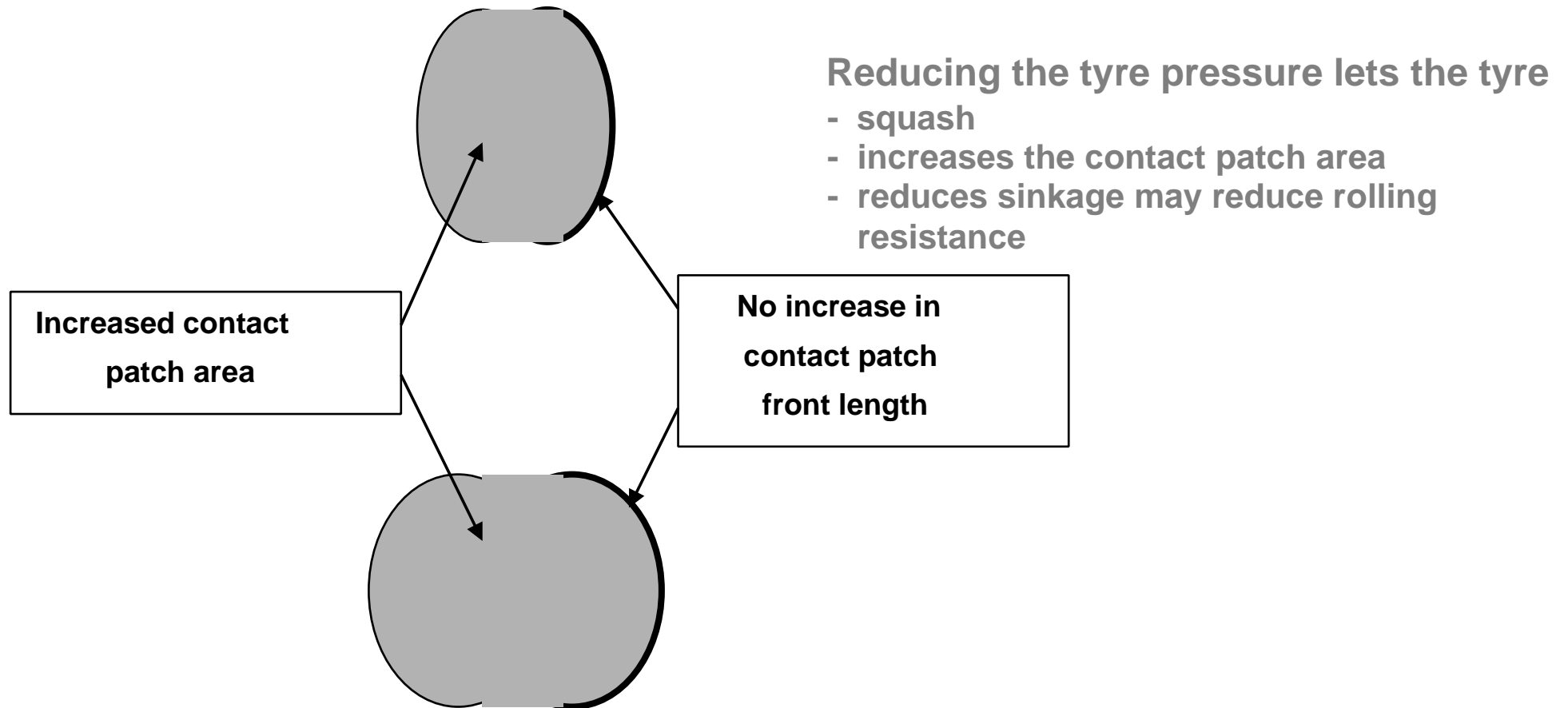
If the ground has a low strength (sand) then the tyre can dig in if it slips

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# Tyres

## Pressure



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# Suspension

## Articulation – What is articulation

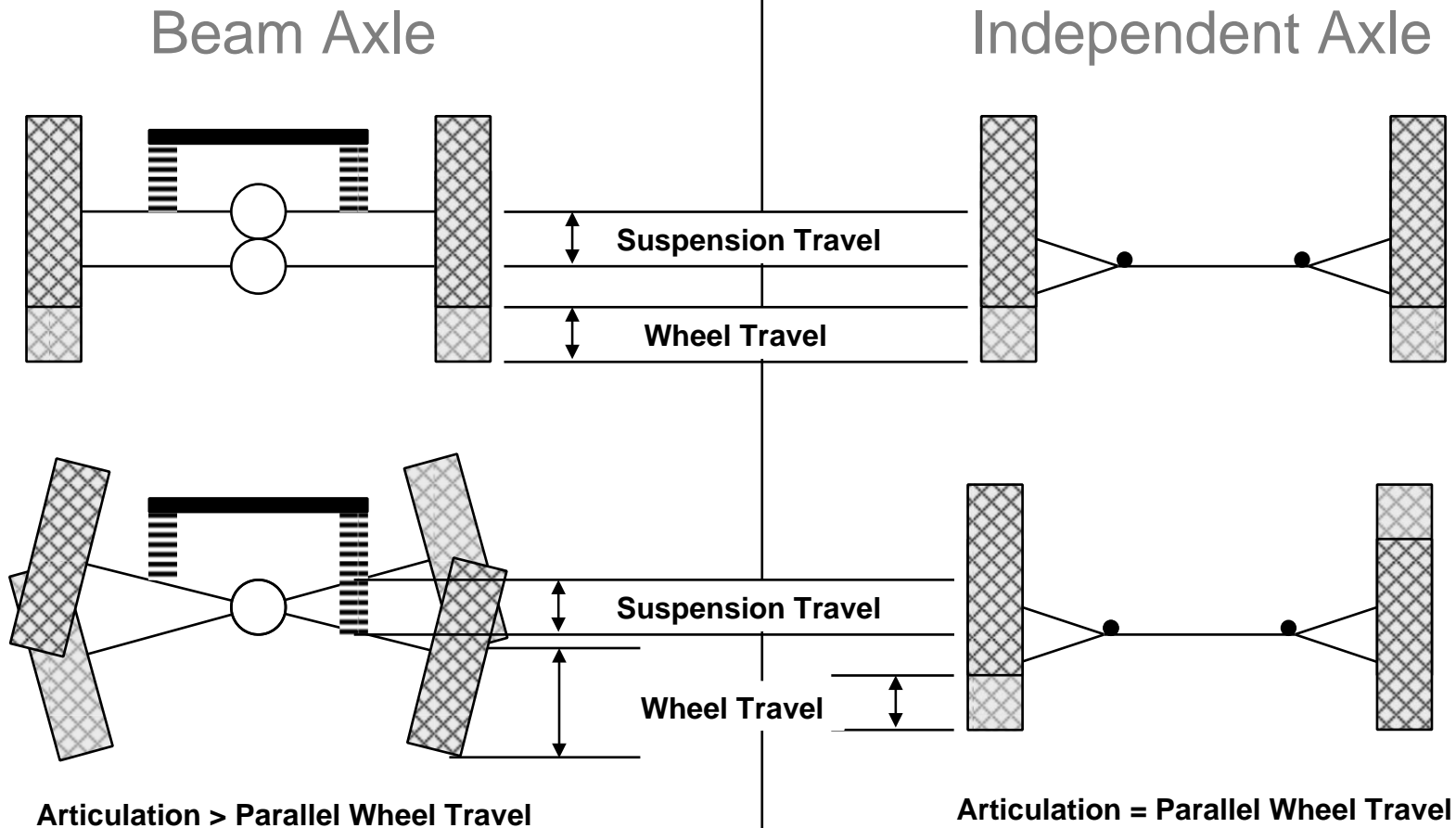


The ability of adjacent wheels to move in opposite directions to maintain ground contact

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# Suspension

## Factors affecting articulation - Suspension type

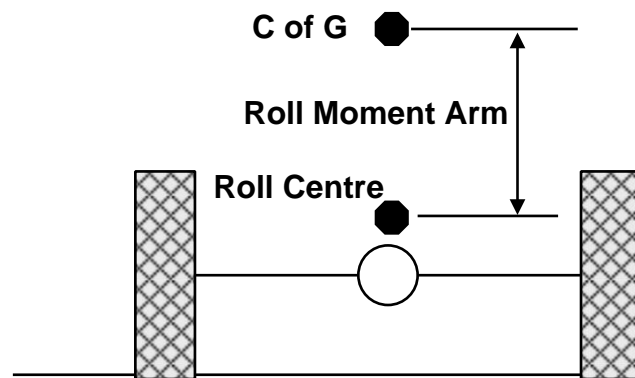


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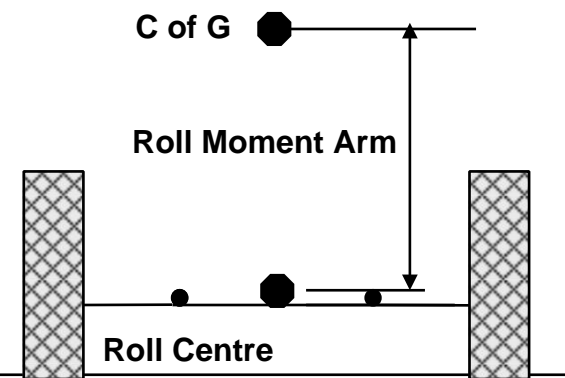
# Suspension

## Factors affecting articulation - Suspension type

### Beam Axle



### Independent Axle



Longer Roll Moment Arm  
More Roll Stiffness Required To control Roll Therefore  
**Greater Articulation Stiffness**

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# Suspension

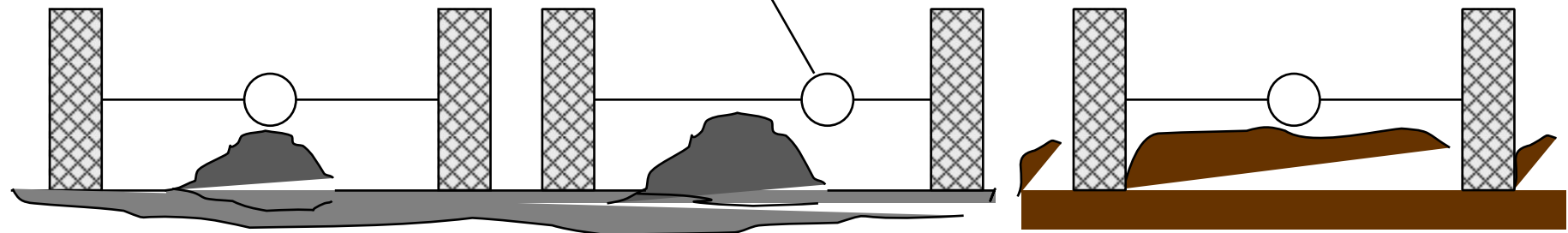
## Ground Clearance – Lateral profile

1. Discrete features - boulders / tree stumps

Two cases to consider

2. Linear features - ruts

Particularly advantageous  
if the differential is off-set



### Discrete feature

The Vehicle can be manoeuvred to take full advantage of the vehicle's ground clearance

### Linear feature

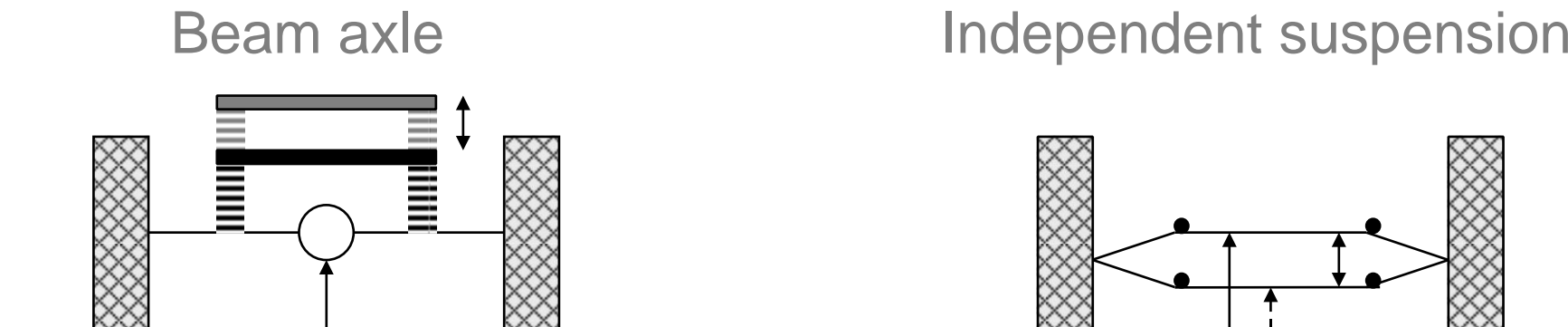
Little or no ability to manoeuvre the vehicle

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# Suspension

## Ground Clearance – Suspension type

Change in ground clearance with suspension deflection



Ground clearance changes  
as suspension moves up  
and down

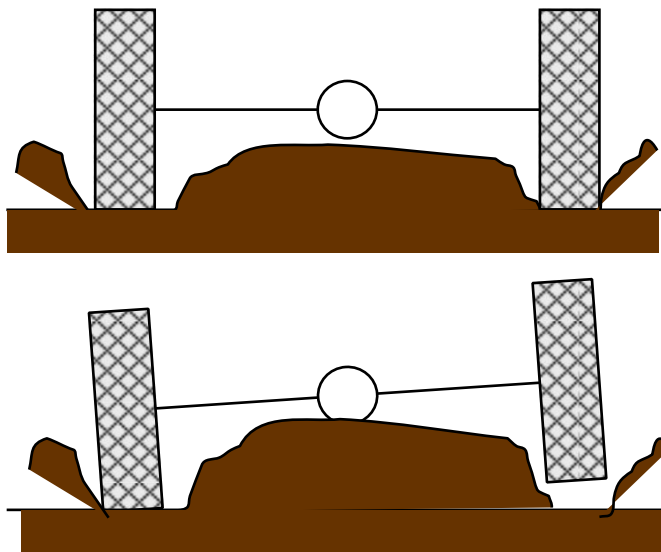
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# Suspension

## Ground Clearance – Suspension type

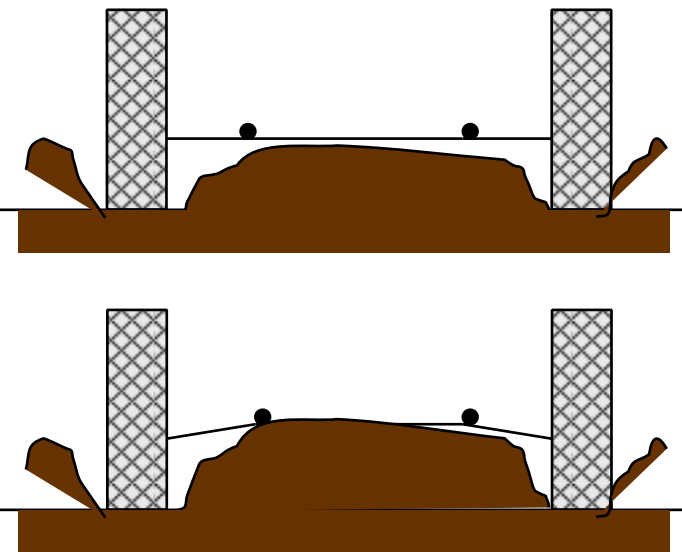
### Change in wheel load with suspension deflection

#### Beam axle



Wheels Lift When Grounding Occurs  
Traction is Lost

#### Independent suspension



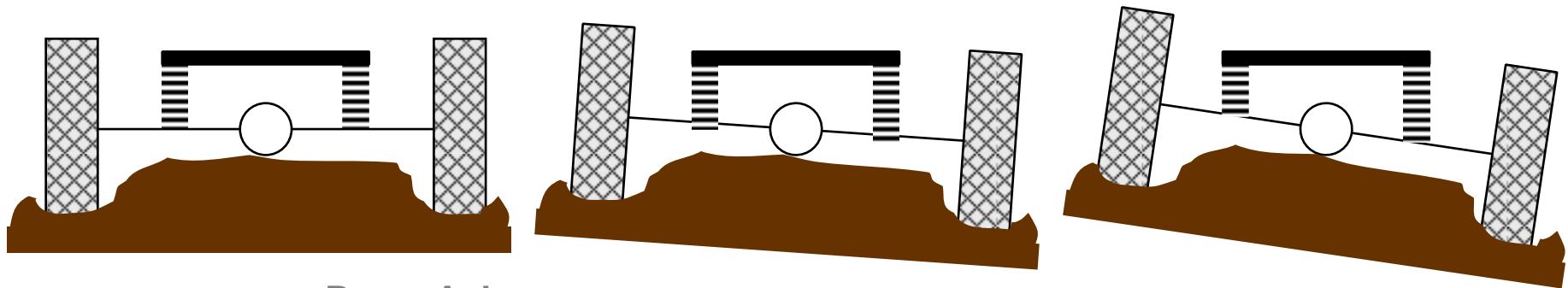
Wheel Loads Reduce When Grounding Occurs  
Traction is Reduced

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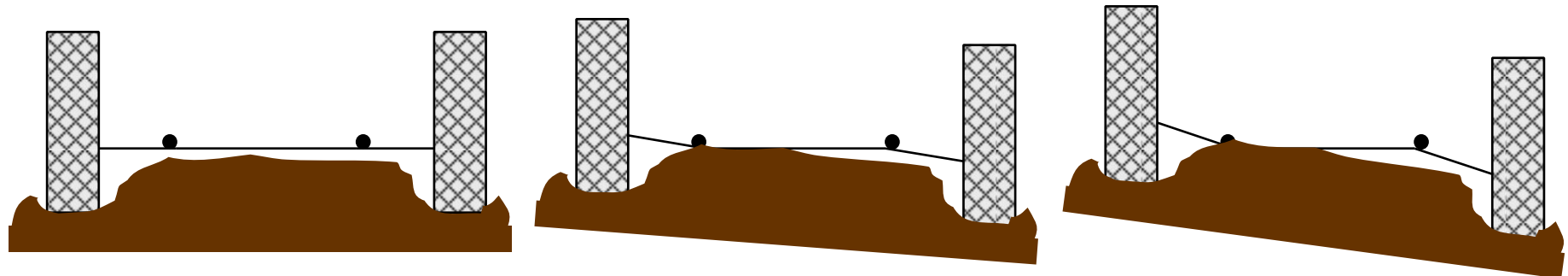
# Suspension

## Ground Clearance – Suspension type

### Ground clearance whilst articulated



**Beam Axle** - Ground clearance is maintained during articulation



**Independent suspension** - Ground clearance reduced during articulation

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