Spread and compact materials manually

RIICCM207D

Compliance documentation

- Legislative, organisational and site requirements and procedures;
- Manufacturer's guidelines and specifications;
- Australian Standards;
- Employment and workplace relations legislation; and
- Equal Employment Opportunity and Disability Discrimination legislation

Regulatory and legislative requirements

- Work Health and Safety Act 2011
- Work Health and Safety Regulation 2011
- Electrical Safety Act 2002
- Electrical Safety Regulation 2002
- Environmental Protection Act 1994
- Aboriginal Cultural Heritage Act 2003

Guidance documents

- Plant Code of Practice 2005, Workplace Health and Safety Queensland.
- Managing the Risks of Plant in the Workplace 2012, Safe Work Australia.
- Construction work Code of Practice 2012, Safe Work Australia.
- Excavation Work Code of Practice 2012, Safe Work Australia.
- Electrical Safety Code of Practice 2010 Working Near Exposed Live Parts, Electrical Safety Office Queensland.

Guidance documents

- Traffic Management for Construction or Maintenance Work Code of Practice 2008, Workplace Health and Safety Queensland
- Manual of Uniform Traffic Control Devices Part 3 (MUTCD Part 3)
- Any relevant standards that provide guidance.
- Manufacturer's Specifications and Instructions
- Other Workplace and Organisational Requirements

Safety Data Sheet (SDS)

- The WHS Regulation 2011 sets out the requirement of a supplier to:
  - Provide a copy of a current SDS to the person conducting a business or undertaking (PCBU), and
  - Provide a copy of an SDS when requested by certain people.
- The WHS Regulation 2011 sets out the requirement of a PCBU to:
  - Obtain an SDS of a hazardous chemical from the manufacturer, importer or supplier;
  - Keep a register containing a list of all hazardous chemicals used at the workplace and put a copy of any SDS obtained in the register;
  - Take reasonable steps to ensure the SDS is not changed other than by the manufacturer or importer; and
  - Keep the SDS close to where the chemical is being used.
- Safety Plan

Safety requirements

- Work Health and Safety Act 2011
- Administration of the Act
- Objective of the Act
- Work Health and Safety Regulation 2011
- Understanding the Work Health and Safety Act 2011

Duty of care

- "Duty of Care" is a common law term used to describe how a person may have responsibilities to the safety and wellbeing of another person.
  - For example, a PCBU (persons conducting a business or undertaking) has a primary duty of care requiring them to, so far as is reasonably practicable, ensure the health and safety of workers and others who may be affected by the carrying out of work.

- The WHS Act 2011 sets out duties of care on a wide number of workplace parties.
- Duty of care is often the basis of cases in civil courts to show negligence.

Duty of care

- A duty imposed on a person to ensure health and safety requires the person:
  - To eliminate risks to health and safety, so far as is reasonably practicable; and
  - If it is not reasonably practicable to eliminate risks to health and safety, to minimise those risks so far as is reasonably practicable.

- What is 'reasonably practicable' in ensuring health and safety?

- Duty of Care parties.

Incident notification

- According to Sections 35-39 of the Work Health and Safety Act 2011, a PCBU must notify the relevant state authority as soon as they become aware of a death, or a serious injury or illness that results in:
  - Immediate hospital treatment as an in-patient
  - Immediate medical treatment for injuries (e.g. amputation, scalping, a spinal injury, loss of a bodily function or a serious laceration, burn, head or eye injury), or
  - Medical treatment within 48 hours of exposure to a substance.
- A serious illness (Regulation 669) is:
  - Any infection to which the carrying out of work is a significant contributing factor, including any infection that is reliably attributable to carrying out work
- PCBU

Licensing of high risk work

- Section 81 of the Work Health and Safety Regulation 2011 states that a person must not carry out a class of high risk work unless the person holds a high risk work licence for that class of high risk work, except as provided in section 82.

Plant

- A PCBU has the primary duty under the WHS Act to ensure, so far as is reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.
  - This duty includes ensuring, so far as is reasonably practicable:
    - The provision and maintenance of safe plant, and
    - The safe use, handling, storage and transport of plant.

Safe Work Method Statements (SWMS)

- Safe work method statements (SWMSs) assist a PCBU to consider how certain activities will be carried out safely.
  - The following should be noted:
    - SWMSs must be easy to understand, signed and dated;
    - SWMSs must be amended if there is a change in the activity and a copy must be given to the principal contactor; and
    - All persons affected by changes must be advised of amendments to the work method statement.
  - The Work Health and Safety Regulation (2011) states that where a PCBU is required to carry out high risk construction work, a safe work method statement must be prepared, or have already been prepared by another person, for the proposed work before that work commences.

Safe Operating Procedures (SOP)

- A Safe Operating Procedure (SOP) is a set of step by step instructions for carrying out a specific technique provided by the workplace.
- The SOP represents how the organisation wants the plant/equipment to be operated.
- When an SOP accompanies plant/equipment the instructions must be complied with.

Inspect and prepare work areas

- The first step in the risk management process is to identify the hazards associated with the work.
  - Underground essential services; gas services; electricity services; petroleum or oil pipelines; water pipes and sewers.
- Assessing the Risks
  - This step involves assessing the risk associated with the hazards identified in Step 1.
  - Risk is the likelihood that death, injury or illness might result because of the hazard. To assess risk, you need to consider both likelihood and consequences.
    - The desired outcome of this step is a prioritised list of risks for further action.

Hazard control measures

Hazard control measures

Extreme	High	Medium	Low

Consequences

- **A:** Death or Permanent Disability
- **B:** Serious Injury
- **C:** Lost Time Injury
- **D:** Casualty Treatment
- **E:** First Aid

Likelihood

- **1:** Very Likely
- **2:** Likely
- **3:** Possible
- **4:** Unlikely
- **5:** Very Unlikely

Matrix	A	B	C	D	E
1	E	E	H	H	M
2	E	H	H	M	M
3	H	H	M	M	L
4	H	M	M	L	L
5	M	M	L	L	L

Personal Protective Equipment (PPE)

- The following is a list of personal protective equipment, which you should use on site for your own safety.
  - Long sleeved shirt and long trousers;
  - High visibility vest;
  - Hard hat;
  - Steel capped safety boots;
  - Gloves;
  - Safety glasses;
  - Hearing protection; and
  - Sunscreen.

Signage requirements

- The Manual of Uniform Traffic Control Devices Part 3 (MUTCD Part 3) provides the technical background and guidance for the placement of temporary traffic control signs and devices used at road works.
  - The MUTCD Part 3 also provides standard diagrams for traffic guidance schemes across a range of work activities and worksites.
  - Selection processes are provided that use tables of key site information including:
    - Lane configuration;
    - Traffic volume;
    - Approach speed; and
    - Type of work.

Tools and equipment

- Hand compaction equipment:
  - Rammers
  - Compactors
  - Rollers

Environmental protection

- Organisational/project environmental management plan;
- Waste management;
- Water quality protection;
- Noise, vibration and dust management; and
- Clean-up management.

Environmental protection

- Typical environmental issues include:

Environmental Issues		
Erosion and sedimentation	Flora and fauna	Noise and vibration
Water quality	Rehabilitation	Waste
Groundwater	Indigenous heritage	Hazardous materials
Air quality	Non-indigenous heritage	Traffic

Pre-start, start-up and shutdown procedures

- Start-up and shutdown procedures will be outlined in the manufacturer's manual.
  - Manufacturer's guidelines and specifications must by law be provided at the point of sale.
  - It is important that you familiarise yourself with these instructions prior to operating the plant/equipment.
    - Following the manufacturer guidelines will ensure that you have followed the correct process; the opposite of this may cause the equipment to fail, pose a danger to yourself or others, or become unsalvageable.
  - If for any reason you are unaware of the process for working with plant/equipment and unable to locate the manufacturer guidelines ensure that you seek advice from your supervisor.

Pre-start, start-up and shutdown procedures

- Pre-start Checks
- Start Up Procedure
- Pre-operational Checks
- Shutdown Procedures

Maintenance and inspection

- It is also essential that that tools and equipment are checked for serviceability, and any faults are rectified or reported prior to commencement.
  - This requires you to follow all workplace protocols for rectification and reporting applicable to your organisation.
  - These protocols will require you to complete forms, place signage on equipment, and report faults to supervisors.

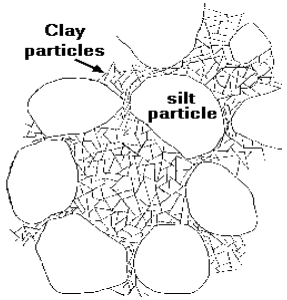
Remember: before you use any equipment identify if there is a maintenance schedule, ensure that there are no discrepancies and that it is signed off.

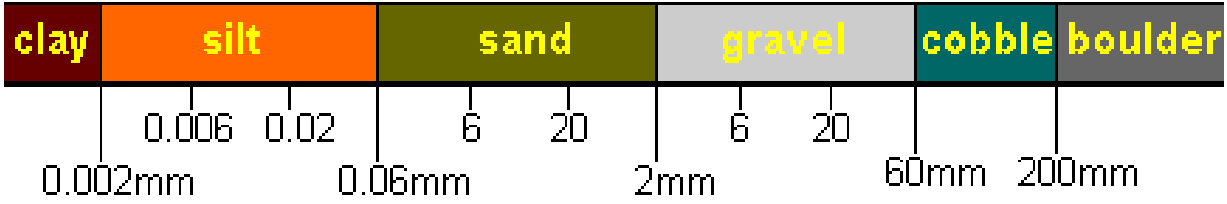
Field tests

- The visual and feel identification test for material type identification;
- The visual identification test for material segregation;
- The visual and feel identification test for material moisture content;
- Project specification testing requirements for material compaction; and
- Speedy moisture content test.
  - Check manufactured material for segregation.
  - Conduct field test to ensure material moisture is suitable.

Material type identification

- Granular Materials
- Soil includes the surface layers of sand, clay, silt, and organic material on the surface of the earth that support plants.
  - Sand
  - Silt
  - Clay





Testing rock

- Rock can be placed into three groups:

Igneous Rocks	Sedimentary Rocks	Metamorphic Rocks
Granite	Shale	Schist
Basalt	Sandstone, Claystone, Siltstone, Limestone.	Quartzite
Diorite	Conglomerate, Breccia, Caliche.	Gneiss, Slate

Plastic Index (PI) and Linear Shrinkage (LS) tests

- The fines component is one of the critical properties of unbound granular materials, which, if in excess and plastic, can cause an undesirable potential for volumetric expansion and contraction.
  - The plastic index (PI) and linear shrinkage (LS) tests, are used to evaluate the quality of the fines passing an AS 0.425 sieve.
    - The PI test, being sensitive to the amount of clay present, can be an indicator of the potential loss of stability that can occur, due to the softening of the clay component when wetted.
    - The LS test, on the other hand, is more sensitive to the type of plastic materials present, and will increase with the amount of flaky, organic and fibrous content.

Material segregation identification

- Soil consists of an assembly of ultimate soil particles (discrete particles) of various shapes and sizes.
  - With any construction material you are aiming for an even mix of coarse and fine particles.
- Segregation occurs when different material types separate, usually during storage or transport.
- The object of a particle size analysis is to group these particles into separate ranges of sizes and so determine the relative proportion by weight of each size range.
  - The method employs sieving and sedimentation of a soil/water/dispersant suspension to separate the particles.

Field sedimentation test

- Field sedimentation tests determines sand content:
  - Used only on sandy soils;
  - Sample taken from the spoil pile; and
  - Representative of soil in the excavation.
    - Fill glass jar and pour 125mm of water on top of soil (37mm of soil)
      - Flat bottom container - at least 175mm high
    - Place lid on jar and shake.
    - Set jar down, and rotate slightly.
      - Larger particles settle out immediately
      - Wait 30 seconds.
    - Mark jar, and silt after several minutes
      - Fine clays in an hour, make second mark.

Material moisture content identification

- The Hand Test
  - A quick method of determining moisture is known as the "Hand Test":
    - Pick up a handful of soil.
    - Squeeze it in your hand.
    - Open your hand.
    - If the soil is powdery and will not retain the shape made by your hand, it is too dry.
    - If it shatters when dropped, it is too dry.

Material moisture content identification

- The Ribbon Test
  - Run only on that part of the soil which passes # 40 sieve; test shows clay material and run on disturbed soil. Take sample from spoil pile and:
    - Mix soil + water to make into plastic mass
    - Roll mass into cylindrical shape 12mm to 37mm diameter
    - Lay across palm of hand
    - Press between thumb and second joint of index finger
    - Pass through thumb
    - Squeeze until it takes the shape of a 3mm to 6mm thick strip
    - Allow to hang freely from hand
      - Clay loam will barely ribbon and break easily
      - Clay = relatively long ribbon 150mm to 200mm or more
      - More clay = longer and stronger ribbon silt has tendency to produce short ribbon with broken appearance

Testing requirements for material compaction

- Guide for estimating soil strengths (CBR)
  - It sounds complicated, but the basis behind the CBR test is quite simple; we are determining the resistance of the sub-grade (i.e. the layer of naturally occurring material upon which the road is built), to deformation under the load from vehicle wheels.
    - Even more simply put, "how strong is the ground upon which we are going to build the road".

Testing requirements for material compaction

- The CBR test is a way of putting a figure on the inherent strength.
  - The test is done in a standard manner so we are able to compare the strengths of different sub-grade materials, and we are able to use these figures as a means of designing the road pavement required for a particular strength of sub-grade.
  - The stronger the sub-grade (the higher the CBR reading) the less thick it is necessary to design and construct the road pavement. This gives a considerable cost saving.

Guide for estimating soil strengths

Guide for Estimating Soil Strengths		
Estimated Consistency by:		*Correlates to:*
Feel	**Sight**	**CBR (%)**
Very soft	Man standing sinks more than .75mm	<0.4
Medium	Man walking sinks about 25mm	0.8 – 1.6
Stiff	Utility ruts about 12mm – 25mm	1.6 – 3.2
Very stiff	Loaded dump truck ruts 25mm – 75mm	3.2 – 6.4
Hard	Insignificant ruts from loaded dump truck	>6.4

Measuring CBR

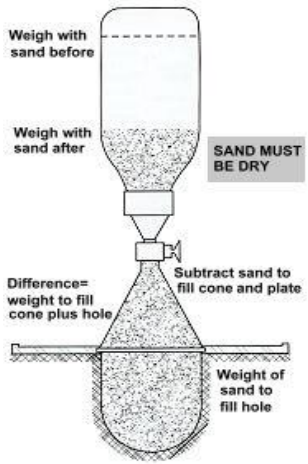
- How do I measure CBR?
- Where do I measure CBR?
- Steps to measuring CBR:
  - A measurement is taken through a series of steps.
    - First, while the penetrometer rod is standing upright, an initial measurement is taken.
    - Then, by allowing the sliding weight to drop from the top stop to the lower stop, the penetrometer rod is driven into the ground.
  - The distance that the lower stop moves as it pushes deeper into the soil is measured and recorded as one blow.
  - This sequence is repeated until the lower stop is driven into the ground. The total depth of penetration is 1m.

Measuring CBR

- Finally, the data is fed into a chart so that the total depth of penetration per blow can be calculated and the resulting CBR number is derived.
  - For matting applications, the first three feet are the most important to a final CBR measurement.
    - If a load is going to shift and if soil is going to be displaced then the first three feet of surface will bear that out.
  - Where the CBR is zero and no one can even walk across the surface of the location, then one can determine instantly that fill material will have to be added to the site and the ground will need matting or another surface supplement to bring the CBR up to an adequate number.

Measuring CBR

- Field Tests
- Nuclear Density
- Sand Cone Test
  - A small hole (150mm x 150mm deep) is dug in the compacted material to be tested. The soil is removed and weighed, then dried and weighed again to determine its moisture content.
    - A soil's moisture is figured as a percentage.
    - The specific volume of the hole is determined by filling it with calibrated dry sand from a jar and cone device.
  - The dry weight of the soil removed is divided by the volume of sand needed to fill the hole.
    - This gives us the density of the compacted soil in Kgs/m³.
    - This density is compared to the maximum Proctor density obtained earlier, which gives us the relative density of the soil that was just compacted.



Direct trucks to required location

- It is important both for safety and economic reasons that set procedures are followed during the loading operations.
  - Soils, aggregates, clay, sand, gravel, stabilised material, pre mix, cold mix, hot mix.
- The nature of the unloading site will dictate the way that the material will be unloaded.
- The following few methods are some of the ways which material can be unloaded:
  - Drive-by dumping; stockpiles and site fill

On-site material testing

- On arrival of the haulage company contracted to haul the road base to site, the worker delegated to spot the truck and dogs will be required to be able to identify if:
  - The road base is too dry, or
  - The road base is too wet.

- In either case this will have a disastrous impact on the cost efficiency of placing and spreading the gravel.

Line, grade and level control methods

- Before setting out for the trimming of sub-grade, it should be confirmed that the earthwork batters are correctly trimmed and that all excess material is removed from the area.
  - During this operation it should be ensured that the surface of the earthworks are to the approximate sub-grade level.
  - These aims may be accomplished by placing stakes on the top of batters at approximately 20metre intervals.
    - These stakes can be measured in from the origin.
  - Finished pavement level on the grade line produced can be marked on these stakes.
    - Trimming of batter is to a point at pavement depth below this mark.
    - When trimming batters, thought should be given to the horizontal earthwork tolerances.
    - Usual tolerances on batters are -50mm to -250mm.

Direct machine operator to spread materials

- Placing filling at structures:
  - When filling is placed at structures such as bridge abutments, retaining walls, wing walls and large culverts, the following guidelines should be maintained.
  - Particular care must be taken in the selection and placing of filling on the approaches to, and around, these structures, otherwise the fill can settle and cause the pavement to lose its shape.
  - A proper foundation must be established and then the correct type of structural filling must be placed and compacted in uniform layers.

Testing moisture content of filling

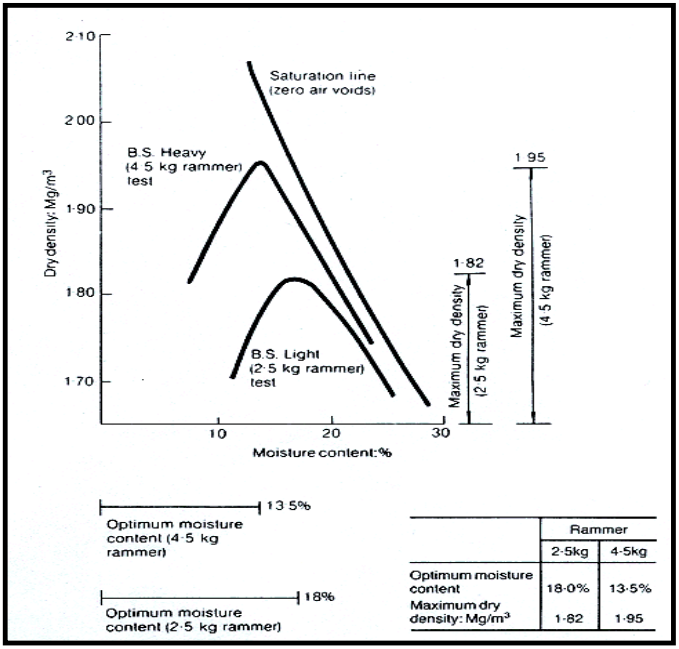
- Moisture is basically used in compaction as a lubricant for the soil particles.
  - Regardless of the type of soil, proper control of moisture is vital to the compaction success.

Too little moisture means there will be insufficient lubrication for the soil particles and, therefore, no maximum density.

Too much moisture makes the material unstable, unworkable and in some circumstances unsafe.

- With precise moisture control, light compaction equipment may give results superior to those obtained from much heavier equipment where the moisture control is inadequate.

Testing moisture content of filling



	Rammer	
	2·5kg	4·5kg
Optimum moisture content	18·0%	13·5%
Maximum dry density: Mg/m³	1·82	1·95

Finish and compact materials

- Compaction is the process of decreasing the volume of a soil or pavement mass by moving the particles into a closer arrangement (i.e. the elimination of voids by the application of some mechanical effort).
  - The soil does not obtain its full strength until all the particles are jammed against each other tightly.
    - If the soil is not compacted the voids would allow infiltration of water which could also weaken the soil.

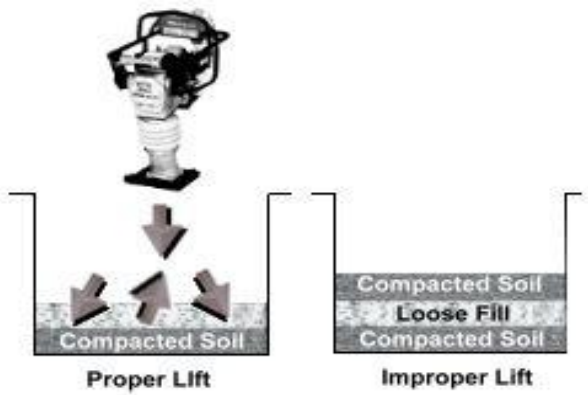
Finish and compact materials

- Neglecting compaction can result in uneven settlement, pot holes, humps, and broken pavement, etc.

- Ultimately it may lead to:
  - Embankment failure;
  - Pavement failure; or
  - Culvert failure.

Finish and compact materials

- Soil type
- Layer thickness
- Compaction equipment
- Moisture content:
  - Hydration
  - Lubrication
  - Swelling
  - Saturation
  - Optimum moisture content (OMC)
  - Compactive effort



Compaction equipment

- Compaction equipment is designed to compact materials in four different ways or with a combination of each:
  - Static Weight – material is compressed by the weight of the roller.
  - Impact – where a series of blows are transmitted to the material
  - Vibrating – a rapid impact effect, which causes the material to stack together.
  - Kneading – material is shoved and kneaded together by a combined vertical and horizontal force.

Compaction equipment

- Machine Operating Instructions

- More specific instructions which apply to plant/equipment will vary according to type of equipment and also manufacturer.
  - Ensure that you familiarise yourself with the specific operator instructions accompanying the equipment before use.

Clean Up

- Requirements for clearing the work area; and
- Requirements for cleaning, checking and storing plant, equipment and tools.