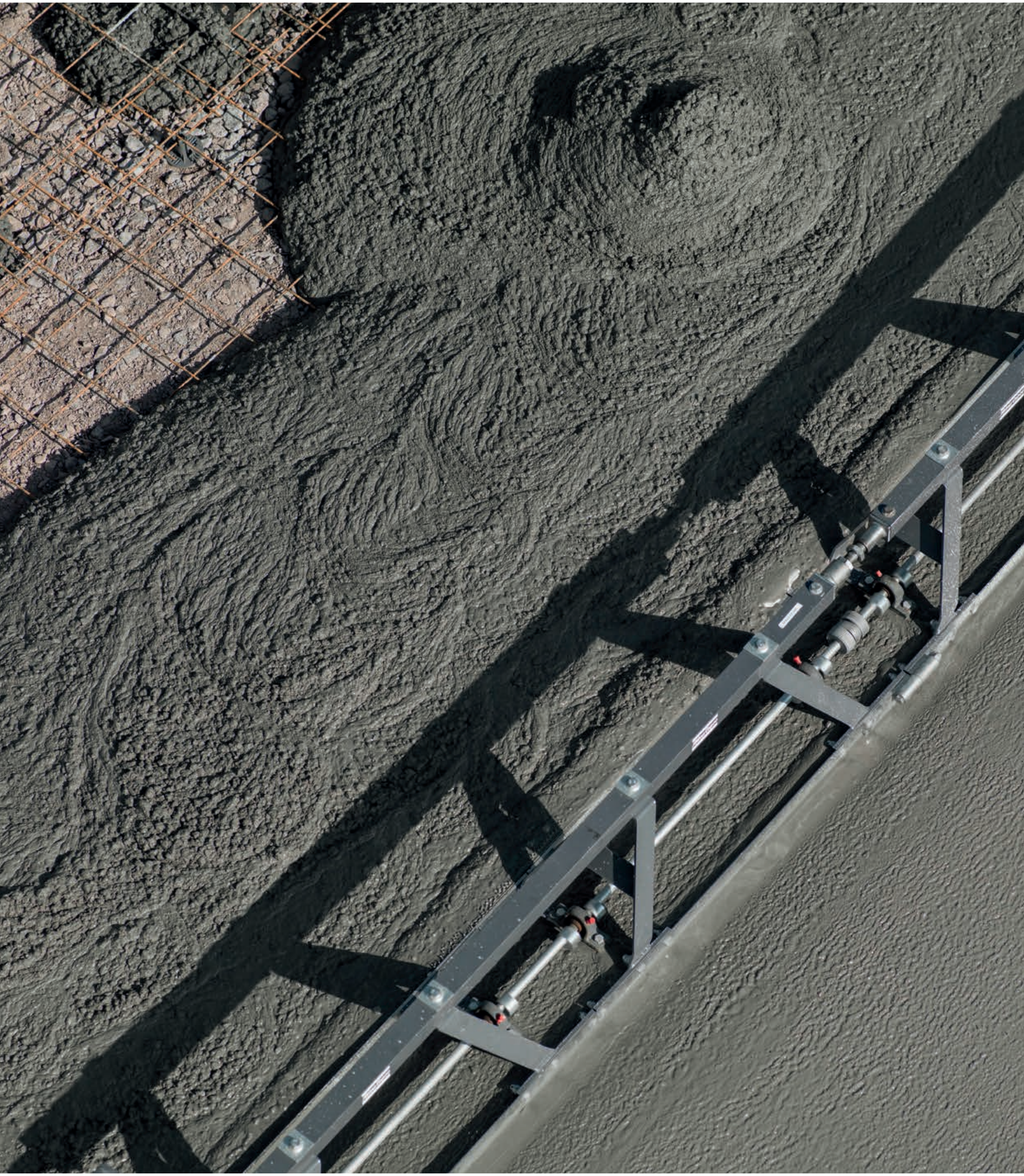
GUIDE TO CONCRETE FLOOR

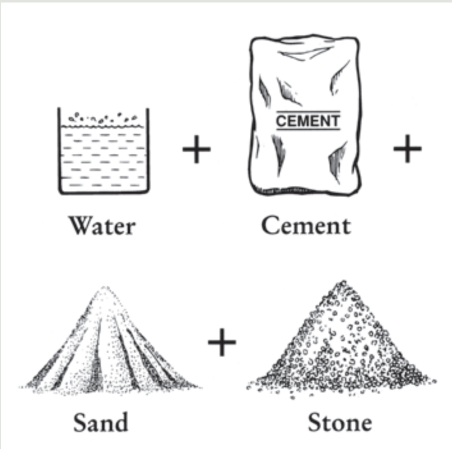
Our know-how for your applications

Atlas Copco

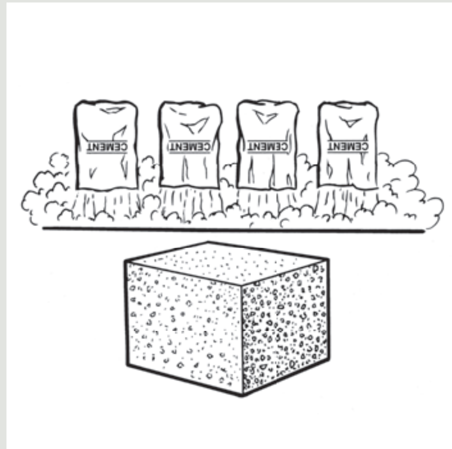


Contents

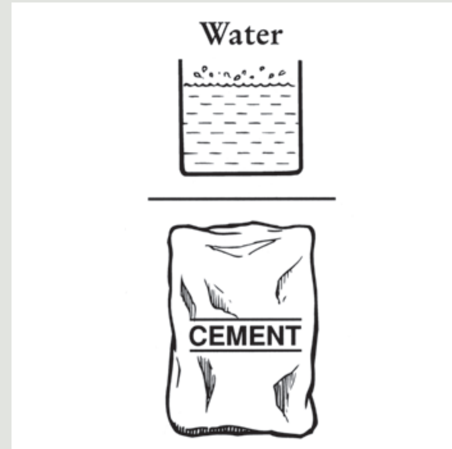
Concrete



Concrete is a mixture of water, cement, sand and stone.



The cement content affects concrete properties. A high cement content gives a high strength whereas shrinkage unfortunately also will increase.



Water content divided with cement gives w/c-ratio. The water/cement-ratio is a theoretical average value and it may change during transport or vibration.

What does concrete consist of?

Concrete is a mixture of water, cement, sand and stone. These four components can be varied to a great extent and the characteristics of the mix and the hard, hydrated product itself can thereby be changed to a great extent.

Cement

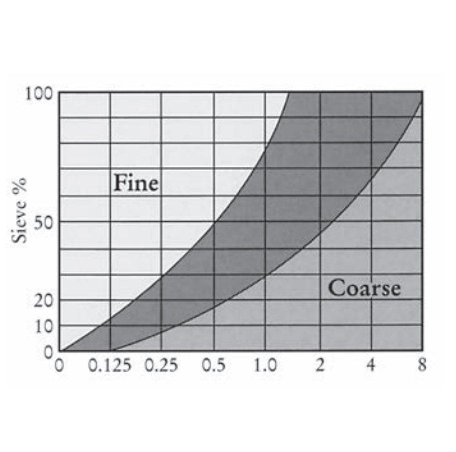
Cement and water are two important components.

Cement content means the amount of cement by weight per cubic meter concrete and can vary from 500 down to 250 kg per cubic meter.

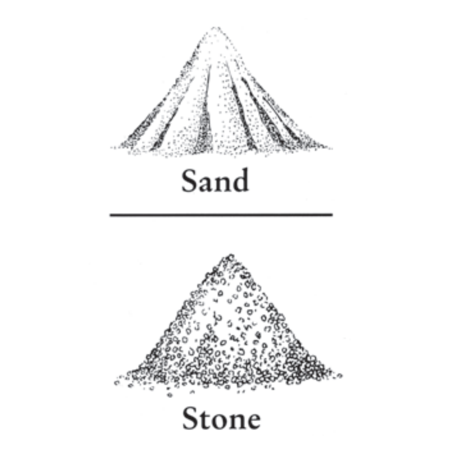
W/C ratio

Water/cement-ratio means the ratio relation water (kg) per cubic meter of concrete divided by cement content. It can be anything from 0.80 to 0.30 at the mixing plant or in truck mixer.

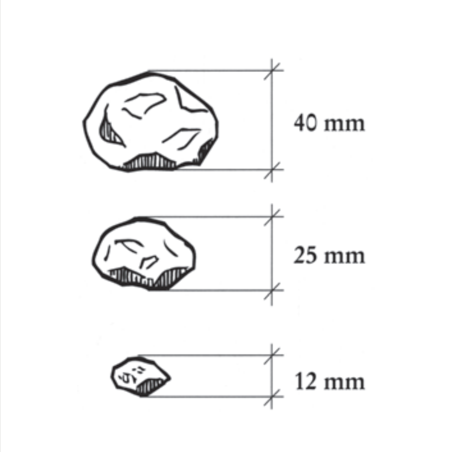
Many architects and engineers think that it is the only factor you have to worry about when you want quality concrete. But it is a little bit more complicated if you wish to get good concrete for floors. The lower the water/cement-ratio, the better the quality you get. But note that when you place concrete on site you will change the w/c-ratio in the slab. We will explain that later.



In certain countries sand means all material between 0–4 mm, in others all material between 0–8 mm.
In Sweden, all material between 0–4 is normally called sand.



Sand/stone-ratio is amount of sand divided with amount of stone.



Max stone size normally should not exceed 1/4 of the floor thickness.

Sand

Sand type and the grading curve for sand are also important. Coarse sand is normally better for high-quality concrete. In some countries sand is 0–4 mm, in others all material between 0 to 8 mm is called sand.

Sand/stone relation is the relation of sand and stones in percent of the total amount of aggregate in one cubic meter. If your sand is 0–4 mm, a good relation sand/stone is 35 to 40% sand and 60 to 65% stone. If sand is 0–8 mm, the relation should be 40 to 45% sand and 55 to 60% stone.

Stones can vary from 4–8 mm up to 32–40 mm. Often the stone part in good concrete is combined of two parts, one fraction A, 8 to 16 mm and another fraction B, 16 to 32 mm.

Stone

Max. size of stones is dependent upon the thickness of the floor/slab and should normally not exceed 1/4 of the floor thickness, i.e. for a 100 mm thick floor, never use larger stones than 25 mm.

But always use the largest possible size. The higher amount of coarse aggregates you use, the lower shrinkage you get and you can save cement. A high cement content increases unfortunately both shrinkage and also curling in the floor.

Additives

A lot of admixtures and additives are available today. In hot climate a retarder is sometimes needed. We recommend (except sometimes retarder) **only** air entraining agents in floors that **are exposed to freeze/thawing** like outdoor floors and freezingplants etc. **Not in ordinary indoor floors and no other admixtures.** The concrete mix characteristic is already affected by so many factors that the addition of admixtures can spoil the mix itself or cause production problems.

Concrete Vibration

Concrete vibration is undertaken to improve its overall performance. Compaction is the process that expels entrapped air from freshly placed concrete thus increasing its density.

It is important that the concrete vibration continues until no further air bubbles can be seen emerging from the surface of the concrete without exceeding the vibration period given in the table page 6.

The most common form of compaction is vibration, undertaken with poker vibrators or surface vibrators such as vibrating screeds. Other methods of compaction include form (external) vibration, tamping and rodding (wood or steel rod).

Adequate vibration of concrete will:

- increase its strength and density and thus allow the design strength to be achieved
- enhance the bond to mesh and bar reinforcement plus any inserted structural anchors and hold downs and thus provide anchorage
- increase the abrasion resistance of the surface and thus reduce wear from traffic
- increase the general durability and thus provide longer life
- decrease the permeability and thus limit penetration of water and other aggressive substances (both from airborne and contained in ground water)
- reduce the risk of plastic settlement cracking over deep screeds and mesh/bar reinforcement (plus other restraints within the concrete) as well as longterm drying shrinkage cracking
- improve the quality of off-form finishes by ensuring concrete completely fills the forms.

Adequate vibration of slabs up to 100 mm thick can generally be achieved through the placing, levelling and finishing operations. Concrete vibration can however additionally be applied on the edge of the form to ease the placement of the concrete.

For deeper elements, additional concrete vibration will be required by one of the methods outlined below.

Internal vibration reduces internal friction between aggregate particles in the concrete and will thus liquefy the mix and obviate the practice of adding excess water to improve workability.

Three basic types of vibration can be used:

- immersion (pokers)
- surface (screeds, screeds)
- form (external vibrators)

Immersion (poker) vibrators

The most common immersion vibrator for residential work is the poker vibrator.

Following table shows the maximum yield that will be achievable per poker diameter (m^3/h):

Poker of Ø 25 mm =	1.5 m^3/h
Poker of Ø 35 mm =	6 m^3/h
Poker of Ø 45 mm =	10 m^3/h
Poker of Ø 55 mm =	20 m^3/h
Poker of Ø 65 mm =	25 m^3/h
Poker of Ø 75 mm =	35 m^3/h
Poker of Ø 85 mm =	40 m^3/h
Poker of Ø 100 mm =	45 m^3/h
Poker of Ø 150 mm =	45 m^3/h

Smaller sizes are often referred to as needle vibrators. They are typically driven by petrol motors, although diesel, electric and compressed air are alternatives.

They are also good for expelling entrapped air voids in deep forms such as industrial floors, slabs, screeds, columns and walls, and allow easy placement of concrete.

The homogenized concrete will have less porosities left inside the concrete providing a better wheel load capacity and lower cracks risks.

Concrete vibration must be done as soon as the concrete is placed in the form, while it is still plastic. Don't let the concrete dry-out and stiffen because it will be too hard to compact, resulting in a lack of vibration.

The radius is dependent essentially on the diameter of the head/tube and the frequency and amplitude of the vibration caused by the rotating eccentric weight contained in it.

The effective radius determines the insertion pattern that should be adopted to ensure adequate compaction of all concrete.

Poker vibrators should be inserted vertically into concrete as quickly as possible, and held stationary until air bubbles cease to rise to the surface. They should then be slowly withdrawn to avoid grout pockets. They should not be dragged through the concrete or over reinforcement as this may cause segregation of the mix.

For honed finishes where the aggregates will be exposed, care is required to compact consistently over the entire area to ensure uniform exposure of the aggregate.

For deeper elements such as walls and columns, adequate space between the reinforcement or to the form face should be provided to allow use of the poker vibrator. Generally, the vibrator should be kept about 50 mm clear of the form face.

Damaged form faces will result in streaks and colour variations in the surface, while inaccessible areas will result in inadequate compaction.

For concrete of average workability (i.e. slump of 80 mm) with a poker size between 25–75 mm, concrete should usually be vibrated for between 5 and 15 seconds.

You can also refer to the table below to know the required vibration period as per the given workability (slump, consistency).

Type	Earth moist 0 mm	Humid 10–40 mm	Plastic 50–90 mm	Semi-fluid 100–150 mm	Fluid 160–210 mm	Super-fluid > 220 mm
Applications	Dams, harbors, jetty…	Bridge, digue, foundations, harbor…	Silo, foundations, slab, industrial floor…	Scale, ramp, roof, wall, column…	Pilars, walls, floors, precast…	Pavement, walls, precast…
Vibration type	Strong vibration in layer of 50 cm	Strong vibration in layer of 50 cm	Standard vibration in layer of 50 cm	Light vibration in layer of 60 cm	Very light vibration (internal or external)	Very light vibration (internal or external)
Ø of vibrator	65–160 mm	65–160 mm	40–65 mm	25–55 mm	25–45 mm	25–45 mm
Vibration period	1–3 min	10–40 s in layers	10–20 s	10–20 s	5–10 s	5–10 s
Hourly vibration capacity	25–45 m^3/hr	25–45 m^3/hr	10–25 m^3/hr	1,5–20 m^3/hr	1,5–10 m^3/hr	1,5–10 m^3/hr

Under-vibration may cause serious defects in concrete and is the most common problem.

Inadequate vibration from under-vibration will adversely affect structural properties such as strength, bond, abrasion resistance and durability (through increased permeability). Other properties such as the quality of the surface finish may also be affected.

Over-vibration is generally not a problem with well proportioned mixes. Use of grossly oversized equipment for an excessive length of time with poorly proportioned mixes or those to which excessive amounts of water have been added may cause problems. Adding excess water to the mix can cause a problem with vibration, possibly leading to material segregation, and to dusting and flaking later.

Revibration is the vibration of concrete which has been compacted some time earlier. The practice is not widely used, partly due to the difficulty of knowing just how late it can be applied. A good rule of thumb is that revibration may be used as long as the vibrator is capable of sinking into the concrete under its own weight.

Revibration can be used to: bond layers of concrete into previous layers; blend cold joints; close plastic shrinkage and plastic settlement cracking; improve the surface finish at the tops of columns and walls; increase the potential strength and wear resistance of floors; and improve bonding to reinforcement.

Floors of Concrete

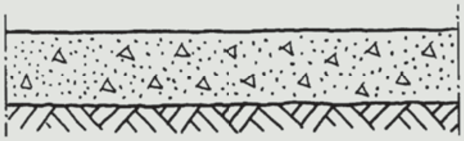
The various parts of a building are subjected to different kinds of stress throughout their existance. In a normal room with floor, walls and ceiling, it is generally the floor that is most exposed.

A finished floor should have many different qualities such as evenness and resistance to mechanical and chemical action. This is why concrete is the natural material. But concrete can be designed, mixed and handled in many different ways. By changing the composition and the handling, strength, wear resistance, shrinkage, frost resistance and water permeability can vary to a great extent. In the case of floors, special attention must be given to certain aspects in order to obtain the best result.

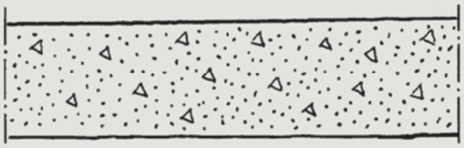
Types of floors

Concrete floors can normally be classified as follows, depending on the nature of the floor structure:

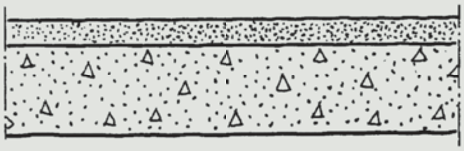
- floors on the ground
- monolithic floor slabs
- floors on structures cast in situ
- floors on prefabricated units
- floors on fill, insulation mats, etc. (floating floors)



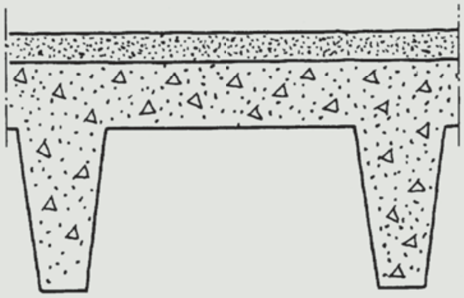
Floors on the ground



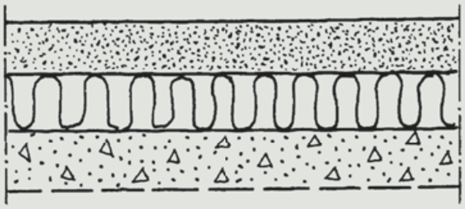
Monolithic floor slabs



Floors on floor structures cast in situ

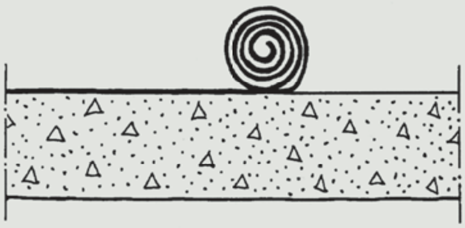


Floors on prefabricated floor units

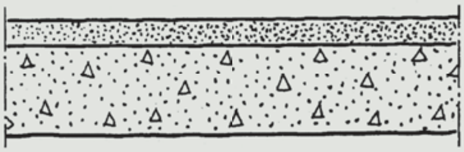


Floors on fill, insulation mats, etc.

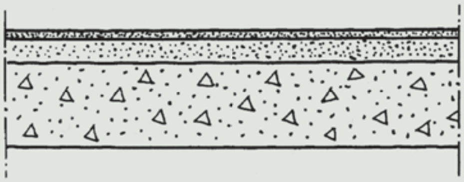
Subfloors of concrete
Part of the floor which is a base for the topping.



Concrete floors
Floor with concrete as the wearing surface (with or without surface treatment such as painting).



Granolithic concrete floors
Floors with especially hard aggregate in the surface layer.



These types can then be sub-divided, according to the function of the floor surface, into:
- subfloors of concrete
- concrete floors

The illustrations show different types of floors on structures cast in situ, prefabricated units, etc. The principles can be applied directly to monolithic floor slabs and floors on the ground which are surface treated in conjunction with pouring.

Whatever the type of floor to be constructed the final quality is greatly dependant on equipment and the knowledge to use them and not only the mix itself.

Preliminary Planning

With requirements of the floor's function as a basis, the project engineer will choose the strength, working methods. The object is to achieve the best possible balance between requirements and costs in which the floors utilization, maintenance and cleaning methods are deciding factors.

When determining quality requirements for concrete floors, the following questions should be answered:

- can the requirements be lowered without disadvantage?
- can a different solution permit lower requirements?
- can the requirements be raised without extra costs?
- can higher requirements give a simpler overall solution?

The following five step preliminary planning procedure can be used:

Step 1. Select a quality class, specifing thickness and reinforcement.
Step 2. Choose surface treatment and finishing methods.
Step 3. Choose a tolerance class for irregularity and slope.
Step 4. State the crossfall.
Step 5. Summary and calculations and equipment selection.

Attention should be given to the position of the reinforcement in the structure. This can be important in connection with edge rising/curling and other long-term deformation.

It is not always necessary to reinforce a floor structure. The need for reinforcement should be decided from case to case, depending on the loads occuring, the bearing capacity of the sub-structure, etc.

The project engineer stipulates a great number of requirements for the floor. The person who does the job must be given a chance to fulfill the requirements. Items of the most diverse nature such as tubing for electric cables, pipes for plumbing, safety reinforcement, etc., are all too often encountered out on a floor surface. The project engineer responsible should be contacted to discuss the problem. As a rule, such obstacles can be removed or concentrated. Where pipes are concerned, it is an advantage if they terminate 10–20 mm below the floor surface. If this is not possible, ducting may be an acceptable alternative.

Laying Floors

Planning

In order to properly plan the job, it is essential to examine the instructions which are the basis for the job. The necessary details are usually found in the general description and on design drawings.

The competence of the labor force and supervisors, the efficiency of the equipment, etc. must be adapted to the specified requirements, the working methods and the finished subfloor or floor.

The following checklist shows which specifications should be kept in mind to be sure of obtaining the right personnel, the right concrete and the right equipment. By and large, this list covers the details that a project engineer should cover in his instructions.

It is not enough to just buy the right equipment. The expertise in the practical use is just as important.

Materials and goods

Concrete

- quality class/strength class
- additives
- consistency
- adaption of the aggregate grading to vacuum treatment where relevant

Reinforcement

- double or single
- spacing

Work procedure

- equipment & method
- workmanship class
- type of floor (floor on the ground ...)
- type of function (subfloor of concrete ...)
- thickness
- crossfall
- reinforcement steel
- execution and positioning of joints
- vacuum treatment
- surface treatmentlfinishing
- curing

Requirements for finished subfloor and floors

- strength
- surface smoothness
- irregularity
- slope

Concrete is a material that demands accurancy in planning and execution. It is difficult, often impossible, to correct poor work later.

Size and positioning of casting sections

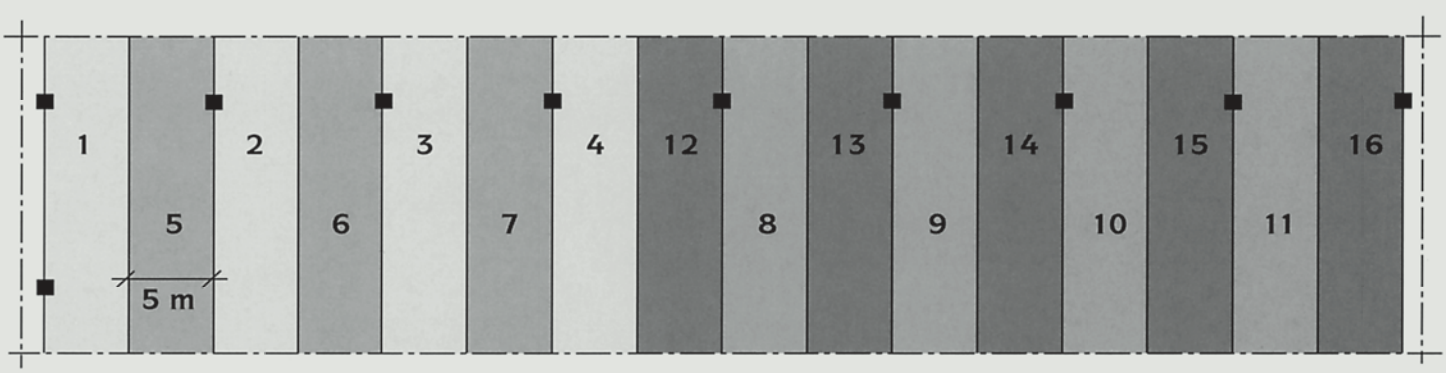
The length and width of the casting sections is often indicated in the instructions. This is primarily necessary for floors on the ground and monolithic floor slabs. The position and execution of construction joints is also described.

If there are no such details in the instructions, the size of the sections should be adapted to the equipment used and with regard to the most efficient working procedures.

Narrow casting sections give a good capacity and require numerous joints but permit light and easily-handled equipment.

Wide casting sections give greater capacity with fewer joints but require larger and heavier equipment.

The illustration below shows suitable positioning of the casting sections and the order in which they are poured.

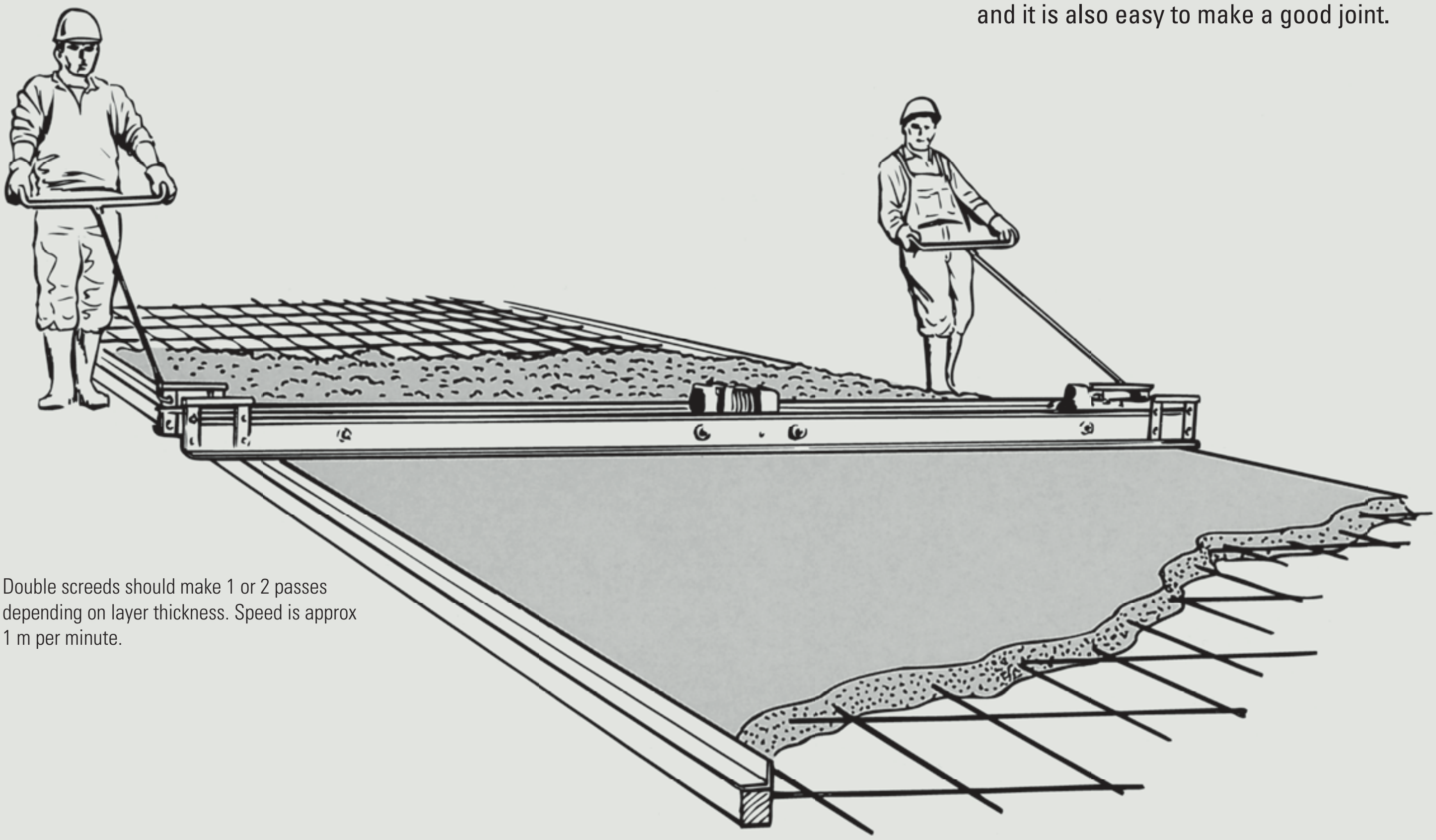


Casting sections and pouring sequence

Sideforms and Screed Guides

There are many different ways to make form stops and screed guides, depending on the type of floor to be laid. Some types, which have proved to give good results in practice, are described below.

Permanent screed guides can often be an economical solution as they do not need to be removed and form part of the floor. Permanent screed guides are made of concrete equivalent strength of the floor being laid. In general, the screed guide should be as narrow as possible. If it is too wide, concrete will accumulate and result in the wrong screeding height. The illustration below shows a suitable design using an angle iron. There is no risk of the concrete accumulating on the screed guide and it is also easy to make a good joint.



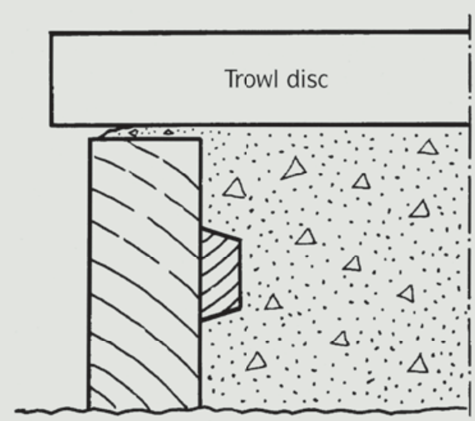
Double screeds should make 1 or 2 passes depending on layer thickness. Speed is approx 1 m per minute.

Floors on the ground

In order to lay a good floor on the ground the bedding foundation must be well compacted to avoid future settlement. Furthermore, the vibrating screed subjects the screed guides to high stresses during casting and if the bedding foundation is not sufficiently firm the screed guides will settle.

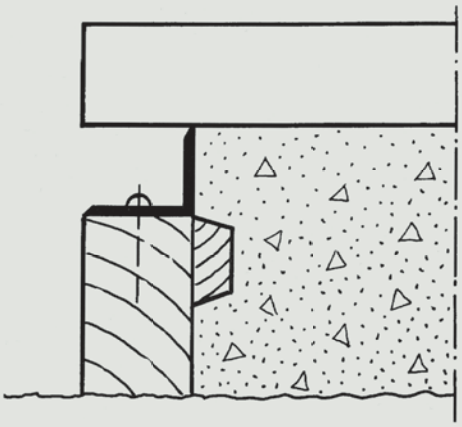
The best way to arrange the screed guides is, if possible, to use the side forms and permanent screed guides.

The illustration to the right shows a problem arising in connection with floating and steel trowelling against a common type of form stop.



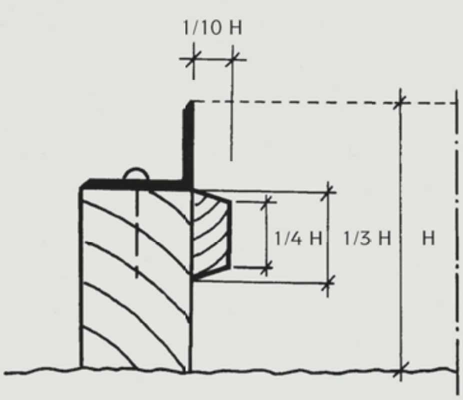
Form stops made entirely out of wood, often results in incorrect height.

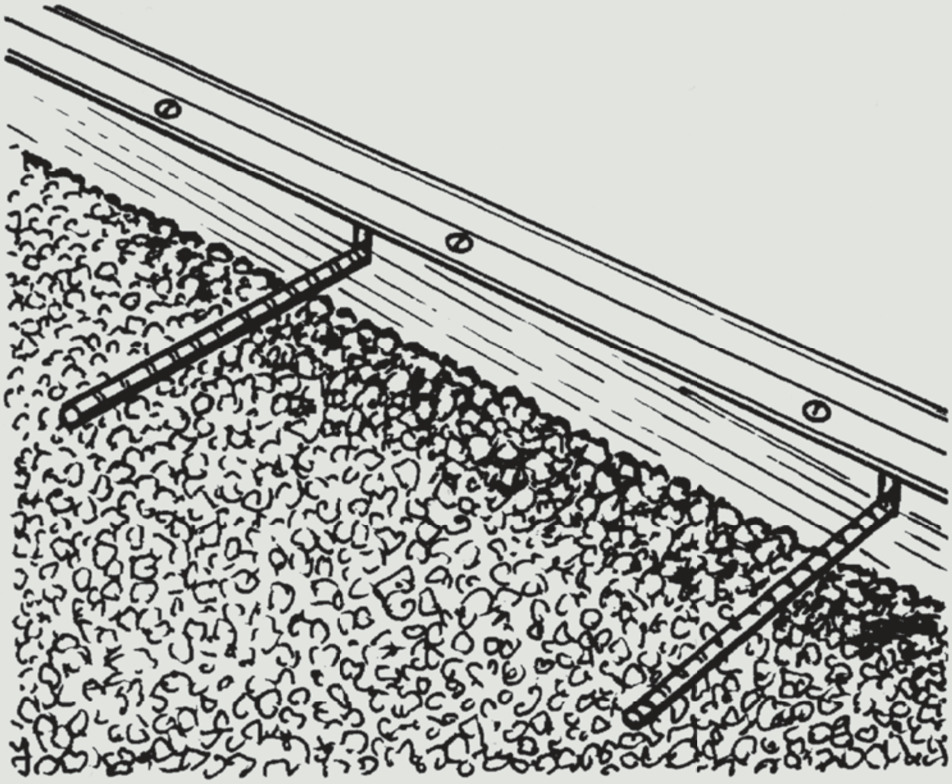
If the side forms are designed as shown below. A good joint will be obtained while brooming and steel trowelling are facilitated.



Form stops of wood equipped with an angle iron gives the correct height.

Construction joints are often made in the form of a grove and tongue. The ledge on the form stop normally has the following dimensions.

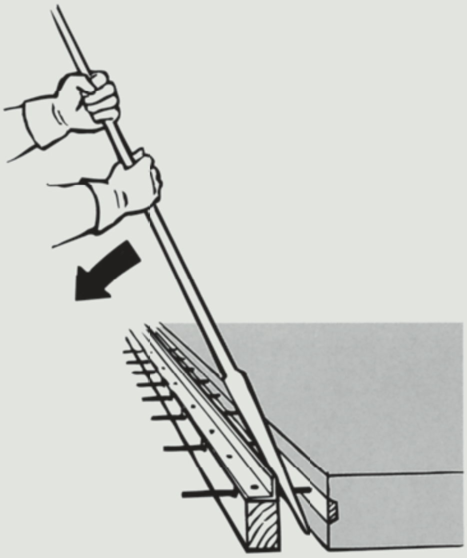




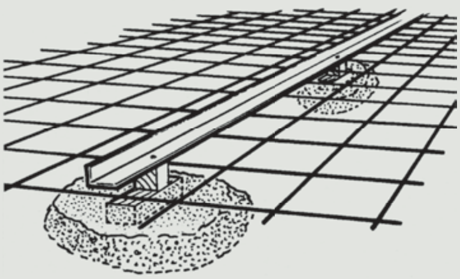
Dowels moulded into construction joint.

Dowels are often moulded into construction joints to prevent edge rising. The dowels should be smooth and straight and be inserted at right angels to the side forms. Half the length should be coated with asphalt to avoid bonding. With this type of joint, care should be taken when form stripping. Form stripping is usually done the morning after laying. It is then difficult to remove the formwork from the floor surface at right angle along the dowels, as the dowels can be pulled loose from the concrete.

Problems will occur if the reinforcement is to pass through the side forms. One way of solving this difficulty is to use an angle iron, e.g. 50 x 70 mm. Wooden blocks approx. 1–1,5 m are fastened to the bar. Concrete markers with a piece of wood on which the screedguides are fastened are then positioned on the foundation. The concrete markers should be large enough to absorb and distribute the force of the screed.



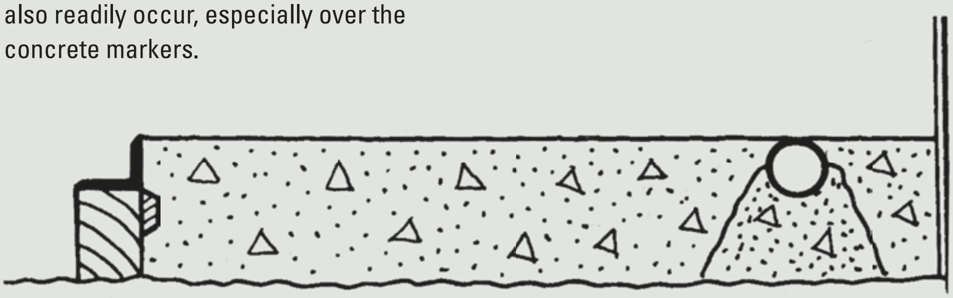
The sideforms are removed with great care.



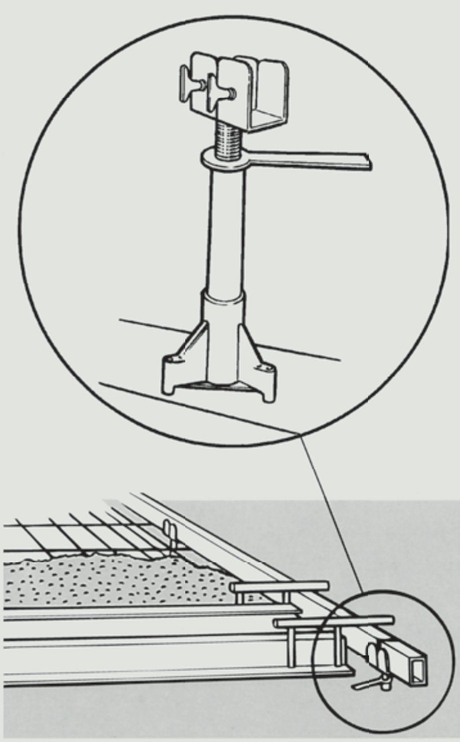
Exemple of screed guide in passing-through-reinforcement.

It is sometimes not possible to use the form stops a screed guides if, for example, they are located beside walls. In such cases, it will be necessary to use rails made of pipes or rectangular steel sections placed on concrete markers.

Screed guides of this type should be avoided if possible as it is time consuming to fill in concrete after the rails. Cracks also readily occur, especially over the concrete markers.



Permanent concrete guide rails. Note: other types of permanent guide rails are available contact your Atlas Copco specialist.



Elevated screed guides with adjustable supports.

Monolithic floor slabs

In the case of monlithic floor slabs, it is difficult to arrange the joints to form easily-handled laying sections. If the joints are not marked on the drawings it will be necessary to consult the designer about their location.

Since the joints can only be located within certain zones, the laying sections can have a width of 15–20 m. It will then be necessary to place the screed guides inside the laying sections.

One way to overcome this difficulty is to use elevated screed guides. All that is left in the concrete is the plastic foot of the support. Drive nails through all the holes in the plastic foot as this will reduce the risk of the support tipping over.

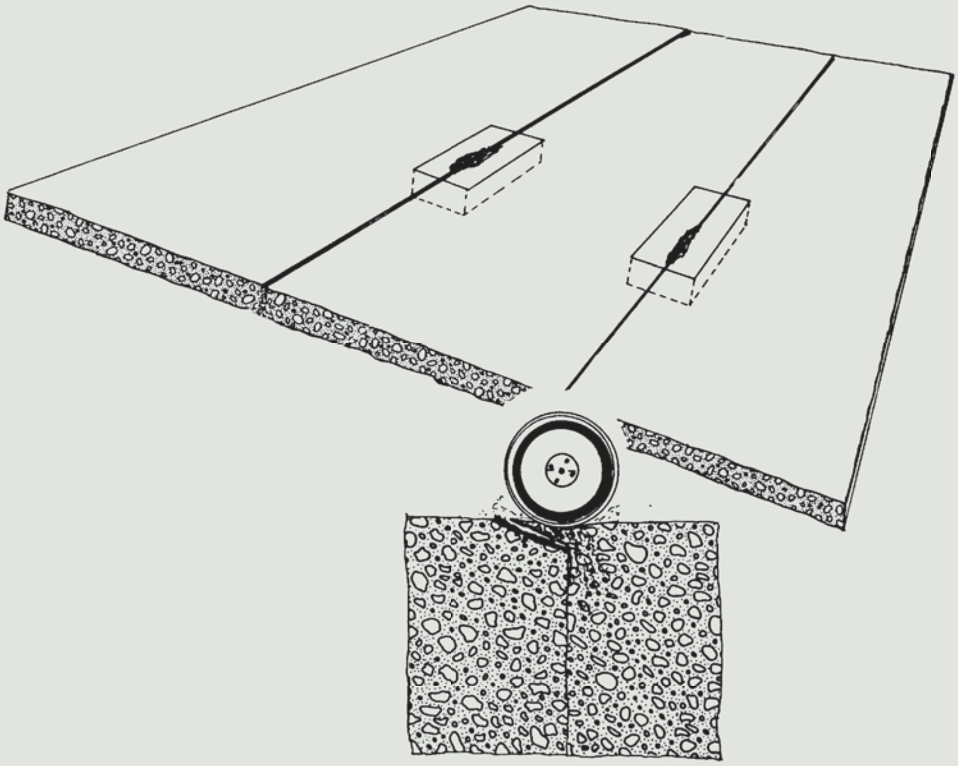
In other respects, the problems associated with side forms, screed guides, etc. are the same as in the case of floors on the ground.

With monolithic floor slabs it is difficult to attain the specified regularity and slop requirements. The form is built up in several stages with shoring, stringers, joists and shuttering panels. When the concrete is poured the form will be subjected to settling and deflection, which is difficult to determine in advance. The screed guides must therefore be readjusted all the time while the concrete is poured.

The advantage of monolithic floor slabs is that a finished floor is immediately obtained in which edge rising and breakaway are avoided.

Difficulties associated with this floor structure are that it is usually laid outdoors with the risk of rain, etc. and that problems are encountered in maintaining the specified tolerances.

Property owners and design engineers have been conscious for a long time that failures on industrial floors cause high repair costs. An important part of the failures can be referred to joints. The joint is the weakest part of a floor.



Why is the joint weak?

A large industrial floor is cast in several bays and consequently, has many joints.

When the floor is put into use, forklifts and other vehicles run over the joint. Thin pieces of concrete break away under weight of vehicles proportionally to the traffic intensity. Costly repairs follow.

Where is the problem?

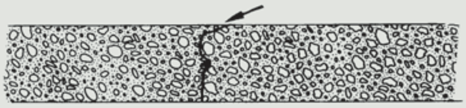
If conventional wooden or steel forms are used it is almost certain that during removal of formwork before casting of next section joints become damaged.

Such joint is weak and causes high repair and maintenance costs. These costs can easily exceed 2–3 times the cost of producing the floor itself.

When the first section has been cast, the conventional form is removed with a crow bar or similar tool. This damages the surface of the joint.

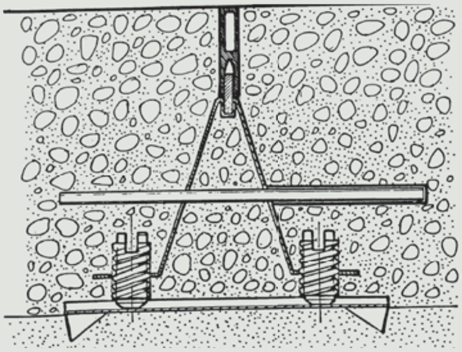
When the second section is cast, the joint is covered with a thin, poorly bound concrete layer.

Obtaining level floor with wooden or steel formwork is quite troublesome.



Combiform noticeably reduce maintenance and repair costs.

- Combiform, set to correct height, act both as stop ends and screed rails for surface vibrators. They are left in the floor.
- Combiform simplify and accelerate casting since the bays can be cast one after another, which increases the production.
- Combiform will be a part of the floor, strengthening it.
- Combiform replace conventional wooden and steel formwork.
- Combiform facilitate meeting specified tolerances.
- Combiform noticeably reduce maintenance and repair costs.
- A quality floor is achieved quicker and at a lower cost with Combiform. Less work with form setting and placing of rails. Also after-work will be reduced.



The solution is to use instead Combiform leave-in-situ rails and stop ends!

Combiform in floors on ground

The usual thickness of floors on ground executed on a base of crushed aggregate, gravel and the like is 100–200 mm. It is important that the base is well compacted and capillary breaking.

When choosing the height of Combiform it is important to consider that the rail will be filled with concrete. The rail must therefore be raised upon the base so that concrete can pass under the rail. The smallest distance between the base and the rail should equal to the maximum stone size in the concrete.

At a floor thickness of 160–200 mm the floor is often reinforced with both bottom and top edge reinforcement. Combiform is very handy to use as the adjustment screws reach through the bottom edge reinforcement and the top edge reinforcement can be jointed through the holes on the sides of the rail.

Combiform in combination with a ground plate is placed on the compacted base. The ground plate hinders the adjustment screws from sinking down to the base. Joining of reinforcement between casting bays and dowels according to design engineer's directions. If there are no special directions, usually dowels approximately 600 mm long with 10 mm diameter are used. These are placed every 250 mm. The rail should be secured against lateral movement for example by lashing it to reinforcement or by hammering dowels on ground through the screw hole at the foot of the rail, at least three per rail length.

It is important to avoid too rapid drying-out of the finished floor. For this purpose for example vacuum dewatering and curing with a membrane curing compound can be used.

The top strip/elevating strip on the Combiform rail can usually be left in the floor. When necessary, the strip can be removed and the space left filled with a jointing compound.

Combiform in floors on an insulation layer

Floors can be cast on various types of insulation, for example, cellular plastic or mineral wool. It is important to follow the directions of the insulation manufacturer.

When choosing Combiform height, it is important to take into consider-ation the fact that the rail has to be filled with concrete. The rail must therefore be raised upon the base so that concrete can pass under the rail. The smallest distance between the base and the rail should be equal to the maximum stone size in the concrete.

At floor thicknesses 160–200 mm the floor is often reinforced with both bottom and top edge reinforcement. Combiform is very handy to use in these cases as the adjustment screws reach through the bottom edge reinforcement and the top edge reinforcement can be joined through the holes on the sides of the rail. Combiform facilitates the work if heating pipes have to be cast in the floor as the rails can easily be placed when the pipes have been placed.

The Combiform rail in combination with a ground plate is placed directly on the insulation. The ground plate prevents the adjustment screws from sinking down to the base. When the insulation plates are compressed at concrete casting, the Combiform rail will follow to a corresponding degree. Joining of reinforcement between casting bays with dowels according to design engineer's directions. If there are no special directions, about 600 mm long dowels with 10 mm diameter are used and placed at intervals of 250 mm. The rail should be secured against lateral movement by lashing it to reinforcement or by hammering the dowels to the ground through the screw holes at the rail footing, at least three per rail length.

It is important to avoid too rapid drying-out of the finished floor. For this purpose for example vacuum dewatering and membrane curing compound can be used.

The top strip/elevating strip on the Combiform can usually be left in the floor. When necessary, it is easy to remove the strip and fill the space with a jointing compound.

Combiform in floors on a moisture insulated base that must not be punctured.

Various types of sealing layers that must not be punctured may be placed directly on ground, on insulation plates or when new concrete is cast on already hardened concrete. The pairs of screws, support points are placed on a plate with a flat bottom side to avoid the adjustment screws damaging the sealing layers. It is important that Combiform is well anchored to the reinforcement so as not to move during casting. When a floor is cast without conventional reinforcement it is necessary to fix the rails laterally with transverse connecting bars, for example at each support point.

Combiform in slabs cast on already hardened concrete

Hardened concrete means here e.g. prefabricated concrete plate, new or old concrete floor.

The layers of new concrete cast on already hardened concrete have normally a thickness of 30–60 mm but thicknesses of 150 mm or more may occur. When choosing the height of Combiform it is important to consider the fact that the rail has to be filled with concrete. The rail should therefore be raised upon the base so that concrete can pass under the rail. Combiform is put on the hard base and the adjustment screws are placed. Holes are drilled through the bottom of the adjustment screw and 20–30 mm down in concrete whereafter a nail plug is hammered which fixes the position of the rail while its height still can be adjusted. The screw can also be fixed by using bolt gun. Another alternative to fix the rail after height adjustment is to fasten it by shooting through the plate at the rail footing. It is important to carefully remove all concrete dust after drilling in order not to lessen adhesion between old and new concrete.

It is important to avoid too rapid drying-out of the finished floor and for this purpose e. g. vacuum dewatering and membrane curing compound can be applied.

The top strip/elevating strip on the Combiform rail can usually be left in the floor. If necessary, it is easy to remove the strip and fill the space with a jointing compound.

Combiform – distance between support points

The recommended distance between the support points varies with load and different rail heights. The table below shows maximum distances between support points at static loading without permanent deformation of Combiform. Remark! It is important to note that when a surface vibrator is used, the load is half the total weight of the surface vibrator per Combiform rail. When the surface vibrator is placed on the rail without having any concrete under it, the load is at highest. But as soon as the surface vibrator is run on concrete, the load is divided so that only a small part of the weight of the surface vibrator is loading the Combiform.

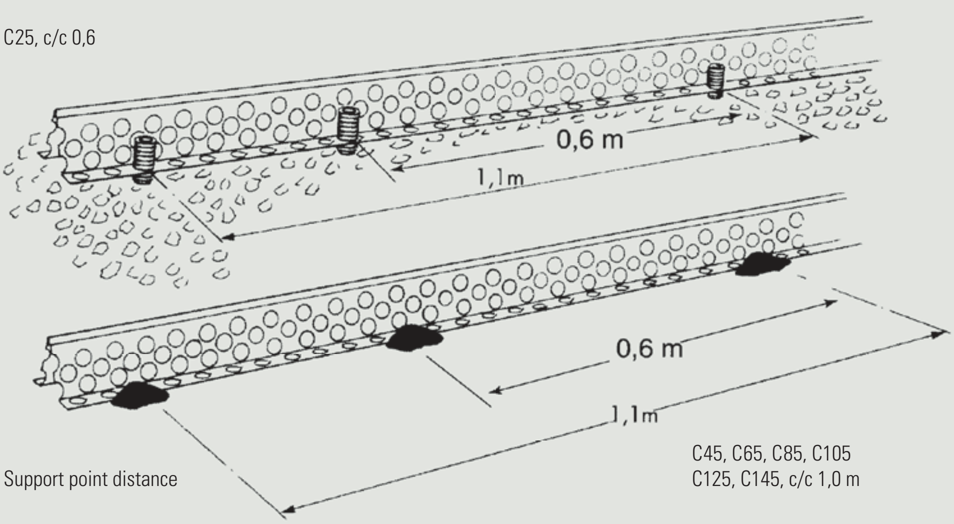
If a heavy surface vibrator is used, an extra support point is recommended where the surface vibrator is placed.

The table shows maximum distance in cm between support points for various load ranges. Please look at the table below.

Static Loading kg	C25	C45	C65	C85	C105	C125	C145
0–50	60	80	100	100	100	110	110
51–100	60	80	100	100	100	110	110
101–150	60	80	100	100	100	110	110
151–200		60	80	80	80	100	100

The static load has been halved and the distances between support points reduced so that they fit to the new lengths (L = 3.5 m) of the Combiform rail.

C25, c/c 0,6

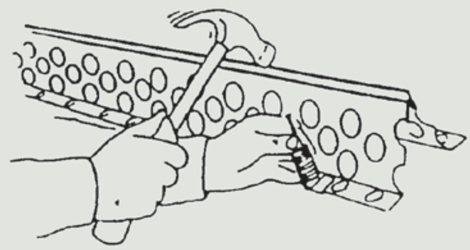


Support point distance

C45, C65, C85, C105
C125, C145, c/c 1,0 m

Combiform – jointing

Normally the Combiform rail need not be jointed. The rail lengths are placed end to end and are kept in their position by reinforcement or, on hard bases, by fastening the adjustment screws with nails or nail plugs.



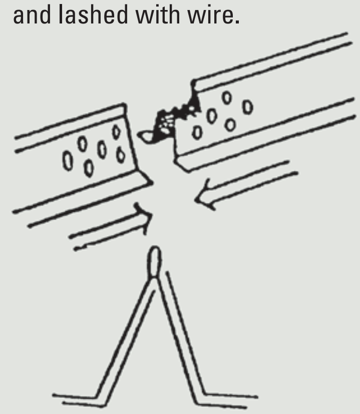
N.B.

If conventional reinforcement is not used it is necessary to anchor the rail on ground. This is easiest done by hammering a round iron bar on the ground through the holes at the rail foot close to each support point.

If you want to fix the rails to each other at joints you may proceed in the following way:

a) On one side of the rail on a level with the uppermost hole line an about 60 cm long reinforcement bar is lashed with wire. Same reinforcing bar as for dowels should be used.

b) On a rail part the top is cut up to the first hole line and about 10 cm in from rail end. The parts are connected overlapping and lashed with wire.



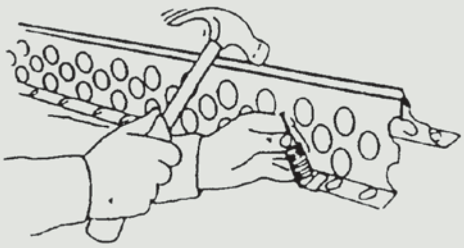
In both cases an extra lock clip can be placed exactly below the joint. A top strip overlapping in the rail joint will further improve the joint.

N.B.

A ground plate is used on a base of crushed aggregate, gravel, insulation or the like.

On hard bases the adjustment screws are fixed to the base as follows:

On wood:	with a galvanized nail
On concrete:	with a nail plug, length about 30 mm
On porous concrete:	with a nail plug, length about 50 mm
On metal-decking:	with a self-tapping screw



The elevating supports are delivered with 50 mm adjustment screws on.

If a ground plate is to be used with elevating supports two ground plates per support are needed.

If a top strip is used the rail heights should be reduced by one step as the top strip will give an additional height of 20 mm.

Example:

A 110 mm slab dimensioned 30 x 40 m is to be cast on a bedding of gravel. The outer forms are wooden. The slab will be divided into five bays, width 6 m. Total rail quantity required: 4 x 40 m = 160 m (46 rail lengths of 3.5 m each). Rail height according to page 131, C85 with 50 mm adjustment screw. Ground plates are needed in order to support the adjustment screws. The distance between the support points (screws) is 1 m. It is advisable to use four support points per each rail length.

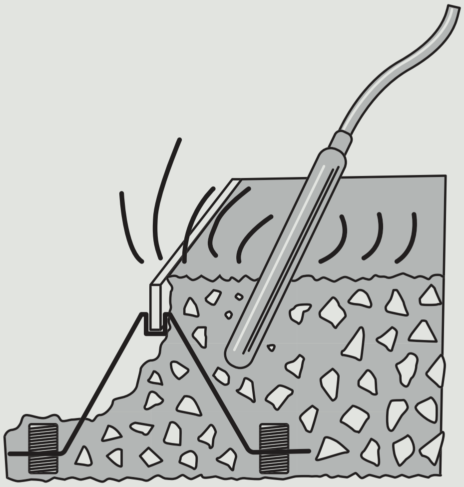
Total material quatity:

Rails C85	46 x 3.5 m = 161 m
Screws L = 50 mm	4 x 46 x 2 = 368 pcs
Ground plates	4 x 46 = 184 pcs
Levelling stick	
Adjustment tool, long	

Joints

When Combiform is used as a screed rail/stop end the rail and concrete will form a homogeneous unit. After the first casting stage, the Combiform rail should be filled up to about 60%. When casting the second stage the rail should be fully filled up. When concrete will shrink the crack formation will be initiated at the rail. The crack formation can however be controlled through different measures described below. At drying out of concrete, curling may occur i.e. the edges of the concrete slab may bend upwards. An important factor influencing this is of course how the drying will proceed – through vacuum dewatering excess water may be extracted from concrete reducing curling and shrinkage.

The shape of the Combiform rail enables providing joints between casting bays with dowels for load transmission. For floors exposed to heavy loads or if a thicker concrete cover is required, Combiform can be completed by an additional elevating strip, which in certain cases can replace cutting of slots for crack control.



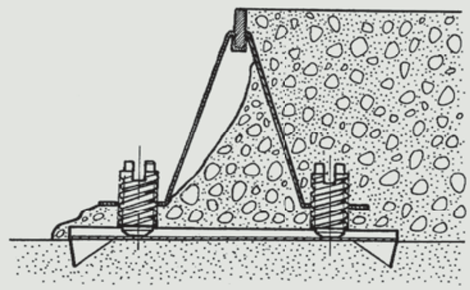
Poker vibrator should be applied close to the Combiform rail so that it will be filled up to at least 60%.

Combiform – choice of components

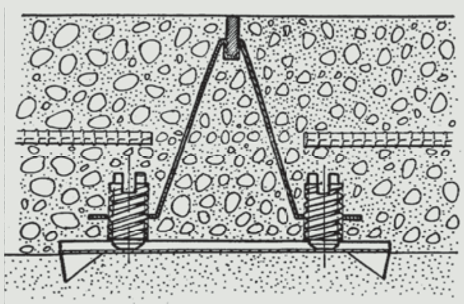
Concrete Thickness	Rail	Other Components
Fine concrete, maximum stone size 12 mm		
30–50 mm	C25	25 alt. 50 mm screw
50–70 mm	C45	25 alt. 50 mm screw
80 mm	C65	50 mm screw
Maximum stone size 16 mm, central reinforcement		
100 mm	C85	50 mm screw
120 mm	C105	50 mm screw
140 mm	C125	50 mm screw
Maximum stone size 32 mm, central reinforcement		
100 mm	C65	50 mm screw
120 mm	C85	50 mm screw
140 mm	C105	50 mm screw
150 mm	C105	75 mm screw
Maximum stone size 32 mm, double reinforcement Concrete cover at bottom edge 40 mm		
160 mm	C105	75 mm screw
180 mm	C125	75 mm screw
200 mm	C145	75 mm screw

Combiform construction joint

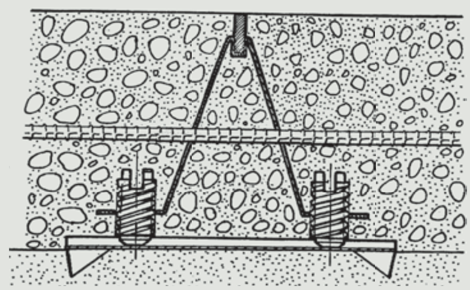
A construction joint is used to divide the slab into suitable casting bays.



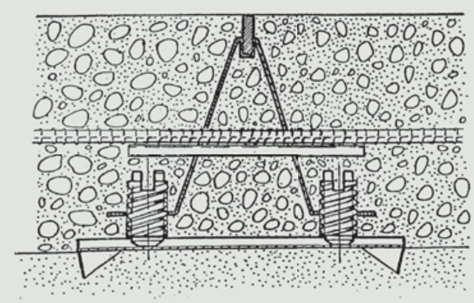
Symbol on the drawing



TYPE A
A construction joint which is not anchored.
No through-going reinforcement.



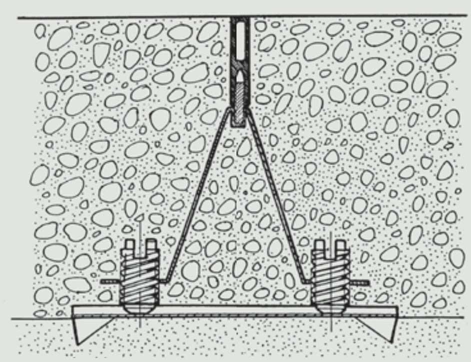
TYPE B
A rigid construction joint with through-going reinforcement. With a through-going reinforcement area, 20% larger than in the slab, cracks can be avoided at the joint.

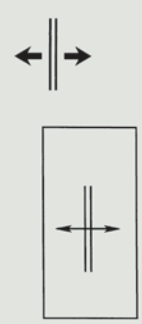


TYPE C
Same as type B but here with dowels at 300 mm distances. This type is used when heavy loads or intense traffic is expected.

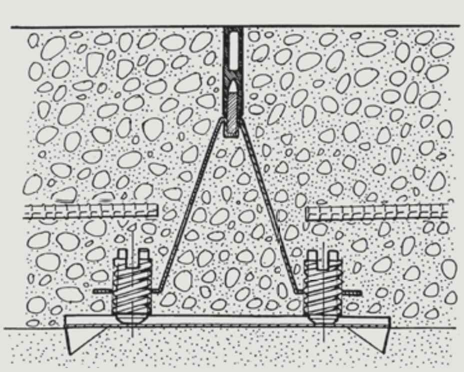
Combiform contraction joint

Contraction joint. With an elevating strip which corresponds to a cut slot at the upper edge of the slab, a straight and controlled separation is obtained when shrinkage occurs. Reinforcement has to be executed so as to allow the contraction.

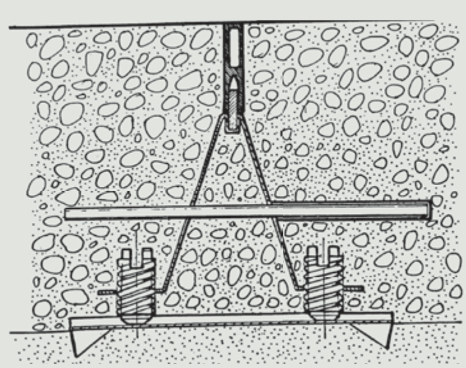




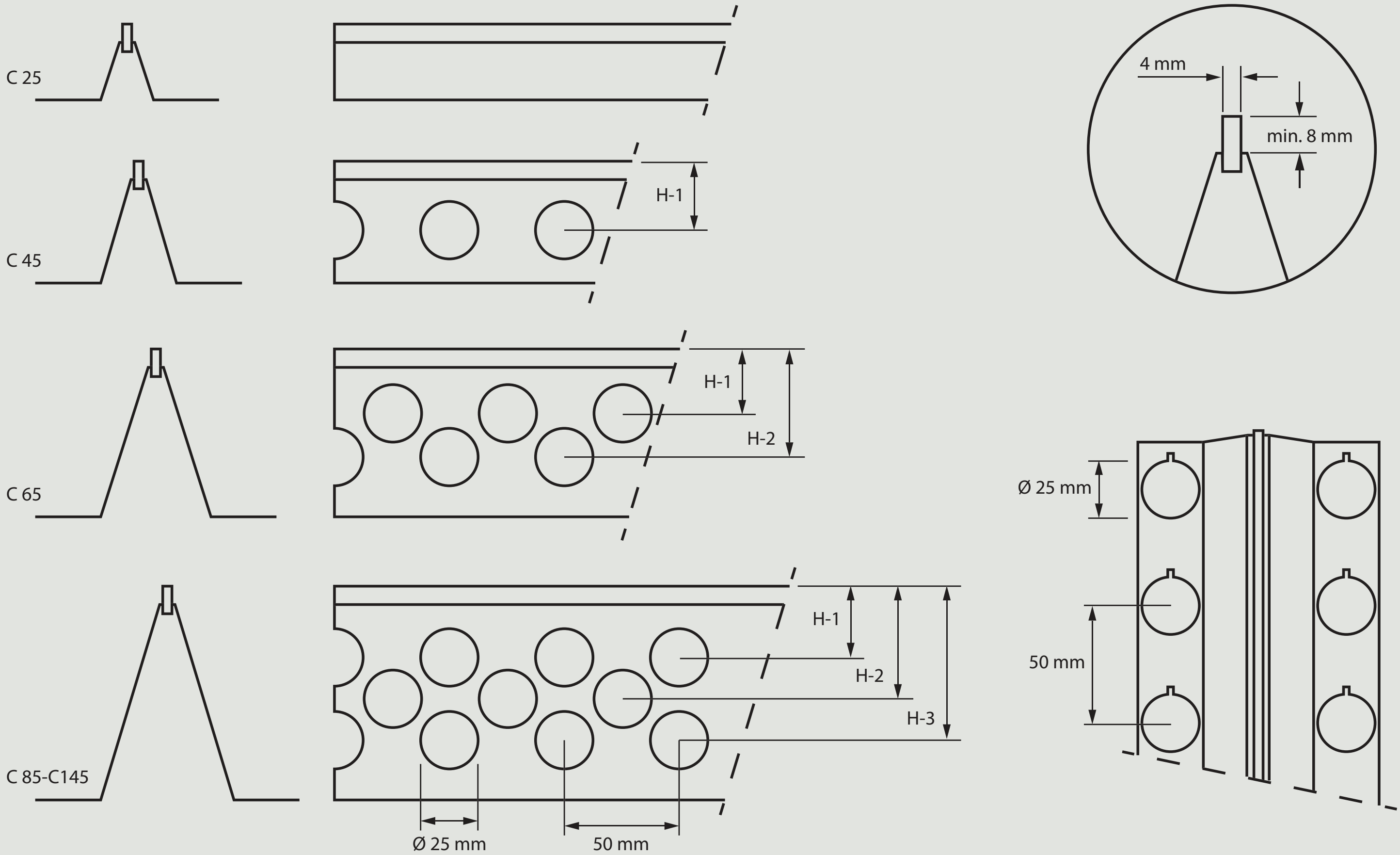
Symbol on the drawing



TYPE A
A straight, single contraction joint. Combiform with an elevating strip which initiates cracks. The strip corresponds to a cutting depth of 30 mm and a width of 8 mm.



TYPE B
Same as type A but here also with through-going dowels at 300 mm distances to transmit heavier loads.

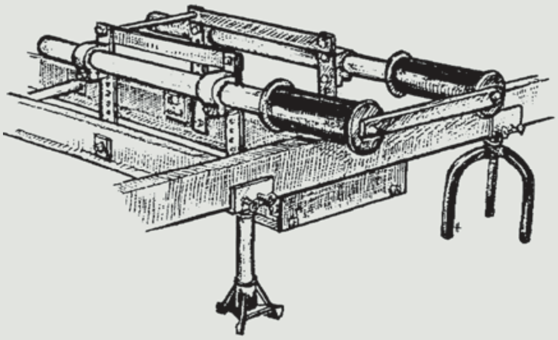


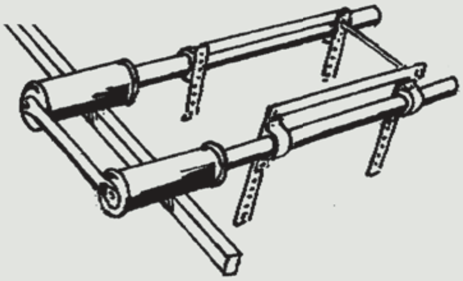
Material; Screedrail: sheetsteel SIS 1142. Top strip: polyethylene plastic.

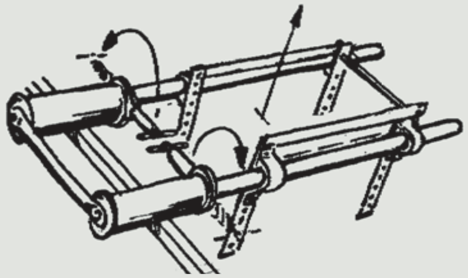
	Height	H-1	H-2	H-3	Width	Weight (kg)	
						1 m	3.5 m
C25	25	–	–	–	80	0.72	2.5
C45	45	30	–	–	90	0.77	2.7
C65	65	28	47	–	105	1.00	3.5
C85	85	31	49	67	115	1.13	4.0
C105	105	32	53	88	130	1.40	4.9
C125	125	32	64	109	135	1.70	6.0
C145	145	32	75	127	160	2.20	7.7

Track Rail System

The Atlas Copco track rail system is used for casting larger continuous surfaces without joints and stop ends .The system consists of outriggers, elevated track rails and rail supports. The system allows achieving high surface flatness since the rails can be adjusted with accuracy.



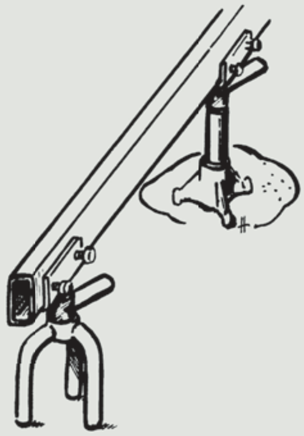




The outriggers are easily mounted on a surface vibrator and can be adjusted both in height and laterally. They are provided with rubber runners which roll on the track rail and dampen the vibrations to avoid rail displacement. On the type U3, the rollers are provided with eccentrics enabling raising the surface vibrator approximately 5 mm above the concrete surface and to roll it back for another pass. This is especially suitable for longer surface vibrators.

Elevated Track Rails

The elevated track rails consist of rectangular 100 x 50 x 3 mm steel profiles to ensure rigidity. Depending on the length and weight of the surface vibrator, the track rails are supported by rail supports at least each three meters and clamped to the support. It is easy to move the track rails along bay during casting. Therefore it is not necessary to have track rails for the entire length of the casting bay.



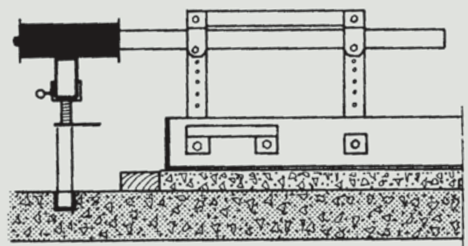
Free-standing Rail Supports

Free-standing rail supports are used as support for the track rail at casting of slabs on ground and on steel forms. The rail supports consist of a tripod on which a clamp with an adjustment screw for height adjustment is placed. The required quantity of supports is placed outside the casting bay (if the base is soft, on a stable underlay) and secured so as not move during casting. The supports are set to proper level. A precise height adjustment is easily made by using the clamp. Also the supports may be easily repositioned.

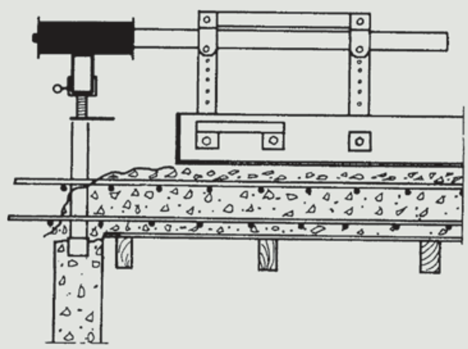
Fixed Rail Supports

Fixed rail supports, cast-in/nailable, can be used at casting of structural slabs, on precast units and/or plywood forms. They consist of plastic cups for embedding in the base concrete or of nailable plastic support bases, support tubes and clamps for height adjustment and fixing the track rails. Support tubes and clamps are re-usable. The plastic cups are used for embedding on concrete markers in precast units or in underlying walls, where the cups and support tubes of suitable length are put in concrete after finished casting of walls. The support tubes may be left and cast in overlying wall as extra reinforcement. The nailable plastic support bases can be used on precast units and plywood table forms. After casting the support tubes and the adjustment clamps can be pulled out and re-used.

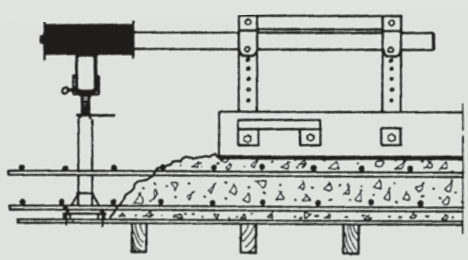
As every construction project has its individual problems with rail setting, Atlas Copco track rail system may be combined in different ways to always find a solution facilitating casting and achieving a good result.



Precast unit



Cast into wall



Nailed on a wooden form

Floors on Floor Structures Cast in Situ

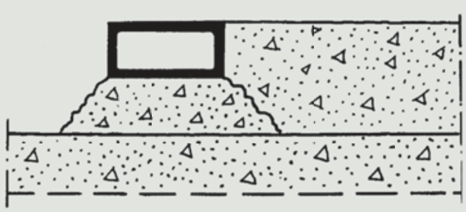
Laying floors on floor structures cast in situ is generally the easiest way of fulfilling requirements of surface smoothness and surface structure as the roof is usually in place and the building heated when the floor is cast.

It would be preferable if the floor could be laid completely without joints, but this is not possible due to the machines and working methods employed. Casting section width is usually 4–6 m. Widths up to 10 m may occur. The length of the casting section is determined by daily capacity.

The top surface of the floor structure cast in situ should be adjusted to such an evenness and height that the layer of floor concrete will be as uniformly thick as possible. The specified crossfall is incorporated in the floor structure.

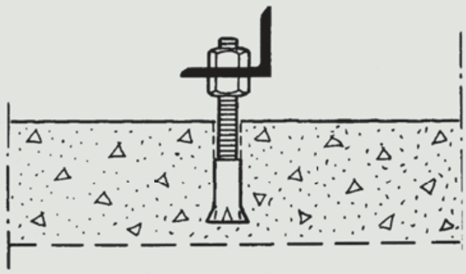
In addition, the floor surface should be brushed with a stiff broom as the concrete hardens. This removes the cement slurry and gives the surface an uneven, corrugated structure which is advantageous for bonding between the floor concrete and the floor structure.

The screed guides, which are generally stripped the day after casting, are easy to make. Square section pipes are often used and can also serve as sideforms.



Screed guide/side form with rectangular profile on concrete markers.

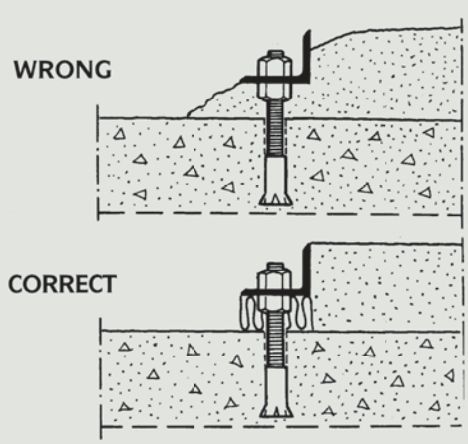
Another screed guide system is illustrated below. This system is more reliable since it maintains its height while the work is in progress.



Angle iron screed guide/side form mounted with an expander seeve.

An angle iron is used as a form stop and screed guide. The bar is mounted in the floor structure by an expander sleeve with connected stud bolts and nuts. The expander sleeve is disposable while the studs and nuts are re-used. Do not forget to clean the studs and nuts. Oil to prevent concrete sticking.

If the gap between the floor structure and the sideform is too large, Concrete will run out and the floor surface will drop. One solution is to use mineral wool as a seal. The concrete surface must be cleaned when the sideform is removed.



Floors on prefabricated floor units

The principles for form stops and screed guides are the same as for floors on floor structures cast in situ. The layer of floor concrete is usually thicker and often reinforced. This places special demands on the sideforms.

In practice there are also other problems. On a drawing the top surface of the prefabricated floor unit may be shown as horizontal line. In actual fact the prefabricated floor unit is cambered. The instructions or designer must then be consulted to determine if the finished floor surface is to be flat or if it is to follow the camber, keeping settlement of the prefabricated unit in mind.

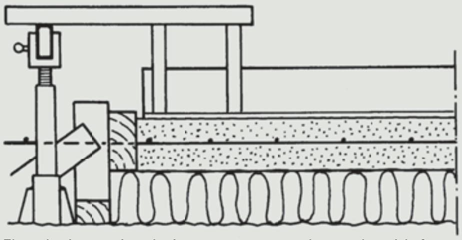
Problems will often arise with the screed guides as there may be wide variations in height between the prefabricated floor units. Moreover, the reinforcement may pass through the side form.

The angle iron side form, previously described under floors structures cast in situ, is also suitable here. The upper nut on the stud holds the reinforcement down if it is displaced and will push up the side form.

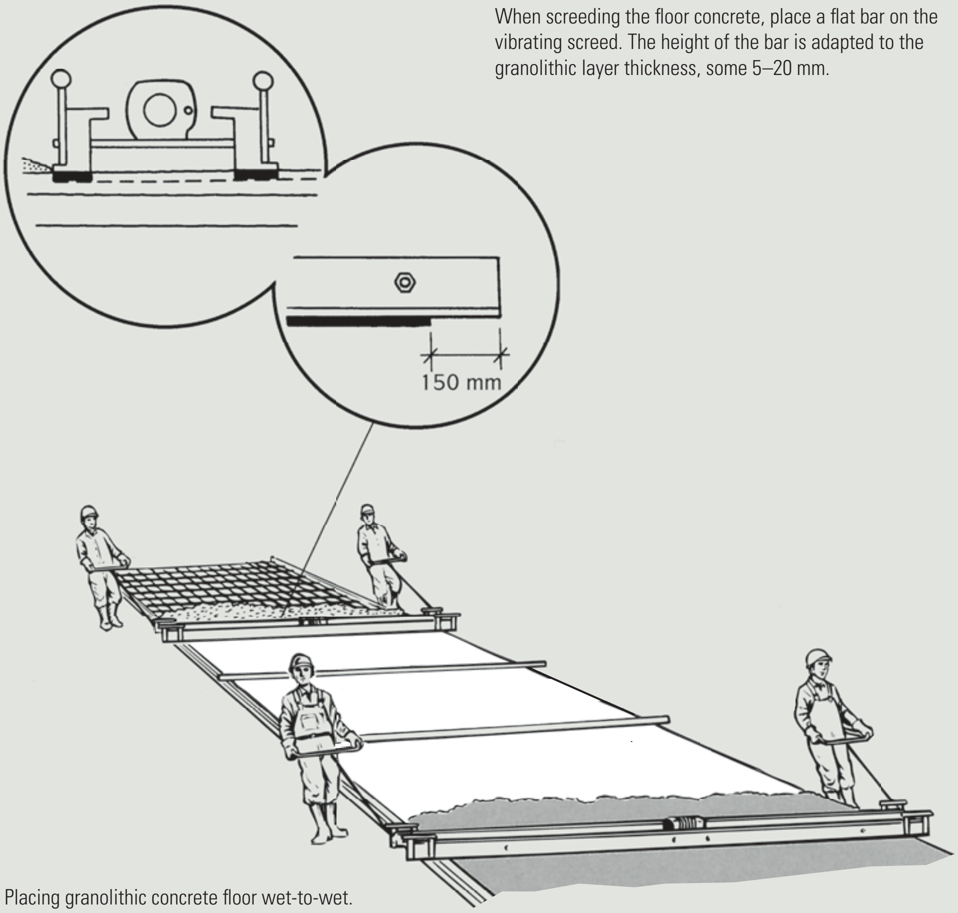
Floors on fill, insulation mats, etc.

Floating floors are difficult to make, particularly as they are often located in small spaces. There is no firm underlying surface on which to place the concrete markers for the screed guides. Compaction during the floor laying process causes the concrete markers to sink to different depths. A way to solve the problem is to use free-standing supports and an elevated screed guide.

Another way is to lay the floor in two layers. The first layer is made about 70 mm thick, reinforced and brushed. This provides a firm underlaying surface on which a layer approx. 50 mm thick is then poured. This method is suitable for floors on floor structures cast in situ.



Floor laying on insulation mats etc. can be made with free-standing supports and an elevated screed guide. Skilled workers are essential when laying floating floors.



When screeding the floor concrete, place a flat bar on the vibrating screed. The height of the bar is adapted to the granolithic layer thickness, some 5–20 mm.

Placing granolithic concrete floor wet-to-wet.

Granolithic concrete floors

To obtain a concrete floor with high durability, a layer of granolithic concrete may be laid on the various types of floors. This layer should be about 5–20 mm thick, according to the manufacturer's instructions, and be poured wet-to-wet on the floor concrete.

Another type of granolithic concrete is available in which the hard material is spread dry on the floor concrete directly after screeding. It is then worked in with a power float or the like.

Cleaning, pre-moistening, etc.

Floors on the ground

Soil (stones, gravel, sand, etc.) as the underlying surface for a floor should have a flat, compacted.surface and be free from rubbish. When pouring, the surface should be dense and thoroughly moist but without pools of water.

Monolithic floor slabs

The form should be cleaned. Forms of wood should be so moist that further swelling due to moisture does not take place.

Floors on floor structures cast in situ

Spilled oil, etc. should be scraped off or removed by a suitable solvent.

In good time before pouring, the floor structure should be cleaned and pre-moistened. The surface should be thoroughly moist with a certain absorption ability. There should not be pools of water on the surface.

Floors on prefabricated floor units

See the instructions above for floors on floor structures cast in situ.

It is not necessary to pre-moist prefabricated floor units of high-grade concrete to ensure good bonding.

Floors on fill, insulationmats, etc.

Insulation materials as the underlying surface for floors should be uniformly thick and cover the area completely. Joints between mineral wool mats should be covered so that no “chinks” allowing the passage of noise or cold are formed. Loose insulating material should be compact where necessary but not crushed.

Foundations of sand, crushed light weight concrete, coke ash, granulated slag, lightweight concrete panels and similar materials which can absorb water from the fresh concrete should be covered with a moisture barrier. The moisture penetrability should not exceed that of double, waterproof craft paper (approx. 0,1 m2h mm Hg). Moisture barriers should be laid with a minimum of 150 mm overlap at the joints.

Floors should be separated from walls, foundations, etc. by strips of cellular plastic, cardboard, porous fiberboard or similar material. These strips should be nailed or taped to the side surfaces.

Grout washing

If the foundation is of hardened concrete it should be grout washed after cleaning to provide the necessary bonding between foundation and floor concrete.

The grout should be a machine-mixed cement mortar in the proportions 1:1.5–1:2 by volume with the same water cement ratio as the concrete to be poured later. It should be applied thinly and worked into the foundation with a bass broom.

The grout-washing mortar should still be fresh when the floor concrete is poured.

It is therefore not advisable to grout wash an area larger than can be covered with floor concrete within 15 minutes.

The effect of grout washing is often discussed. Investigations show that when high-grade concrete is used, bonding between the prefabricated floor unit and the floor concrete is not improved by grout washing. In such cases, thorough vibration is of decisive importance.

Pouring the concrete

Concrete can be mixed directly at the jobsite or delivered from a nearby plant. At the jobsite, the concrete is carried from the receiving hopper or mixer to the work area by dumper, wheelbarrow, crane with skip or by pump.

Dumpers and wheelbarrows can be used safely on non-reinforced floors where it is possible to drive or wheel them out to the pouring section.

On reinforced floors the concrete is best tipped into the pouring section from the sides. Alternatively, gantries and trestles may be used. The structural reinforcement must stay in place and should not be moved out of position in conjunction with pouring. The reinforcement should not be used as a runway as trestles for gantries.

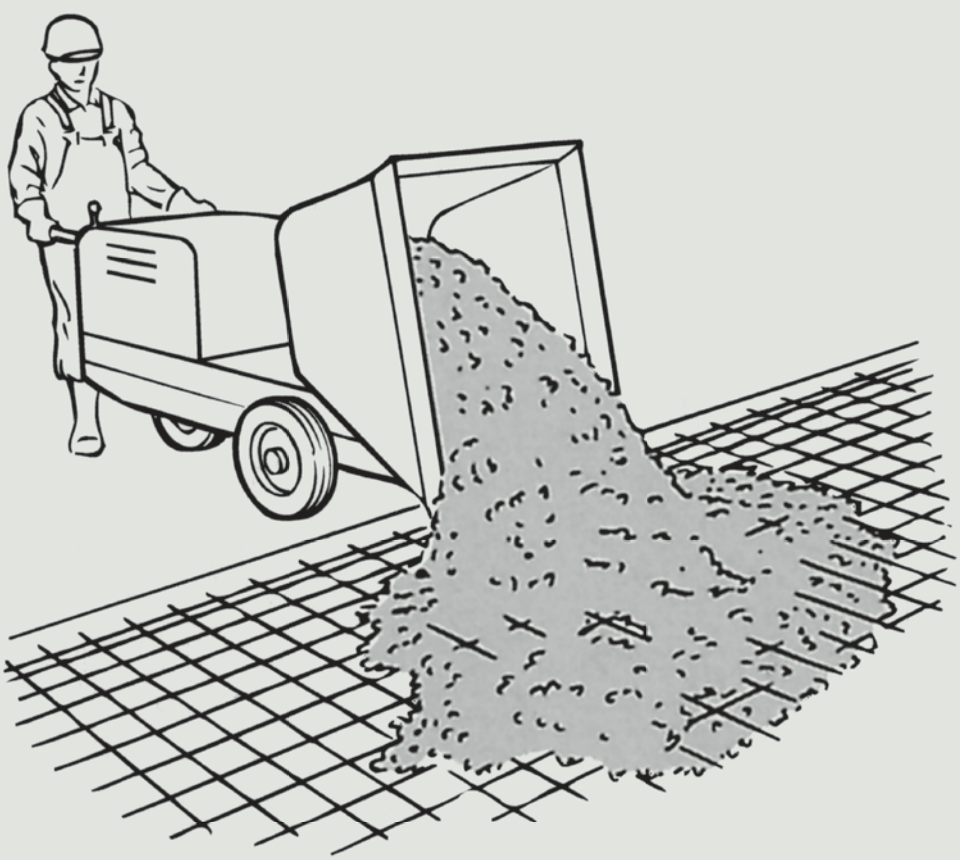
Consistency of the concrete

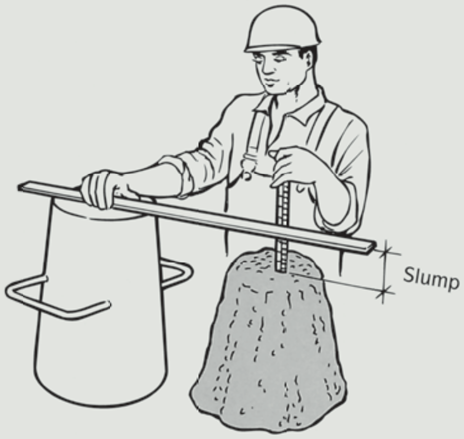
Slump: this is a measure of workability, i.e. how easily the concrete can be worked. Note that a ready-mixed concrete supplier is allowed a variation of 25 mm (1 in.) on any slump specified. Always try to use a concrete for floor slabs of no more than 50 mm (2 in.) slump.

e.g. Slump
50 mm (2 in.)

The table below gives the limits of consistency according to the two most common methods of measuring – slump cone and vebe consistency meter.

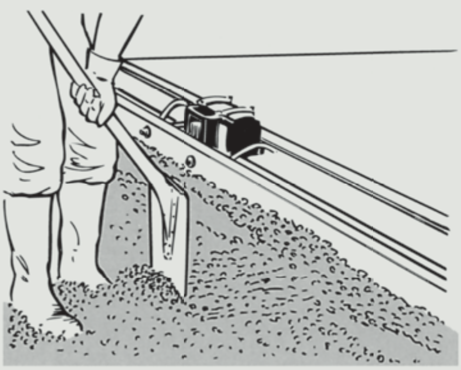
Type	Consistency	Slump	Ø of Poker	Vibration duration	Hourly capacity
–	Earth moist	0 mm	65–160 mm	10–40 s	25–45 m³/hr
S1	Humid	10–40 mm	65–160 mm	10–40 s	25–45 m³/hr
S2	Plastic	50–90 mm	40–65 mm	10–20 s	10–25 m³/hr
S3	Semi-fluid	100–150 mm	25–55 mm	10–20 s	1,5–20 m³/hr
S4	Fluid	160–210 mm	25–45 mm	5–10 s	1,5–10 m³/hr
S5	Super-fluid	>220 mm	25–45 mm	5–10 s	1,5–10 m³/hr





Measuring with a slump cone.

If a contractor mixes his own concrete on site, job specifications will determine the proportions of cement, fine and coarse aggregate and give the workability required for the job.



A roll of 10–20 mm diameter is sufficient in front of the screed. Surplus concrete should be shovelled away.

The steel mesh reinforcement may sometimes need adjustment while the concrete is being poured. A hook can be used as shown in the illustration.

When pouring with a crane and skip, the usual method for monolithic floor slabs and floors on the ground, the concrete is spread directly from the skip. Do not dump the entire load in one place and then move it with a poker vibrator.

The simplest way to spread the concrete is by pumping. This eliminates the need to build gangways for wheelbarrows or wait for lifts and the concrete can be spread very evenly from the beginning. The job itself will determine the most economical and practical method.

Vibration

Single or double vibrating screeds are used to screed and compact the concrete floor. They have a depth effect of 100–200 mm. For thicker layers, it is necessary to first use a poker vibrator to ensure that the concrete is throughly vibrated. Floors with double reinforcement should always be vibrated first with pokers.

For floors on hardened concrete, experience has shown that proper vibration is important to obtain the desired bonding. Tests show that on pre-fabricated floor units, bonding was reduced by approximately 70% because of poor surface vibration. Poor vibration consequently gives poor bonding.

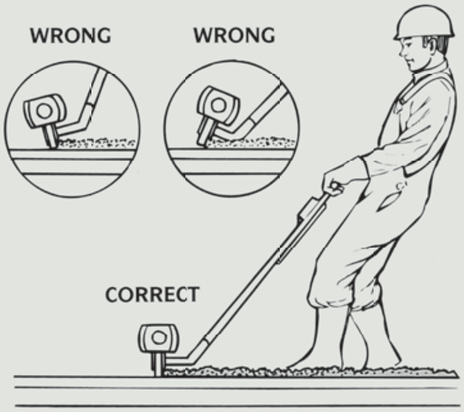
Vibrating screeds

The vibrating screed moves forward due to the effect of vibration. A reverse switch mounted on the handle or on the screed makes it possible to select the desired direction of rotation of the vibrator. To change the screed direction it is only necessary to flip the switch.

When vibrating and screeding concrete surfaces, always make sure that there is a surplus of concrete in front of the screed. A ”roll” of 10–20 mm diameter is sufficient. If there is too much concrete the screed will be heavy to pull and the surface will be uneven as the concrete swells up behind the screed. Surplus concrete in front of the screed should be shovelled away. If there is too little concrete the result will be pitted and poorly prepared concrete. If it is necessary to pour more concrete, it should be done before the second screeding pass.

Two passes are normally required to produce an acceptable smooth surface. The screed is usually carried back when the second pass is to be made.

The screed should not pulled too fast, approximately 0,5–1 m/min is the right speed.



Screeding with a single screed.

Double screeds

Vibrating double screeds are now used on most types of concrete floors. They have a good compaction effect and give good surface smoothness. They are easy to use and have a large surface capacity.

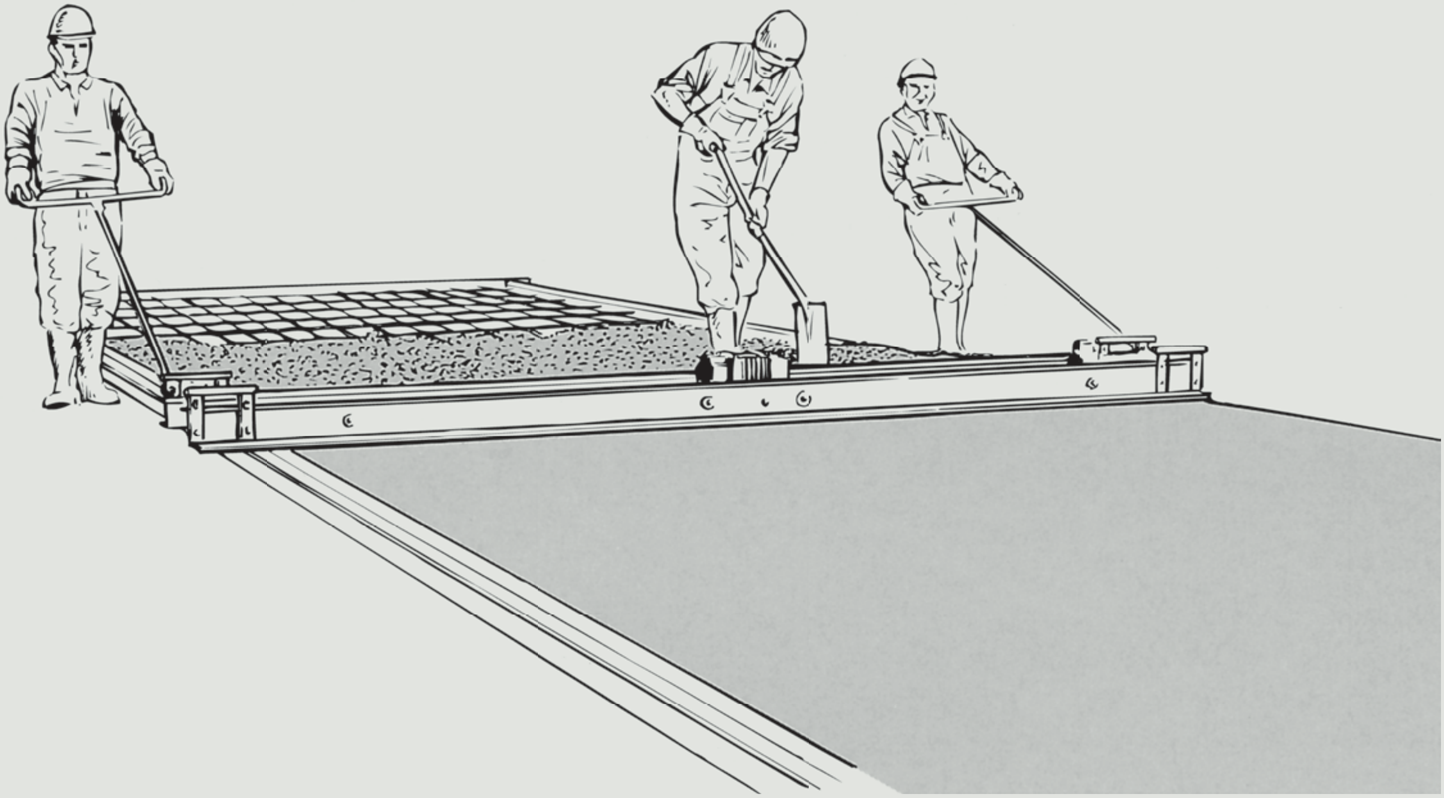
Single screeds

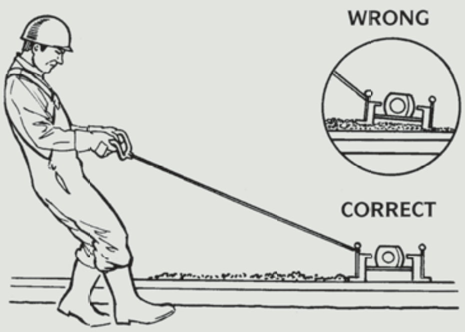
Vibrating single screeds are generally handled by two men – one to pull and one to adjust the concrete in front of the screed. Single screeds are used for all types of floors and are particularly suitable for small jobs, such as home garage floors, driveways, narrow rooms, etc. Single screeds are also used to supplement double screeds.

Single screeds are primarily used for concrete of up to plastic consistency on which they have a depth action of 100–150 mm. On thicker concrete layers, vibrating screeds are used in combination with poker vibrators to ensure that the entire concrete layer will betreated. On monolithic floor slabs the combination of poker vibrator and vibrating screed should always be used to produce a non-porous undersurface.

Single screeds are up to 4 meters long and are usually non-adjustable.

Make sure when screeding that the bottom of the screed is horizontal. If it is slanted the vibrating effect and surface smoothness will be poor. If the screed is rocked back and forth the surface will be wavy.





Use a sufficiently long pulling line so that the screed is not lifted.

Double screeds are primarily intended for concrete of up to plastic consistency on which they have a depth action of 150–200 mm. On thicker concrete layers the vibrating screeds is used in combination with poker vibrators to ensure that the entire concrete layer is vibrated. On monolithic floor slabs the combination of poker vibrator and vibrating screed should always be used to produce a non-porous undersurface.

Normally three or four men are needed when vibrating and screeding concrete surfaces with double screeds. Two men pull and steer the double screed. One or two men do the shovelling and always ensure that the right amount of concrete is in front of the double screed.

It is important not use the screed continuously in as long stages as possible since it will leave marks in the concrete where it stops. One way to reduce the size of the marks is to hold the pulling lines taut when starting the screed and to continue pulling until the vibrator is switched off and has stopped.

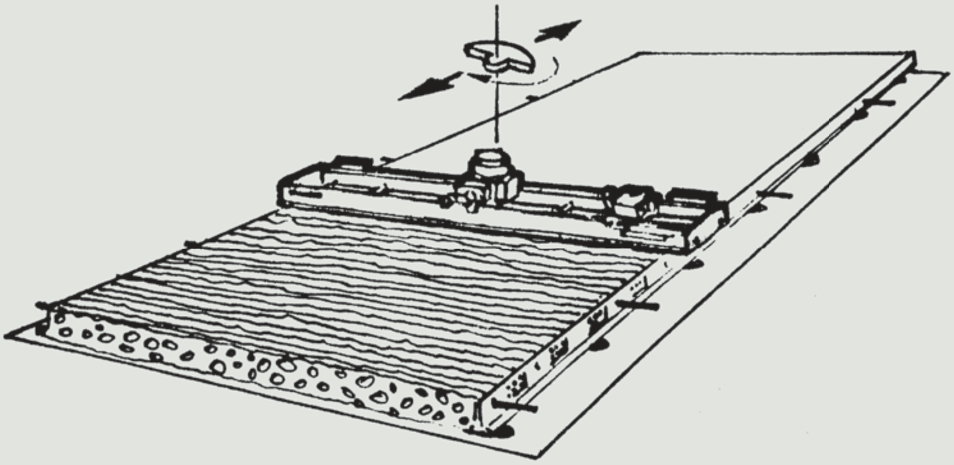
It is also important to use the full length of the pulling lines. If short lines are used the pull will give the screed too much of an upward angle and it is easy to accidently lift the front part of the screed.

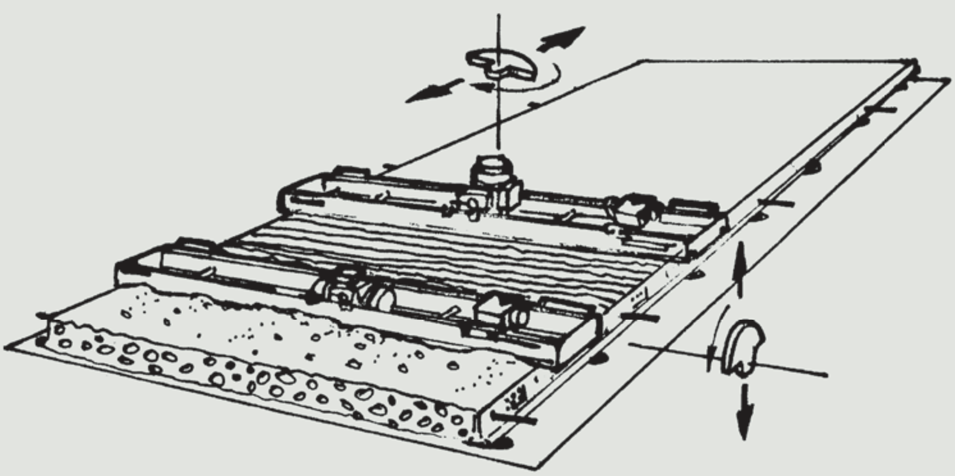
Screeds presently available on the market have a maximum length of about 10 m and are made of aluminium. Straightness can be adjusted. Always remember that wide bays make it more important to use the screeds correctly to avoid level differences.

Surface levelling

At a higher flatness requirement, surface levelling is carried out . This can be done by turning the vibrator unit of the surface vibrator to vertical position. No depth vibration takes place, only levelling action, removing irregularities on the surface that appear when there is too much concrete in front of the screed during surface vibration. Pulling speed depends on the concrete consistency.

The initial speed should be approximately 1 meter per minute.





Surface vibration/levelling

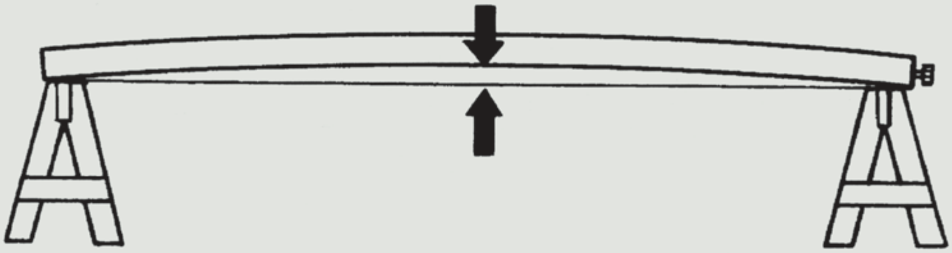
A combined surface vibration/levelling can be carried out simultaneous-ly on concrete surfaces with normal flatness requirements. Two surface vibrators are coupled together at a distance of approximately 75 cm from each other. The first machine produces depth vibration with horizontally placed vibrator unit and the rear one levels the surface with vertically positioned vibrator unit. On bay widths exceeding 4 m the screeds should be pulled with a winch.

Pulling speed about 1 meter per minute.

Adjusting double screeds

1. Place each end of the vibrating screed on a support, use a spirit level to ensure that both supports are horizontal. A slight difference in height between the outer ends is, however, of no significance.
2. Then stretch a length of piano wire along the lower or upper edge of the screed. Tighten the wire until it is absolutely straight.
3. Loosen the bolts holding the vibrator mounting bracket to the screeding screeds.
4. Tighten to the required height with the two adjusting screws at the ends of the screeds. The amount of camber is partly determined on the length of the screed. Check that both screeds are equally tighten.

Finally, check the end supports to ensure that the screed rests squarely on all four support points and that it is not crooked. If necessary, adjust with the frame screws holding the vibrator mounting bracket and also tighten the locknuts on the adjusting screws.



A levelling instrument can be used instead of piano wire when adjusting the screed. Always follow the specifications when adjusting the screed tention.

Cleaning screeds

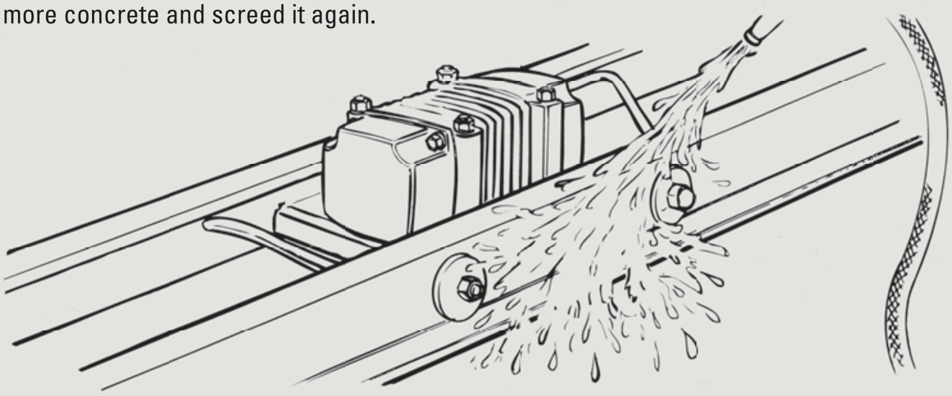
It is important to clean the screed every day. Those who use the screed are those who benefit most by ensuring that it is kept clean. Once concrete has adhered to the screed, more concrete will easily attach itself and the screed will become heavier and heavier to use. The efficiency of the screed will also deteriorate the more concrete there is on it.

One way of preventing concrete from adhering to the screed is to smear it with oil every day after cleaning. Corrosion-inhibiting oil such as Tectyl may be used and it lasts longer than ordinary oil.

The screeds should be hosed down with water and brushed with a stiff broom immediately after use and before the concrete has hardened. If this is done every day the screed will retain its efficiency, be easier to handle and last longer.

Conclusion

If an unadjusted and crooked vibrating screed or poorly-levelled screed guide supports are used, the quality of the floor will be poor. It is not possible to eliminate unevenness, depressions, etc. afterwards. If for any reason .a large gash or unevenness has occurred in the surface, pour more concrete and screed it again.



Daily cleaning is essential to ensure that you have a screed that is efficient and easy to handle.

Finishing

After the concrete has been poured it is given a finishing treatment according to the type of surface that is desired. The most common methods of finishing are:

- levelling
- screeding
- brooming
- floating
- steel trowelling
- machine grinding

Levelled surface
A levelled surface is obtained if the concrete is levelled with a shovel or similar after pouring.

Screeded surface
A screeded surface results from screeding with a straight-edge, vibrating screed. Note: Levelling screeds do not vibrate but ”saw” the surface during levelling.

Broomed surface
A broomed surface is obtained if the concrete is brushed with a broom after screeding.

Floated surface (rough)
This surface can be obtained on a screeded surface either by maual floating or by using a power float fitted with a circular disc. Fill uneven areas during disc floating.

Steel trowelled surface (smooth)
This is carried out on the freshly floated surface either with a hand trowel or by using a power float with blades for fine trowelling.

The size of the surface determines if the work is done manually or with the aid of a machine. Power floating is the only method on vacuum-treated floors as the surface is so hard that it is difficult to finish by hand.

Power floating/ machine trowelling

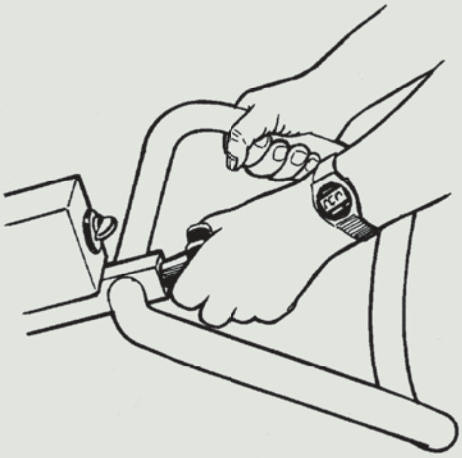
Dead-man will stop the machine when the operator looses the control of the machine and has to inadvertantly let the handle go.

When machine trowelling fresh concrete surfaces, a distinction is generally made between two different operations: rough trowelling and fine trowelling.

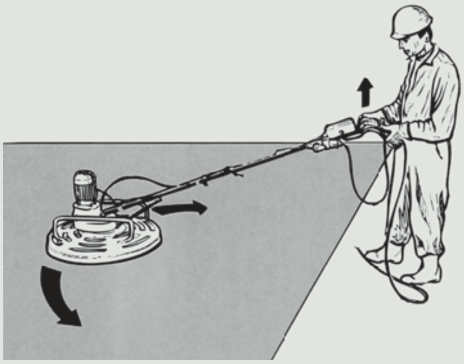
Rough trowelling is carried out with a solid round disc. It is performed either to produce a smooth surface for subsequent fine trowelling or to produce a finished surface similar to that obtained by floating.

If subsequent trowelling is specified, rough trowelling must be carried out as soon as possible so that the moisture forced up to the surface will have time to evaporate and the concrete to begin setting before fine trowelling.

If the concrete is vacuum treated, rough trowelling can be carried out as soon as the suction mats are removed. Suction mats leave some minor unevenness in the concrete surface which must be removed by rough trowelling.



The angle of the blades are adjusted from the handle.



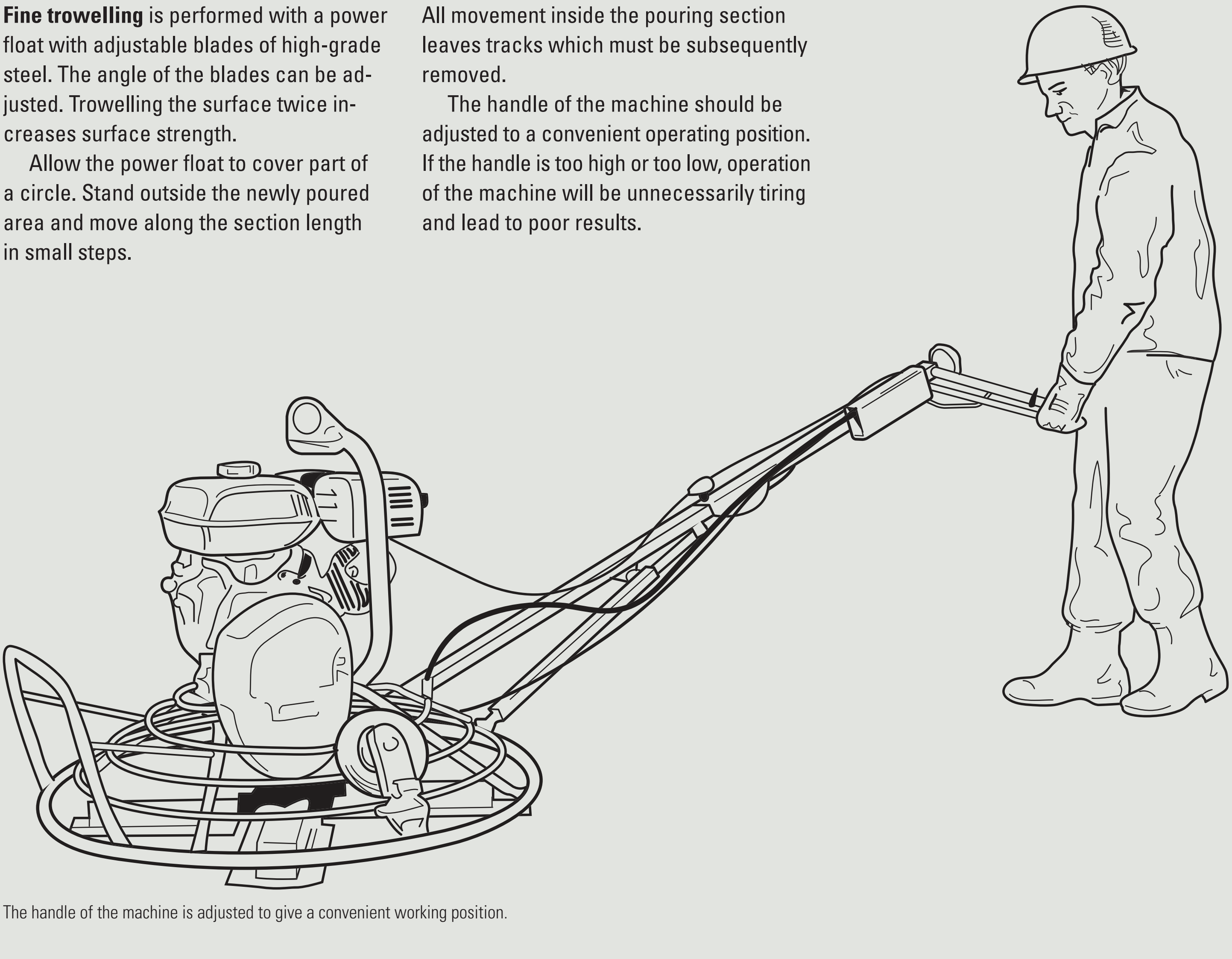
The power float is manoeuvred by lightly raising or lowering the handle.

Fine trowelling is performed with a power float with adjustable blades of high-grade steel. The angle of the blades can be adjusted. Trowelling the surface twice increases surface strength.

Allow the power float to cover part of a circle. Stand outside the newly poured area and move along the section length in small steps.

All movement inside the pouring section leaves tracks which must be subsequently removed.

The handle of the machine should be adjusted to a convenient operating position. If the handle is too high or too low, operation of the machine will be unnecessarily tiring and lead to poor results.



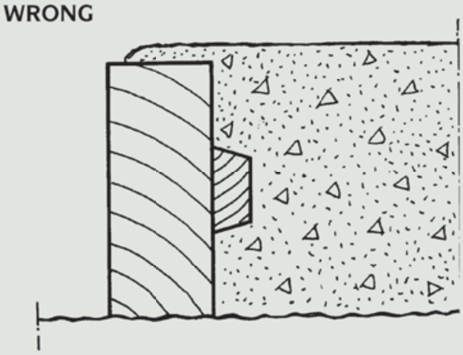
The handle of the machine is adjusted to give a convenient working position.

Rough trowelling

Rough trowelling is started when the concrete is so hard that it can be walked on without showing any large marks. If the concrete has been sufficiently vacuum treated it is possible to rough trowel the surface immediately after vacuuming.

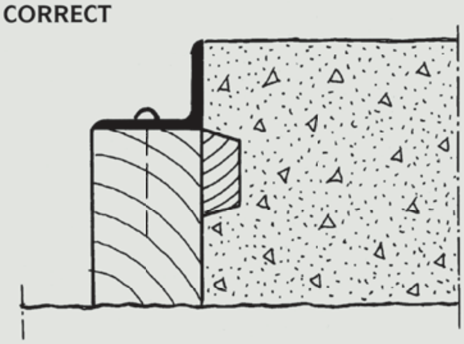
Any minor holes in the surface should be filled with fresh concrete before rough trowelling. If there is a surplus of material at form stops and/or a wide form stop, the floor will get the wrong height.

WRONG



A thin side form generally does not cause this problem.

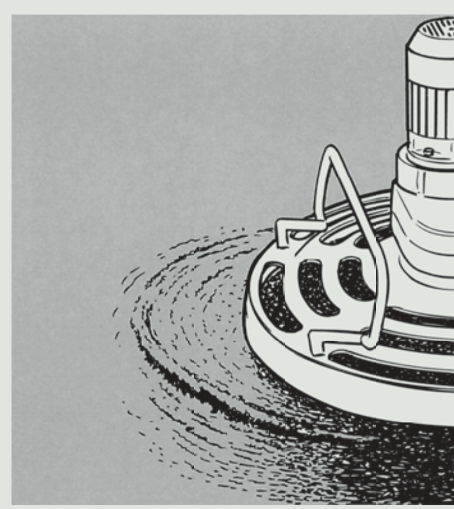
CORRECT



When pouring concrete next to previously laid floors the same problem occurs as when a wide side form is used. Make sure that the edge of the adjoining floor is free from old concrete, etc. One way is to fit a long handle to an ordinary steel trowel and keep the edge clean.

Keep the edge of adjoining surfaces clean.

When rough trowelling, the machine should be guided in wide sweeping movements so that it does not stay too long in the same area and make holes in the surface.

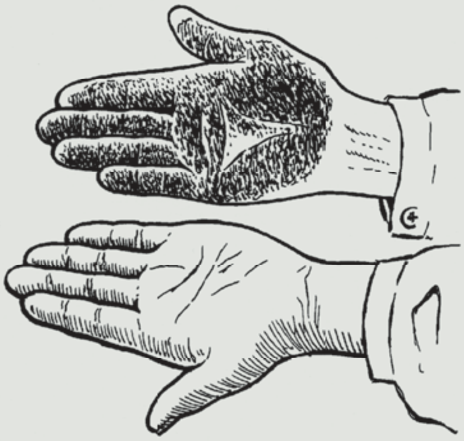


If a roll of concrete forms round the finishing disc, the work was started too soon.

Fine trowelling

The waiting time before fine trowelling can start after rough trowelling depends on the concrete mix, air humidity and temperature. A practical way to know when it is time to begin fine trowelling is to press the palm of your hand against the concrete surface. If concrete adheres to your hand it is too soon for fine trowelling. If fine trowelling is started too early the blades will leave marks in the concrete.

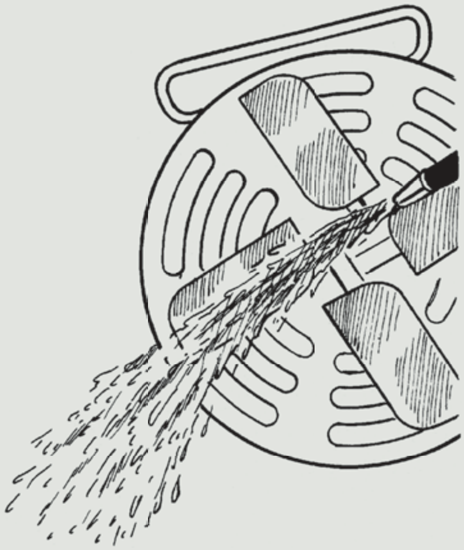
As a rule, at least two passes are necessary when fine trowelling. In the first pass the blades should be set at a slight angle to avoid excessive surface pressure on the concrete. The second pass is then carried out as late as before the concrete has set too hard. Experience of the concrete team is vital.



Do the handtest before fine troweling.

Cleaning the power float

It is equally important to properly clean the machine after use, especially the trowelling disc and trowelling blades as old concrete adhering to them will leave marks in the concrete surface.



Be careful at the daily cleaning.

Conclusion

To achieve high quality results, it is important to not trowel too much. Excessive finishing will cause fine material to rise to the surface. Concrete with fine aggregate contracts more than concrete with coarse aggregate and the risk of crack formation is increased. Moreover, the concrete will be less wear resistant and will be more prone to dusting.

Curing

One of the most vital operations when laying concrete floors is the curing process. It has a great influence on the final quality.

When properly carried out, curing reduces the risk of cracks, splits and edge rising.

Moist curing should start as soon as possible after finishing and continue for at least seven days – for granolithic concrete at least 14 days.

Moist curing by hosing with water should not be done on floors laid on fill, insulating mats, insulating plates, etc.

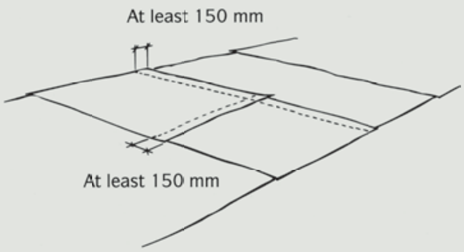
Moist curing should not be done with sawdust which can discolour the concrete (e.g. alderwood sawdust).

The concrete should not be subjected to quick drying when the during is completed. Drying should be a slow process.

There are many different ways of moist curing concrete. Two of the most common are:

Plastic or cardboard covering

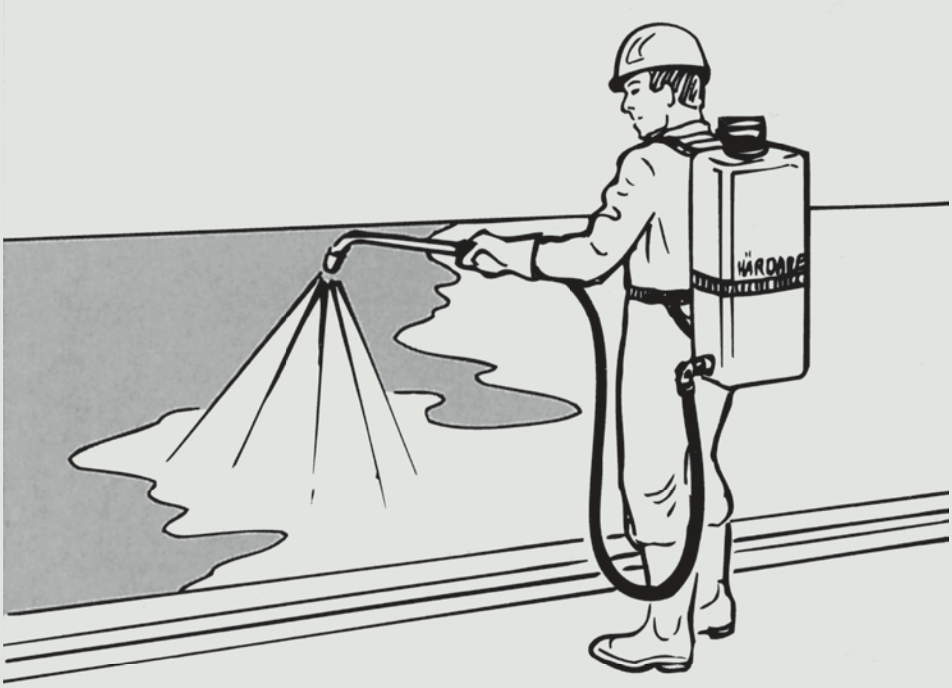
The moisture barrier should have a moisture penetratability not greater than that of double, waterproof craft paper (approx. 0,1 m2h mm Hg). The moisture barrier should be laid with an overlap of at least 150 mm at the joints. At heavy traffic points the moisture barrier should be protected by fiber board panel, gangways, etc. Such moisture barriers or other devices used in connection with moist curing should be left in place as long as possible. Special care should be taken when moist curing floors where rapid drying is likely, such as next to windows and doors, beside radiators and hot water pipes, etc. Intensive heating (above room temperatur) and excessive ventilation should not be allowed during the weeks immediately following floor laying. In very hot climates covering with plastic and keep moist for at least 14 days will avoid surface cracking and ensure effective curing.



The moisture barrier is layed with at least 150 mm overlap at the joints.

Membrane curing

The intermediary for membrane curing should be evaporation inhibited and usable down to degree C. It should not be of such type that makes subsequent surface treatment, bonding and the like difficult. It should be applied as soon as open water has disappeared from the surface but before the surface has dried.



Grinding

The concrete floor surface consists of a thin layer of fine material which has less resistance to wear than the rest of the concrete. If a thin surface layer about 0,5 mm thick is removed by machine grinding, greatly improved wear resistance is obtained as well as a reduced tendency to dust.

Machine grinding also ensures better results if the concrete floor is to be painted or coated with plastic since the surface layer is a thin zone of weakness between the surface treatment and the strong concrete.

To achieve good machine grinding results the floor must have a smooth, steel-trowelled surface. Machine grinding is an extremely expensive way of correcting mistakes in surface smoothness, such as joints which are not level.

When grinding to depth of approx. 1,5 mm – deep grinding – the concrete stone structure will be brought out. Deep grinding is far more timeconsuming than surface grinding.

Grinding is normally done 2–6 days after laying the concrete. If the concrete strength is too low, small stones may be torn away from the surface. On the other hand, if the surface is too hard the grinding will require more time.

Filling

No matter how carefully and skillfully a floor has been finished, filling is still sometimes necessary. Nevertheless, the basic rule must always be to avoid filling wherever possible.

There is a wide range of different fillers on the market, many of them with special characteristics that require different methods of use.

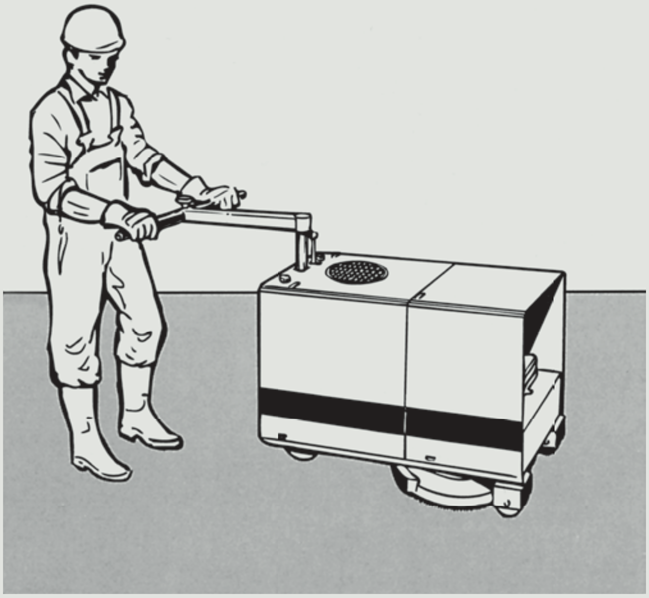
When choosing a filler it is necessary to consider the load on the floor. An epoxy filler, for example, is not used in a room that will have a vinyl floor covering or where no stress occurs on the floor, nor should a simple single-component filler be used for industrial aisles.

Any impurities on the concrete surface will have a negative effect on bonding. The most common types of impurities are dust, oil grease and chemicals.

Surface dust is a barrier to the filler because it prevents the filler from penetrating into the concrete pores and gaining a proper hold.

Cleaning a surface with a broom is usually inadequate. It is better to blow the surface clean with compressed air or go over it with a powerful vacuum cleaner.

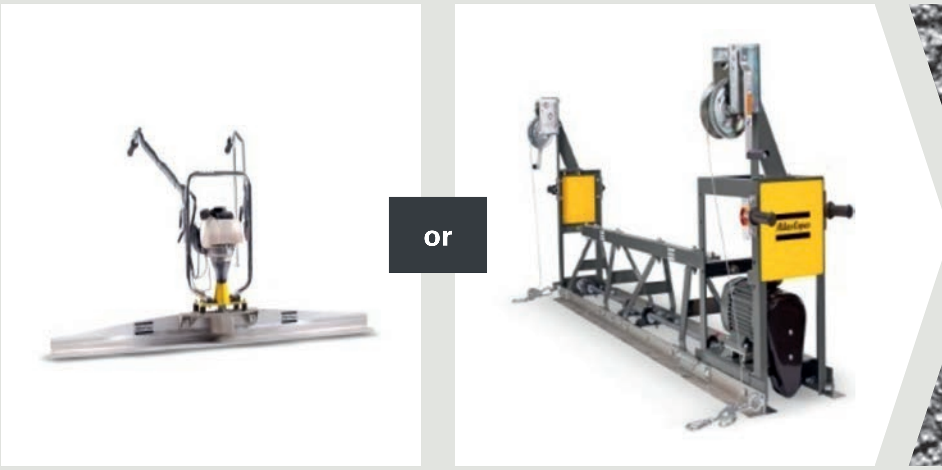
If the surface is marred by oil or grease stains they must be removed with a hydrochloric acid solution. Afterwards the surface should be hosed down with plenty of water to remove all traces of the hydrochloric acid.



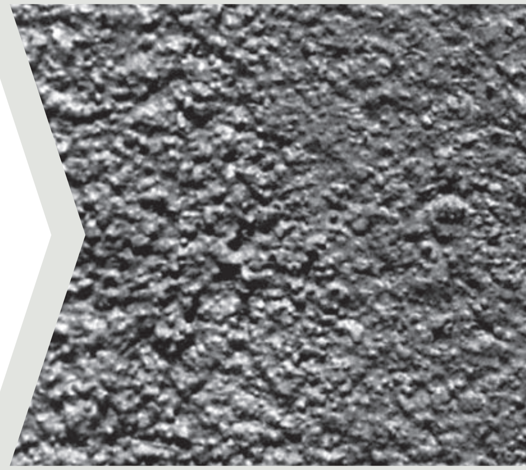
Generally, grinding is done 2–6 days after laying the concrete. Satalite controlled grinding machines ensure perfect levels.
In the future robot laser controlled grinding machines will make grinding easier.

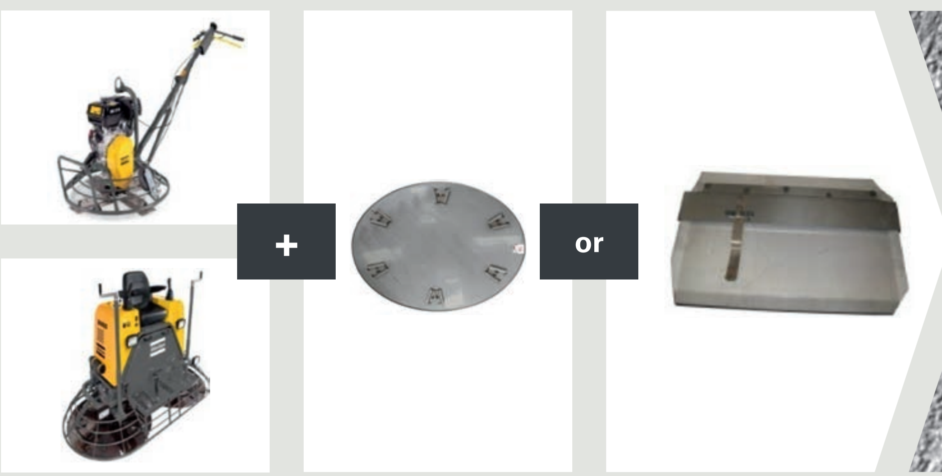
Sometimes filling is necessary.

Types of concrete surfaces

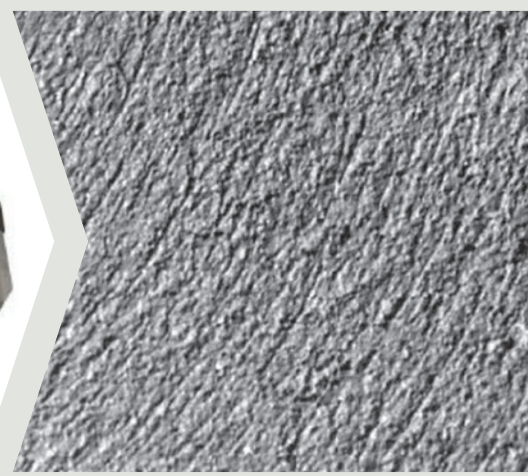


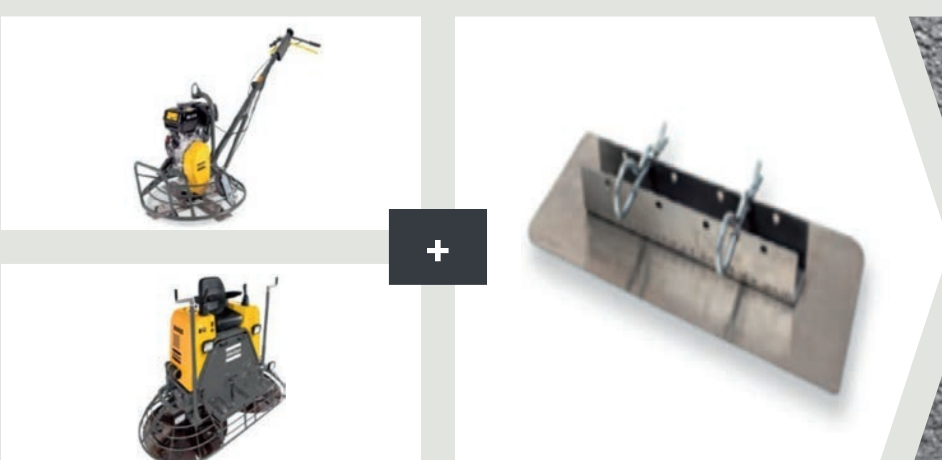
Screeded surface (rough)





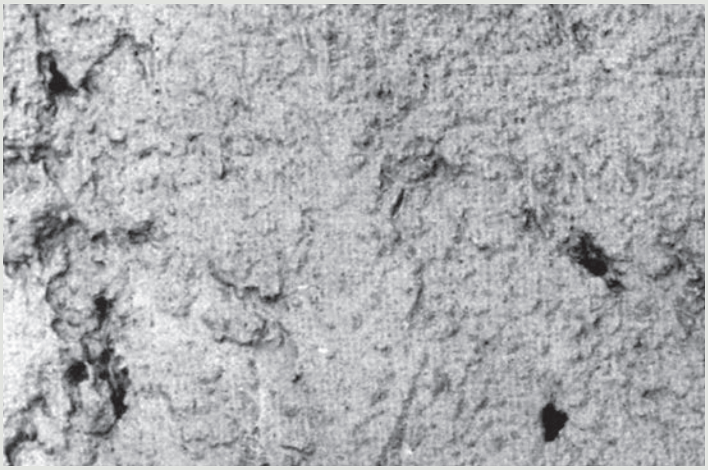
Floated surface (rough)



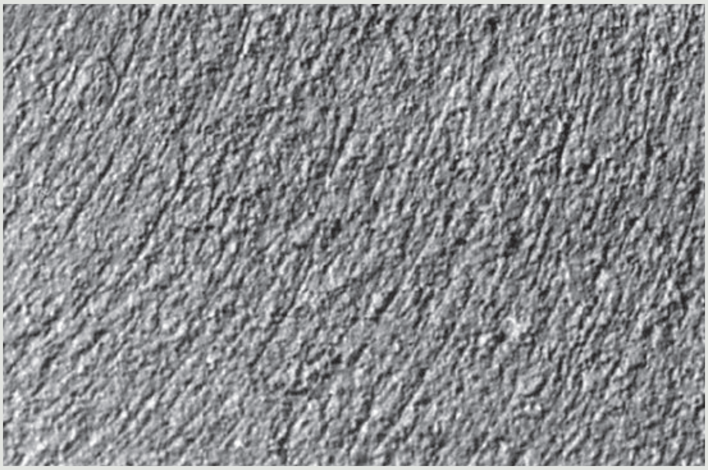


Steel trowelled surface (smooth)

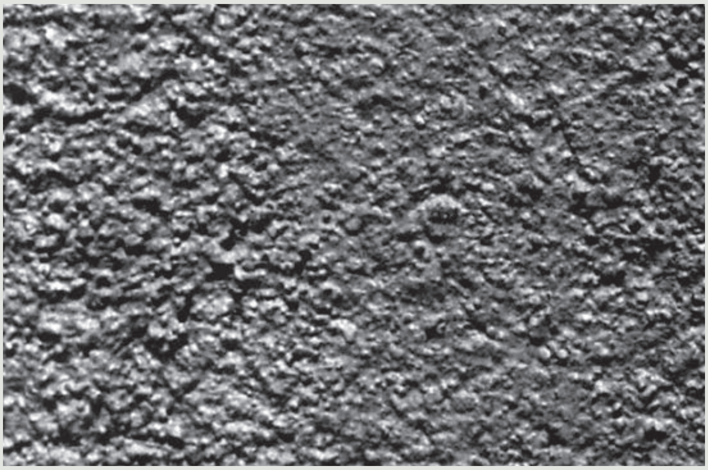
Levelled surface



Floated surface (rough)

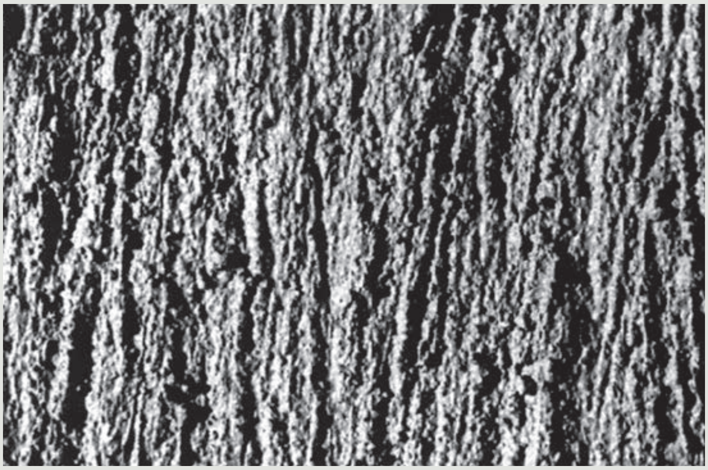


Screeded surface

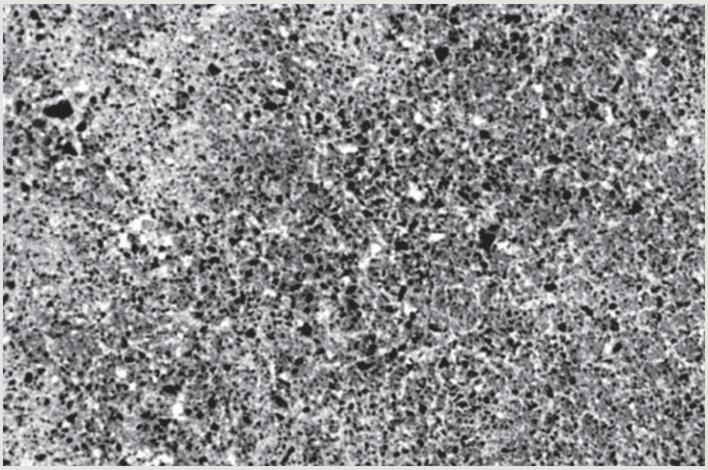


Steel trowelled surface (smooth)

Broomed surface



Machine-ground surface



Conversion Tables

To simplify conversion from and to metric system use conversion tables. All specification shown in the Product Sales Guide follow the international SI standard.

	To convert from		into
Distance	1 mm 1 cm 1 m	= = =	0.0394 in 0.394 in 39.370 in = 3.28 ft = 1.094 yd
Area	1 cm^2 1 m^2 1 km^2	= = =	0.115 in^2 10.764 ft^2 = 1.197 yd^2 0.386 $mile^2$ = 247.097 acres
Volume	1 cm^3 (ml) 1 dm^3 (l) 1 m^3	= = =	0.061 in^3 = 0.034 US fl oz 61.024 in^3 = 0.035 ft^3 = 0.264 US gal. 35.314 ft^3 = 1.308 yd^3 = 264.173 US gal.
Speed	1 km/h 1 m/min	= =	0.278 m/s = 0.911 ft/s = 0.304 yd/s = 16.667 m/min = 54.681 ft/min = 18.227 yd/min = 0.621 mile/h 0.060 km/h = 0.037 mile/h
Weight	1 kg 1 t	= =	2.2051 b 1,000 kg = 2,204.586 Ib
Linear load	1 kg/cm 1 kN/m	= =	6,000 Ib/in (pli)Note: for daily use kg/cm approx. kN/m and Ib/in aprox.Ibf/in. 5,710 Ibf/in.
Density	1 t/m3	=	1 kg/dm^3 = 62.427 Ib/ft^3 = 1,685.527 Ib/yd^3
Force	1 N	=	1 kgm/s^2 = 0.102 kp = 0.225 Ibf
Pressure	1 kPa	=	1 kN/m^2 = 0.010 kp/cm^2 = 0.010 bar = 0.145 Ibf/in^2 (psi)
Energy	1 kJ	=	1 kNm = 0.239 kcal = 737.562 Ibf ft
Effect	1 kW	=	1 kJ/s = 1.360 hp (metric) = 1.341 hp (UK, US)
Temperature	0° C	=	32°F (Each degree celcius (°c) is equal to 1.8°F)

Glossary

Admixture
This is a substance other than water, aggregates or cement that is added to a concrete or mortar mix to improve or modify some of the properties of the mix, or of the resulting concrete or mortar. These include pigments (coloring agents), modifiers to slow or accelerate the setting time, plasticizers to increase workability, water proofing and water reducing agents, noise reducer (foams), aluminum powder (to create air voids)…

Aggregates
The granular ingredients of a concrete or mortar mix: natural sand, gravel and crushed rock. Aggregates make up to 80% of the volume of concrete.

Cement
This is the grey powder used in the concrete mix, once mixed with water, this cement becomes the glue that keeps the sand and aggregates together. They are produced by cement producers, sold in bags or bulk quantities. They can have different quantity of fly ashes and therefore different qualities.

Compaction/Vibration
Removal of entrapped air during the concrete mixing, for that operation we can use either pokers, beams or external vibrators: to fill the forms, surround the reinforcement and to achieve the strength, durability and quality of finishes specified. The concrete vibration also increases the bond between the concrete and the reinforcement bars up to 25%. The size of the concrete poker will depend on the concrete slump and the quantity of concrete to be poured. This is obvious that the poker has to go through the rebars, so the diameter has to be adapted.

Curing
Keeping the surface of concrete, mortar or render continuously damp, after placement, to slow evaporation and to ensure enough moisture for optimum hydration and subsequent hardening. Proper curing during the early life (7–10 days) of concrete improves its strength and durability, and reduces cracking and dusting of surfaces.

Laitance/cement milk
A layer of weak, non-durable material brought to the surface by bleeding, and exacerbated by overworking the surface of wet concrete when finishing. This weak layer can also come from over-vibration with pokers or beams. This is therefore necessary to adapt the vibration duration and/or the numbers of passes with beams to the slump (water content) of the concrete.

Matrix
The mixture of cement paste and fine aggregate (sand) that binds the coarse aggregates.

Plastic settlement cracking
Surface cracking caused when concrete settles over an embedded object, for example reinforcing mesh or service pipes, and at a change in depth of concrete. The crack usually appears on the surface parallel to the restraining object. It often happens in concrete containing too much water, and receiving insufficient compaction.

Plastic shrinkage cracking
Surface cracking caused by premature moisture loss from the surface of plastic concrete: usually in hot and windy conditions.

Segregation
Segregation is an uneven distribution of slurry and aggregates in the concrete. This can be the result of over-vibration with pokers or beams, but can be also resulted by the excess of water in the concrete mix. The way to pour the concrete will also involve segregation, especially in the case of formwork, a concrete fall of more than 2 meter, will force the heavier aggregates to sink inside the wet mix, but a poorly sealed formwork allowing the laitance to escape during the vibration can also create honeycombs.

Slump (slump test)
This is a standardized measurement of the consistency of the concrete, the consistency will change with the water content inside the concrete mix, it gives an indication of the workability of the concrete and will influence the types of machines that have to be used to place and vibrate, level and finish the concrete. The slump has to be indicated when ordering it to the batching plant.

Water-cement ratio
The ratio of the mass (a scientific measure of the weight) of the water in the concrete to the mass of the cement in the concrete, mortar, render or grout. Adding water to a mix increases the water-cement ratio. The higher the water-cement ratio, the lower the strength and durability.

Workability
The degree of ease of handling, placing and finishing concrete or mortar. The greater the slump or water/cement ratio (see both terms above), the greater the workability.

Levelling
This operation consists in giving a shape to a concrete floor or slab; it can be flat, but also curved. The flatness of the concrete pour will depend of the type of machine to be used; this will be achieved with beams, screeds, the vibrating ones providing better results than non-vibrating ones.

Surfacing
This operation consist of reparing all small defaults that can be left on the surface of concrete after the leveling. The floor finishing will depend to customer requirement and will be done with power trowels. The surface can be left rough (ex. outdoor concrete) or very smooth (ex. inner industrial floor). The discs will provide rough surface, when finishing blades are used, the smoothness will depends on weight of the machine and pressure applied by the blades on the concrete.

Constructions joints
Used to ease the concrete pouring, it is possible to drive the reinforcement through this joint to increase the solidity of the construction

Contraction/expansion joints
allows movement in the plane of the floor, it is used on slab on ground to reduce movement against the ground.

Isolation joints
separate entirely two construction parts, to allow both vertical and horizontal movements. It can be used to isolate the floors from walls, columns…

COMMITTED TO SUSTAINABLE PRODUCTIVITY

We stand by our responsibilities towards our customers,
towards the environment and the people around us.
We make performance stand the test of time.
This is what we call – Sustainable Productivity.

www.atlascopco.com