**Designing stairways in production environments**

**Ensuring stairways and platforms don’t become trip hazards**

**Occupational accidents in industrial environments often involve stairways, with employees at risk of stumbling, slipping or even falling. To avoid mishaps like these, stairways must be designed with safety in mind. This requires extensive** [**expertise**](https://welcome.item24.de/whitepaper-treppen-und-podeste?utm_source=google&utm_medium=cpc&utm_campaign=tps&utm_form=186252743677&gclid=CjwKCAjwu_mSBhAYEiwA5BBmf_WniY5J17oGSfUzfduf659DW8JzYyk19yoSZXYAxZOV5Fvm6ykf4RoCFm0QAvD_BwE)**, and there are numerous regulations and standards to take into account. Ensuring tread surfaces are large enough, calculating a suitable pitch and factoring in weight loads are all important considerations when designing safe stairways. Anti-slip surfaces and optimum lighting play an important role, too.**

Installing stairways and platforms in industrial environments may seem straightforward at first, but there are numerous regulations and standards governing how they are designed. In the past, poor designs would often lead to falls and accidents on stairways. A number of regulations were introduced to prevent this and make stairways safer to use. The DIN EN ISO 14122 standard, for instance, defines the basic requirements for permanent means of access to machines that are not directly accessible from the ground level or a floor. Stairways are the preferred method of accessing machinery and plants. As such, they must not exceed a pitch of 45°. Stepladders and machine steps with a pitch of 45° to 75° are used if a stairway cannot be installed. In contrast to stairways, users must keep their eyes on stepladders as they descend. The pitch angle on ladders is between 75° and 90°. They should, however, be avoided wherever possible, as they increase the risk of accidents. “The step length and step-length formula used to calculate a stairway’s ideal pitch ratio form the basis of stairway design,” explains Benedikt Weiss, product development team leader at item. The market leader in building kit systems for industrial applications supplies stairways and platforms made of a variety of aluminium profiles. It places a large emphasis on safety and therefore adheres to all current standards and the regulations of German accident insurance and prevention institutions. Engineers use the step-length formula to design stairways that are as easy to climb as possible. According to this formula, the average step length (S) of 630 mm is equal to the height climbed (h), also known as the rise, multiplied by two, plus the going (g): S = 2h + g = 630 mm ± 30 mm. The going denotes the area of a stair tread where users will set their foot down and is measured as a horizontal line from the front edge of one step to the front edge of the next step up. The rise (h) is the vertical distance from the tread surface of one step to the tread surface of the following step.

**Safe stairways in industrial environments**

Stairways with steps that feature a rise of 170 mm, a going of 290 mm and an incline of around 30° are considered particularly safe. Stairways with this going-to-rise ratio also take the least amount of effort to climb. “Stairways designed to standard dimensions require a large surface area,” says Weiss. “However, there often isn’t enough space available in industrial environments to install stairways of that size.” That’s why conventional machine steps are designed to take up less space and have an angle of incline of around 45°. The step height must remain consistent across the entire stairway. If this is not possible, the rise of the starting level and starting step can be reduced by a maximum of 15 percent only, in order to ensure the effort needed to climb or descend the stairway is in line with ergonomic principles. Greater variations in rise are awkward and can lead to falls.

**Numerous safety requirements**

“Using the item Stairway/Platform System, employees can safely access various areas of machines and work on different levels with adequate protection,” says Weiss. item configures the ideal solution for the space available, taking into account all safety-relevant aspects relating to overlap, step width and height, anti-slip features, lighting, loads and the design of guard-rails. The overlap (r) of a stair tread refers to the amount by which the horizontal front edge of an upper step protrudes over the step below. The overlap and going (g) are added together to provide the step depth (t). As per DIN EN ISO 14122-3, the overlap must measure at least 10 mm. The minimum width of auxiliary stairways leading to working or maintenance platforms is fixed at 600 mm. However, if a stairway is used by several people at once, it must be at least 1000 mm wide. The headroom must be at least 2300 mm for stairways and at least 2100 mm for working platforms and walkways. This may be reduced to 1900 mm under exceptional circumstances.

**Taking targeted measures to prevent accidents on stairways**

With most accidents on [stairways](https://www.item24.com/en-de/stairway-platform-system/stairways/) caused by slipping on the edge of a step, stair treads need to be designed with anti-slip protection. Grip safety is denoted by a rating from R9 to R13. Additional measures, such as attaching anti-slip tape to the step surfaces, can be taken to provide extra protection against slipping. In the case of outdoor stairways, the increased risk of slipping due to wet or icy weather conditions must also be taken into account. Appropriate stair lighting is key to preventing accidents and falls on stairways. Illuminance of 150 lux at a height of 200 mm above the step surface improves safety, with coloured markings on the step edges helping to increase safety further. Stairways in industrial environments must be able to accommodate a set weight load. According to DIN EN ISO 14122, this is at least 1.5 kN/m² if the stairway is only climbed by one person not carrying a load, or 5 kN/m² if it is climbed by several people or by one person carrying a load. As a result, the load-bearing structure and the steps must not exhibit deflection of more than 1/300 of their span and/or a maximum of 6 mm.

**Guard-rails and hand-rails**

All machine steps must feature a hand-rail. If there is a risk of falling 500 mm or more, a guard-rail comprising a hand-rail and knee-rail prevents people falling from the stairs or inadvertently entering a hazardous area. [Guard-rails](https://www.item24.com/en-de/stairway-platform-system/guard-rails/) are also required when the gap between the platform and the machine or wall exceeds 120 mm. Guard-rails used in workshops must be between 900 and 1000 mm in height, while those used for platforms must be at least 1100 mm high. In exceptional cases, provided the width of the stairway is below 1200 mm, it is possible to have guard-rails on just one side. On guard-rails, the distance between the hand-rail and knee-rail, and between the knee-rail and foot-rail must not exceed 500 mm. Each guard-rail must be able to accommodate the anticipated loads; this is assessed separately. The minimum recommended clearance between a wall and the hand-rail is 75 mm, but may be reduced to 50 mm under exceptional circumstances. The hand-rail itself must be easy to grip and measure between 25 and 50 mm in diameter. “The guard-rails in the item Stairway/Platform System also offer maximum safety,” explains Weiss, “because all the components are securely fastened to the aluminium profiles.” The versatile fasteners eliminate the need to perform welding work or mitre cuts on the guard-rails, meaning stairways and platforms can be easily extended as required.

**Designing platforms**

Since climbing stairs is tiring, an intermediate [platform](https://www.item24.com/en-de/stairway-platform-system/platforms/) should be installed after a maximum of 18 consecutive steps or a climb of 3000 mm. As per DIN EN ISO 14122, the highest step in the stairway must be at the same height as the platform. Safe platforms should be at least as long as the stair treads are wide, but never shorter than 800 mm. Traffic loads are to be taken into consideration for stairway platforms, too. For instance, the platform must be able to bear 2 kN/m². Besides a sufficiently stable surface to walk and stand on, it must also provide protection against falls. This is achieved by a guard-rail system comprising a hand-rail, knee-rails and stanchions. Foot-rails also prevent objects from falling off the platform. A foot-rail measuring at least 100 mm is required if the gap between the platform and the machine is 20 mm or more. item platforms can either be free-standing or integrated directly into the machine. As they feature the Line 8 groove from the MB Building Kit System, the platforms are compatible with all accessories, such as guards, floor elements and doors.

**Calculating stepladder dimensions**

If, for example, stairways are not an option due to a lack of space, stepladders are a suitable alternative for dealing with height differences. Stepladder steps with a pitch of 45° to 75° must be at least 80 mm deep. The overlap should be equal to or greater than 0 mm. Guard-rails are required on both sides of the stepladder. The guard-rails must be 500 mm to 800 mm apart. It is essential to have at least 2300 mm of headroom above the stepladder. As a general principle, the step-length rule should also be used to design and calculate the dimensions of a safe stepladder.

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**Image 1:** Rise and going

**Image 2:** Safe stairways from item

**Image 3:** Defined pitch

**Image 4:**  Overlap

**Image 5:** Step edge markings

**Image 6:** Steps under load

**Image 7:** Intermediate platform

**Image 8:** Foot-rail

**Caption 1:** Step dimensions are calculated using the step-length formula, taking account of going and rise.

**Caption 2:** Stairways with steps that feature a rise of 170 mm, a going of 290 mm and an incline of around 30° are considered particularly safe.

**Caption 3:** From stepladders to ramps – means of access arranged according to pitch.

**Caption 4:** The overlap and going are added together to provide the step depth.

**Caption 5:** Additional measures, such as anti-slip tape or coloured markings on step edges, help increase safety on stairways.

**Caption 6:** Stairways in industrial environments must be able to accommodate a set weight load.

**Caption 7:** If a stairway’s pitch exceeds 36°, an intermediate platform must be installed after each flight that spans a height of 3000 mm.

**Caption 8:** A foot-rail measuring at least 100 mm is required if the gap between the platform and the machine is 30 mm or more.

**About item**

item Industrietechnik GmbH is a global market leader in building kit systems for industrial applications and employs around 500 members of staff. It has been designing and marketing construction solutions for machinery, fixtures and plants since 1976. Today, the item product portfolio comprises more than 4,000 high-quality components designed for use in machine bases, work benches, automation solutions and lean production applications.Thanks to the inclusion of transport solutions and dynamic elements, the company’s products can cover virtually all working processes, from manual production to automated manufacturing. The highly skilled employees work day in, day out to develop innovative solutions for state-of-the-art mechanical engineering and also offer exceptional consulting services. item is headquartered in Solingen, Germany. Eleven branches and support centres ensure the company is always close to customers in Germany. The group has wholly owned subsidiaries in the USA, China, Mexico, Italy, Poland and Switzerland.

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