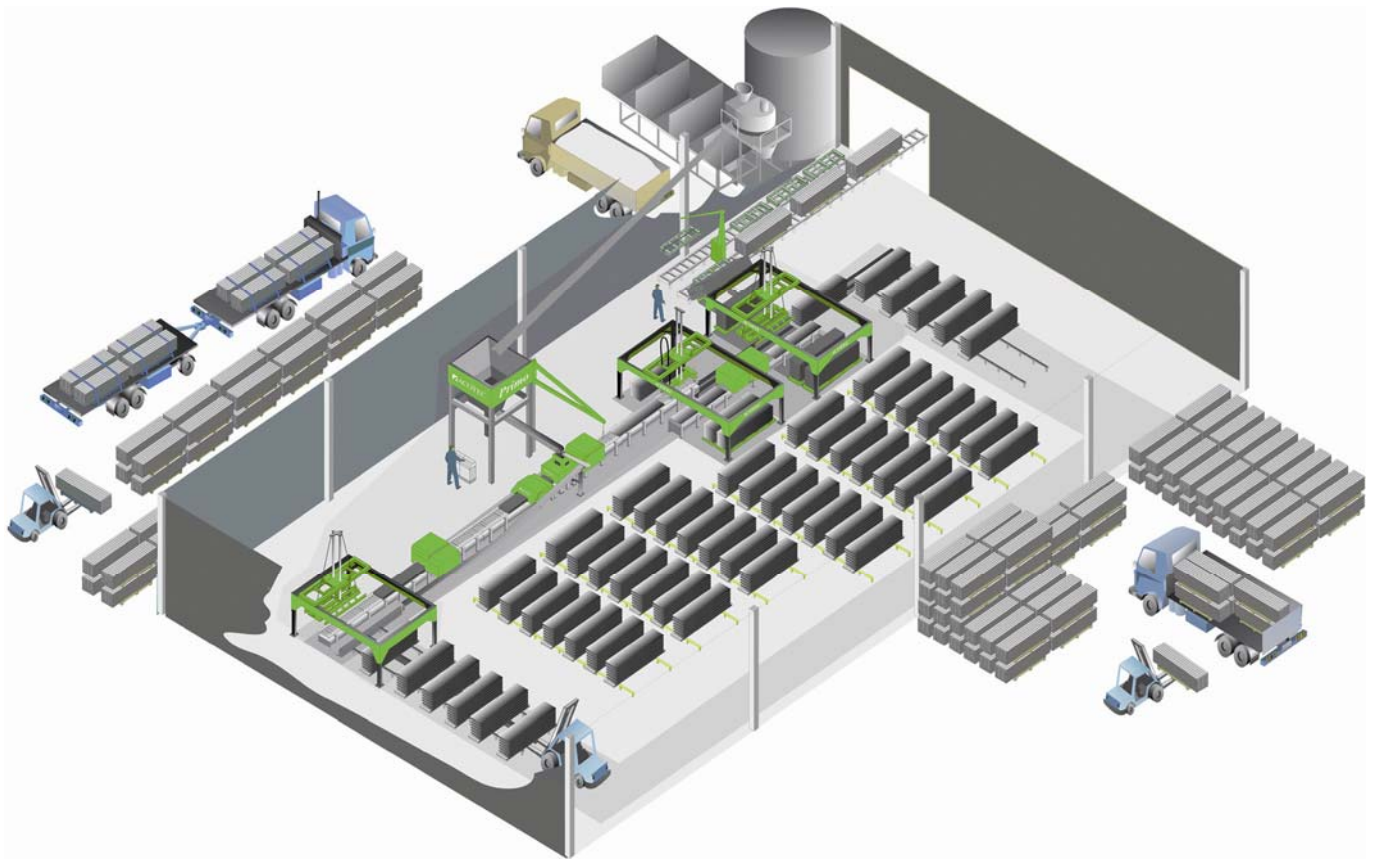


ACOTEC

Acotec-panel production



Key words: Acotec, Acotec Line by Elematic, Acotec-Panel, partition wall, party wall, internal wall, Aco

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1. Introduction

Traditional on-site construction methods for both single dwellings and high-rise buildings meet with efficiency problems in societies where labor costs are high and consequent demand for fast construction exist. In many countries, the climate limits to the construction period: for example, just half of the calendar year can be used efficiently for constructing a building.

The prefabrication of lightweight building elements has made a positive change to the situation. Complete prefabrication lines for the manufacturing of lightweight concrete wall modules from Elematic Oy Ab can result in substantial savings in construction costs, when compared to conventional on-site methods. Time and labor savings of up to 50 percent have been reported by companies who use prefabricated Acotec elements.

Prefabrication of wall elements is particularly beneficial in areas with high economic growth, the consequent high demand for residential and other buildings and high labor costs. With Acotec-Panels, cost savings of 30-50% can be achieved, depending on the local situation.

The capacity of a factory in one shift operation (300 workdays/a) will be 150.000 m²/year – just enough for partition walls for 1500 dwellings.

The products are mainly used in housing construction for different kinds of non-load-bearing walls (partitions, in-fills, party wall, etc.). In addition, load-bearing applications are in use, especially in low-rise, low- to medium-cost housing.



1.1. Advantages

Acotec-wall is an advanced new building material that can be used to build lightweight partition walls that have extremely good properties. The product has been on the market in some countries for more than 15 years – so it is a proven product. It has been used in seismic areas for a long time, as well.



The process is easy to install – even into an already existing building => reasonable investment with a typical pay back time of 1.5-2 years meaning a quick return on investment.

Other process advantages include:

- A nearly automated production plant involves less labor and management than conventional block and precast factories do.
- The plant is a compact state-of-the-art plant with a very low space requirement.
- The production line is capable of producing many lengths and thicknesses of product, both for the storage and for on-the-spot ordering. Changing from one thickness to another takes only about 0.5 h and the production cycles are flexible. Even short series can easily be manufactured, which provides the opportunity to adjust manufacture to the market situation.
- The products can be sold for numerous applications – from housing to commercial and even landscape building.
- Simple and reliable machinery means less maintenance and continuity to production.
- The low noise level inside the factory and no needing to use water for cleaning improves working atmosphere.

- Elematic, your one-stop-supplier is a reliable technology partner capable of delivering everything you need: not just the production line itself, but also automation, other software, handling equipment, concrete batching and mixing plant, and accessories needed for the plant to run smoothly.
- Getting everything from a single source means total functioning and true partnership.

As an Acotec producer, you can supply your client, the builder, with the following advantages:

- A solid stone-based material to increase the property value
- A superb finish that only needs a skim coating, equaling savings in plastering and finishing
- Increased living quality and added value due to good sound isolation – 40 dB sound insulation can be reached even with a standard 92 mm Acotec wall.
- Excellent resistance against mold and rot in wet conditions adds not only value but means less repairs; for example, >50% of all bathrooms built in Finland (new and refurbishing) have Acotec walls.
- At the construction site savings are achieved from quick installation and the possibility of using regular construction workers instead of highly skilled labor. The hollows of the Acotec walls act as natural conduits for electrical wires and piping – no opening and post-plastering of the surfaces required and, due to being a non-reinforced wall, electrical cables can be used without shielding tubes.
- Clean sites, better site management thanks to less mess and traffic
- The Acotec walls, due to flexibility in pre-cut sizes allow all designs; the architects do not need to change their designing customs.
- Local production and deliveries are quick and have fewer risks.
- The product itself is recyclable and is thus environmentally safe even at the construction site.

2. Production process

The Acotec production line for wall elements (Acotec-panels) is comprised of a mixing plant and an extrusion line with a specially developed, low-noise stationary extruder. The whole line requires only approximately 900 m² of ordinary factory space and can therefore be installed in existing production facilities.

The prefabrication process itself can be operated very conveniently by two to four workers. The process starts with choosing the right mix, which is of paramount importance. By using the recommended mixes, moisture-resistant, fireproof walls with easy workability can be achieved. The elements can consequently be sawn or drilled with ease.

The stationary extruder represents the heart of the production line, producing concrete modules for a wide variety of applications.

Immediately after they have been extruded, while they are still wet, the elements are cut to the required length and stacked into piles. This is possible due to the water/cement ratio used in the mix being low enough to make the elements sufficiently compact. Having been pre-cured for approximately 20 hours, the steel plates under the modules are removed and returned to production in a completely no-waste process.

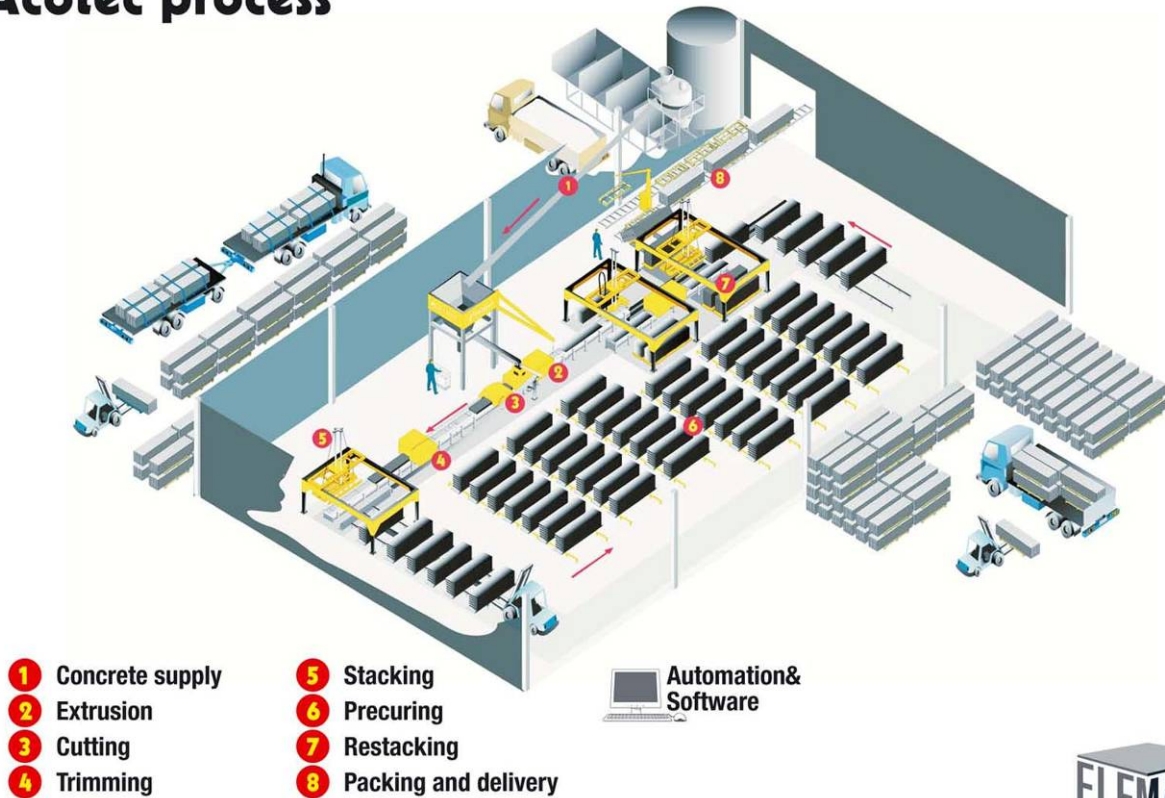
Elements are stored for two weeks to allow them to completely harden before they are transported to the construction site.

This automated production method is very fast. The extruding speed is approximately 80 m²/h, which means that up to 100.000 m² of high-quality elements can be produced in one year (one shift and 220 workdays). In addition, this automated production needs only few workers (2-3) keeping production cost very low.

This production method is also environmentally friendly. During production, very little noise (<80 dB) and vibration level exist. The raw-materials used are natural materials, just water, sand, cement and lightweight aggregate. The production does not need any additives and chemicals.

A more specific description of the process follows:

Acotec process



The manufacturing process of the Acotec wall elements consists of 8 stages controlled by one unique automation system:

- Concrete supply (1)
- Extrusion (2)
- Cutting (3)
- Trimming (4)
- Stacking (5)
- Precuring (6)
- Restacking (7)
- Packing and delivery (8)
- Automation

2.1. Concrete supply

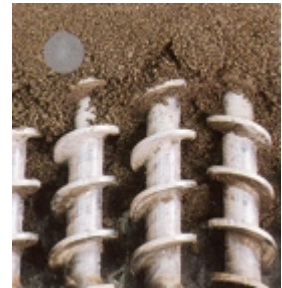
The concrete required is batched and mixed at an automatic batching and mixing station. The relatively dry aggregates are automatically batched into the mixer, after which cement and water are added into the mixture. Moisture content of the mixed concrete must be automatically controlled and adjusted. After mixing, the concrete batch is fed to the conveying system, which brings fresh concrete to the line's hopper.



Concrete supply

2.2. Extruding

The Acotec -wall elements are formed in a continuously operating extruder. The concrete is compacted onto thin base molds, which support the products while it is being procured. The base molds are then automatically fed to the extruder as a continuous ribbon. The base mold length determines the standard lengths of the products. There can be a maximum of five plate lengths in the system at the same time. The extruder compacts the concrete with extrusion screws against the packing bar and sidewalls. The top surface of the product is vibrated by a vibrating plate.



Extruder feed screws

2.3. Cutting

After extruding, the products are cut according to the base mold length. A circular saw cuts the fresh concrete on each base mold seam. Then the cut product together with the supporting plate is pulled to the stacker.



Cutting a slab

2.4. Trimming

When necessary, the fresh product is topped at a specified point, where the manually adjusted circular saw cuts off the wanted trimming piece. Trimming length is max. 20 cm. The trimmed-off concrete is then recycled back to the extruder.



Fresh cut Acotec panel

2.5. Stacking

Cut, fresh products are stacked into precuring stacks. Depending on the product thickness and weight, each stack contains 4 to 10 products and base molds. Stacks are supported by steel pallets, which are automatically fed underneath each stack.

Then the stacks are moved to the procuring area either by an automated conveyor system, by a forklift or by a crane.



Stack of Acotec panels

2.6. Precuring

The stacks must stay in the precuring storage area, which is, where natural curing (temperature should be above +10°C) occurs for 15 to 24 hours. In a dry climate, the stacks should be covered with tarpaulins.

The product stacks are moved in and out of the storage area with a forklift, a crane or automatic conveyor lines.



Precuring area

2.7. Restacking

After procuring has taken place, the products are strong enough to withstand automatic handling. The products are then separated from the base molds, which are put back into circulation after passing through a cleaning and oiling unit. The products are restacked to form delivery stacks with 4-10 products on top of each other. The stack is pushed against a wooden delivery pallet and turned on its side.



Restacking

2.8. Packing

Delivery stacks are strapped and preferable wrapped before transportation to delivery storage. Stacks must stay in delivery storage for at least 14 days before being transported to a construction site.



Packing

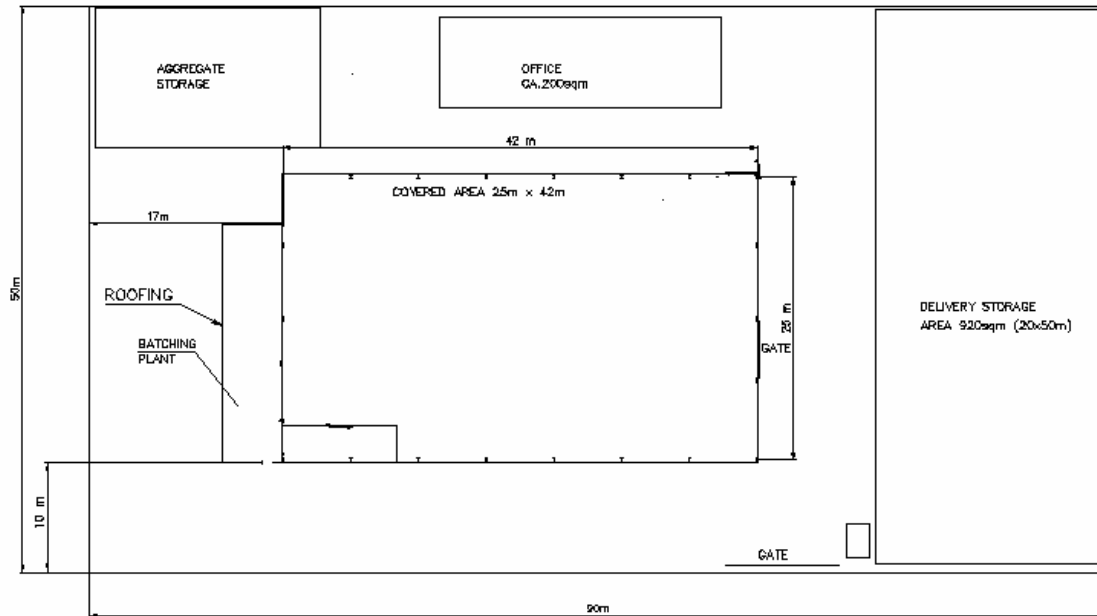
3. Production facility requirements

3.1. Land, factory building and general utilities

The table below shows some basic utility requirements:

Production personnel	2 -4	Person
Production space	20 - 30 x 40	m
Land area	3000 - 5000	m ²
Connecting power (without mixing plant)	50 - 60	KVA
Compressed air consumption (6 bar)	0.3 – 0.5	Free air m ³ /min
Water consumption	1.5	m ³ /h
Concrete consumption	4 - 8	m ³ /h
Temperature in the factory	+10 - +35	° C
Site area	Paved	
Free inside height in the factory	min. 5.5	m

A basic site layout:

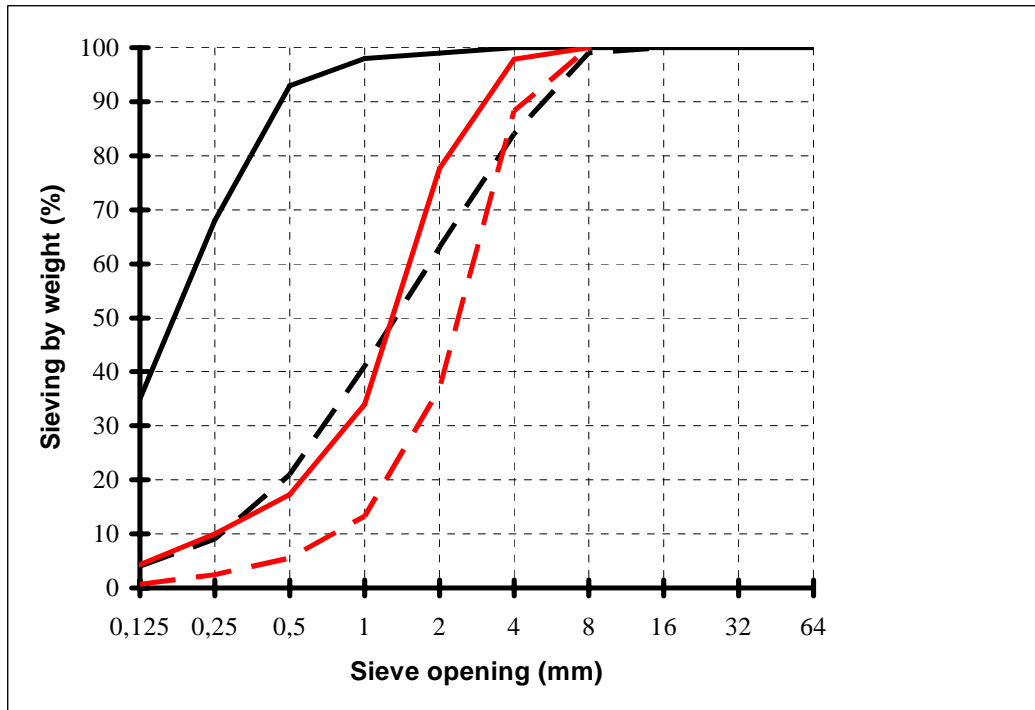


3.2. Raw materials needed for the Acotec process

Aggregates

- Fine sand _____
- Coarse sand _____
- Lightweight aggregate 1 _____
- Lightweight aggregate 2 _____

Particle size distribution



Sand

- No organic materials
- No silt or clay
- Water suction < 2.5% (weight)
- Chlorides < 0.1% (fine sand)
- Chlorides < 0.05% (coarse sand)
- Sulfate < 0.4%
- Alkali reactivity should be checked ASTM C 227

Lightweight aggregate

Lightweight expanded clay (LECA)

Formulas

One of the main advantages of this process is that the used raw material mix can vary. The choice can be according to available raw materials, or depending on what the Acotec element will be used for. The governing features of the mix are that it must be earth-dry, zero slump concrete with a set particle-size distribution for aggregates.

The main advantage of the Acotec element is that it is a lightweight panel. This can only be achieved when lightweight expanded clay (bulk density 350-500 kg/m³) e.g. LECA®, or other lightweight aggregates are used. The process can be run with standard concrete as well, although the products are then heavy and cannot be installed manually.

A quite typical formula includes

- cement 250-350 kg
- coarse + fine sand 600-750 kg
- lightweight aggregate 350-450 kg
- water 80-150 kg

4. Technical data

The normal extruding speed of the line is 2.4 m/min for a total output of 80 m²/hour. In one shift operation, 150.000 m²/300 workdays is easily reached in practice. The line can also be run in two and three shifts.

5. Additional information

5.1. Reference plants to visit include:



China



Spain



Finland



China



Taiwan



United Kingdom

5.2. Location of plants and manufactured products

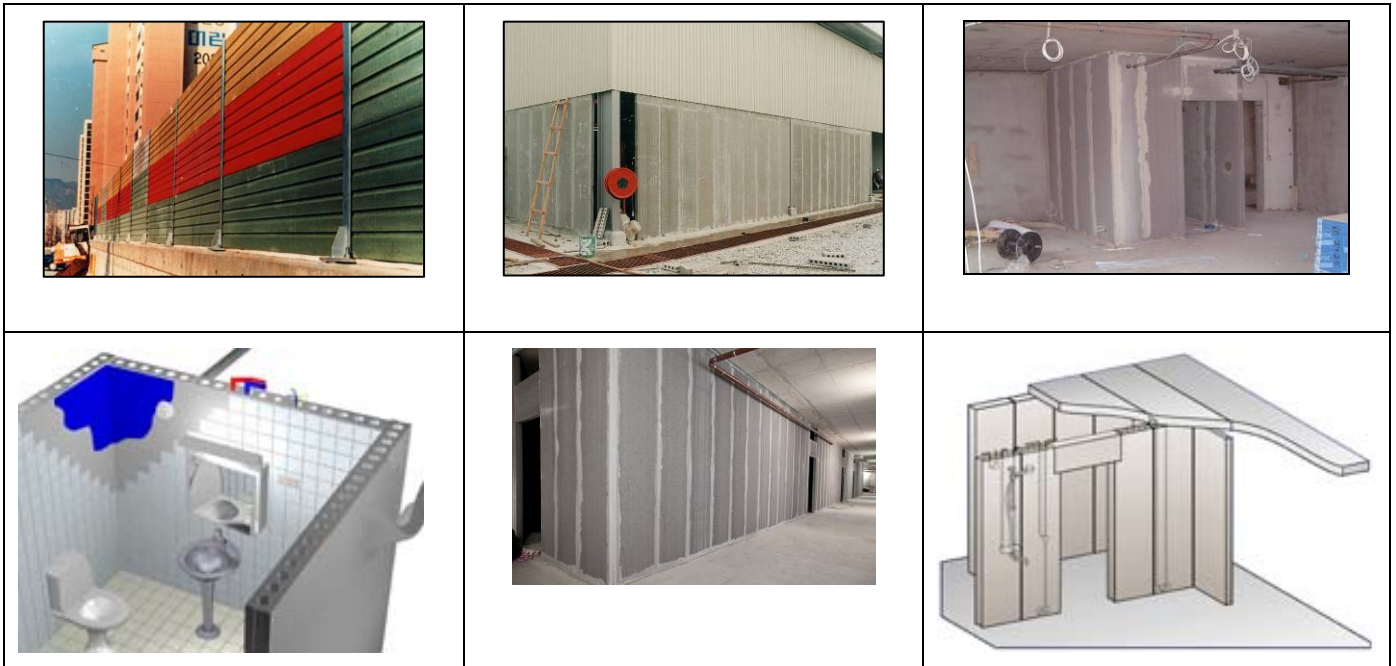
Acotec wall panel factories can be found in for instance in the countries listed below, which also states the most common product thicknesses manufactured in these factories:

Country	Product thicknesses, mm	Country	Product thicknesses mm
China, <i>Shanghai</i>	75, 100, 120	Philippines	75, 100
China, <i>Beijing</i>	90, 120	Portugal	75, 100
China, <i>Xinjiang</i>	68, 90, 120	Saudi-Arabia	68, 100, 120
China, <i>Gunagzhou</i>	75, 100	South-Korea	75, 100
Finland	68, 92, 120	Spain	75, 92,120
Indonesia	75, 100	Taiwan	75, 92,100
Ireland	75, 100, 120	Thailand	85
Malaysia	75, 100	United Kingdom	92

In many countries the Acotec wall elements are sold under name Acotec® which is a registered trademark of Elematic Oy Ab.

5.3. Application of Acotec wall elements





Elematic is a leading supplier of precast concrete machinery and equipment as well as the only supplier capable of delivering complete production plants anywhere in the world. Elematic's superior technology and industry expertise is currently in use in more than 100 countries across five continents. Elematic is headquartered in Toijala (Akaa), Finland.



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