

Techniques for Working With Porcelain Tiles and New Adhesive Technology



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2.1 INTERNATIONAL SPECIALISED SKILLS INSTITUTE

International Specialised Skills Institute Inc fills gaps in industries and enterprises where the means of doing so are not available through government programs or Australian TAFE institutes and universities. Operations are directed towards rebuilding specialised skills and knowledge, which are disappearing, or bringing leading-edge technologies to Australia. The way in which this is achieved is by building global partnerships through the Fellowship program, then the fellow sharing what he/she has learnt overseas through education and training activities- one fellowship; many benefits.

2.2 THE AUSTRALIAN CONTEXT

Australia is very fortunate in having a structured training system in the building and construction trades; the Apprenticeship. This is not the case in all other countries. I was surprised to learn that Italy, where my research was conducted, has no formal (government funded) training for the trade of tile laying.

Obviously our apprenticeship system is of great benefit to people entering the trade and in theory our nation should have highly skilled, qualified tradespeople operating in industry. On closer inspection however, this is not always the case and there are many so-called tilers operating in the industry who are untrained and unskilled. I will detail why this is happening, but first let me explain how an apprenticeship works.

Firstly the individual enters a contract of training with his/her employer, this is for a term of four years. The employer is required to teach the apprentice, while he/she works day to day for the firm, and is also required to send the apprentice to trade school on scheduled dates. When or if the apprentice completes his/her term and is found competent in both trade schooling and on the job training then they shall receive a certificate of proficiency as proof of their qualification. The individual may now start up a business and become self employed or otherwise work for a firm as a qualified tradesperson with papers. This is the ideal scenario but unfortunately not always the case.

The problem we have here in Victoria is that not all trades are licensed, in fact most trades do not require the operators to have a licence. This, in itself makes a mockery of our apprenticeship system as many, I believe over 50% of tilers, do not have indenture papers and have not received enough (if any) proper training to operate competently. Many do not go through an apprenticeship and do not attend trade school, but instead work for a tiler (most likely unqualified) and try to quickly learn the basics so that they may start up their own business. Legally there is no stopping this from happening and they may even employ others, in turn further reducing the skills and knowledge of the subsequent worker. This is having a devastating impact on the building and construction industry where poor workmanship is becoming the norm. Although there are certain steps currently being taken to avoid this situation, we have a long way to go yet.

Another issue we have is the need to upskill in line with new products that have been developed in Europe and are now on the market worldwide. The new range of porcelain tiles that have become hugely popular on our market is one such example.

2.3 ORGANISATIONS AND INDUSTRY

Large tile manufacturing companies, which export worldwide, have a major impact on this industry. Research and development centres within these companies are constantly working on innovative new products to keep one step ahead of others.

Ceramic tiles can be compared to clothing, they are both influenced by fashion trends. What was in vogue only five years ago may be totally outdated today, so there is a need for constant changes, with new high tech products constantly being developed. New trends are usually conceived in Europe where the research and development facilities are leading edge, especially in Italy. These trends have an impact on the Australian market and also influence the type of products that are manufactured locally. Needless to say, porcelain has gained immense popularity here on domestic and commercial applications.

Changes in tile technology also demand changes in fixing techniques and adhesive technologies. The latter has advanced significantly. Today the international adhesive companies produce far superior products than yesteryear and are constantly researching and developing for the future.

Fixing techniques for tiles have changed over the years due to many factors, some of which are as follows:

- Construction materials in general have changed with the use of lightweight frames for housing/buildings and a move away from solid masonry construction.
- Waterproofing requirements are now mandatory.
- There is a greater range of tiles available, each with its own characteristics.
- Vitrified tiles and porcelain tiles have very low porosity resulting in bonding difficulties.
- Large format porcelain tiles with rectified edges require the preparation of a very smooth, flat substrate and great accuracy when installed.
- Tough, hard body vitrified and porcelain tiles are difficult to cut.

The Australian Tile Council is a national industry organisation with branches in each state. Working for tile manufacturers, importers, retailers and tile fixers, it looks into problems faced by the industry and subsequent solutions. Currently its influence is minimal due to a lack of support from industry.

2.4 AIM OF FELLOWSHIP

The aim of this Fellowship is to address problems and shortcomings we have in our industry by gaining skills and knowledge and embracing traditional and leading-edge technologies. This is achieved by overseas research and the knowledge gained is thereby brought back and shared. By doing this we can bridge skill gaps and alter attitudes to advance our industry, which is of benefit to all.

2.5 SKILLS AND KNOWLEDGE GAPS

Europe is the centre for the development and research of new products in the ceramic tile industry, adhesive technology and the associated fixing techniques. Leading edge research has brought about advancements in the ceramic tile range. These advancements include improved durability, more pleasing aesthetics and a larger range available, including frost and chemical resistant products.

The new ranges of porcelain tiles are an example of these advancements, however they have completely different characteristics compared to traditional glazed ceramic tiles. Since the majority of porcelain tiles are imported, Australia is well behind Europe in their knowledge of the product. This is also true for the installation/fixing of porcelain tiles. It is this lack of knowledge that I am specifically targeting with this Fellowship. Australia requires expert knowledge and tuition on the new methods of fixing, cutting and working with porcelain tiles.

New adhesive specifically designed for use with porcelain tiles have also come on the market, along with self-levelling compounds. Due to the ultra low porosity that is a characteristic of porcelain tiles, it is essential that the tile fixer use a compatible adhesive when installing the tiles.

Many tilers and tile merchants are uneducated in relation to new products and technologies. They are recommending and using traditional methods of fixing tiles, which ultimately leads to failures. There have been many known failures due to the incorrect use of methods and products when installing porcelain tiles. Evidence suggests that the tilers are unaware of the mistakes they are making.

With porcelain tiles gaining huge popularity in Australia (and the world), this problem must be addressed. The tiling industry in Australia must be educated so that they have sufficient knowledge of the products they are selling and installing.

3.0 FELLOWSHIP PROGRAM

3.1 Introduction

In late September of 2002 I set off on my research trip to Italy. The tile manufacturing industry is based in the north, the Emilia Romagna region. I also visited areas in the Veneto and Friuli region for some additional research.

The manufacturing plants I visited produce the following products;

- Porcelain tiles
- Glass mosaics
- Tile adhesives

I attended two international trade fairs, Cersaie in Bologna and Marmomacc in Verona. I was invited to a workshop seminar with Kerakoll, a large Italian company who manufacture adhesives for tiling and other building trades. I also made a visit to Mapei technical centre in Milan, the largest adhesive company in Italy.

Finally towards the end of my trip I corresponded with staff at several tile retail shops and also with tilers. With the latter, I was fortunate enough to actively participate in a project working alongside local tilers and gaining some valuable hands-on experience.

3.2 Educational Institutions/Host Organisations

Educational institutions specifically for the tile laying trade were not to be found, probably due to the fact that Italy does not have an apprenticeship system. Instead there are specialised private schools for artistic mosaicists and certain heritage trades. However, adhesive manufacturers Kerakoll and Mapei have their own technical centres and run short courses for tile fixers.

3.3 Program Content

Cersaie:

Cersaie is an international trade fair for tiles, tile accessories and tiling products. The trade fair is attended by companies from all over the world, who display their latest range of products and innovations. Held at the exhibition centre in Bologna, Italy, it is regarded as the biggest and most significant international fair for tiles.

Cersaie confirmed that the trend towards porcelain tiles is increasing, especially large format products with glazed or polished surfaces. Border tiles, listellos and inset tiles in glass, porcelain and even metal were some of the innovations. Displays showed tiles laid diagonally with borders cut-in and modular systems using a series of three or four different size tiles together. Also in fashion were glass mosaics, tumbled marble borders and feature panels, especially water-jet cut products in circular and elliptical patterns. See pictures below.



With these advanced products on the market it is easy to appreciate just how difficult the installation of tiles has become. Tilers are required to have a greater knowledge of the tiles so they are able to work with them competently.

Bisazza:

My contact with Bisazza was established initially through Mr Skender Bregu of the Italian Trade Commission (Sydney), who I met at IATICE 2002. Through e-mail correspondence I was informed of Bisazza Australia in Sydney and contact with Drrsa Paola Rizzotto, the office manager, was established. With the backing of ISS, in particular Carolynne Bourne, who corresponded with Ms Rizzotto, a tour of Bisazza in Vicenza was approved.

Bisazza S.P.A are world leaders in the manufacturing of glass mosaics. Founded in 1956 as a local business for Italian arts-and-craft industries, it now leads the world in creating the most innovative glass mosaic products. Bisazza headquarters are in Vicenza where there is a superb showroom, research and development department, design studio incorporating CAD design facilities, and a manufacturing plant. The company has three other production facilities and eight branches in Australia, France, Hong Kong, India, The Philippines, Spain, the UK and the USA.

In addition to the classic glass mosaic produced industrially in paper-faced format, the name Bisazza is associated with specialty mosaics featuring 24-carat gold and traditional vitreous glaze finishes (hand cut), also with avventurina - a synthetic stone developed in Venice during the 17th century. Please see pictures below for some examples.





La Faenza and Marazzi tours

Verino and Jim Erneste, from Erneste Ceramic Imports, were my contacts for the tours of La Faenza and Marazzi manufacturing plants. They have purchased tiles from these companies for a number of years and were in Italy for the annual trade fair.

La Faenza and Marazzi are two major Italian companies who manufacture porcelain tiles. Both have high technology manufacturing plants in Sassuolo using automated production lines. To see the full process of raw materials being mixed, pressed, decorated, fired, cut and polished, then packed is quite amazing. The process is very sophisticated using high technology equipment and the end product is of superb quality. Here is a brief outline of the manufacturing process:

Mixing: The raw materials, which are homogeneous in granular structure, are dried to 3% moisture content and then mixed.

Pressing: At a pressure of 350-400 kg/ sq. cm the raw material is pressed in a template.

Decoration: The raw tile may receive coloured enamels, silk-screening, or even be polished, depending on the type of finish required.

Firing: The kiln, which is about 120M long, is fuelled by methane burners. The tiles are transported through on a slow moving conveyer belt, taking about 42 minutes from entry to exit. Peak temperature in the kiln is 1230 degrees Celsius, it is critical that the temperature does not fluctuate.

Quality control: Tile goes through quality control where it is checked and sorted for colour and defects by both human eye and electronic sensors.

Cut and polish: For rectified porcelain tiles only, the batch is taken to a cutting and polishing line. The tiles are trimmed (rectified) and bevelled on edges, then honed/polished to three different finishes; satin, semi-polished and full polish. Tiles that do not go through this process are labelled "natural finish".

Packing: Tiles are stacked, boxed and loaded onto pallets.

All these processes are fully automated with the exception of quality control and sorting. There is normally one or two people overlooking the whole operation, it's amazing that such a large production plant operates with so few workers.

Kerakoll

Kerakoll S.P.A. is an Italian company who manufacture products for use in the building and construction industry. Contacts made at Cersaie 2002 resulted in an invitation to a workshop seminar at the Kerakoll Training Centre, and a meeting with customers manager Ludovico Casati Rollieri. The workshop

involved a practical demonstration and sampling of Kerakoll's H40 range of tile adhesives, all of which are designed to be compatible with porcelain and homogeneous tiles. Other products demonstrated were primers, waterproofing membranes and self-levelling compounds.

In order to develop a very high degree of competency and acquired in-depth knowledge of avant-garde technology, Kerakoll founded its own training centre for the development and exchange of technical knowledge. The Training Centre, where experiences of operators from all over the world can be exchanged and discussed in relation to products, application technique and technology, is a professional 'workshop' where sector operators at all levels can attend training and refresher courses and can access information regarding every aspect of their work.

The training is not only of great benefit to the tiling contractor, but also for building/construction companies, architects, tile retailers, stonemasons, mosaicists/craft-workers, and many others. Research and development in adhesive technology has brought about constant changes and new products making it difficult to stay up to date. Specialised training centres like this one would be a way to bridge knowledge gaps and keep informed.

Kerakoll have recently entered the Australian market through Sovereign Trading P/L in Victoria, the national distributor. Sovereign Trading are currently setting up Kerakoll headquarters in West Footscray and plan to have a small workshop and training centre.

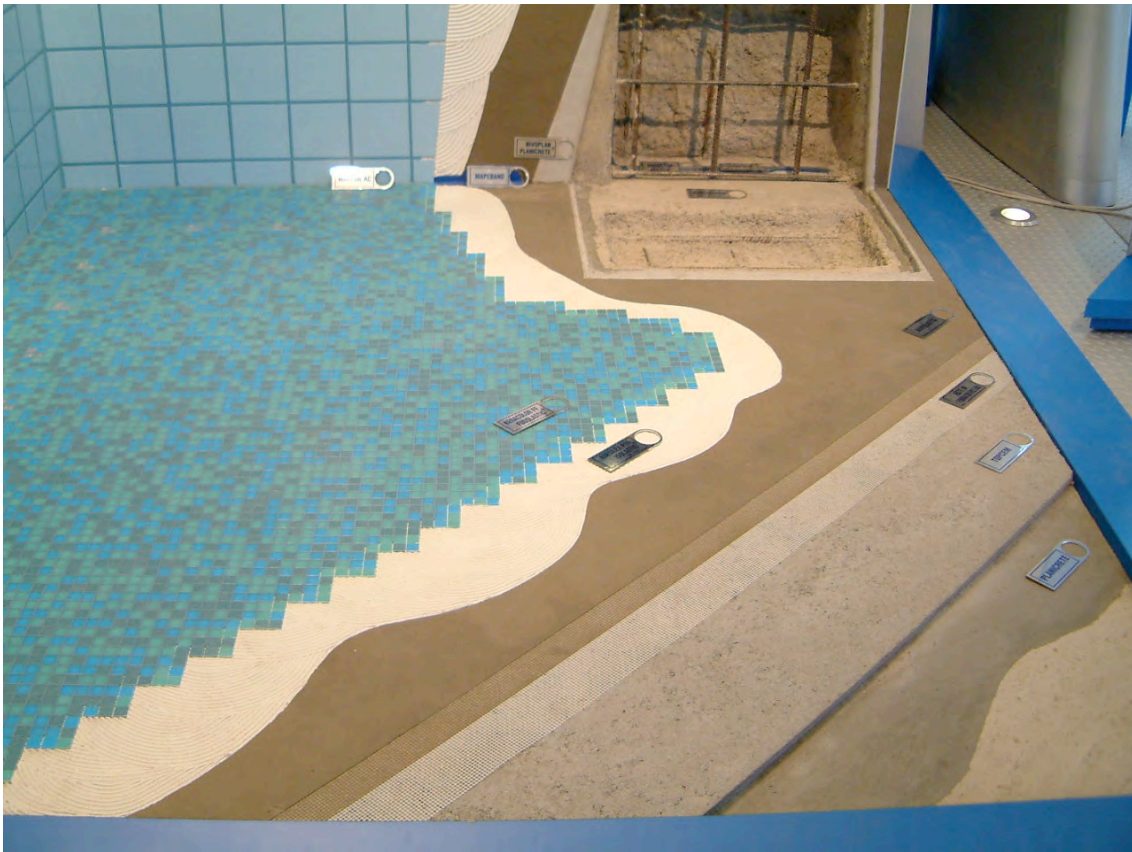


Kerakoll Training Centre with manager Ludovico Casati Rollieri on right.

MAPEI

Founded in 1937 in Milan, MAPEI is today the largest producer worldwide of adhesives for the building industry and one of the largest manufacturers of chemical products for construction in general. With offices and factories located in over twenty countries around the world MAPEI Quality system has been certified according to ISO 9001 standard for research, development, production, marketing and customer assistance.

Mr Francesco Stronati, an engineer with MAPEI involved with technical service, met with me at the Milan office. We spoke about the problems associated with selecting the right adhesive products for various different specific requirements. Mr Stronati eagerly outlined the new European classification system for adhesives and grouts, which he believes will become international standards. This would be beneficial, as the classifications would simplify matters for the tilers who are struggling to stay up to date with the latest products. See pictures below and over page.



Today we finally have a new European classification for adhesives and tile grouts suitable to technological evolution. In fact the old definitions for paste and cement grout products do not correspond to today's use. They were too complicated and obsolete. Finally the new classification ensures building installers and professionals simplicity, safety and respect for quality.

Why new techniques?

The tiles available on the market have changed size, absorbency and have different substrates. They have improved. New installation products are needed, therefore technically evolved.

One single system?

The new classification of products for installation distinguishes them according to a single, coordinated European model. With this system, users can easily classify the products according to their field and their characteristics.

Why the respect for quality?

A single and certified model ensures the user the product's quality. Only several products are manufactured by companies that are ISO 9001 certified.

Installation products that have performances lower than the minimum standards, or that do not undergo the quality insurance program prEN 12004 (adhesives) and prEN 13888 (grouts) standards, can not be marked with the conformity label.

What are the differences?

PRODUCTS ARE NOW FINALLY CLASSIFIED ACCORDING TO THEIR PERFORMANCES, THANKS TO ADDITIONAL TECHNICAL CHARACTERISTICS, THAT ARE DISTINGUISHED WITH A CONFORMITY LABEL ON ALL PACKAGING AND DOCUMENTS.

In coherence with the principals of innovation, transparency and clarity, MAPEI has immediately decided to conform with the new standards and to identify all its products with a conformity label on packaging and documentation.

- ✓ All MAPEI products have the specific requirements provided by prEN 12004 and prEN 13888 standards (see tab. 1 and 2) and are measured by methods approved by a qualified international organisation (CEN);
- ✓ The MAPEI System for Quality Insurance conforms with the above mentioned standard requirements and was ISO 9001 certified until 1995, renewed in 1998 and verified annually;
- ✓ MAPEI respects the control and registration programs to ensure a continuous quality production;
- ✓ All information provided by the above mentioned standards are on all MAPEI packaging and product documentation. This information is necessary to ensure a correct and safe use of the products.

A classification for adhesives and grouts, established by the normative, can be seen in tables 1 and 2. This makes it easier to identify and therefore chose the product according to the type of installation.

The most important points for classifying adhesives (prEN 12004) are the following:



- 1) The adhesives are divided in three types according to their chemical composition (C = cementitious, D = dispersion, R = reaction resin).
- 2) Each type is subdivided in **classes** according to its specific characteristics and then again divided into **fundamental** characteristics, that the adhesive must necessarily have (1, 2), and **optional** characteristics, important properties only for specific applications and uses (F, T, E).

The classes that make ceramic tile adhesives easy to identify and to chose are:

normal adhesives	class 1 fundamental
improved adhesives	class 2 fundamental
fast setting adhesives	class F optional
slip resistant adhesives	class T optional
extended open time adhesives	class E optional

Fundamental classes 1 e 2 can be combined with each of the other optional classes. For example class 1FT is for normal fast setting and slip resistant adhesives, while class 2E is for improved adhesives with extended open time.

3) For each characteristic the minimum values required have been defined.

N.B. Cementitious, paste or reaction resin adhesives of class 2 all have bonding characteristics superior to class 1 adhesive.

However, since the products identified with the same label can be different, quality wise, it is therefore absolutely necessary to refer to the performance characteristics declared by the manufacturer in the technical data sheet.

The majority of MAPEI adhesives are C2 (adhesives with superior bonding) although some, such as Kerabond and Keralfloor, that are usually in class C1, pass to class C2 if admixed with Isolastic.



The most important points for classifying grouts (prEN 13888) are the following:



1. Grouts are divided into 2 types according to their chemical composition (CG = cementitious e RG = reaction resin).
2. Each type of cementitious grout is subdivided into 2 classes according to its specific characteristics,

Normal cementitious grout	class 1
Improved cementitious grout:	class 2
- with high abrasion resistance (Ar)	
- with reduced water absorption (W)	

Class 2Ar W is for improved cementitious grouts with high abrasion resistance and with reduced water absorption.

3. For each of these characteristics the minimum values required have been defined.

N.B. A cementitious class 2 has superior characteristics to class 1 grouts.

However, since the products identified with the same label can be different, quality wise, it is therefore absolutely necessary to refer to the performance characteristics declared by the manufacturer in the technical data sheet.

All MAPEI cementitious grouts are class 2 (grouts with improved characteristics).



The 2 following tables allow for a correct choice of Mapei adhesives and grouts for ceramic and stone material tiles and a comparison with competitor products based on objective and verifiable criteria.

Tile Retailers

In the Veneto region I visited various tile retail shops and made enquiries about tile sales and installations. It was interesting to see how closely the staff worked with their clients, detailing all the characteristics of each tile and asking about specific needs. It's not easy today purchasing tiles as there are many factors to consider aside from cost and aesthetics, like size, slip resistance, scratch resistance, hardness, water absorption, ease of maintenance, chemical/frost resistance and others. By having a close association between staff and client all these factors can be considered and the best tile (within budget) can be chosen for the project.

In a similar way, tile retailers work as a team with tilers, sharing the knowledge they have on the products they sell with the requirements of the tiler. This teamwork results in a better understanding of the characteristics of the tiles so that a compatible tiling system may be adopted.

The purchasing and installation of tiles is a procedure where client, retail staff and tiling contractor work in collaboration with each other, resulting in a successful project which is of benefit to all. This procedure should be standard practice here in Australia.



Work experience

Two days of work experience in the Veneto region gave an in-site into the way tiling contractors operate in Italy. Tiling tools and materials are very similar to here, as are techniques and methods, with the following exceptions:

- Floor screeds for tiling are about twice as thick compared to our norm, and finished with an electric troweller (helicopter). Also they are allowed about six days to set before tiles are fixed.
- Floor tiles are laid first, then wall tiles.
- Rooms to be tiled are totally empty, devoid of all cabinets, shelving, kitchen and laundry units, skirting, architraves, plumbing and electrical fixtures.

This last point is of great significance as the tiles are an integral part of the building/dwelling, not just add-on items. All the fixtures mentioned are installed after the tiling is completed, which is a common sense approach. There is far less cutting of tiles which makes the task easier for the tiler and results in a neat, seamless finish. Another advantage is that if the layout of the room is one day altered, or cabinets are changed, there is no need to buy extra tiles to fill the gaps. This building practice should be adopted here in Australia.

3.4 Outcomes

Cersaie 2002 confirmed that the trend towards porcelain tiles is continuing unabated. With manufacturing processes constantly improving, the tile is of superb quality and far superior to the monocottura and bicottura products in almost every aspect. Some of the advantages are:

- Strength and durability.
- Superior surface finish. Porcelain can be polished to imitate natural stone (granite, marble).
- Very low water absorption (< 0.5%), resulting in nil moisture expansion of tile.
- Frost and chemical resistant.
- Size variation is minimal, especially with rectified porcelain.

Water-jet cutting technology has brought about more intricate designs with feature panels and border tiles. The result is that tiling is becoming technical, with greater skill and knowledge required than compared to ten/twenty years ago. This brings an increase in labour cost and in combination with the higher purchase price of porcelain, the supply and fix process is very expensive.

Adhesive technology has moved forward, with a range of adhesives now available to cater for virtually all types of installations. Many adhesives are designed to be used with homogeneous tiles like porcelain, which are difficult to bond. Again a greater knowledge of these products is required and a way of achieving this is through workshop seminars at training centres. The European classification system for adhesives and grouts goes a long way towards simplifying things, it's a good system which should be adopted world-wide.

Tile retailers have an important role in ensuring that the most appropriate tile is selected for the given project, also they are required to work in close conjunction with the tiler. By doing this, the tiler is able to access technical data on the tiles and understand the requirements.

4.0 RECOMMENDATIONS

With such a beautiful range of porcelain tiles available today, which can be specified for just about any project, the potential of this product is endless. However there have been many problems associated with it, a lack of understanding is the main reason for this. As the Asian tile manufacturing companies continue to improve, producing quality products at affordable prices, the porcelain tile will become mainstream not only in commercial applications but also domestic housing.

Generally the main problems are associated with poor workmanship or failures with tiling installations. There are many factors which contribute to this, some of which are:

- The industry is fragmented, with divisions between retailers, tilers, adhesive companies, builders and architects.
- Building practices which consider tiling to be an add on operation and not an integral part of the building.
- Many tilers lack skill and knowledge when working with porcelain.
- A lack of knowledge in adhesive systems for tiling.
- Constant up to date training is not available in industry.

The solution to this problem is not an easy one, requiring a combination of government regulations, coherence between different sectors of the industry and improving skills and knowledge. To achieve this the following must take place:

- Licensing of the trade so that all tiling contractors are required to be qualified. This would ensure that they have been trained and are competent, skilled tradespeople. The state government must make this a compulsory requirement, just like in the plumbing and electrical trades.

- The industry must unite so that retailers, tilers, adhesive companies, builders and architects work as a team. By doing this they will be able to share technical knowledge and not work against one another- therefore the project can be specified accordingly.
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- Tiling must be considered an integral part of a building/dwelling, not an add on accessory. Building practices must change to allow for this.
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- Adhesive companies need to run workshop training to keep industry up to date with the constant changes and developments. They could do this through training centres or by working with TAFE institutes.
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- A classification system for all tile adhesives on our market, similar to Europe's (prEN 12004), is required, with Australian Standards backing.

Further skills gaps

In relation to mosaic tiling, and in particular glass mosaic, there is a lack of skills and knowledge in Australia. Bisazza Mosaic in Sydney are currently looking at setting up a specialised course for working with glass mosaics. A masters level course, to develop advanced skills for past graduates, could be developed through ISS Institute, who have run innovative mosaic courses in the past. It would be a great opportunity and would attract pool tilers, mosaicists and art/craft workers.