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CHANGING REGULATIONS FOR TREATED FRAMING IN NEW ZEALAND

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Summary

In the mid 1990's a new Building Code was introduced in New Zealand that was performance based rather than prescriptive. At about the same time the use of untreated kiln dried machined pine framing timber was allowed as an alternative to preservative treated framing. The culmination of many factors resulted in buildings with a lack of weather tightness. The untreated framing was then susceptible to decay once exposed to moisture in a non drying environment. A review of building industry legislation discovered the problems were much broader than just weather tightness. Many changes are being implemented including to acceptable building design as an example but there is also the return to a requirement for preservative treatment of external wall framing for many buildings. A new hazard category, H1.2, has been created in the new preservation standard to recognise the need for decay protection of framing should the moisture content be conducive to decay in framing at any time during the required 50 year minimum service life.

History

New Zealand introduced a new Building Act in 1991 and with this was established a Government agency called the New Zealand Building Industry Authority (BIA) whose responsibility is to oversee building controls. In 1995, the BIA published the New Zealand Building Code (NZBC). These were regulations describing the performance required to meet the purpose of the Act, although the documents were not prescriptive in how to meet or exceed the minimum requirements. The performance based approach could be viewed as a means to avoid over regulation and also to allow innovation. For timber framing the performance outcome was quite clear. For any building element that is to provide structural stability, then the life of the building element is to be no less than 50 years. This applies to timber framing. However building elements such as exterior cladding, roofs and joinery only require 15 years. Protective coatings applied to the building envelope only need 5 years life. The way was also open for producers to offer products with other minimum service lives and provided the Territorial Authority (local Councils) were satisfied the requirements were being met; a code compliance certificate for the building would be issued.

This introduction of the NZBC coincided with a situation where a large timber company was promoting the acceptance of untreated kiln dried radiata pine for framing. Until this time the chemical preservation of framing was regulated and

compulsory. This had been the case for about 40 years following a previous Government enquiry in the early 1950's that established the Timber Preservation Authority (TPA) and subsequently approved the use of borates. Borate treatments were the preferred framing treatment. This framing timber was primarily produced as wet framing treated by borate diffusion processes. There was a growing demand for dry timber (<18% moisture content) and prompted by other drivers such as the need to reduce costs and the use chemical free timber (prompted by environmental awareness and contamination at treatment sites). Unfortunately the preservation specification only recognised insect borers as the biological hazard for timber framing. The fungicidal benefits of the borate treatment were not highlighted. Commercial interests prevailed and the argument was confined to the effect the change would have on the risk of borer in framing timber.

With the focus narrowed only on borer risk in buildings it proved impossible to stop the introduction of kiln dried, machined, untreated pine framing. When there was evidence to support the theory that kiln drying, machining (smooth timber surfaces) and moisture content were an unattractive environment for borers. There was vigorus debate and memories of that time linger and have been revisited many times particularly when the decay of framing later became apparent. Termites were not an issue. New Zealand was and still is considered not to have a termite hazard.

In 1995 the use of kiln dried, machined, untreated pine framing was accepted into the New Zealand Standard for Timber and Wood-based products for use in buildings. This showed untreated pine framing as being equivalent to the H1 preservative treated framing. Inevitably the timber producers controlled supply, the benefits of dry framing were widely promoted and soon the accessibility to treated framing (particularly boron treated framing) became problematical. By 1999 there were already warning signs of a problem with decay in timber framing from a lack of weather tightness in buildings. This gradually escalated and the media (newspapers, television) became increasingly involved. In early 2000 the fungicidal benefits of borate treatments were being recognised and also chemical companies were investigating fungicidal additives for Light Organic Solvent Preservatives (LOSP)

The reaction was to specify boron treated H1 as houses with treated framing were claimed to be in sound condition. . Debate raged as to whether the H1 borate treatments with a specification of 0.10% m/m BAE in the central one ninth cores used in for borer protection would provide protection from decay. A sample of Forest Research analyses of H1 framing timber during 2002 and 2003 indicated the cross-section concentrations were on average > 0.60% m/m boric acid equivalent even though the core concentration was only required to be 0.10%m/m. At this concentration protection from decay was considered to be assured.

However the market was also being supplied with LOSP H1 treatments, a permethrin only formulation. The preservative standard still only recognised H1 as a requirement for insect protection, and suppliers who were unable t supply borate treated framing supplied the 'equivalent'. There were also incidents of suppliers colouring the LOSP

timber pink/red; unfortunately the user thought this was the borate diffused timber they remembered from the past. Some producers had also got rid of borate treatment facilities so as the demand for a framing treatment gained momentum the opportunity for custom treatment by LOSP facilities accelerated. From an initial 10-12 plants mainly focussed on H3 treatments the number is now closer to 30 plants.

In the mid 1990's the treated framing market was estimated at 200,000m^3 and virtually all preservative treated. Now the size of the framing market on an annual basis starts from estimates of 400,000m^3 and upwards of which 60% is expected to now be preservative treated. The growth reflects the NZ population growth from 2.5M to 4M through immigration. Auckland has been the growth market (population 1.5M) with 21 new houses being built each day and currently 107 new residents arriving every day.

Leaky buildings

The public expectation when buying a new house is that it will comply with the New Zealand Building Code and with this confirmed by the local council who should have issued a Code Compliance Certificate.

It would also be reasonable to expect the non-structural cladding to have remained compliant (weathertight) to meet the minimum 15 years life, as required under the building code. Maintenance may include washing the walls annually and perhaps repainting after about 10 years. Any substantial damage within a shorter timeframe than the mandated 15 years would be unexpected.

Nevertheless relatively new buildings have leaked allowing damage from decay to timber frames. Reports of occasional leaks and then of timber decay started in the 1990's commonly on houses 5-7 years old with monolithic cladding systems (Bennett, 2002). Untreated timber framing is not the cause of the weather tightness issues. However the continuance of boron treated framing would have prevented, limited or slowed down the decay problems that have arisen. However given the drive for the supply of dry framing in the mid 1990's unless the preservative specification of the time had acknowledged the potential for decay in framing, any treatment would just as likely have been of the LOSP permethrin only type.

The lack of weather tightness is the culmination of many different factors. Some examples would be: In-fill housing characterised by roofs with either no or minimal eaves, faster construction practises, use of claddings sealed on the outside without any drainage behind, poor detailing and workmanship. This has made it a difficult problem to link to specific single causes and subsequently to rectify quickly and simply.

Cladding products and how these were used had changed over the years. The use of plaster based claddings allowed architects much more freedom in designs. Other trends were building on a site with a view (coastal and high wind zone areas),

buildings more than two storeys high, eaves disappearing , complex roof structures, parapets being a popular look, detailing increased, flashings omitted around windows, doors and other openings , enclosed balconies or decks over living areas, handrails penetrating balustrades and walls. In fill housing and demand for central city accommodation was a growth area with multiunit condominium developments involving many different people (one example that has been mentioned is of 50 sub-contractors on a single site). In hindsight here was an obvious lack of oversight that one might get in the construction of a single residential home.

While sheet materials might be anticipated to shed water, clearly any imperfections or faults at joints or junctions of materials allowed water to enter and accumulate. If that water could not drain away quickly then the inevitable would happen. The decay of the untreated framing timber would eventuate.

The following newspaper headlines are a selection of what was appearing in the print media as the awareness of leaky building problems grew in New Zealand.

Houses rot as industry quarrels.
Kiln dried framing and poor cladding are blamed for decay in new homes. Weekend Herald, May 26-27, 2001

Builders stung to action on house rot. The New Zealand Herald, May 28, 2001

Builders' insurance counts cost. The New Zealand Herald, May 29, 2001

How the rot set in Weekend Herald June 2-3, 2001

Crisis costs councils thousands. A building inspection system is being shaken up as negligenc claims rise. Weekend Herald, April 20-21, 2001

The rot sets in. For thousands of New Zealanders, the dream of a new home is turning into a sodden nightmare. Weekend Herald, April 13-14, 2002

Toxic rot crisis in new homes. A Herald investigation uncovers the scope of New Zealand's rotting buildings. One new house in 10 may be vulnerable and $1b repair bill is predicted. Weekend Herald, April 13-14, 2002

Rot set to lift cost of new home. The building industry does a turnaround on using treated timber in wall frames to cope with leaks. Weekend Herald, July 27-28, 2002

Authority warns rotting buildings may collapse Weekend Herald August 24-25, 2002

Leaks force evacuation plan. Residents of a 16 month apartment complex may have to move because of a toxic mould scare and the possibility of major repairs. The New Zealand Herald, September 13, 2002

Govt squashes calls for full leaks inquiry. Design-obsessed architects, cost cutting managers and workers lacking basic skills are all blamed in the leaky buildings report. The New Zealand Herald, September 18, 2002

Developer faces mass lawsuit. On the eve of a report into the rot taking hold of the building industry, four big developments by one company fall under a cloud. Weekend Herald September 14-15, 2002

Sodden walls spar $3.5M suit.
A widely used cladding is at the centre of a damages claim by residents of an 85 unit Grafton development. Weekend Herald September 21-22, 2002

Fans falling from ceiling
Apartment owners in The Aucklander tower are taking legal action against the developer and builder. The New Zealand Herald, September 25, 2002

Rot risk warnings ignored for years.
More than 40,000 leak-prone homes have been built since the problem was detected. The New Zealand Herald, October 10, 2002

Rotting homes crisis to bring ban on untreated timber.
[A headline in The New Zealand Herald on 19th March 2003 and sharing front page with George Bush warning Saddam Hussein

Minister: Why no action on leaks ? Building watchdog asked to explain cladding hold-ups. Weekend Herald, March 22-23 2003

Changes

The Building Industry Authority commissioned a review on the weather tightness of buildings in 2002. This report included a number of recommendations and was presented in two parts. One conclusion was the potential for a major systemic breakdown across the industry. Buildings have always leaked but more traditional buildings had a greater degree of redundancy in the design. It was also noted the level of accountability in the building sector was unacceptable. A repair bill of $120M to $240M was identified in the report but estimates as high as 1 billion dollars have also been proposed.

A Government Select Committee (Administration) subsequently conducted their own review and heard submissions from a sample of all stakeholders affected by the weather tightness issues. They were also shown examples of timber being supplied to building sites that already had decay present. The release of their report has prompted changes culminating in new Building Act to become effective early November 2004.

In December 2002 the Government set up the Weathertightness Homes Resolution Service within the Department of Internal Affairs to help homeowners who thought they had a leaky home. As of the 30 September 2004, there are 1920 active claims, 1240 assessment reports have been completed, 179 resolutions completed (127 by mediation, 12 by adjudication, 40 by other means). There have been many claims settled out of court but the value of settlements has been kept confidential. More cases are pending and may still get to a public courtroom. It is also understood local Councils have reached settlements with homeowners. It is not possible to put a monetary figure on the costs of claims settled to date. The number of buildings affected by weather tightness issues is still not known; it could be 20,000 or much higher. Perhaps the scale of the problem will not become known until the buildings are older.

Knowledge gained from learning about the Vancouver building problems helped in identifying appropriate changes in New Zealand systems. The 4D's concept of deflection (keeping rain away from sensitive areas) , drainage (means to remove water) , drying of moisture from external walls (ventilation) together with durability of critical wall components have been drivers for many changes in the new building code amendments affecting external moisture and durability. That led to one conclusion that claddings should have a drained and ventilated cavity – a major change for building practises with popular monolithic claddings. Other changes are being implemented too including treatment of framing in most at risk buildings as the last line for defence. The treatment of the framing timber was identified as an additional practical approach to minimising potential adverse effects (as in decay) on a building element (framing) that is required under the building code to have a 50 years or more service life. The move to treatment of framing was not only driven from concerns about decay in buildings with potential weather tightness issues but also evidence that dry timber (kiln dried to < 18% moisture content) was unable to be maintained in this condition during the storage, delivery or construction phases.

Weather tightness of a building could not be guaranteed thereby putting critical building elements at risk. Roof and plumbing leaks are not an uncommon problem. The reliance on weather tightness that depends on maintenance by owners was also an inadequate guarantee of protection. In 2003 the proposed amendment to the Building Code, Durability clause B2 issue for discussion was going to require all timber framing to be preservative treated. Major producers of timber framing argued against this move but it was clear the status quo of allowing untreated framing for all buildings could not be sustained. Some justifications for treatment were obvious but treatment of all framing was viewed as an overkill reaction that needed a compromise. Generally all external wall framing is now required to be treated unless a single storey building (with eaves) that has a brick veneer with a drained ventilated cavity.

The review of submissions culminated in an amended B2 Durability clause in the NZBC and was effective from 1 April 2004. Load bearing framing elements are required to have a minimum 50 year life. The amended external moisture clause

(E2) has also been issued in 2004 with descriptions of acceptable design solutions. The requirements in this document become effective for new building consents from 1 February 2005.

While it is clear untreated framing is not the cause of the leaky building problem, it is also accepted untreated framing that is exposed to dampness for a few months or longer has no protection from decay. It is also problematic because the cladding is only required to have a 15 year life, equating to an expected 2-3 times replacement during the minimum life of the framing structure. The vulnerability of the framing to moisture will increase with the deterioration or failure of the cladding unless there is good maintenance and prompt replacement when the cladding fails.

The New Zealand Standard NZS 3602 was reissued in December 2003 specifying the degree of preservative treatment for specific timber products in buildings. Compliance to this Standard has been recognised as an acceptable solution to comply with the requirements of the NZBC. This standard only refers to the Hazard Class (not to specific preservative types, penetration or concentration requirements). Included is a new H1.2 category for framing that describes a need for decay protection. This is on the basis of short term protection (2 years+) to allow for a leak to be identified and remedied. The treatment is not designed to protect timber that is to be in a permanently damp environment. It is however intended to protect framing, a critical 50 year building element, in the event of an adverse condition arising from a weather tightness failure. In other words it is part of the risk management. More crucial timber used in enclosed decks or balustrades are specified as H3.1, exterior exposed beams as H3.2 while an exterior enclosed wall is H1.2. The hazard classes and approved preservatives are provided in the preservative standard document referred to as NZS 3640:2003.

Preservative treatment

NZS3640 was issued as a full Standard and superseded MPNZ 3640, a miscellaneous publication. The NZS3640 standard covers rounds and sawn timber. Reconstituted wood products, plywood, laminated veneer lumber and glue laminated products are separately covered under joint Australian/New Zealand Standards AS/NZS 1640 Parts 2 – 5 inclusive. The remaining AS1604 Part 1 covers preservation of sawn timber and rounds but is now only applicable to Australia, or for New Zealand companies producing timber for export to that market.

The NZ3640 standard is linked to the performance requirements in the NZ Building Code via NZS3602. As there are references to performance of building elements, 15 and 50 years, it became also necessary to reassess the treatments in the hazard class 3. This became particularly important as data became available that indicated a drop off in performance of LOSP tin treatments under some exposure circumstances and therefore doubt about the long term performance for some end-uses.

The hazard classifications applicable to preservative treated timber in New Zealand are summarised in Table 1. The significant changes were the splitting of H1 into two categories; H1.1 (equivalent to the old H1) and the inclusion of a new H1.2. The second significant change was the splitting of H3 into H3.1 and H3.2 to broadly reflect the different performance requirements in the building code. A significant consequence was that only a single LOSP preservative, copper naphthenate, is still approved under the H3.2 hazard classification for structural and decking elements.

Table 1 – Hazard classification for preservative treated timbers

Hazard class	Exposure & Service conditions	Biological hazard	Examples of typical uses
H.1.1	Protected from weather, above ground, always dry	Borers	Interior finishing timbers
H1.2	Protected from weather, above ground but with risk of moisture content conducive to decay	Borers, decay	Wall framing
H2	Protected from weather, above ground, exposed to ground atmosphere where not well ventilated	Termites	Framing exported to Australia (not applicable to New Zealand framing)
H3.1	Exposed to the weather, above ground, periodic wetting	Borers, decay	Cladding fascia, joinery
H3.2	Exposed to the weather, above ground, or protected from weather but with risk of water entrapment; more critical end uses	Borers, decay	All the H3.1 uses plus decking and structural timbers
H4	Exposed to the weather, in-ground contact or in fresh water; includes severe or continuous wetting	Borers, decay	Fence posts, landscaping timbers

H5	Exposed to the weather, in-ground or in fresh water; includes severe or continuous wetting ; more critical applications	Borers, decay	House piles, poles, crib walling
H6	Exposed or immersed in seawater or in estuarine ground		

However the revision of treatment specifications and issue of the standard was really prompted by the leaky building problem. The informal preservation industry response from 2002 and through 2003 was the introduction of a 'H1 PLUS' LOSP treatment (existing LOSP permethrin H1 formulation plus some idocoarb [IPBC]). Following review of data in particular from framing trials undertaken at Forest Research and confirmation of analytical methods, this treatment became recognised within the new H1.2 classification.

Attention was also given to reviewing issues around the identification of treated timber. Under the previous specification (MP3640) each piece of timber was required to be end branded or tagged. However once the timber was used in a structure the end identification was typically obscured or cut off. The problems with traceability or identification of timber is further compromised when the frame is pre built by a frame and truss manufacturer prior to delivery on site.

This problem was particularly obvious when investigating supply of H1 framing in the market place when questions were being asked as to whether it was borate treatment or LOSP permethrin or tin/permethrin treatments, as all are colourless. It was also a problem when assessing consequences of leaks and remediation in buildings. In addition the CCA, tributyl tin, copper naphthenate and copper azole formulations for example all trigger tracking regulations under the HSNO Act (ERMA, 2004). The new identification measures may prove helpful in the future for the later disposal of timber after its useful life.

The approved treatments for timber framing (H1.2) are summarised in Table 2. In addition it is accepted that treated timber of a higher hazard class (Hazard classification H2 accepted) could also be used provided identification requirements are complied with. The IPBC/permethrin LOSP treatment must also have a water repellent defined as a combination of waxes and hydrocarbon resin to a minimum of 3.5% in the treating solution. The elemental tin concentrations for H1.2 are (but coincidence only) half the H3.1 concentrations. All treatments are required to completely penetrate the sapwood and the % m/m concentrations apply to total sapwood cross-section.

Table 2- Preservative components approved for timber framing (H1.2)

Preservative	Component	% m/m concentration in oven-dry weight of wood
Water borne preservatives		
Boron compounds	H_3BO_3	0.40
Light organic solvent preservatives (LOSP's)		
Tri butyl tin oxide (TBTO)	Sn	0.04
Tributyl tin naphthenate (TBTN)	Sn	0.04
Iodocarb (IPBC) & permethrin		0.025 & 0.006

Another decision by the Standards committee was that framing timber would be coloured. The pink/red colour previously associated with boron was to be retained for that treatment and the chemical industry nominated blue for the LOSP framing options. More debate ensued when the timber industry also wanted a 'green' LOSP that would also comply with H3.1. Some treatment plants were already colouring LOSP H3 treatments (their justification being 'people recognise green timber as being treated') and these suppliers wanted the option of this coloured solution also to be recognised in the standard. This was agreed provided the green was distinctly different from the natural green of the copper containing preservatives. Colouring timber also covered the identification issues arising from timber processed through custom treatment facilities where only end tags were used (that might be anticipated to be subsequently removed or obscured in the construction process). Plants producing timber and doing their own treatment on site are now commonly using repetitive imprint or ink branding along the lengths of timber. This has been an important improvement for traceability and later identification of the supplier, treatment and hazard classification.

The preservative colouring designated for timber framing is as follows:

H1.2	TBTO *	Blue
	TBTN *	Blue
	IPBC/permethrin *	Blue
	Boron	Pink
H3.1	TBTN *	Green
	TBTO *	Green
	Propiconazole/tebuconazole/permethrin*	Green

* These are all LOSP treatments in hydrocarbon solvent (white spirit) carrier.

Reference colours have been given although the intensity and durability have not been specified. It is possible this may be addressed in the next amendment to the standard to provide further clarity.

Another change was the requirement to include a preservative number in the identification marking. The inclusion of a preservative number had already been a requirement for products treated to any the Australian (AS1604) series of standards so was generally accepted as a useful improvement. This meant there was also the means to distinguish between the different LOSP active components options for example even when the timber was all blue. .

Treaters are now required to brand each piece of timber with:

(a) the plant responsible for the treatment by means of a plant number (or trade name),

(b) the hazard classification; framing being H1.2, decking being H3.2 as examples,
(c) the preservative type; the following code numbers are approved:

CCA oxide	01
CCA salt	02
Boron	11
TBTO	56
Copper naphthenate	57
Copper azole	58
TBTN	62
IPBC	63
Propiconazole/tebuconazole/permthrin	64
Permethrin	70
Alkaline copper quaternary	90

example **665 01 H3.2**

Industry responses

Now that the discussions, debate, and many decisions have been made around the relevant standards and Building Codes clauses, the industry is working together to implement the changes. This has been a direct benefit to the preservation industry that has been enjoying the revival of a previously lost market. There has also been a resurgence of interest in borate treatments particularly as the treatments have a less hazardous profile than the LOSP options and without the residual solvent and odour that linger in timber following treatment. However the market is now used to being supplied with a dry framing product so any of the water-based treatments are still limited by market acceptance by any process that needs a ‘re-dry’ step after the

preservative treatment. However some companies are working on innovative new treatment systems which will allow the boron treatment of dry timber without 'rewetting'.

Compliance with the standards results in a product that is an acceptable solution to meet the Building Code requirements. There are also opportunities for manufacturers to have alternative solutions to meeting the Building Code. This year one company has introduced a treated framing product (a borate envelope treatment) under the Building Industry Authority CODEMARK® scheme. The deviation from complying with the preservation standard (that requires full sapwood penetration) was not happily welcomed by some although the producer had been able to demonstrate equivalent performance to more traditional treatments. We may see other innovative ideas and approaches to problem solving treatment issues as the performance criteria are better understood.

Although there is a choice of treatments, the use of the colours has created some confusion. Some builders have found it easier just to chose the H3.1 treatment for all timbers rather than manage different types of timbers (hazard classifications or product choices) for different places in the structure.

On-going issues

New Zealand has many houses built over a 10 year period that have a risk of weather tightness issues at some time in their lifetime. This was particularly emphasised when on the 6 October the Building Industry Authority issued another reminder about decks, balconies and balustrades deteriorating and posing a risk to people's safety:

The Building Industry Authority again reminds owners of dwellings that balconies supported by untreated kiln-dried timber, particularly those situations where water pools rather than draining away harmlessly, pose a safety risk.

The reminder follows the Auckland City Council recently issuing a Notice to Rectify, advising the owners of a high-rise apartment building that balconies for 17 apartments were dangerous. The BIA understands these cantilevered balconies were constructed with untreated timber and may have been structurally weakened through the ingress of water and subsequent rotting of the timber framing.

Serious concerns about the safety of balconies, decking and balustrades emerged in the wake of the investigations into the weathertightness of houses in 2002.

The BIA issued public warnings twice and reminders have also been published in several BIA publications sent to territorial authorities and industry stakeholders. In light of this latest finding, the BIA

reminds industry of this potential danger.

The BIA strongly recommends that territorial authorities, their advisors (e.g. builders, designers) and other professionals pay particular attention to this risk whenever they are on site. They should look for signs of potential problems in decks, balustrades and balconies that may be at risk of damage and rotting from water ingress.

Structures that pose a risk are those that rely on timber beams for support. Sometimes these beams are hidden behind cladding. Structures at most risk are on buildings with flat, lightweight claddings with plaster-type finishes, with balconies supported by untreated kiln-dried timber.

Risk factors

For balconies, consider these questions:

* *Has untreated kiln-dried timber been used for structural support of the floor or balustrade?*
* *Is the building clad with lightweight materials with a plaster finish?*
* *Does water puddle on the surface rather than drain away?*
* *Are there any holes or cuts in the balcony floor surface or ballustrades?*
* *Is it on a split-level or two or three storey house or a multi-storey apartment building?*

Look at the balustrade:

* *Is it clad with lightweight material with a plaster finish?*
* *Does it have a flat top where water sits?*
* *Does it have a railing where water is able to leak down screw holes?*

Warning signals

* *Balconies that move when walked on.*
* *Damp spots or stains where the balcony joins the main part of the building.*
* *Cracks, particularly near joints and corners.*
* *Balustrades that wobble.*
* *Balustrades where damp spots or stains can be seen on the cladding.*

The BIA strongly recommends that, if warning signals are evident, advice should be sought from a qualified expert as soon as possible.

Such warnings serve as a reminder that the legacy of the last decade is not going to disappear even with the changes being implemented now. All stakeholders must now work together to ensure awareness of the importance of weather tightness in buildings in actively managed in new buildings, now and in the future.

Literature

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