

## TIMBER-BASED OUTDOOR DESIGN SOLUTIONS IN NEW ZEALAND URBAN ENVIRONMENTS: MATERIAL PERFORMANCE, SUSTAINABILITY AND SPATIAL INTEGRATION

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**Abstract.** Timber occupies a different position in the public realm of Aotearoa New Zealand than it does in most of Europe. It is not principally a warm accent applied to a mineral substructure but a load-bearing, surface-forming and space-defining material, used continuously across decks, edges, seating, terracing and shelters. This paper reports the second phase of a comparative field study of timber in public outdoor space. The first phase surveyed eleven European cities from Oslo to Barcelona; the present phase applies the same photographic and assessment protocol to Wellington, New Zealand. The method combines structured photographic documentation with visual condition assessment and comparative analysis of the standards and chemicals regulation governing outdoor timber in each region. Three arguments are developed. The New Zealand approach is material-led: the timber deck is the public ground plane, and seating, steps and thresholds are generated by folding and thickening that plane rather than by placing discrete furniture on a hard surface. In the surveyed European cities the same operation appears, but almost exclusively within one typology, the harbour bath and its sun deck, while the remainder of the public realm reverts to timber as an applied accent on mineral construction. Because that pattern holds across the full latitudinal range of the European sample, and in small cities as well as capitals, it cannot be read as an adaptation to the northern climate or to municipal budget; it is a design and procurement convention, and therefore open to change. Comparable service lives are reached by different routes: New Zealand makes a fast-grown, non-durable plantation softwood serviceable through a prescriptive hazard-class treatment system, whereas European practice relies on naturally durable species, modified timber and constructive protection, in part because the most effective preservatives have been progressively restricted. Reclaimed timber occupies a narrow but instructive niche: it is technically and narratively attractive, but its use in the European public realm turns less on the gesture of reuse than on the documented provenance of the source stream. In both surveys, observed condition correlated more strongly with detailing than with species or treatment class, and the decisive detail is the junction: how timber meets timber, steel, concrete and ground determines durability, reparability and the prospects for material recovery more than the specification of the board itself. That is the finding most readily transferable to Baltic conditions.

**Keywords:** timber, public outdoor space, landscape architecture, material performance, New Zealand

### Introduction

Discussion of timber in the built environment has, over the past decade, been dominated by buildings. Mass timber, cross-laminated panels and their embodied-carbon performance have generated a substantial comparative literature, and the argument for substituting biogenic for mineral materials is now familiar to any practitioner [23]. The outdoor public realm has received far less systematic attention. Decks, promenades, steps, seating, edges, retaining structures, play elements, shelters and boardwalks are rarely the subject of technical research, even though they are exposed to conditions more severe than most building envelopes, are replaced more often than any part of a building, and are the parts of the built environment that citizens actually touch.

This asymmetry has consequences. Outdoor landscape elements sit in the harshest categories of every classification system in use, whether the five European use classes of EN 335 [10] or the six New Zealand hazard classes of NZS 3640 [25]. The assumptions that make timber comfortable in a building, namely long service life, sheltered conditions and a stable moisture content, do not transfer automatically to a bench standing in salt spray. At the same time, outdoor timber is where material choice becomes public experience. The temperature of a surface under the hand on a cold morning, the acoustic quality of footfall on a deck, the way a material greys unevenly with orientation, the way it invites people to sit down where no bench was drawn: these are not incidental properties. They are among the strongest arguments for the material, and they are almost entirely absent from the life-cycle literature.

New Zealand offers an unusually clear case for examining what a timber-led public realm looks like in practice. Its

plantation estate is overwhelmingly one fast-grown species. Radiata pine (*Pinus radiata*) accounts for roughly ninety per cent of the planted production forest area, on an estate of about 1.82 million hectares [19]. The species has low natural durability and therefore depends almost entirely on preservative treatment for exterior use, an arrangement codified in a national hazard-class system that is unusually prescriptive and unusually well understood by specifiers, contractors and merchants alike [3, 24, 25]. Treated structural timber is stamped with its class, and the classes are common vocabulary on any building site. The result is a design culture in which exterior structural timber is a cheap, local and entirely normal default rather than a premium gesture or an environmental statement.

Wellington sharpens the case further. The city occupies a reclaimed harbour edge exposed to the winds funnelled through Cook Strait, with high salt loading, frequent wind-driven rain, significant seismicity and an ultraviolet regime considerably more aggressive than that of comparable northern-hemisphere latitudes [18]. Over roughly three decades its waterfront has been rebuilt as a continuous public promenade linking a sequence of precincts [29], in which timber has been used as the primary spatial material rather than as a finish. Projects such as Waitangi Park [17] and North Kumutoto [16] have established what local practitioners describe as a waterfront vernacular of simple, exposed, robust and frankly industrial construction, drawing on the memory of the working wharf that preceded it. The North Kumutoto pavilion, a matrix of vertical timber battens on a lattice structure hovering above a heavy hardwood deck, was designed explicitly as an analogue of the pohutukawa

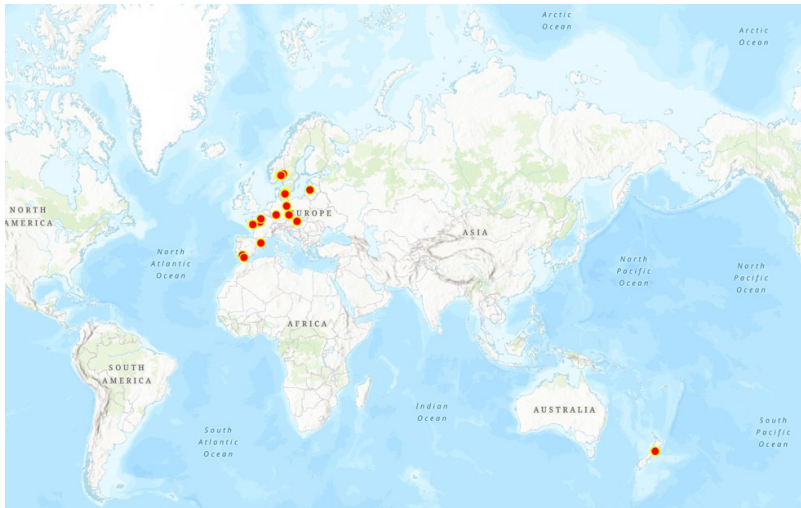


Fig. 1. Distribution of the surveyed locations. The European sample spans nineteen degrees of latitude and both metropolitan and small-city administrations, allowing climate-driven and convention-driven patterns to be distinguished. Survey locations mapped by the authors [Basemap: Esri Topographic. Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community]

tree, filtering rather than excluding wind and rain [4].

The present paper continues a line of comparative field research into timber in public outdoor space. An earlier phase examined the use of timber in the built fabric of Copenhagen from the standpoint of visual and aesthetic quality [13] and analysed contemporary trends and diversity in wood-based public amenities, again with Copenhagen as the principal case [28]. Those studies established the European baseline used here, which the wider survey reported below extends across several further cities: a public realm in which timber is valued, in places actively promoted by municipal architecture policy, and applied with considerable typological variety, but applied nonetheless, as a material added to a predominantly mineral urban fabric. The question that motivated the present phase was whether that pattern is a necessary consequence of the northern climate and the European regulatory setting, or a design convention that could be otherwise. Wellington offers a place where it demonstrably is otherwise.

The aim of this paper is to characterise how timber is used in outdoor public amenities in New Zealand urban environments, and to establish what is genuinely transferable to European, and specifically Baltic, practice. Five questions organise the work. What kinds of element are made in timber, and what typologies recur? Where in the city are they placed, across the range of park, street, square, waterfront, courtyard and play settings? At what extent does timber appear in each, from a single object to the whole ground plane? For what use is it intended, and how is it actually occupied? How is the timber joined, both to itself and to the other materials it meets, and what kinds of construction do those junctions produce? And, across all of these, how do these elements perform visibly under coastal-urban exposure, and where do the New Zealand and European approaches converge and diverge? The study is therefore concerned with the diversity of timber use rather than with its frequency: with the range of what the material is asked to do in public space, and with the settings in which each role appears.

The novelty of the study lies less in any single observation than in the connection of three layers usually treated separately: the regulatory layer of standards and chemicals restrictions, normally the province of wood technologists; the technical layer of species, treatment, detailing and weathering, which belongs to building science; and the spatial and experiential layer, which belongs to landscape architecture. Practising designers must reconcile all three in a single specification, and the argument advanced here is that the reconciliation, rather than any layer taken alone, is what distinguishes the New Zealand case.

## Materials and Methods

The study uses a qualitative, case-based comparative design carried out in two field phases. It combines photographic field documentation with structured visual assessment, comparative document analysis of standards and regulation, and typological interpretation of spatial organisation. No destructive testing, moisture measurement or laboratory analysis was undertaken, and the material claims made here are accordingly restricted to what is visually verifiable in the field or established in the cited technical literature.

The first phase covered European practice across a wide latitudinal, climatic and administrative range. Documentation was carried out in eleven cities: Copenhagen, Oslo, Helsinki and Tallinn in Northern Europe; Paris and Nantes in Western Europe; Berlin, Frankfurt am Main, Prague and Nitra in Central Europe; and Barcelona in Southern Europe. Copenhagen and Oslo were treated as the primary cases and have been reported separately [13, 28]; that material is re-examined here against the New Zealand evidence rather than restated, while the remaining cities are used comparatively and are published here for the first time. The composition of the sample is analytically important rather than incidental. It runs from Oslo at almost sixty degrees north to Barcelona at forty-one, that is from a climate with a long frost season to a Mediterranean one with none, which makes it possible to separate what in European practice follows from climate from what follows from convention. It also pairs capitals and large metropolitan centres with Nitra, a small regional city, so that the observed patterns can be tested against differences of budget and administrative capacity as well as of latitude.

The second phase applied the identical protocol in Wellington, New Zealand, in February 2026, along the central waterfront promenade and in adjacent central-city open spaces. Because both phases share the same observers, the same recording protocol and the same assessment scale, differences between the two bodies of material can be read as differences in practice rather than as artefacts of method. Figure 1 shows the distribution of the surveyed locations.

Each documented element was recorded through a consistent sequence of four views: an overview showing the element in its spatial context and its relation to circulation and edge; an assembly view showing junctions, fixings, visible substructure and drainage gaps; a close surface view showing weathering, checking, wear polish, fastener staining and coating condition; and an interface view recording timber-to-ground, timber-to-metal, timber-to-concrete and end-grain conditions.

Every site was visited by two assessors, who agreed each element's condition on the spot and entered it into

a structured questionnaire in the ArcGIS Survey123 application. Each record captures site and setting type, classified as park, street, square, waterfront or promenade, courtyard, playground or other, together with element type, apparent species or product, apparent treatment or modification, contact class, the structural configuration of the element, the materials the timber meets at each junction, the junction and fixing type, the extent of timber in the element, ranging from a discrete object through a bounded surface to the whole ground plane, the intended and the observed use, visible defects and an overall condition rating, together with its coordinates and photographs. Condition was assessed on a five-point ordinal scale adapted from the rating conventions used in wood durability field trials [30], running from sound through slight, moderate and severe change to failure, and applied only to visible attributes. Because deterioration below grade cannot be assessed without probing, elements in ground contact are reported as not assessable below grade. Species and treatment identifications are visual and were not confirmed by sampling. Digital capture in the field was chosen for three reasons: it enforces a consistent record across cities and phases, it removes the transcription step between field notes and analysis, and it produces a geolocated dataset that can be analysed spatially and published as an openly readable map rather than as a table. Sampling was purposive and directed at maximum variation. The objective was not to inventory every amenity element in a city, nor every timber element within it, but to capture the widest observable range of timber applications and of the settings in which they occur. Elements were therefore selected to span the setting types listed above, the range from object to surface, the range of intended uses, and the range of construction and junction types, so that the resulting record supports comparison of what timber is used for rather than estimation of how often it is used.

The regulatory comparison draws on primary documents. For New Zealand these are NZS 3602 and NZS 3640 together with Clause B2 of the New Zealand Building Code, which sets the durability periods that exterior elements must achieve [20, 24, 25]. For Europe they are EN 335 on use classes and EN 350 on the classification of natural durability [10, 11], together with the chemicals instruments that now effectively govern specification, namely the Commission Directives restricting arsenic compounds and narrowing the approved applications of other wood preservatives, together with the ongoing restriction work under REACH [6, 8, 9]. This layering matters: in Europe, chemicals law rather than construction standards have become the binding constraint on what a landscape architect may specify.

Four limitations should be stated, the first of which is also a deliberate sampling decision. Both phases were carried out in the warm season. This was chosen intentionally, because outdoor amenities are used most intensively by residents and visitors in warm weather, and several of the qualities this study is concerned with, namely how a surface is sat on, leaned against and occupied, are only observable when the space is in use. The cost of that choice is that each survey is a snapshot which captures condition rather than rate of change, and that the winter behaviour of the northern European elements, including snow clearing, grit and de-icing salt, is recorded through its traces rather than in operation. Second, because the two assessors agreed each rating on site rather than recording independently, the data represent a consensus judgement and do not permit inter-assessor variability to be quantified. Third, the ages of elements were inferred from published project documentation and cannot

always be established precisely, which weakens any inference from condition to service life. Fourth, and following directly from the purposive sampling strategy, the dataset has no denominator. It records the range of timber applications encountered but not the proportion of a city's amenity stock that they represent, so no claim is made about how common timber is in any of the surveyed cities, and depth of coverage varies between them. The study accordingly claims analytical rather than statistical generalisation, in the sense that it proposes transferable principles rather than representative frequencies.

## Results and Discussion

### *Timber as the ground plane*

Six typologies recur across the Wellington sites, and they are best understood as a sequence rather than a list, because each grows out of the one before it. The first and most consequential is the continuous deck used as public ground plane. Large horizontal areas are surfaced in timber boards rather than in stone, concrete or bound gravel, and the deck is not attached to a building or confined to a special zone; it is simply the ground on which the city walks. Board direction indicates the line of movement, and a change of board module or gap width marks a threshold as effectively as a change of paving material would elsewhere (Fig. 2).

From the deck comes the second typology, the folded plane, in which the surface lifts, tilts or steps to become a seat, a viewing terrace, a ramp or a stair without any change of material. Seating here is not an object placed on a surface but the surface itself deformed, which yields a high ratio of usable sitting edge to square metre, removes the visual clutter of separate furniture objects, and permits a range of postures that a fixed bench does not (Fig. 3).

The third typology extends the same logic to the water. Where public space meets the harbour, the edge is thickened into steps, platforms and ledges that allow people to descend towards the water rather than merely look at it. Timber is the appropriate material here for reasons that are physiological before they are aesthetic: its low thermal conductivity means it is neither burning nor freezing to the touch, and its surface is forgiving enough that people sit, lie and climb on it without hesitation (Fig. 4).

Fourth are the shelter and canopy structures, which are deliberately incomplete. Light, permeable batten assemblies provide partial shade and partial shelter rather than enclosure; the designers of North Kumutoto have described the intent as embracing the elements rather than controlling them, and the pavilion is accordingly not waterproof by design [4]. Timber's capacity to be assembled as a screen or filter rather than as a wall is what makes that position architecturally available (Fig. 5).

Fifth are the retaining, terracing and ground-forming elements, in which heavy sections are stacked to hold soil, form planting terraces and negotiate level change. This is the typology in which ground contact, and therefore the highest hazard classes, is unavoidable, and it is also where reclaimed material most often appears. Sixth are the freestanding elements: seats, bollards, edge rails, wayfinding supports, bin surrounds, balustrade infill and play components (Fig. 6), almost always fabricated for the site and detailed to match the larger elements around them. Freestanding objects are therefore not absent from the Wellington record; what distinguishes it is that they share the section sizes, fixings and surface treatment of the ground plane they stand on.

Read against the setting categories used in the survey, the striking feature of the Wellington record is how little the role



Fig. 2. Continuous timber deck as public ground plane, Wellington waterfront. Board direction indicates the line of movement; the gap module governs drainage and drying rate [photo by the authors, 2026]



Fig. 3. The folded plane: deck surface stepping to form seating and viewing terrace without change of material. The section, rather than an added object, produces the sitting edge [photo by the authors, 2026]

of timber changes as the setting changes. The same material, in the same structural role, carries the waterfront promenade, the park terrace, the street edge and the play surface, and the recorded extent sits at the surface end of the scale in each. What shifts between settings is section size and degree of exposure, not the decision about what the material is for. That constancy is what allows a single design logic to be read across an entire public realm, and it is the point at which the New Zealand and European records diverge most clearly. Four spatial operations follow from it. Continuity: one material carries the pedestrian from promenade to terrace to seat to water edge, so that continuity of material substitutes for the hierarchy of paving types that European public space design conventionally uses to signal function, and the signalling is done instead by geometry. Softness within robustness: these are hard-working, structurally frank and visibly industrial spaces, yet the surface a body meets is warm and slightly yielding. Weather as programme rather than adversary, expressed in shelter that is partial by intention. And cultural grounding, the operation with no European equivalent, since New Zealand public-realm projects work within the Te Aranga principles, which are outcome-based principles founded

on Maori cultural values and directed at enhancing mana whenua presence, visibility and participation in the design of the physical realm [2]. In Wellington the same orientation appears in the city's own waterfront policy, which states that Māori cultural presence on the waterfront should be an active one, showing a living culture with a focus on waka culture, and which identifies the lagoon as the site for a waka shelter and related cultural activities [29]. Within such a framework material choice is not neutral: timber connects to the working harbour, to the waka landing and to place-based narrative in a way that imported stone or precast concrete does not, and the framework gives that connection institutional weight rather than leaving it to the designer's discretion. The nearest European analogues, arguments from regional vernacular and heritage continuity, are real but weaker and more easily set aside under procurement pressure.

#### *Exposure, junction and detail*

Wellington's exposure regime combines wind-driven salt spray, high wind pressures carrying abrasive particulate, frequent wetting followed by rapid drying, and a severe ultraviolet flux. The last is routinely underestimated by northern-



Fig. 4. Occupiable water edge in heavy timber. Low thermal conductivity and a forgiving surface make timber the appropriate material where bodies meet the harbour edge [photo by the authors, 2026]



Fig. 5. Permeable batten canopy. Partial shelter as design intent: the structure filters wind, rain and light rather than excluding them [photo by the authors, 2026]

hemisphere specifiers reading latitude alone: comparative measurements across mid-latitude monitoring sites found peak ultraviolet intensities at a New Zealand site exceeding those at comparable North American latitudes and altitudes by  $41 \pm 5$  per cent, attributed to lower ozone amounts, a cleaner atmosphere and the closer Earth–Sun separation of the southern summer [18]. For material degradation the relevant quantity is annual dose rather than summer peak, so the practical difference is smaller than that figure suggests, but photodegradation of surface lignin, coating breakdown and greying do proceed faster than European experience at the same latitude would predict.

Against that background, the clearest finding of both phases is that visible condition correlated far more strongly with detailing than with either species or treatment class. Drainage and drying rate dominate: elements with generous board gaps, ventilated substructures and unobstructed drying paths were in visibly better condition than nominally identical elements in which a nosing, a flush junction or an abutting planter had created a trap. This is consistent with the logic of the European use-class system, in which the critical distinction within exterior above-ground exposure is between limited wetting with rapid drying and prolonged wetting [10], and it means that a poorly detailed element in a high treatment class will routinely be outlived by a well-detailed element in a lower one. End grain is where failure begins: cut ends, notches, bolt holes and mitred junctions showed the earliest and most severe checking and staining across the entire survey, and where preservative-treated timber is cut on site the treated envelope is breached and the

untreated core exposed [3]. In a landscape context, where site-cutting is unavoidable and end grain is frequently left upward-facing, this is a first-order design decision rather than a construction detail.

Because the survey recorded what the timber meets at every junction, the two bodies of material can be compared not only by what is built but by how it is put together. Four junction conditions recur, each with a different failure mechanism and a different design attitude. Timber-to-timber junctions in the Wellington projects are predominantly mechanical, visible and generously dimensioned: boards laid on joists at open gaps, heavy sections stacked, bolted or coach-screwed, with the fixing treated as part of the visual language rather than concealed. Nothing observed depended on adhesive and very little on proprietary hidden clips. The consequence is repairability, since a single board or member can be replaced without dismantling its neighbours, which is what makes a timber ground plane maintainable at city scale; the corresponding weakness is the number of penetrations, each a route for water into the section and, in the salt zone, a site of corrosion staining.

Timber-to-steel junctions carry most of the structural work, with galvanised or stainless brackets, plates, shoes and pins transferring load where timber is weakest, at bearings, post bases and cantilevers. The recurring good practice is that the steel lifts the timber clear of the wet zone so that end grain never stands in water, and that the two materials meet across a drained or ventilated gap rather than face to face; where that gap is absent, the junction traps moisture at the point of highest stress. Metal specification proved to be a durability



Fig. 6. Freestanding timber elements in Wellington's public realm: seats, bollards, edge rails, wayfinding supports, bin surrounds and play components. Almost all are fabricated for the site and detailed to match the larger elements around them [photo by the authors, 2026]

decision rather than an ironmongery one, since copper-based preservatives in contact with insufficiently specified metals accelerate corrosion, and the resulting stains are read by the public as decay long before any structural loss occurs. Timber-to-concrete and timber-to-ground junctions are where the two regions diverge most sharply. New Zealand practice, backed by a treatment system that certifies timber for direct ground contact, is comparatively relaxed about putting the material into the ground, and the hazard class rather than the detail carries the risk. European practice, having lost much of that chemistry, displaces the risk into the detail by interposing metal, raising bases onto plinths and keeping timber clear of soil and splash. Read side by side, the two records describe the same problem solved once with chemistry and once with geometry.

The construction types these junctions produce differ correspondingly. The Wellington record is dominated by the ventilated deck on a joist substructure, extended horizontally to whatever size the space requires, and by the stacked or crib assembly of heavy sections for terracing and level change, with lighter batten screens and lattices for canopies above. All are site-fabricated, additive and open-ended. The European record contains the same deck construction, but alongside a large population of composite assemblies in which timber is a facing on a steel or concrete frame, and of factory-assembled units delivered complete. Those assemblies perform well and often look better for longer, but they are difficult to repair in part, and at end of life their materials are hard to separate, which is the practical reason why the circularity argument for outdoor timber is won or lost at the junction rather than in the specification of the board.

Three material strategies coexist across the Wellington projects: treated plantation softwood in the appropriate hazard class as the economic default for substructures and secondary elements; dense durable hardwood where wear, span or civic prestige justify the cost [16]; and thermally modified radiata pine, developed domestically as a preservative-free alternative, in cladding and decking. On the last, one qualification deserves emphasis because it is frequently obscured in marketing material: European field trials found that after seven and a half years in ground contact the thermally modified materials tested classified

as slightly durable to not durable, while the same materials above ground classified as very durable to moderately durable [30]. Thermal modification is an above-ground solution. Finally, weathering is an aesthetic phenomenon before it is a structural one. Radiata pine decking checks and cups, pronounced on flat-grain boards and markedly less on vertical-grain and modified products, while heavy hardwood decking weathered to a uniform silver-grey that was consistently legible as intended patina rather than neglect. The distinction between designed and undesigned greying is largely a matter of orientation, detailing and uniformity of exposure across a single element, and it is compounded by a quality no cast material offers: high-traffic timber surfaces develop a burnished wear polish that records use. That reading is not only the designer's. Wellington's waterfront policy describes the evidence of use and of industrial and maritime wear as irreplaceable indicators of the history of the area, and the physical traces of age and occupation as its collective memory [29].

#### *Element rather than ground: the European field phase*

Set against Wellington, the European material resolves into a clear pattern, and the pattern is not one of absence. Timber is abundantly present in the surveyed cities, in several of them actively promoted by municipal architecture policy, and it appears in a wide range of amenity types [28]. What differs is its structural and spatial role. Across the sample the dominant condition is timber applied to a mineral substructure: slatted seating on steel or concrete frames, timber tops on cast bases, cladding to retaining walls, decking laid as an inlay within a matrix of paving. The ground plane remains stone, asphalt or concrete, and timber marks the places where the design invites the body to stop (Fig. 7).

The most significant result of the European phase is that this pattern is stable across the whole range of the sample. It is as evident in Barcelona, where there is no frost, no snow clearing and an outdoor season several months longer, as it is in Oslo, Helsinki or Tallinn, and as evident in Nitra as in Berlin or Paris. The accent paradigm therefore cannot be explained as an adaptation to a hard winter climate, nor as a function of municipal budget. It is a design and procurement convention, which is precisely why it is open to change.

One typology is the exception, and it is instructive. In the



Fig. 7. The European accent paradigm: timber applied to a mineral substructure as catalogue seating and inlaid decking, with traces of winter maintenance at the deck-to-paving interface [photo by the authors, 2025]



Fig. 8. Oslo: harbour bath and sun deck. The one European typology in which the timber surface becomes the ground plane and folds to produce seating, steps and water edge [photo by the authors, 2025]

harbour bath, the urban swimming platform and their associated sun decks, the European projects do exactly what the Wellington waterfront does everywhere: a continuous timber surface becomes the ground, then folds into steps, benches, ramps, diving platforms and water edges without changing material, and is occupied in a range of postures that no bench affords. The Copenhagen harbour baths and quayside decks and the Oslo bathing and promenade decks of the inner fjord are the closest European relatives of the Wellington waterfront (Fig. 8), and comparable water-edge decks recur elsewhere in the sample. Their existence matters, because it shows that the material-led move is neither climatically impossible nor regulatorily forbidden in Europe. It is programme-restricted, and the restriction runs along the setting categories themselves: where the brief is bathing or a water edge, European practice designs the ground plane in timber; where the brief is a street, a square or a park, the recorded extent drops back to the object end of the scale. In the European record the role of timber is a function of setting, whereas in the Wellington record it is not.

Three further observations bear on the comparison. What varies with latitude is the deterioration mechanism rather than the role of the material: in the northern part of the sample, winter maintenance leaves traces that have no Wellington equivalent, including grit abrasion, localised splintering along snow-clearing routes and staining from de-icing salt at the deck-to-paving interface, and slip resistance is treated as a design problem in a way it is not in Wellington; in Barcelona these are replaced by ultraviolet degradation and heat, so that shading, species selection and coating maintenance carry the weight that winter detailing carries in the north. Second, bespoke and catalogue solutions coexist throughout the sample, and the balance between them is not what separates the European record from the Wellington one. Site-specific timber elements are common, and in the Nordic cities they are the norm along waterfronts, where seating, steps, decks and edges are fabricated for the location and fitted to terrain, water level and use. What distinguishes the European record is therefore not that its elements are less individually designed, but that even the bespoke ones are conceived as elements: timber is shaped with considerable invention within a bounded object or zone, while the surrounding ground plane stays mineral. Third, in the newer waterfront and harbour-side quarters considerable stretches of the timber-surfaced public realm are delivered and maintained by developers rather than by the municipality, which affects both specification and maintenance cycle and connects this material question to the wider discussion of privately owned publicly accessible space [27]. Across the whole sample, timber-surfaced space is consistently more recent than its surroundings, more often associated with regeneration and event-driven programming than with the permanent civic ground plane, and consistently the material most visibly appropriated for informal occupation, particularly by young people [14].

#### *Two routes to the same durability*

Both regions begin from the same physical logic. Both classify exposure severity before choosing a material, through the six New Zealand hazard classes or the five European use classes, and both draw the same distinction between above-ground exposure and ground contact [10, 25]. Both recognise, at least in their technical literature, that constructive protection outranks chemical protection in determining realised service life. Both credit timber as a renewable, carbon-storing substitute for mineral and metallic materials, and the

Table 1. Timber in the public realm: comparative conditions in New Zealand and Europe  
 [construction by the authors from the two field phases and the standards cited in the text]

| Dimension                           | New Zealand (Wellington)                                                                                                                             | Europe (surveyed cities)                                                                                                                                                                   |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dominant resource                   | One fast-grown plantation softwood ( <i>Pinus radiata</i> , ca. 90% of planted production forest), low natural durability, locally abundant          | Diverse resource: spruce, Scots pine, larch, oak, plus imported durable hardwoods; wider species choice and cost spread                                                                    |
| Route to durability                 | Prescriptive national hazard-class preservative treatment (NZS 3640); CCA approved for all hazard classes, alongside copper azole and ACQ at H3.1-H5 | Natural durability (EN 350), modified timber and constructive protection; CCA use restricted from 30 June 2004 to industrial impregnation and specified professional uses, not public sale |
| Binding constraint on specification | Building Code durability requirements (Clause B2) and the hazard-class standards                                                                     | Chemicals law (Biocidal Products Regulation, REACH) more than construction standards                                                                                                       |
| Climate stress profile              | Salt spray, extreme wind, high UV dose, frequent wet-dry cycling, negligible freeze-thaw                                                             | Freeze-thaw and de-icing salt, prolonged winter wetting, lower UV dose, slower drying, longer moisture residence                                                                           |
| Design position of timber           | Primary spatial and structural material; forms the public ground plane                                                                               | Usually a secondary or accent material applied to a mineral substructure; decking confined to designated zones                                                                             |
| Design of elements                  | Site-specific and fabricated, and continuous with the ground plane                                                                                   | Site-specific and catalogue solutions coexist; bespoke design is common, but conceived as bounded elements rather than as ground                                                           |
| Cultural frame                      | Indigenous design principles (Te Aranga) institutionalised in the design process                                                                     | Heritage, regional vernacular and craft traditions; no equivalent binding framework                                                                                                        |
| Reclaimed timber                    | Reuse of heavy sections culturally accepted; fewer regulatory obstacles                                                                              | Reuse constrained less by the material than by documentation: service history and treatment must be establishable                                                                          |
| Maintenance model                   | Periodic board replacement within an explicitly repairable system                                                                                    | Expectation of low-maintenance, long-warranty product performance                                                                                                                          |

comparative life-cycle literature on buildings supports that credit, with a review of one hundred case studies reporting embodied energy for timber buildings on average 28 to 47 per cent below that of concrete and steel equivalents respectively, though the magnitude depends heavily on end-of-life assumptions and on how biogenic carbon is accounted for [23]. And both, in their better projects, accept visible weathering as legitimate rather than defective.

The divergence begins with what is available and what is permitted. New Zealand has one abundant, cheap, fast-grown and non-durable species, and has built a comprehensive treatment system around it. Under NZS 3640 chromated copper arsenate is approved as a treatment for all hazard classes, on the grounds of broad-spectrum effectiveness against insects, wood-destroying fungi and marine borers, alongside copper azole and alkaline copper quaternary, which are approved at H3.1 to H5 [3, 25]. Europe has a more diverse resource but has progressively narrowed the same chemistry. Commission Directive 2003/2/EC restricted the use of arsenic compounds in wood preservation from 30 June 2004, following a scientific opinion that identified risks to human health from the disposal of CCA-treated wood and, in particular, risks to children from its use in playground equipment; CCA type C remains permitted only for industrial vacuum or pressure impregnation, and the treated wood may be placed on the market only for specified professional and industrial uses, not for sale to the public [9]. The two regions reached different conclusions about the same substance rather than possessing different information about it. New Zealand assessed the public-health aspects of CCA-treated timber in playgrounds and residential buildings in 2003, and the regulator concluded that a formal reassessment under the Hazardous Substances and New Organisms Act was not necessary, while endorsing activities directed at minimising exposure [22]; the national agency states that the research it commissioned found it extremely unlikely that the health

of adults and children would be affected by contact with treated timber around the home and in playgrounds [5]. There is accordingly no New Zealand legislation restricting the use of CCA-treated wood to particular end uses [22], and the material remains in ordinary use in decks, landscaping, retaining walls and playground structures. The European restriction, by contrast, followed a scientific opinion that weighed disposal pathways alongside direct contact, and identified risks to children from playground equipment specifically [9]. The divergence is therefore one of risk judgement and of regulatory scope, not of a substance permitted in one region and unknown in the other. What follows from it is that European practice has had to substitute species selection, modification and detailing for chemistry across the whole of the public realm, a more demanding and more expensive design problem which nonetheless produces knowledge the New Zealand system has had less need to develop. Table 1 sets out the principal differences.

#### *Reuse and reusability in landscape elements: potential and challenges*

Two distinct propositions are often merged under the heading of circularity, and the survey material makes it useful to separate them. The first concerns timber that has already served: reclaimed sections entering a landscape project from an earlier use. The second concerns timber that is placed with its next use in mind: material specified and assembled so that it can be recovered intact when the element it belongs to is altered or removed. The first was observed in the surveyed public realm as a minor but recurring practice, in heavy sections used for edging, terracing, seating blocks, bollards and level change, where dimensional heft and an evident earlier life are legible in the finished element. The second is not directly observable at all, since reusability is a property of an assembly that only becomes apparent when the assembly is taken apart. Both belong in the same discussion, and

outdoor landscape elements are an unusually favourable setting for both.

The potential rests on three characteristics of this class of element. Structurally, most public-realm timber components are modest: spans are short, loads are distributed, and consequences of local failure are limited and visible in advance, which makes material of uncertain but conservatively estimated capacity easier to accommodate here than in a building frame. Materially, reclaimed heavy sections are frequently favourable in their own right, since old-growth or long-seasoned timber tends to be denser, more dimensionally stable and slower to absorb water than fast-grown plantation stock. And constructionally, as the preceding section described, these elements are already assembled mechanically, at accessible junctions, in a form intended to be repaired board by board; an assembly that can be repaired can in principle also be dismantled and its members recovered.

The challenges fall into two groups. The first is informational. Mechanical properties of reclaimed timber cannot be assumed; grading rules for recovered material are absent or immature; hidden metal is common; the service history is frequently unknown; and established certification routes do not exist. The documented consequence is that practice tends to downcycle recovered timber rather than reuse it at equivalent function, and that reuse is easiest where a designer works from the material outwards, letting the geometry of the element follow the sections that are actually available rather than specifying dimensions in advance and searching for stock to match [12, 15, 21]. The same logic can be applied prospectively, since the information that is missing from reclaimed material is information that a designer is able to record at the moment of construction.

The second group concerns the chemical history of the material. Timber that has spent a first service life outdoors has usually been preservative-treated, and the treatment determines what a second use may be. Several preservative systems have had their approved applications progressively narrowed in the European Union, including a prohibition on treated wood in playgrounds and in other outdoor places for public enjoyment or where skin contact is likely [8, 26], and the reuse and secondary use of wood treated with certain substances has itself been the subject of restriction proceedings, with residential landscaping among the secondary applications considered [6]. Traceability is the operative issue rather than the material as such: it has been recommended that treated wood carry permanent marking so that its origin remains identifiable throughout its life [1], and where a service history cannot be established, an element is difficult to place in the settings where landscape architects most often want it, namely those involving skin contact, food contact or children's play.

Taken together, these conditions suggest that the constraint on circularity in outdoor timber is documentary rather than technical, and that it is largely within a designer's control at the point of specification. Recording species, section, treatment and fixing type for the elements now being built, and preferring reversible mechanical connections, single-material assemblies and a limited range of repeated section sizes, addresses prospectively the same gaps that make present-day reclaimed stock difficult to use. This is consistent with the direction of European circular economy policy, which places emphasis on the design stage as the point at which the recoverability of construction materials is determined [7], and it locates the question in the same place as the durability question examined earlier: in the junction and in

the specification rather than in the material itself.

What transfers, and what does not

The Wellington evidence does not support importing New Zealand's palette or its chemistry. Radiata pine is not a European resource, and the treatment regime that makes it work is precisely what European chemicals regulation has narrowed. What transfers is the design logic, and the harbour baths of Copenhagen and Oslo are the proof that it can be built in a Nordic climate under European rules; the task is to release it from the bathing programme and apply it to the ordinary ground of squares, waterfronts, courtyards and park edges. Five propositions follow:

- Design the ground plane in timber, not only the objects standing on it. The largest experiential gain comes from the surface, not from the bench.
- Generate furniture by deforming the surface. Folding, thickening and stepping produce more sitting edge and less clutter than the same budget spent on discrete objects, whether catalogue or bespoke.
- Specify by exposure micro-zone rather than by project. A single plaza may contain conditions equivalent to EN 335 use classes 3.1, 3.2 and 4; treating them identically guarantees premature failure in the worst zone and over-specification in the best.
- Design the junction first. Mechanical, reversible and accessible fixings; drained and ventilated interfaces; metal shoes and raised bases where regulation has removed the chemistry that once permitted direct ground contact; and explicit treatment of site-cut end grain. Durability, repairability and material recovery are all decided here.
- Let the material grey, and say so in the specification. Uncontrolled greying reads as neglect; uniform, designed greying reads as patina, and the difference lies in orientation, detailing and managed client expectation.

One research gap limits every argument made here. The comparative life-cycle literature on timber substitution is almost entirely building-focused [23]. Outdoor public-realm elements have different geometry, shorter and more frequent replacement intervals, higher treatment intensity per unit volume, and different end-of-life pathways, since preservative-treated timber is commonly excluded from both energy recovery and material recycling streams. There is at present no adequate body of life-cycle data for landscape-scale timber elements as distinct from buildings, and that is where a follow-up study to this paper should be directed.

## Conclusions

Timber in New Zealand's urban public realm functions as a primary spatial material rather than as an applied finish. It forms the ground plane, and seating, edges, thresholds and shelter are generated by deforming that plane rather than by placing furniture upon it. This is a design position, not a consequence of climate or resource, and it is available to European practice.

Observed condition was governed more by detailing than by species or treatment class, and the decisive detail is the junction. Drainage and drying rate, end-grain protection and fastener specification accounted for most of the visible variation between elements. Wellington builds with visible, mechanical, generously dimensioned fixings and site-fabricated assemblies that can be repaired a board at a time, and places timber in the ground on the strength of its treatment class; the European record contains the same deck construction alongside a large population of composite and factory-assembled elements that perform well but are

difficult to repair in part or to separate at end of life. Since durability, reparability and material recovery are all decided at the junction rather than in the choice of board, the junction is where an outdoor timber strategy should be designed first. In the surveyed European cities timber is abundant, varied and in places policy-supported, but it is applied to a mineral substructure rather than forming the ground. The single systematic exception is the harbour bath and its sun deck, where European practice does precisely what Wellington does throughout. Because the accent paradigm holds across the whole range of the European sample, from Oslo to Barcelona and from capitals to a small regional city, it cannot be attributed to the northern climate or to administrative capacity. The material-led approach is neither climatically impossible nor regulatorily forbidden in Europe; it is confined to one programme, and that confinement is a convention rather than a constraint.

New Zealand and European practice converge on a shared physical logic of exposure classification, constructive protection and renewable material substitution, but diverge in resource base, chemical regulation, procurement culture and the institutional standing of indigenous design principles. The divergence is best understood as two routes to a comparable service life rather than as a difference of competence or ambition.

Outdoor landscape elements are a favourable setting both for reusing timber and for building in a way that keeps timber reusable, because their structural demands are modest and their assemblies are already mechanical and accessible. The binding constraint is documentary rather than technical: species, section, treatment and fixing type determine what a second use may be, and that information is absent from most recovered stock while being fully within a designer's control for the elements now being built.

The outcome transferable to Baltic and Northern European cities is accordingly a design logic rather than a material palette: a surface-led conception of public space, specification by exposure micro-zone, assemblies designed for replacement, and detailing substituted for the chemistry that regulation has withdrawn. The absence of life-cycle data for landscape-scale timber elements remains the most significant gap in the supporting evidence.

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