Package contents and design basis

What this package contains, what governs it, and what is assumed

01 CONTENTS

Ten sheets. Each carries the decision, the evidence, and the hold that remains

SHEET	TITLE	WHAT IT IS FOR
ST–0600	Package contents and design basis	Scope, owner approvals, model traceability and the quantities used by this package
ST–0601	Anchorage typology and selection	The four families of stay-to-deck anchorage, what each costs, and why this one
ST–0602	Anchorage zone general arrangement	Plan, elevation and section through one anchorage bay
ST–0603	Edge node plate layout	Plate sizes, grades and the load path through the node
ST–0604	Weld map and fatigue detail categories	Mapped weld references, candidate categories and the open fatigue verification
ST–0605	Anchor head and supplier envelope	What the stay system demands of the structure around it
ST–0606	Corrosion, drainage and dehumidification	What keeps it alive for 100 years in a marine environment
ST–0607	Stressing, replacement and access	How it is tensioned, how a strand is changed, how a person reaches it
ST–0608	Tolerances and shop first-article test	What must be proved once before 256 are built
ST–0609	References, hold points and verification	Every source, every hold, and the state of each check

02 WHAT GOVERNS, AND WHAT DOES NOT

The gap is named rather than glossed

SUBJECT	POSITION
Project approval route	**Owner acceptance is required.** The NZTA Bridge Manual excludes cable-stayed bridges and railway loading. A project-specific cable-stay and rail design basis, documented departures and special studies are hold H1.
Technical assurance	Manage as a Category 1 structure under the Highway Structures Design Guide, including an independent design review. Design and review certification are not recorded for this package. [H1]
Proposed stay-system basis	PTI DC45.1-18 with published errata and fib Bulletin 89 (2019). These are proposed references, not an accepted project basis. [H1]
Steel and fatigue	AS/NZS 5100.6 and EN 1993-1-9 are candidate design references. The current consolidated edition, project amendments, rail spectrum and detail-category applicability remain to be confirmed. [H1/H3]
Anchorage capacity	PTI requires the anchorage to transmit the full ultimate tensile force of the cable, and prohibits hard filling or cement grout in the anchorage area so individual strands remain replaceable. [H1]

03 THE QUANTITY THAT DRIVES EVERYTHING

Reference stay BACK-01; actual preliminary demand is separated from cable limits

QUANTITY	VALUE
Critical stay / strands	BACK–01 / 73
Preliminary SLS demand	8.242 MN
45% GUTS SLS threshold	9.165 MN
SLS demand / threshold	0.899
Preliminary ULS demand	11.319 MN
65% GUTS ULS threshold	13.239 MN
ULS demand / threshold	0.855
Cable GUTS	20.367 MN
Stay inclination at deck	30.6°
Back / main fan pitch	8,387 / 10,484 mm
Model anchorage assemblies	256

WHY THE COUNT MATTERS

2 towers x 2 fan directions x 32 positions x 2 deck edges = 256 assemblies. The P01 count of 128 omitted the second tower. The first-article test on ST-0608 remains a hold before series fabrication.

MODEL TRACEABILITY

Model basis: **waitemata_crossing_city_context_P02.skp**. P02 retains 256 named edge-girder housings and moves the provisional node and deck stay ends outside and below the active path. It preserves the P01 stations and longitudinal geometry. This package is model-informed, not a direct SketchUp viewport export. Component IDs, chainage and project datums remain holds.

Anchorage typology and selection

Four families of stay-to-deck anchorage, what each costs, and why this one

01 THE FAMILIES

Every long-span cable-stayed deck uses one of these, or a hybrid of them

	ARRANGEMENT	ARGUMENT FOR	ARGUMENT AGAINST
A	**Anchor box inside the box girder** A fabricated steel box welded inside the girder, taking the stay force into the webs and diaphragms. The most common arrangement on steel box decks.	Load path is short and direct. Anchorage is protected from weather. No obstruction on deck.	Stressing and replacement happen inside a confined space. The welded box is a fatigue-critical region inside the primary structure, where a crack is hardest to find.
B	**Blister on the deck top** A raised anchor block on the deck plate, with the stay entering above the running surface.	Simplest fabrication. Fully accessible for stressing and inspection.	Occupies the deck surface. On this bridge it lands inside the declared 3.0 m active path, leaving 2.2 m clear, and it repeats at all 32 positions per face. This is the arrangement the model originally carried and it is why this package exists.
C	**Edge girder with transverse diaphragm** The stay anchors into the edge girder, with a diaphragm carrying the transverse component into the deck plate and soffit. Stonecutters uses cross-girders at each stay anchorage.	Keeps the deck surface clear. Load path into the girder is well understood and has substantial precedent.	The diaphragm is a fatigue-critical welded attachment inside the box. Access for stressing is still internal and confined.
D	**External node outboard of the deck edge** A welded steel node cantilevered outboard of the deck line, below the usable surface, with the anchor head reachable from inside the box.	The active-mode envelope stays continuous at every position. The stay system reads cleanly in elevation. The anchor is reachable and replaceable.	Adds torsion and an eccentric transfer that needs 3D proof. The node is exposed. Fabrication is a repeated cantilever assembly. **No built precedent was found for anchoring outboard of the deck edge on a bridge of this class.**

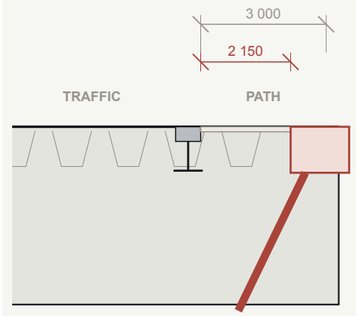
SELECTION

Family D is developed, and family C is retained as the fallback. D is selected on the user envelope and on replaceability, not on structural efficiency: C is the more conventional and better-precedented arrangement, and if the 3D torsion check on ST-0604 fails, the package reverts to C without changing the deck section.

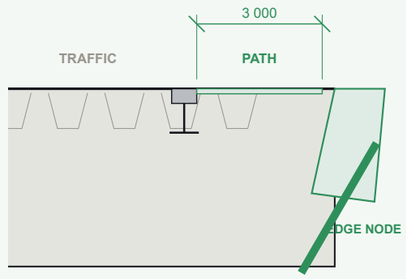
02 COMPARABLE SCHEMATIC SECTIONS

Outer deck edge; NTS

B · BLISTER, REJECTED



D · EXTERNAL NODE, DEVELOPED



03 THE HONEST POSITION

Stated so a reviewer does not have to find it

Families A and C together account for almost every long-span steel box deck built. The external node is not a novel idea structurally, but it is being applied here in a position where no built example was found. That is a real risk and it is carried as hold H1 on ST-0609, not treated as settled.

IF THE PRECEDENT GAP IS UNACCEPTABLE

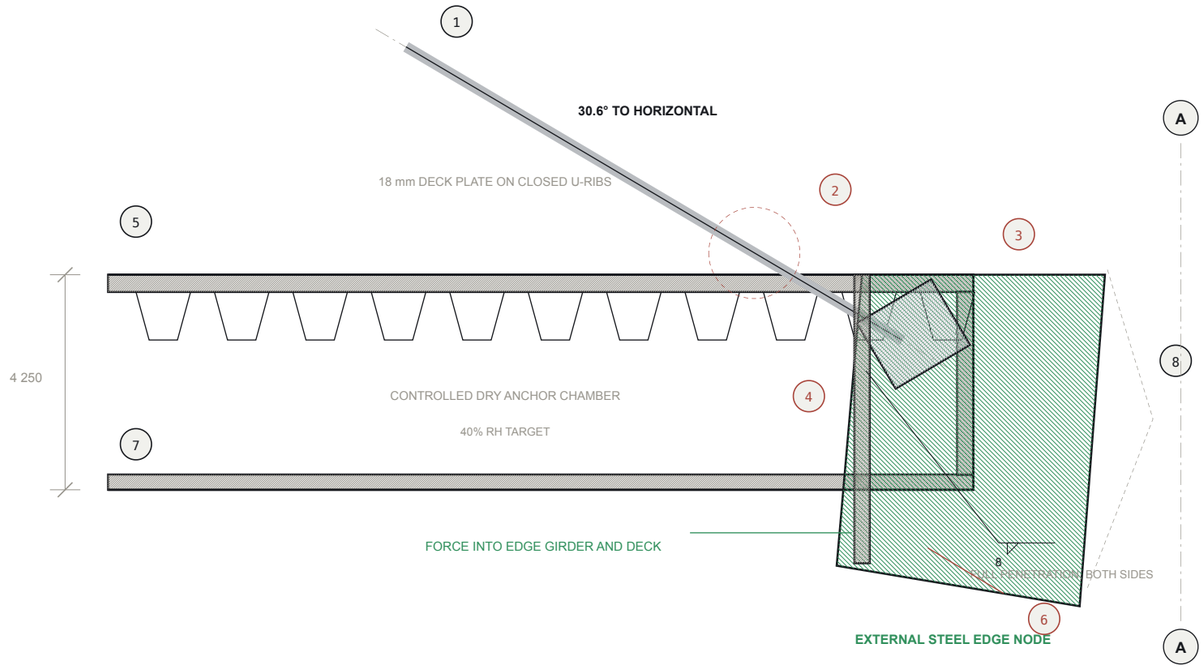
Revert to family C. The deck section, the stay geometry and the fatigue strategy are unchanged. What is lost is the continuous active path, which returns to 2.2 m clear at each anchorage.

Anchorage zone general arrangement

One anchorage bay in section, elevation and plan; the load path through it

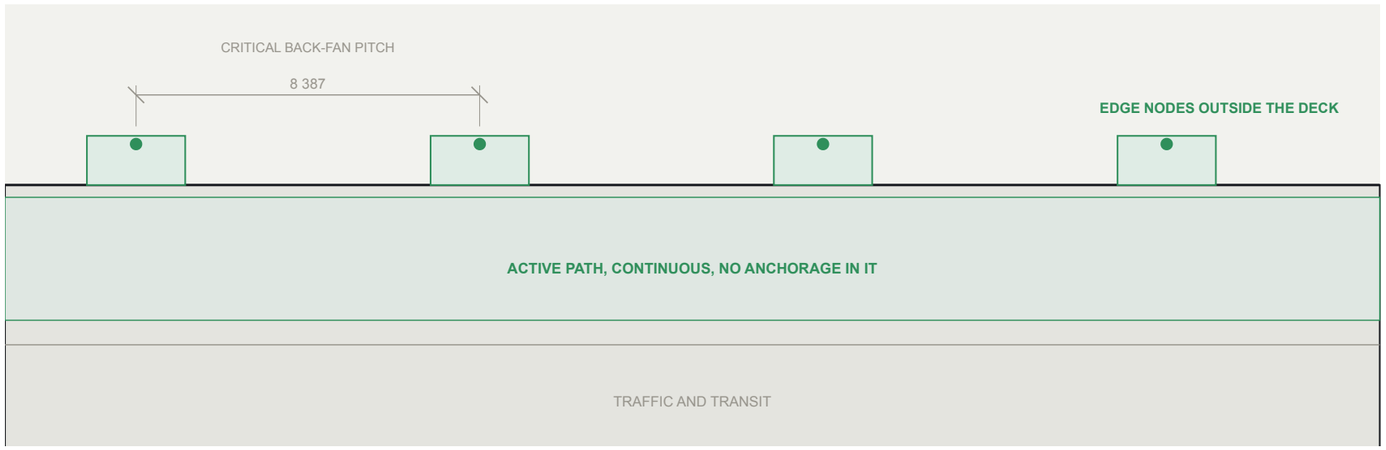
01 SECTION ON THE STAY AXIS

Reference stay BACK-01; back-fan position; schematic / NTS



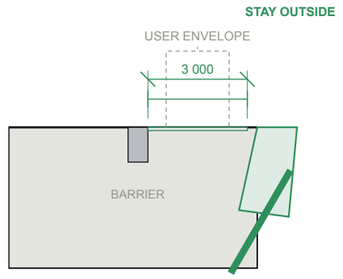
03 PLAN, ONE REPEATING BAY

Reference stay BACK-01; back-fan pitch 8,387 mm; schematic / NTS



02 TRANSVERSE ENVELOPE AND SET-OUT

The stay passes outside the user envelope; schematic / NTS



FIELD	BASIS
Reference stay	BACK–01
Offset from tower datum	320,000 mm
Back / main pitch	8,387 / 10,484 mm
Chainage, RL, local XYZ	HOLD H2

04 SECTION CALLOUTS AND LOAD PATH

Bubbles 1 to 8 on the section; no governing fatigue detail is claimed

REF	ELEMENT / ROLE
1	Stay cable: 11.319 MN preliminary ULS demand
2	Transition and damper zone: supplier hold H4
3	Anchor head and bearing plate: supplier hold H4
4	Node diaphragm: transfers force and eccentric moment to the box
5	Deck plate and closed U-ribs: local fatigue check H3
6	Low-point drain and tell-tale: durability hold H5
7	Controlled dry anchor chamber: access and RH holds H5/H6
8	Removable non-structural fairing: geometry hold H4

THE ECCENTRICITY

The load path is stay to head, bearing plate, node diaphragm, edge girder, deck and soffit, then tower. The outboard node also delivers torsion. Global-local analysis and fatigue ranking have not been completed and remain holds H2 and H3.

Edge node plate layout

Plate sizes, grades and how the force turns the corner out of the deck

01 PLATE SCHEDULE

Provisional. Thicknesses are set by the 3D analysis at hold H2, not here

REF	ELEMENT	PROVISIONAL	GRADE	STATUS
P1	Node bearing diaphragm	50 mm	S355 J2+N	PROVISIONAL
P2	Node side shells	30 mm	S355 J2+N	PROVISIONAL
P3	Node soffit	25 mm	S355 J2+N	PROVISIONAL
P4	Edge-girder transfer diaphragm	40 mm	S355 J2+N	PROVISIONAL
P5	Bearing plate, machined	80 mm	S355 J2+N	PROVISIONAL
P6	Deck plate, local thickening	18 to 25 mm	S355 J2+N	PROVISIONAL
P7	Guide pipe	supplier	supplier	HOLD H4

THROUGH-THICKNESS

P1 and P4 may develop through-thickness tension at welded joints. The required Z-quality class, toughness and lamellar-tearing checks must be set by the verified stress state, material thickness and fabrication procedure. They remain hold H2, not a released grade.

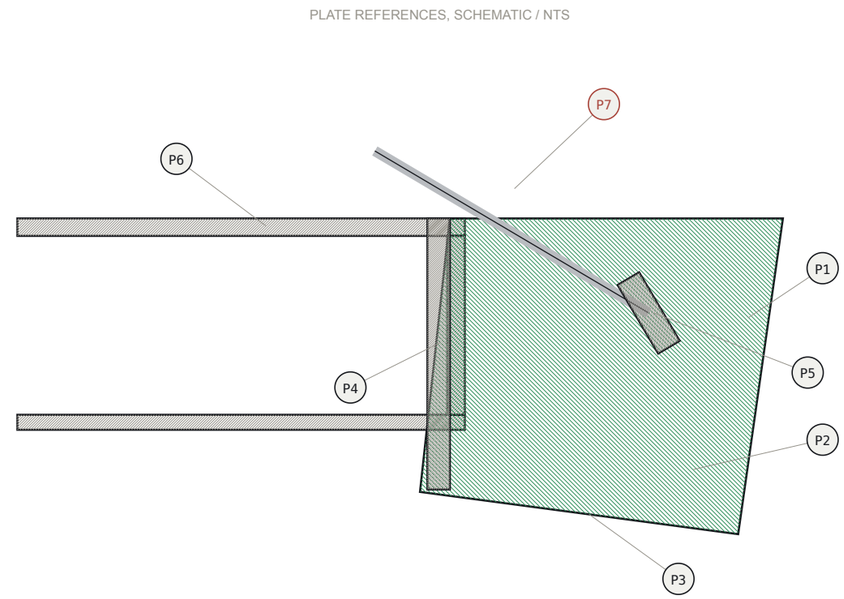
03 HOW THE FORCE TURNS THE CORNER

The reason the node is a box and not a bracket

The stay arrives at 30.6°. Its component along the deck is carried straight into the edge girder. Its component across the deck, and the moment caused by the node sitting outboard, have to be turned through the node shells into the diaphragm and then shared between the deck plate above and the soffit below. A single plate bracket cannot do that without prying; a closed box can.

02 SECTION

P1 to P7 mapped to the provisional node; schematic / NTS



NOT A FABRICATION PLATE LAYOUT

Profiles, closure dimensions, radii, cut-outs, edge preparations, tolerances, drain and vent holes, machining extents and weld symbols remain holds H2 to H5.

Weld map and fatigue detail categories

Mapped weld references and provisional fatigue classifications; no governing detail is claimed

01 WELD SCHEDULE

Candidate EN 1993-1-9 reference strengths at 2 million cycles, N/mm2; all are H3

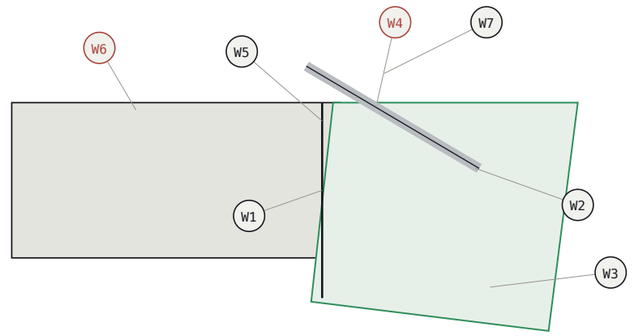
REF	LOCATION	TYPE	CAT	STATE
W1	**Node end diaphragm to edge girder web** Main load-path weld. Stress range, weld preparation and category reference remain H3.	Full penetration butt, welded both sides, ground flush	80 PROV	HOLD H3
W2	**Bearing plate to node diaphragm** Bearing and local bending interaction requires global-local analysis.	Full penetration butt, welded both sides	80 PROV	HOLD H3
W3	**Node shell longitudinal seams** Stop/start locations, execution class and weld procedure remain undefined.	Automatic fillet or butt, both sides, with stop and start positions	112 PROV	HOLD H3
W4	**Node shell to deck plate** Candidate critical detail because it crosses the deck-plate stress field.	Transverse fillet-welded attachment	71 PROV	CANDIDATE
W5	**Diaphragm cope holes at the rib run-outs** Cope holes are a geometry problem, not a weld. Rib run-outs must be coordinated with the diaphragm so the two do not stack.	Cut and ground, not welded	–	HOLD H3
W6	**U-rib to deck plate, through the anchorage bay** Partial penetration drops the category to the root-crack value. Standard for orthotropic decks but it must be checked against the local stress here, not the global.	Partial penetration, one side, 80% throat	36 ROOT PROV	CANDIDATE
W7	**Guide pipe to node face** Non-primary attachment on a fatigue-loaded face; supplier geometry remains H4.	Fillet, sealed	71 PROV	HOLD H3

FATIGUE SCREENING HYPOTHESIS

No governing fatigue detail has been identified. W4 and W6 are candidate critical locations because they sit in the orthotropic deck stress field. W1 remains in the check set because it transfers the stay force and eccentric moment. The ranking requires local stress ranges, road and rail spectra, damage summation and detail-reference confirmation.

02 WELD REFERENCE MAP

W1 to W7 are located here; schematic / NTS



WELD LOCATIONS, SCHEMATIC / NTS

03 WHY FATIGUE IS A DESIGN DRIVER

And why a static check would pass while the detail still fails

A stay carries a large permanent force and a small live range. The static check is within the preliminary cable thresholds: SLS ratio 0.899 and ULS ratio 0.855. What is not comfortable is that this deck carries **road and rail**, so the anchorage bay sees a high cycle count at a stress range set by axle and bogie passage, not by the stay.

The deck plate, ribs and anchorage welds must be assessed together. The category assignment above is a screening hypothesis, not a conclusion.

04 WHAT HAS NOT BEEN DONE

Named so a reviewer is not misled by the table above

ABSENT	CONSEQUENCE
Local shell or solid FE of the anchorage zone	Categories above are assigned by inspection of the detail geometry, not by analysis
Stress ranges and cycle counts	No traffic spectrum has been applied; no damage summation exists
Rail loading spectrum	Not defined. Rail is likely to govern the range
Fatigue testing of the detail	An unclassified local detail requires test substantiation rather than assignment to a category

HOLD H3

No weld on this sheet may be released for fabrication until the local fatigue analysis is complete and each category is either confirmed or substantiated by test.

Anchor head and supplier envelope

What the stay system demands of the structure built around it

01 WHAT THE SUPPLIER FIXES, AND WHAT WE FIX

The commonest cause of rework on a stay bridge is drawing the structure before the system is chosen

ITEM	SET BY	CONSEQUENCE FOR THE STRUCTURE
Anchor head and ring nut	Supplier	A published 73-strand stressing end gives head Ø420 × 200, ring nut Ø560 × 190, bearing plate Ø680 × 100. A second gives bearing plate Ø715 × 110, ring nut Ø536 × 180. [H1/H2]
Recess pipe	Supplier	Ø457 to Ø480, one source stating a **1 930 mm minimum length**. This sets how far the node projects. [H2]
Jack envelope	Supplier	A 73-strand group jack runs about **780 × 760 in section, 965 long**, needing **780 mm** strand protrusion; a monostrand jack about **1 100 mm**. One supplier states **1 500 mm minimum clearance**. [H2]
Guide pipe and deviator	Supplier	A national approval for a 6-73 assembly lists a **2 350 mm deviated length** and components to about Ø508. [H1]
Damper type and reaction	Supplier	A second load path into the node that is not in the sizing
Permitted angular deviation	Supplier	Qualification uses **10 mrad** static deviation; one system claims a bending filter good to **50 mrad**. Treat 10 mrad as the test condition, not as licence for loose setting out. [H1]
Stay force and inclination	Designer	BACK-01: 8.242 MN preliminary SLS, 11.319 MN preliminary ULS, 30.6°
Anchorage position and pitch	Designer	Back fan 8,387 mm; main fan 10,484 mm; 32 positions per fan

A COMPARISON THAT MUST NOT BE MADE

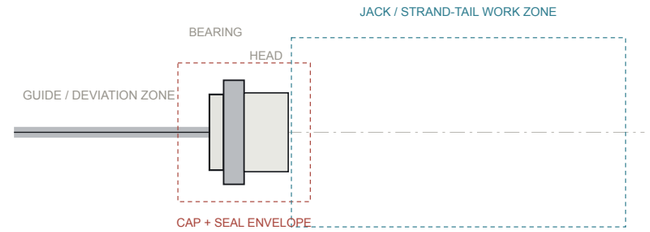
For this preliminary 73-strand record, **9.165 MN at 45% GUTS** and **13.239 MN at 65% GUTS** are allowable thresholds. The analysis demands are 8.242 MN SLS and 11.319 MN ULS. These quantities must not be exchanged. Frequent and fatigue force envelopes do not yet exist. [H3 gap]

HOLD H4

No plate on ST-0603 is released until the supplier envelope is fixed. The two published bearing plates above differ by 35 mm in diameter, which alone changes the node end diaphragm.

02 SUPPLIER INTERFACE ENVELOPE

Required components and work zones; all controlling dimensions are H4; NTS



ALL ENVELOPE DIMENSIONS AND REACTIONS: SUPPLIER HOLD H4

03 WHAT PTI REQUIRES OF THE ZONE

These are requirements, not preferences

1. **FULL ULTIMATE FORCE**
   The anchorage must transmit the full ultimate tensile force of the cable, 20.37 MN, not the design force. [H1]
2. **NO HARD FILLING**
   No cement grout or hard filler in the anchorage area. The void between the strand bundle and the anchorage must allow individual strands to be monitored and replaced. [H1]
3. **PROTECTIVE CAP**
   A steel cap over the anchor block, strand tails and wedges, with wax or grease on exposed steel. [H1]
4. **MATERIAL**
   Anchorage tubes, ring nuts, bearing plates and guide pipes in high-strength low-alloy structural steel. [H1]

A CATEGORY ERROR TO AVOID

Stay qualification is **2 million cycles at 159 to 200 MPa stress range, upper stress 45% GUTS, not more than 2% wire breaks, at 10 mrad deviation**, then tensile capacity. That proves the cable, the anchor head, the wedges, the deviation device, the transition and the seals.
It proves nothing about the welded steel node. The node needs its own EN 1993 fatigue, fracture and local force-transfer verification. Two evidence chains; ST-0604 handles the second. [H1 values, H2 attribution]

Corrosion protection, drainage and dehumidification

What keeps this alive for a hundred years in a marine environment

01 THE THREE BARRIERS

Each independent, so one failing does not expose the steel

1. **THE STRAND ITSELF**
   Individually galvanised, wax filled, HDPE sheathed. The strand is protected before it ever reaches the structure.
2. **DRY AIR IN THE ANCHORAGE**
   Dry air injected at the anchorage flows through the annular space between strands and vents near the pylon. A built prototype targets **below 40% RH**. Treat **≤40% RH** as a candidate performance target only; the durability engineer must set the project criterion, sensor locations, alarm bands and redundancy. [H1/H5]
3. **COATING ON THE NODE**
   A marine protective system with maintainable access is required. Galvanizing feasibility, surface preparation, coating build-up, dry-film thickness, venting and touch-up are unresolved and remain H5.

02 DRAINAGE

Water gets in. The detail decides whether it gets out

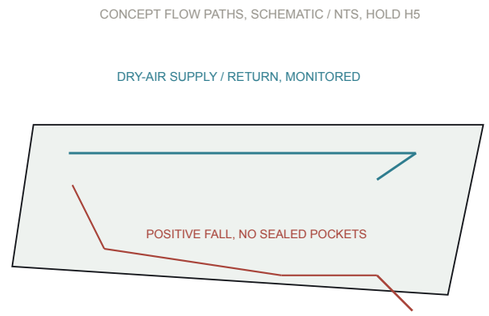
LOCATION	REQUIREMENT
Transition tube	Positive fall to a **roddable low-point drain discharged outside the box**, with a tell-tale. A retrofit on a built cable-stayed bridge added a **30 mm drain** through the anchorage blister plus holes through the guide tubes and a two-part guide tube, because the original detail trapped water. [H1]
Node interior	No sealed pockets. Vent and drain at the lowest point of every compartment
Fairing	Non-structural, removable, drained separately from the node
Anchor chamber	Sealed against water but served by the dry air system, and monitored

THE FAILURE THAT IS EASY TO DRAW IN

A node cantilevered outboard with a sealed lower compartment is a water trap. If the drainage on this sheet is value-engineered out, the coating becomes the only barrier and the design life is not 100 years.

03 FLOW-PATH CONCEPT

Dry-air and drainage routes must be converted into coordinated physical details



04 MATERIAL COMPATIBILITY

Marine exposure punishes mixed metals

PAIRING	REQUIREMENT
Stainless to coated carbon steel	Isolate. 316 or higher for exposed pins and fasteners, with isolating washers and sleeves
HDPE sheath to steel guide pipe	Published practice is an **HDPE overlap sleeve onto the steel guide pipe, sealed with a neoprene boot and steel bands**. A known leak path. [H1]
Galvanized to duplex coating	Compatible system, applied after vent-hole touch-up, not before
Aluminium anywhere near	Avoid. If unavoidable, isolate fully

05 INSPECTION

A barrier you cannot inspect is a barrier you cannot rely on

Every one of the three barriers must be inspectable without dismantling primary steel: the sheath visually from the deck, the dry air system by its own instrumentation, and the node coating from inside the box and from a stable external platform.

WATER TEST

Current stay recommendations are described as testing the complete anchorage, transition, seals and **at least 1 m of free length under a 3 m dyed-water head for 96 hours**. Use this only as a candidate benchmark. The adopted standard, complete specimen, water head, duration and acceptance criteria must be confirmed in H5. [H2]

HOLD H5

Coating system, metal compatibility schedule, drainage design and the dehumidification specification are all to be confirmed by the durability engineer before fabrication.

Stressing, replacement and access

How it is tensioned, how a strand is changed, and how a person reaches it

01 STRESSING SEQUENCE

Strand by strand, from inside the box

1. **FIRST STRAND SETS THE DATUM**
   An isotensioning method references every subsequent strand to the first, so the bundle ends at a uniform force without jacking the whole cable.
2. **REMAINING STRANDS TO MATCH**
   72 further strands, each stressed to the datum. The chamber must hold the jack, the operator and the strand tails at once.
3. **RECHECK AFTER DECK LOAD**
   Forces are re-measured after the deck is complete and adjusted at the ring nut.

WHAT SETS THE CHAMBER SIZE

Not the anchor head. Published 73-strand equipment: a group jack about **780 × 760 in section, 965 long**, needing **780 mm** strand protrusion; a monostrand jack about **1 100 mm**; one supplier stating **1 500 mm minimum clearance**. Add room to fit and remove the jack, contain the strand tails and stand up. [H2]
This cannot resolve until the supplier confirms whether stressing is strand by strand or as a group.

02 REPLACEMENT

Designed in, not hoped for

REQUIREMENT	PROVISION
Single strand replacement	No hard filler in the anchorage, per PTI. Strands de-tensioned and withdrawn individually
Whole stay replacement	The stay is detached at tower and deck, removed, and a replacement brought in and fixed at both ends
Traffic during replacement	Lane closure envelope and the load case with one stay absent are both undefined here
Lifting and handling	Permanent lifting points inside the chamber and on the node

03 ACCESS

If it cannot be reached it will not be maintained

ELEMENT	ACCESS
Anchor head and ring nut	From inside the deck box, standing, at every one of the 256 positions
Chamber route	Internal lit walkway with fall protection. A 900 mm clear route is a layout placeholder only; the project access criterion and full equipment envelope remain hold H6
Transition and damper	Removable cover from inside; the guide pipe exterior from a platform
Node exterior and coating	External stable platform. Not yet designed
Drainage tell-tales	Visible from the internal route without dismantling

HOLD H6

Safe access, fall protection, lifting points and the replacement route must be proved at full scale before series fabrication. A route that works on a drawing and not with a jack in it is a route that does not work.

04 THE LOAD CASE NOBODY DRAWS

And which decides whether replacement is possible at all

Replacing a stay means the structure carries a permanent load case with one stay absent and the two adjacent stays taking its share. That case sets the reserve in the deck, the adjacent anchorages and the tower. It is not in the sizing on ST-0600 and it is not a detailing matter: it is a global analysis case that has to exist before the anchorage can be called replaceable.

Tolerances and shop first-article test

What must be proved once, before 256 are built

01 TOLERANCES THAT MATTER

Most tolerances are routine. These four are not

ITEM	WHY IT IS CRITICAL	SET BY
Angular deviation at the anchor head	The stay system tolerates a stated deviation before the bending filter is overloaded. Exceed it and the fatigue qualification no longer applies	Supplier
Bearing face flatness and squareness	Eccentric bearing on the plate turns axial force into local bending in the diaphragm	Fabricator
Node position along the deck	Sets the stay geometry and therefore the force distribution. Cumulative error over 32 positions is the risk	Fabricator
Weld profiles at W1, W4 and W6	Candidate fatigue-sensitive locations. Preparation, toe treatment, tolerances, NDT and acceptance criteria remain H3/H7	Designer / fabricator

CUMULATIVE ERROR

An error of a few millimetres per bay is invisible at one anchorage and is 32 times larger by the end of the fan. Set out from a survey datum, not from the previous node.

03 WHY A FIRST ARTICLE AND NOT JUST INSPECTION

The economics of 256 repetitions

Inspection catches a bad unit. A first-article test catches a bad **method**. With 256 assemblies, a method fault found at unit 40 is 40 rejections and a programme problem. Found at unit 1 it is a procedure change.

02 FIRST-ARTICLE TEST SCOPE

One complete assembly, proved before series fabrication is released

1. **DIMENSIONAL**
   Full survey against the model: bearing face, anchor axis, node position, guide pipe alignment.
2. **WELD QUALITY**
   NDT extent and acceptance to the approved inspection and test plan. Destructive sectioning or procedure-qualification mock-ups for W1, W4 and W6 as the plan requires.
3. **TRIAL ASSEMBLY**
   Anchor head, bearing plate, guide pipe and damper trial fitted with the actual supplier hardware.
4. **STRESSING REHEARSAL**
   A jack of the real length operated in the real chamber envelope, by a person, to prove the space works.
5. **DRAINAGE**
   Water poured into every compartment and observed leaving at the tell-tale.
6. **COATING**
   Galvanize, vent-hole treatment and duplex system applied and tested on the real geometry, including the internal corners.

RELEASE

Series fabrication is released only when the project test plan, numeric acceptance criteria, responsible signatories and all six results are approved. That is hold H7.

References, hold points and verification

Every source, every hold, and the honest state of each check

01 VERIFICATION RECORD

Any HOLD blocks fabrication of the anchorage

CHECK	STATE	EVIDENCE
Anchorage typology screened	PASS	Four concept families compared on ST-0601; professional acceptance remains H1
Stay demand and thresholds separated	PASS	BACK-01: demand 8.242/11.319 MN; thresholds 9.165/13.239 MN
Assembly quantity reconciled	PASS	2 towers x 2 fans x 32 x 2 edges = 256
P02 model path clearance	PASS	256 nodes outside |y|=19.0 m; path outer edge |y|=18.7 m; stay axis |y|=20.0 m
Governing fatigue detail identified	HOLD	Not established. W4 and W6 are candidates; W1 remains in the check set. H3
Project design basis accepted	HOLD	Owner-approved cable-stay and rail basis, departures and Category 1 review not recorded. H1
Deck torsion from eccentricity	HOLD	Not analysed. H2
Fatigue categories	HOLD	Assigned by inspection, not by analysis or test. H3
Supplier geometry	HOLD	System not selected. Every head-related dimension provisional. H4
One stay absent	HOLD	Global load case does not exist. H6
Built precedent for the arrangement	HOLD	None found. H1

03 SOURCES

Evidence grade E1 primary/official, E2 secondary or inferred, E3 assumption; H1 to H7 are project holds

SOURCE	WHAT IS TAKEN FROM IT	GRADE
PTI DC45.1–18 + errata	Recommendations for Stay Cable Design, Testing and Installation. Anchorage must transmit full ultimate force; no hard filling in the anchorage area; strands individually replaceable.	E1
fib Bulletin 89 (2019)	Acceptance of stay cable systems using prestressing steels.	E1
NZTA Bridge Manual v3.4	Excludes cable-stayed bridges and railway loading; use with TAN 26-01 interim HN amendments.	E1
NZTA Highway Structures Design Guide	Category 1 technical approval, Structure Design Statement and wholly independent review route.	E1
KiwiRail B–ST–DE–3036, Issue 2.0 (2024)	Rail bridge design annex; project rail-owner criteria and loading remain to be adopted.	E1
AS/NZS 1100.501:2002	Structural engineering drawing practice. This concept package is schematic and NTS.	E1
AS/NZS 5131:2016 / SNZ TS 3404:2018	Steelwork fabrication and steel structures; project execution requirements remain H2/H7.	E1
AS/NZS 5100.6 / EN 1993–1–9	Candidate steel and fatigue bases. Confirm current editions, amendments and exact fatigue-detail references before design issue.	E1/E2
NYSDOT 598.00000111	Stay cable system specification: anchorage tubes, ring nuts, bearing plates and guide pipes in high-strength low-alloy structural steel; steel cap over anchor block, strand tails and wedges; wax or grease on exposed steel.	E1
NCHRP Synthesis 353	Stay acceptance basis: 2 million cycles, 159 MPa range, upper stress 45% GUTS, not more than 2% wire breaks.	E1
Supplier tables / 6–73 approval	Screening geometry for 73-strand heads, bearing plates, recess and guide tubes, group and monostrand jacks. Not a selected system.	E2
Bridge precedents and service reports	Stonecutters family-C precedent; Uddevalla dehumidification; ANZAC drainage retrofit; FHWA transition-seal reporting.	E2

02 HOLD POINTS

Close with signed evidence, not a verbal assumption

- H1 **PRECEDENT AND ARRANGEMENT**
  Confirm the external node is acceptable given that no built precedent was found for anchoring outboard of the deck edge, or revert to family C on ST-0601.
- H2 **3D STRUCTURE AND TORSION**
  Global model confirming deck torsion from the eccentric transfer, node and diaphragm capacity, and the plate thicknesses on ST-0603.
- H3 **LOCAL FATIGUE**
  Shell or solid analysis of the anchorage zone with a real traffic and rail spectrum, confirming or substantiating every category on ST-0604.
- H4 **SUPPLIER ENVELOPE**
  Stay system selected; anchor head, bearing plate, jack length, guide pipe, damper and permitted deviation fixed.
- H5 **DURABILITY**
  Coating system, metal compatibility, drainage and dehumidification confirmed for 100 years in this exposure.
- H6 **ACCESS AND REPLACEMENT**
  Safe access, fall protection and the stay replacement route proved at full scale, with the one-stay-absent load case analysed.
- H7 **FIRST ARTICLE**
  The six tests on ST-0608 passed and reported.

STATUS OF THIS PACKAGE

Ten sheets of detail with seven open hold points. That ratio is normal at this stage and is the point of the package: the drawing exists so the holds can be identified precisely enough to be closed, not so anything can be built from it.