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Peirianwyr Ymgynghorol
Consulting Engineers

REPORT ON REPAIR OF FENDERING TO BERTHING PLATFORM

LLANDUDNO PIER

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REPORT ON REPAIR OF FENDERING TO BERTHING PLATFORM, LLANDUDNO PIER

1.0 Introduction

1.1. In October 2009 Datrys were instructed by Conwy County Borough Council to undertake a condition survey of the fendering arrangements to the seaward mooring platform at Llandudno Pier. The purpose of the inspection was to determine the present condition of the fendering and to identify the scope of remedial works that would be necessary to allow the pleasure boats Waverley and Balmoral to once again use the facility. A budget costing for the works was to be provided.

1.2 The inspection of the berthing and mooring platform structures did not form a part of the brief.

2.0 Location

2.1. The berthing platform is located at the north end of Llandudno Pier. Its plan dimensions are 18 x 7.5m. The platform is approximately 9m off the end of the Pier and is accessed via a lattice bridge. A mooring platform is located some 18m to the south and is accessed separately from the Pier. The berthing faces of the platforms align and run approximately NNE.

2.2. The Pier at Llandudno extends to a point below low water and it is estimated that there is approximately 2m of water at the berth on spring tides. The location is sheltered from the predominant winds from the west by the Great Orme but has a 170km fetch to the north. The site is susceptible therefore to wind generated waves from this direction with a potential significant wave height of 4m.

2.3. The berthing platform consists of 20 steel piles supporting 3 reinforced concrete slabs. The associated mooring platform is of a similar construction but with 12 piles supporting a single smaller concrete slab. The fendering framework, of hardwood baulks, is attached to the eastern face of the berthing platform only and is separated from the concrete slabs by individual rubber fenders. Its detailed form and condition is described below

3.0 History

3.1 It is understood that the platforms were constructed in 1969 and they have previously been used by the Waverley and Balmoral with displacements of 740t and 540t respectively. The last visit by the Balmoral was in June 2006.The berth was also used by the Isle of Man

ferry and the Lady of Mann with a displacement of 4,500t used the facility on a regular basis and is recorded on the berth in June 2003.

3.2 The owners of the Pier informed us that they had undertaken repairs of the fendering in the past and had used a small crane mounted on the platform and accessed from the Pier. A scheme for further repairs had been proposed several years ago at a cost of £80,000 but had not been implemented. Local fishermen who regularly use the platform felt that the condition of the framework had deteriorated significantly in recent years.

4.0 Survey work

4.1. The survey was carried out on a visual basis only. No sampling, testing or uncovering was carried out.

4.2. The initial survey was undertaken on 28 October 2009 with the County Maritime Officer and members of the Council Engineering and Design Department. During the initial survey access was gained only to the upper slab of the berthing platform which allowed a general view of the berth to be obtained and at-hand inspection of the upper timbers of the framework. It was not possible however to view the lower portions of the fendering as the access staircase was deemed to be unsafe.

4.3. A second inspection was therefore arranged for 3 November to coincide with a suitable tide and permission was gained to allow access to the middle slab of the platform. Access to the lower slab was not possible as the stairs had been lost. At-hand inspection to most of the remaining framework was possible during the second survey which revealed that much of the framework was now missing as described below. The remaining timbers and fittings did give an indication of the original form and both have been shown on the enclosed drawings.

5.0 Observations

5.1. The fendering comprised of a hardwood rubbing framework held off the berthing platform by rubber fenders. The vertical rubbing faces comprised of 7 lines of hardwood baulks of 450x450 cross-section. Many of the verticals were formed of pairs of timbers although whether these were original or additions during maintenance work is unclear. The verticals were supported by 3 lines of hardwood cross-beams of 350x350 cross-section set at the same level as the platform slabs.

5.2. The principal support between the verticals and the cross-beams comprised of a fabricated steel U-shaped bracket bolted onto the top surface of the beam and then bolted to the sides of the verticals through the side plates alone. This detail had generally failed and

appears to have caused splitting of the timbers due to eccentric loading.

5.3. The framework was suspended from the piles of the berthing platform through chains and substantial fork-and-eye turnbuckles. These connected from beneath the upper platform slab to the top surface of the middle cross-beams and occurred at each pile position. The remains of other chains hung beneath the middle cross-beams whose function was probably to act as a hanger support to the lower cross-beams. A horizontal chain arrangement was fixed at either end of the framework to provide longitudinal restraint.

5.4 Circular rubber fenders were located between the cross-beams and the platform slabs behind each line of verticals. The fenders were connected to the cross-beams by a substantial steel strap along the axis of the fender and bolted to the side of the cross-beam.

5.5 Of the original framework of 3 cross-beams and 7 lines of verticals only 2 cross-beams remained whilst 5 lines of verticals were missing. The loss of the lower beam had lead to the loss of the attached rubber fenders which provided a lower bearing point for the framework against the bottom slab. In its absence the framework had rotated from the vertical causing the compression of the middle rubber fenders and the loss of contact between the upper slab and the framework.

5.6 Other significant defects noted were:

- Permanent compression set in upper rubber fenders.
- Significant corrosion of the steel fittings.
- Failure of the brackets connecting the verticals and cross-beams.
- Localised splitting of the timbers where bolts had been overstressed.
- Decay of ends of vertical timbers suggesting similar decay may be present in the remaining cross-beams.

5.7 Although the inspection did not specifically include the berthing platform itself it is considered noteworthy to record that the steel piles showed extensive signs of corrosion and longitudinal splitting of the corroded surfaces. It is understood that an inspection of the structure has been carried out in recent years and which concluded that no immediate remedial works were required. The conclusions of the report and its recommendations should be reviewed in the light of any proposals to reuse the berth.

6.0 Discussion

6.1 From the inspection it is clear that most of the timber elements of the fendering framework have been lost together with their associated

fittings. The verticals that remain show extensive decay at both their upper and lower ends. It was not possible to view the ends of the cross-beams but it is probable that they will also have been subject to some decay especially at the middle beam. Locally the timbers show distortion and splitting where bolted fittings have failed.

6.2 The form of the fendering and most of its fittings are considered to be substantial. Its primary function would be to provide a rigid framework that would distribute the berthing energy of the vessel via the vertical members to the continuous cross-beams causing the simultaneous compression of a number of rubber fenders. The fendering also acts as a rubbing surface for the moored vessel and would therefore be subject to vertical loads due to wave action on the vessels and varying tide levels.

6.3 The vertical downward loads applied to the framework would be transferred by the verticals to the cross-beams through the bolted steel bracket described above. The lowest cross-beam was supported from a vertical chain suspended from the middle beam. This beam in turn was suspended from beneath the upper slab of the berthing platform by inclined chains. This load path would be critically dependant on the adequacy of:

- the steel brackets to support the verticals.
- the bolts through the beams connecting the chains to support the cross members.

It is clear from the form of the remains that both of these details have largely failed.

6.4 The steel bracket is considered to be particularly vulnerable to corrosion and overstress. Where the plate connects to the verticals it reduces to a pair of unstiffened steel plates subject to eccentric loading. The remains of these plates show failure of the plate due to buckling under bending.

6.5 The bolted detail at the chains has performed adequately at the critical middle cross-beam where its failure would have resulted in the loss of the entire framework. The lowest cross beam is absent however and it is unclear from the remains of the chains whether the failure was due to the bolted connection or the chain itself.

7.0 Conclusions

7.1 The fendering framework was of a substantial construction and comprised hardwood vertical and horizontal baulks

7.2 Most of the timbers and fittings of the framework have been lost.

7.3 The timbers that remain show signs of decay and splitting due to overstressing of bolted connections.

7.4 The loss of most of the vertical members is as a result of the failure of the steel bracket connecting them to the cross-beams. The detail is considered to be vulnerable to the effects of corrosion and overload.

7.5 The lower cross-beam appears to have been lost either as a result of the failure of its bolted connection to the supporting chain or the chain itself.

7.6 The framework and its fittings are considered to be in a condition where they cannot sensibly be repaired without a significant on-going programme of monitoring and repair. As such the framework should be replaced in its entirety.

7.7 The structure of the berthing platform is of an age and in a condition where its adequacy should be reviewed. The same considerations would also apply to the adjacent mooring platform.

7.8 If the berth is to be brought back into use then ancillary works will need to be undertaken these would include:

- Clearing the berth of debris
- Reinstating, repairing or replacing the access stairs.
- Reinstating balustrades to the lower platforms.

7.9 The cost of the refurbishment work is substantial and consideration should be given to alternative fendering and berthing arrangements that might prove to be both more cost effective and appropriate for the vessels envisaged. Due consideration should be given to the exposed nature of the site.

8.0 Recommendations

8.1 The present fendering should be replaced in its entirety.

8.2 The adequacy of the existing berthing and mooring platforms should be confirmed.

8.3 To replicate the original fendering a new framework should be installed at a budget cost of £320,000 including fees and contingency.

8.4 Alternative berthing and fendering arrangements should be considered to identify the most effective arrangement for the berth.

Costings

The costings have been prepared assuming that the work will require the use of a suitable jack-up barge with crane. A method of working has been outlined which entails the removal of the existing frame and the clearing of the berth using the barge and their disposal of the debris along the Pier. Delivery of the material for the new framework is also assumed to be along the Pier which may require load spreading and a partial closure.

The making good of the platforms and stairs has not been included in the costings

Timber framework	£70,000
Rubber fenders	£10,000
Chains and fittings	£20,000
Barge mobilisation and de-mobilisation	£45,000
Towage to site	£15,000
Charter and other costs	£70,000
Divers and safety boat	£5,000
Contractor's overheads	£35,000
Contingency	£30,000
Fees	£20,000
Budget Cost	**£320,000**

PHOTO 1:

PHOTO 2:

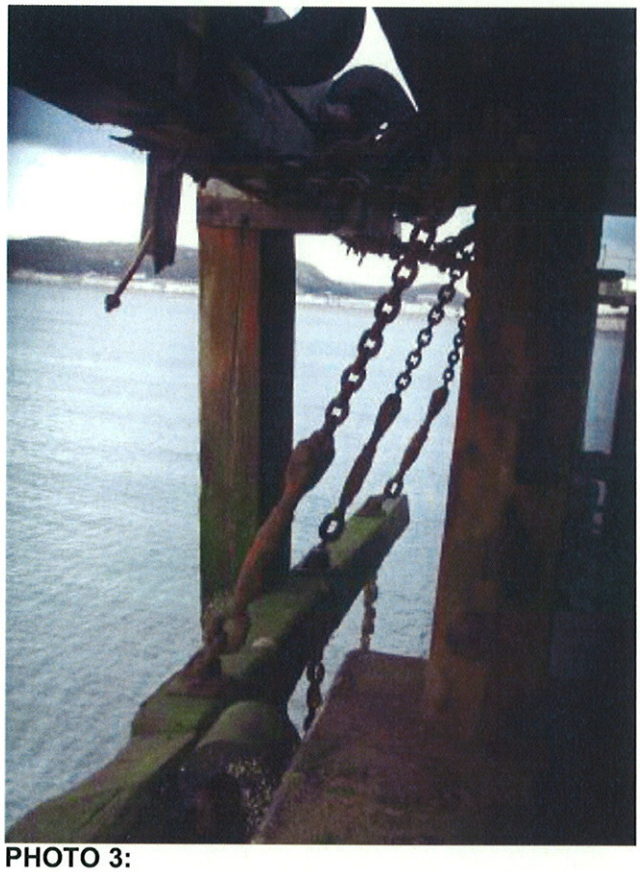


PHOTO 3:

PHOTO 4:

PHOTO 5:

PHOTO 6:

PHOTO 7:

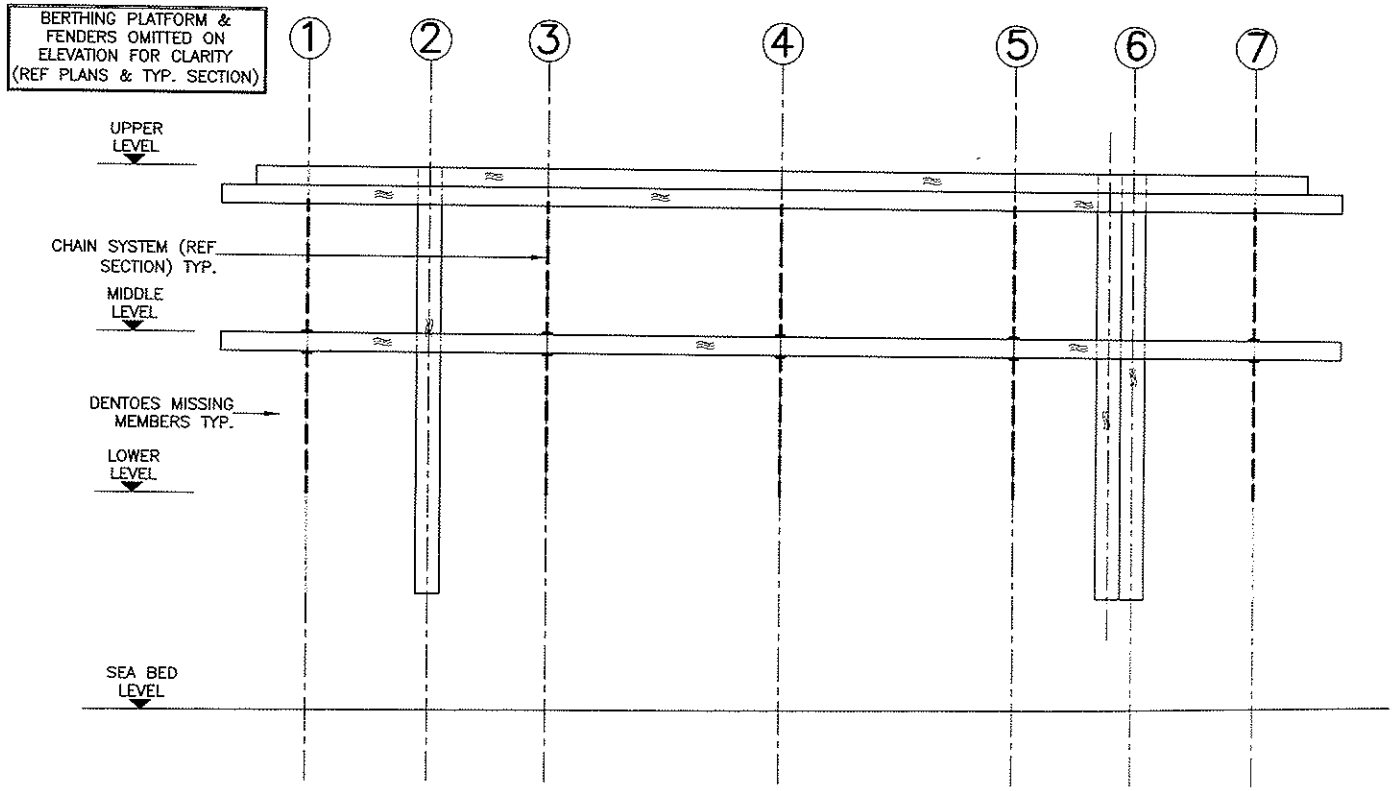
PHOTO 8:

PHOTO 9:

PHOTO 10:

PHOTO 11:

PHOTO 12:



EXISTING ELEVATION

(FACING SEA)

1:100

TITLE: Existing Framework — Elevation —	PROJECT: Llandudno Pier	DATRYS Peirianwyr Ymgynghorol Consulting Engineers	Yr Aelwyd, 3-5 Church Street, Caernarfon, 01286 671027, 01286 674434, info@datrysconsulting.com, www.datrysconsulting.com (Telephone, Fax, E-mail, Internet)	Job No. 09224	DATE 5.11.09 / SCALE 1:100
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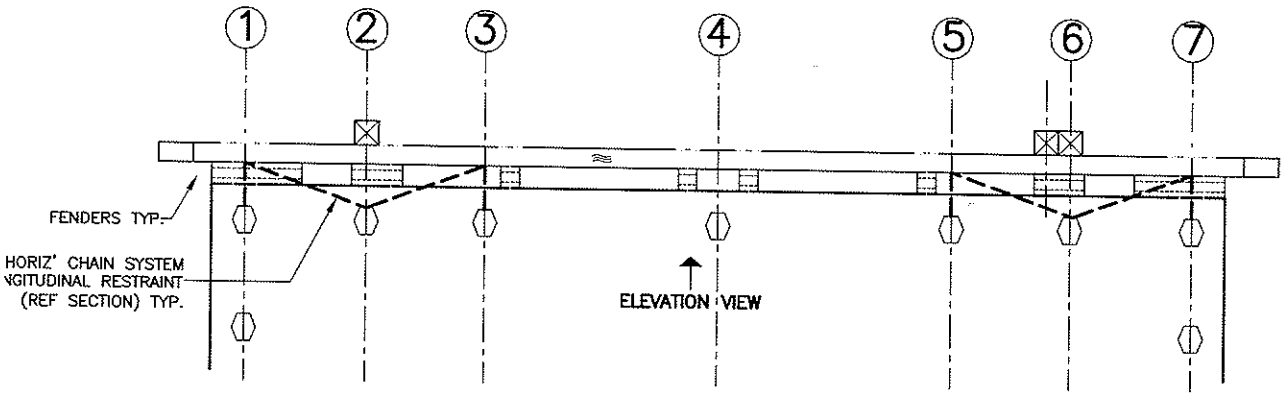
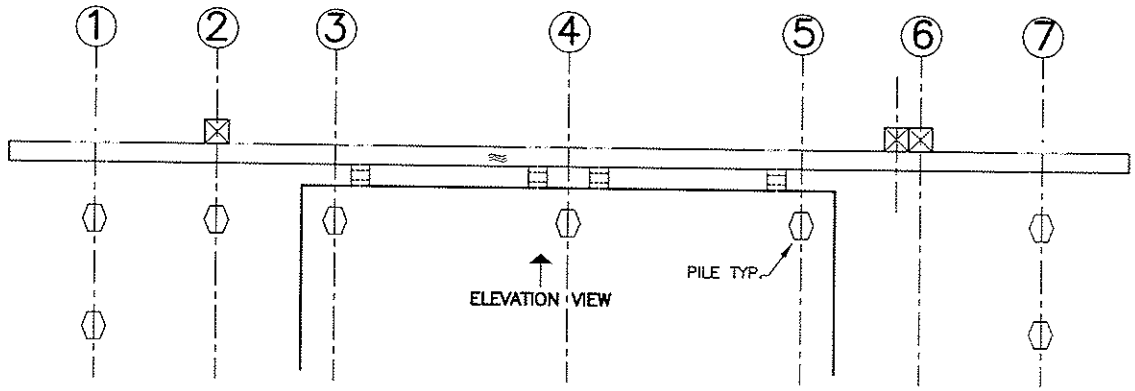
				DRAWN CJ	DRG No. 0001 / REV



UPPER LEVEL PLAN

1:100



MIDDLE LEVEL PLAN

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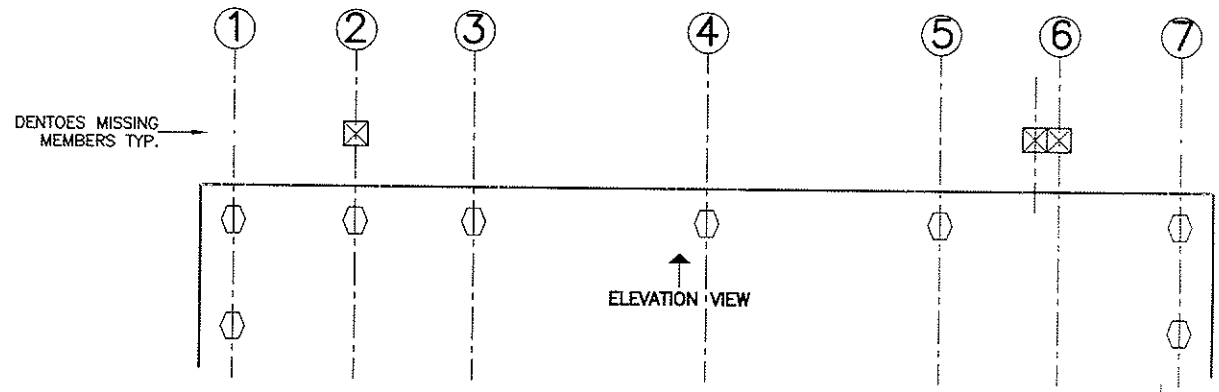

LOWER LEVEL PLAN

1:100

TITLE

Existing Framework
– Plans –

PROJECT

Llandudno Pier

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Job No. 09224	DATE 5.11.09	SCALE 1:100
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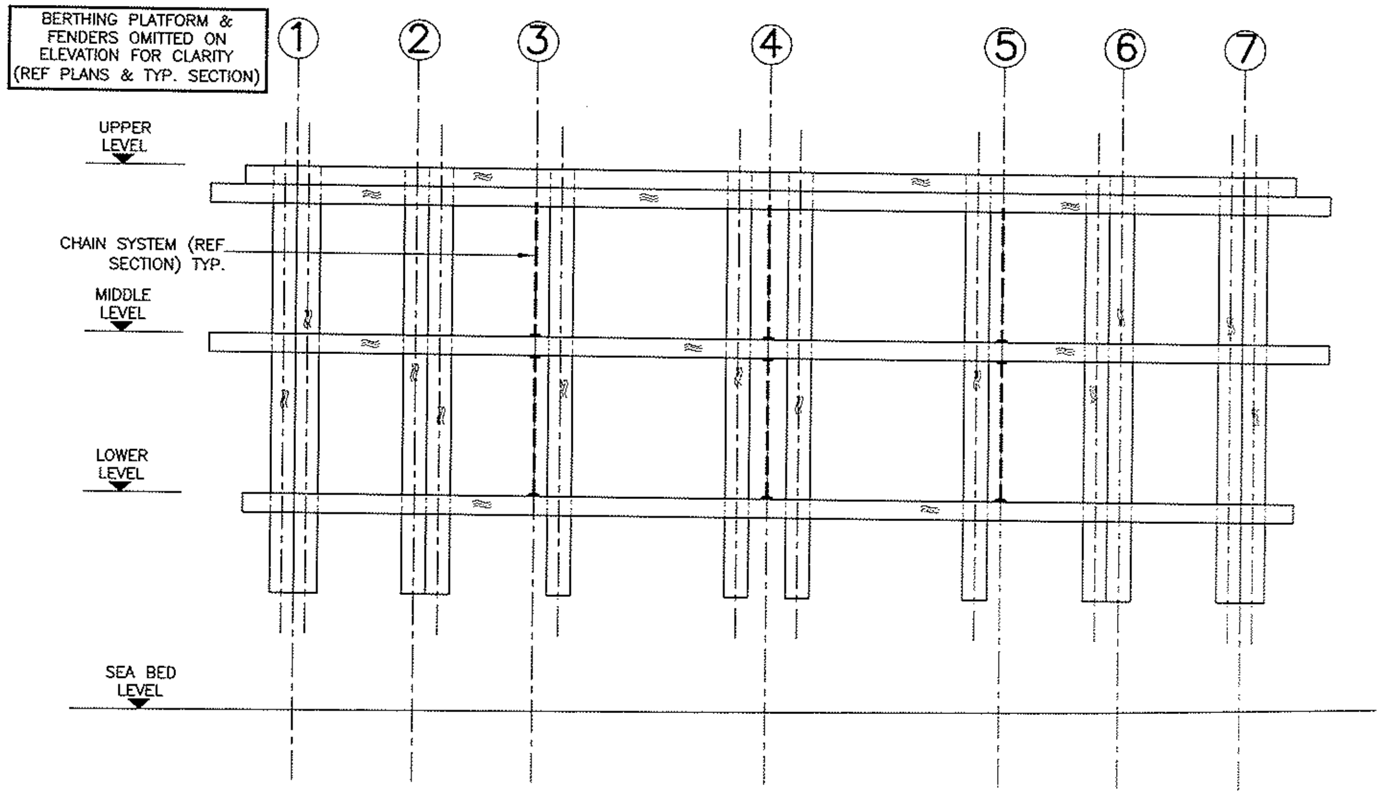

ELEVATION

(FACING SEA)

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			ACAD Ref.09224/0003	CHECKED EPW	PASSED
			DRAWN CJ	DRG No. 0003	REV

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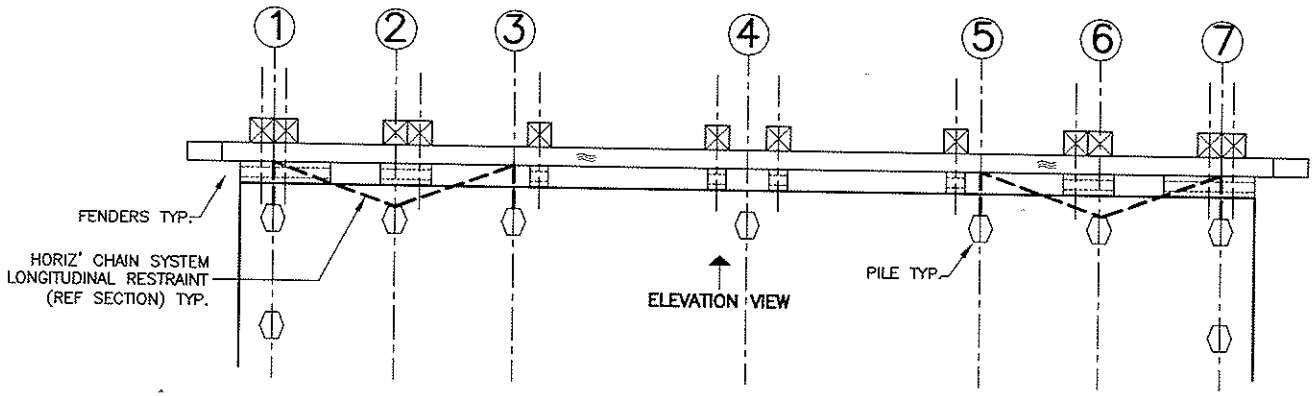

UPPER LEVEL PLAN

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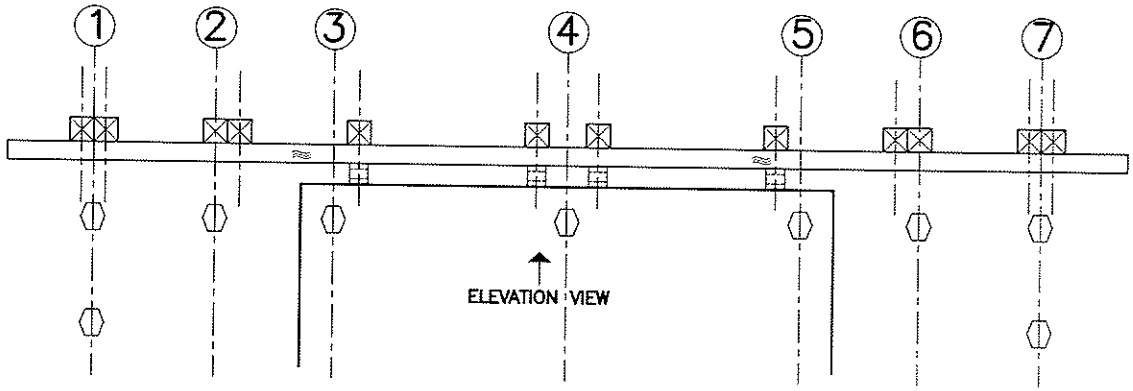

MIDDLE LEVEL PLAN

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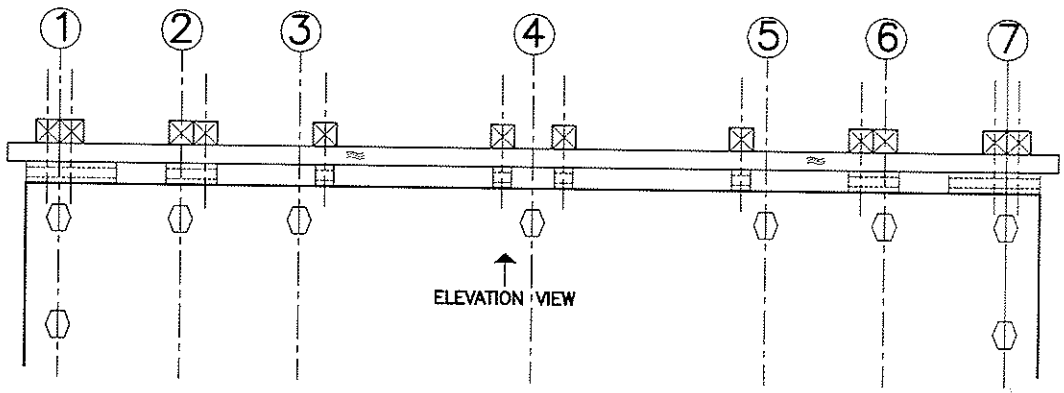

LOWER LEVEL PLAN

1:100

TITLE

Reinstated Framework
— Plans —

PROJECT

Llandudno Pier

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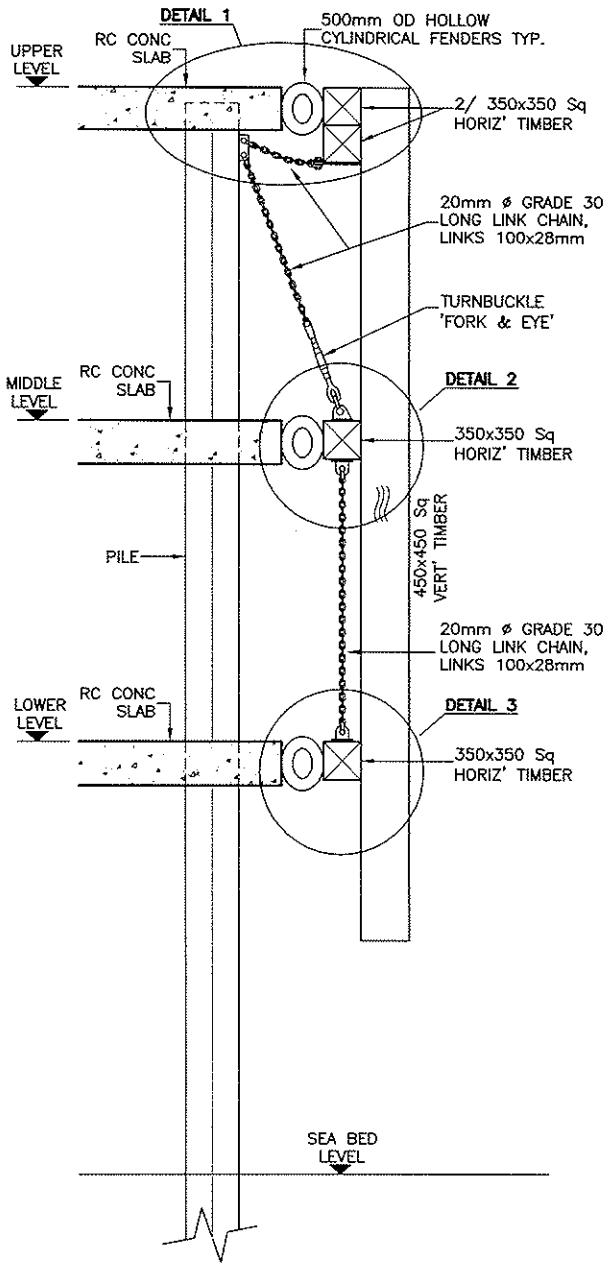

TYP. SECTION

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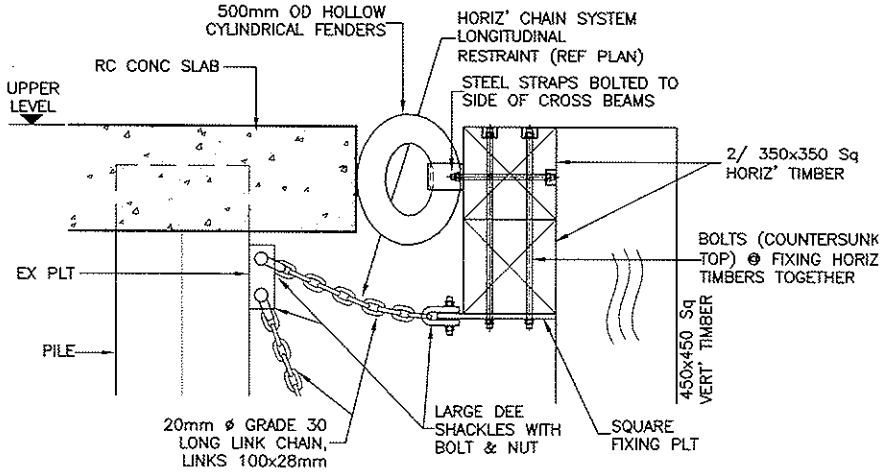
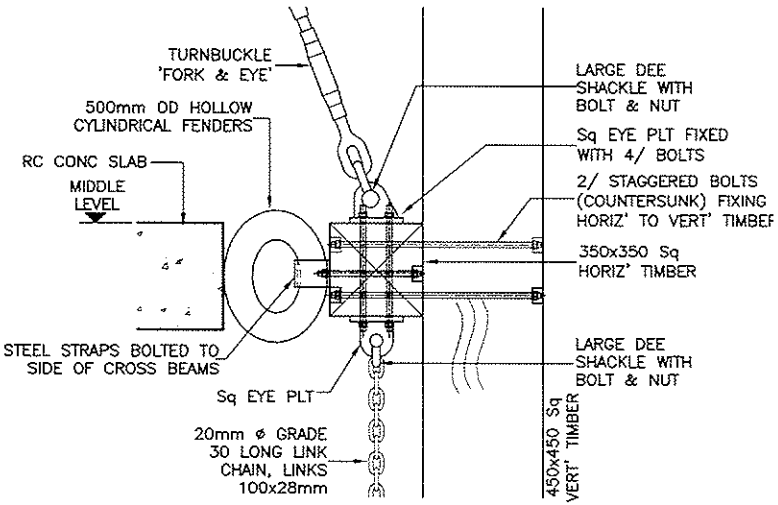


DETAIL 1

1:20



DETAIL 2

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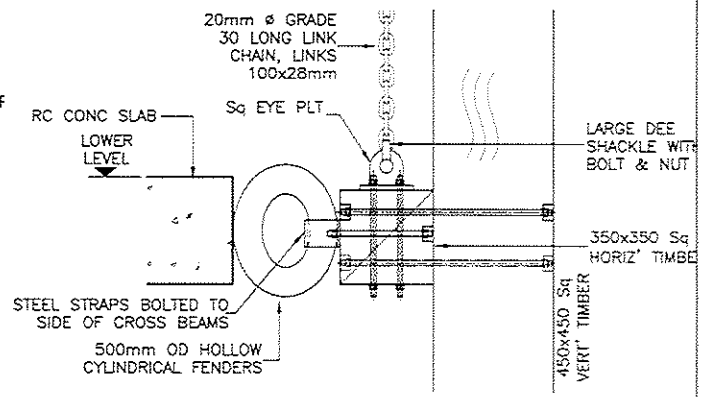

DETAIL 3

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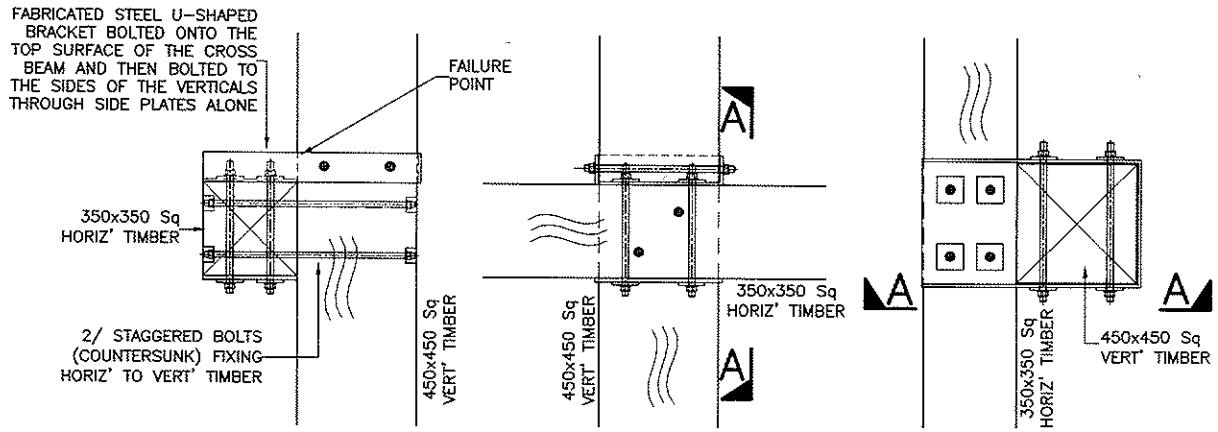
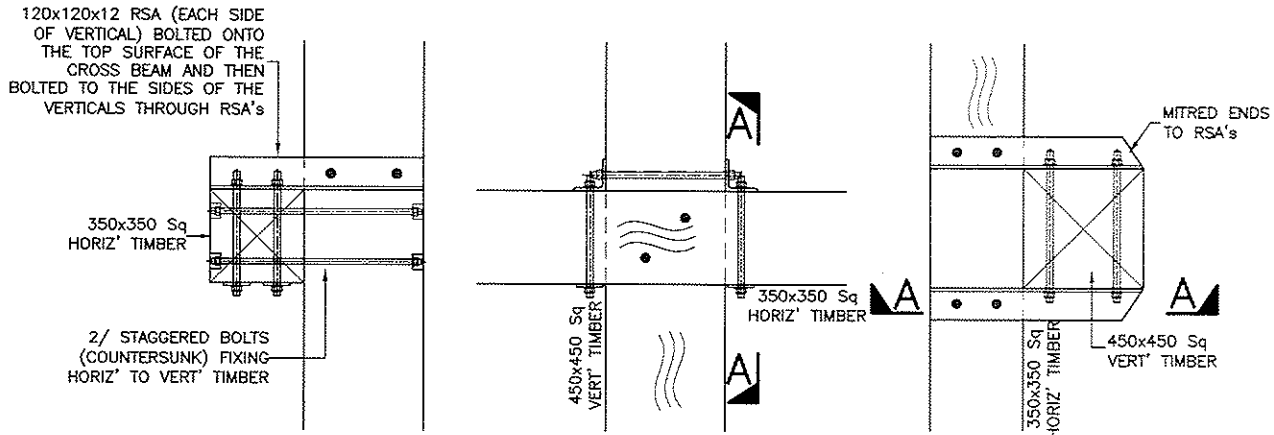


FAILED PRINCIPAL SUPPORT BETWEEN THE VERTICALS & THE CROSS-BEAMS

1:20



ALTERNATIVE PRINCIPAL SUPPORT BETWEEN THE VERTICALS & THE CROSS-BEAMS

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