

BARMOUTH NORTH PROMENADE
OUTLINE BUSINESS CASE
BUDGET & SCHEME REVIEW

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Introduction

Ultimate Engineering Solutions Ltd, have been engaged by YGC (Ymgynghoriaeth Gwynedd Consultancy) to review the buildability, budget and risks for the construction of the betterment to Barmouth's North Promenade sea defences, based upon 2 drawings prepared by Arup:

- ARP-XX-EP-DR-CS-0001- GA P01
- ARP-XX-EP-DR-CS-0001- SK P01 – see Appendix 1



Barmouth is a seaside resort within Cardigan Bay, West of Wales, at the mouth of the Mawddach Estuary. The town is principally a seaside resort comprising of mainly residential and holiday properties combined with hotels, and a promenade to the west of the Town. Between the centre of the Town and the promenade is the local railway line which runs parallel and between the promenade and the Town centre.

Access

Access to the site is from the A496 and crossing the level crossing in the centre of the Town at point A as indicated below. There is a highway crossing of the railway at point B of the Town but this is not suitable for HGV's due to a height restriction of 10' 6".





Level Crossing at point A looking East 1

Material Supply

From an initial take off of quantities there is an extensive requirement for imported materials as detailed in the table below:

Material	Quantity	Lorry Movements
Rock Armour	10,000T	1,000
Beach Nourishment	75,000m ³	13,500
Under Layer 100 - 300 kg	3,000T	300
Sheet piles	500 T	50
Concrete	9,000m ³	3,035
Aggregate for Promenade	7,500 T	750
Rebar	400T	40
Site Plant etc		100
	Total	18,775

If all the materials were delivered to site by road, all the deliveries would be by HGVs and would need to cross the level crossing in the centre of the Town and unless restricted it would mean over 150 lorry movements a day ie one lorry movement every 4 minutes, which for a busy seaside resort in peak summer is not acceptable.

YGC have held initial discussions with Gwynedd Council and it has been indicated that traffic movements would be restricted.

Rock Armour

There is 10,000 tonnes of rock armour required all of which can be sourced locally or from European ports eg St Malo.

The armour could be sourced locally from the following quarries:



Quarry		Delivery
Minfford	Basalt	Road
Ystrad Meurig	Basalt	Road
Penmaenmawr	Limestone	Road/ Sea

The material from Penmaenmawr could be supplied by sea from Port Penrhyn, and dumped on the beach at highwater. This method was adopted for 10,000 tonnes of rock armour by Jones Bros when they constructed the Sea defences at Tywyn.

Beach Nourishment

Arup had modelled the beach nourishment on 30-40mm, but stated that coarser the better from a beach maintenance point of view and requested investigating prices for :

- 40mm - 120mm
- 40mm -70mm

Cefn Graianog Quarry is a sand and gravel quarry near Caernarfon and can provide both grades of material for approximately £24/t. There is an option of delivery by sea from Port Penrhyn and the approximate cost is double ie £48/T. However it will take approximately 12 months for the quarry to manufacture the material.

Suggested material delivery solution

Due to the number of HGVs restrictions that Gwynedd Council could impose as a planning condition, a viable solution would be to bring the rock armour in by sea and the remainder of the material in precontract over a 12 month period and stockpile it in the old railway yard. This would bring the no of HGVs down to a more reasonable figure of 56 /day ie 1 every 15mins.

Programme

UES drew up a high level programme based on a 12 month advanced manufacturing of the beach nourishment and this is detailed in Appendix ii. This programme is based on a 5 day week and has a construction period of 35 weeks.

Risk

UES reviewed the key risks in a joint risk workshop with Arup and assessed these risks in a range low, high and most probable. The various risks were costed and an over all Mean Expected Value (MEV) was £3.418m. The risk register is in Appendix iii

The key 5 risks are:

1. Increase in fuel due to increase in fuel levy in 2022. It is expected that the benefits of “red diesel” will be removed from the industry and all plant and machinery are to use white diesel which will effectively double fuel costs for plant and aggregates. It is expected that plant costs will increase by up to 20% and aggregates up by 15%.
2. Steel prices are currently very volatile due to world shortage of steel and currently prices are being fixed of only a week. It is likely that steel will be at a premium at time of construction.
3. Marine licence approval conditions / requirements needing additional surveys etc delaying the project.
4. Damage to adjacent infrastructure/property during construction- there is a risk that there will be repair work to the level crossing and highway will need some reinstatement due to the high number of HGV's.
5. The promenade infill is unknown and on previous schemes there has been contaminated ground requiring the material to be removed to a licensed facility.

Scheme budget

UES reviewed the outline Bill of quantities and brought the pricing schedule up to 2021 pricing.

Most of the pricing increased due to inflation and current market conditions. However there were 2 prices which were significantly cheaper. A budget for the piles was obtained from Ivor King piling based on the revised 7m long AZ24-700 pile over a length of 515m. This price came in considerably cheaper than the initial budget which was based on 700m. UES has put forward that, for Scheme budget purposes, the original length of 700m with the new rate £1,201/lm is used.

The other item was the price of beach recharge material which was originally £62/ m³ based on the Twywn Rate in 2011 and increased by inflation. The 2021 estimate is £57.50/m³, due to the potential increase in quantities and quarrying costs we felt it was prudent to keep to the original cost of £62/m³.

The suggested 2021 Scheme budget for the promenade works is **£15,815,976.18**, a breakdown and a comparison against the 2019 budget is included in Appendix iv.

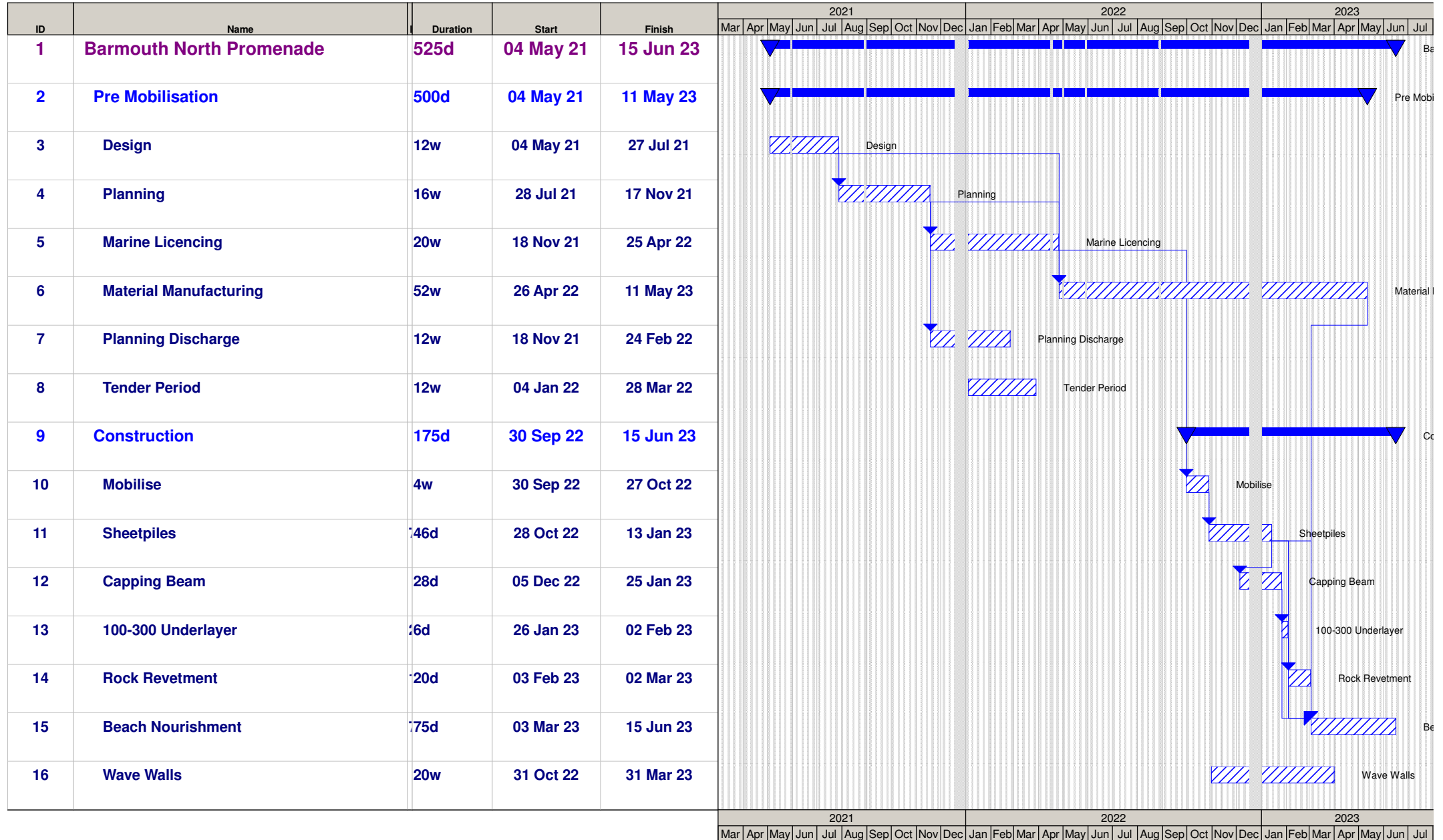
Barmouth North Promenade OBC

Appendices

Barmouth North Promenade OBC

Appendix ii - Programme

Barmouth North Shore



Programme Title: Indicative Programme	Notes:	Programme no: 2020/ygc/01		Revision:
		Drawn By: Jeremy Sturla	Date Drawn: 16 03 21	Revision Date:

Barmouth North Promenade OBC

Appendix v – Copy of UES presentation - Buildability Review 13th January 2021

Barmouth North Promenade Buildability Review

13th January 2021

North Promenade Barmouth - Site Location



North Promenade Barmouth - Access



North Promenade Barmouth - Access



North Promenade Barmouth - Access



North Promenade Barmouth - Access



**Railway Crossing
Option A**

North Promenade Barmouth - Access



**Railway Crossing
Option B**

**Height restraint of
10' 3" not suitable
for HGVs**

North Promenade Barmouth - Access



Queries / Issues to resolve

1. What is happening to the existing timber groynes?
2. Is the Town council going to restrict HGVs in any way
3. Access to beach by Ramps – can we use existing?

North Promenade Barmouth - Key Materials

Material	Quantity	Lorry Movements
Rock Armour	10,000T	1,000
Beach Nourishment	75,000m ³	13,500
Under Layer 100 -300 kg	3,000T	300
Sheet piles	1,500 T	150
Concrete	9,000m ³	3,035
Aggregate for Promenade	7,500 T	750
Site Plant etc		100
	Total	18,835

North Promenade Barmouth - Rock Armour

Rock Sources

- Circa 5 million tonnes per annum rock quarried in N Wales
- Circa 8 million tonnes per annum rock quarried in NW England
- Circa 10 million tonnes per annum rock quarried in S Wales
- Circa 22 million tonnes per annum rock quarried in SW England
- Imported materials from Scandinavia, Ireland & France

North Promenade Barmouth - Rock Armour

Circa 60% of rock quarried is unsuitable for armour production

- Narrow bedding and / or jointing of rock masses fine for aggregate but unsuitable for armour
- Massive bedding and / or jointing required
- Physical / Chemical Properties

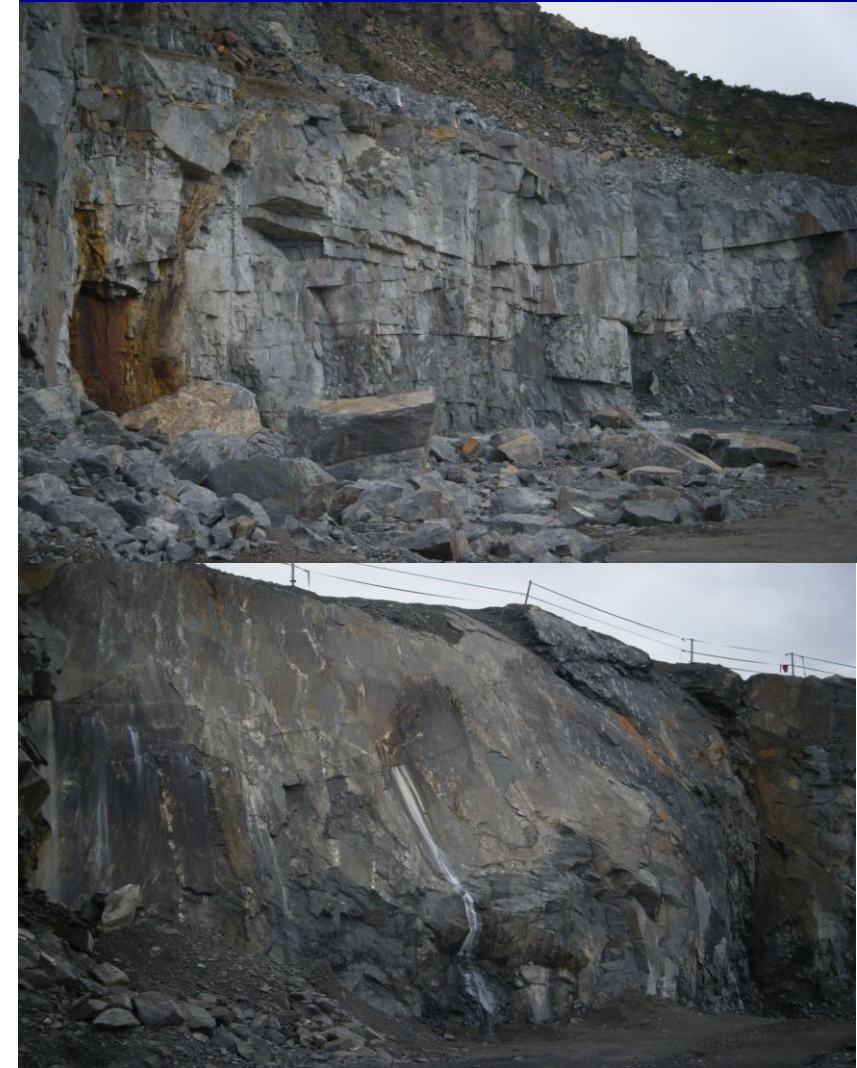
Density

Strength

Structure

Composition

Other Specification Requirements



North Promenade Barmouth - Rock Armour

So, How much is available in Wales

Easy sum.....

- 15 Million Tonnes
- 60% Unsuitable leaves circa 6 Million Tonnes
- 12.5% Yield leaves circa 0.75 Million Tonnes

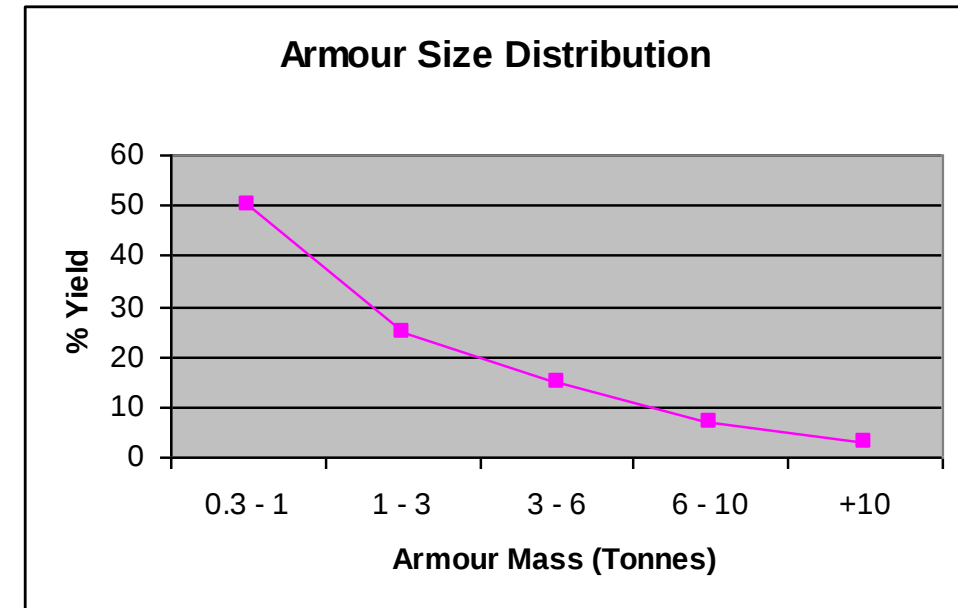
What's the problem?

North Promenade Barmouth - Rock Armour

So, What's the problem ?

Availability diminishes with size

- 0.3 – 1Tonne 375,000 Tn
- 1 – 3 Tonne 187,000 Tn
- 3 – 6 Tonne 112,000 Tn
- 6 – 10 Tonne 53,000 Tn
- +10 Tonne 23,000 Tn



North Promenade Barmouth - Rock Armour

Options

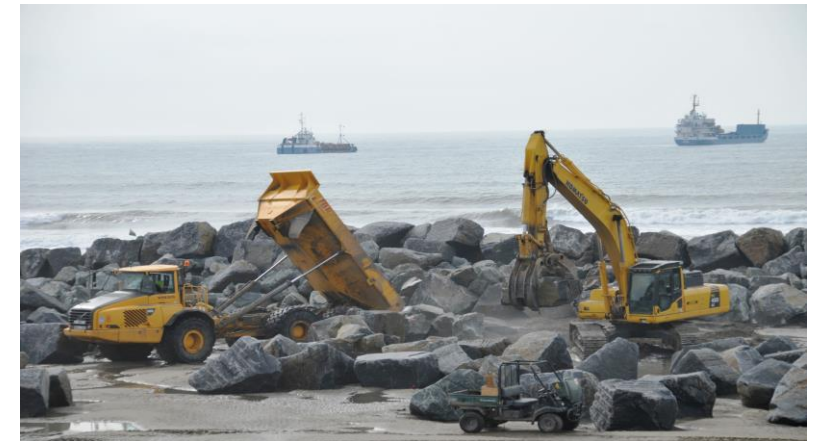
BY Road

Lowest Cost & Minimal Environmental Impact –
– Smallest possible grades from local (within
50 miles) quarries delivered by road.



By Sea

High Cost & Medium Environmental Impact –
Large grades from distant quarries delivered
by road or sea. Double Cost



North Promenade Barmouth - Rock Armour

Local Rock Armour Supply



Quarry		Delivery
Minfford	Basalt	Road
Ystrad Meurig	Basalt	Road
Penmaenmawr	Limestone	Road/ Sea

North Promenade Barmouth - Beach Nourishment

Options

1. Crushed local Rock - ex Mynfford
2. Processed local gravel ex Cefn Grainog
3. Slate as an under layer topped with either 1 or 2 above
4. Dredge materials from St George's Channel



North Promenade Barmouth - Sheet Piling



ARUP

YGC

ues
Ultimate Engineering Solutions Limited

North Promenade Barmouth - Sheet Piling



Benefits of this Approach

- Promenade has risk of voids and hence could fail
- Use of under armour as piling mat
- Lends to it self to using a leader rig

North Promenade Barmouth - Concrete Structures

Pre - Cast or Cast insitu

Pre Cast Advantages

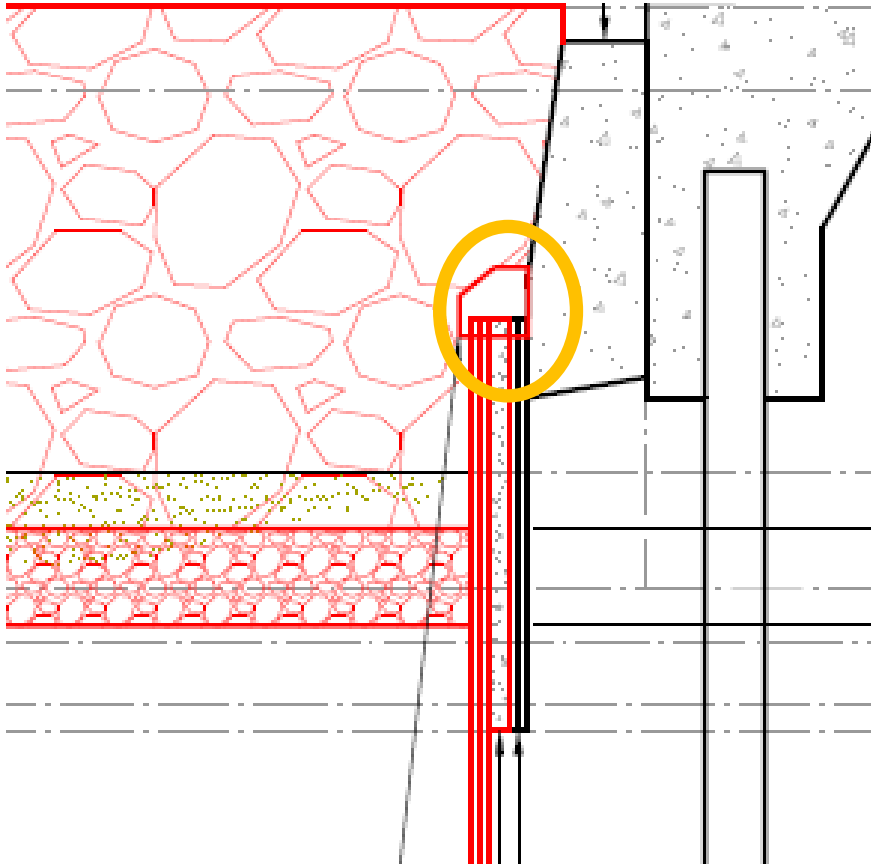
- 1.Improved quality – constructed in factory conditions
2. Repeat shapes lead to reduced costs
- 3.Installation on site is fast - reduces the on site programme
- 4.Reduces plant and resources required on site
- 5.Requires less room on site – delivery just in time

Pre Cast Dis-advantages

- 1.Requires detailed design to cover every aspect
- 2.Tighter tolerances in initial construction
- 3.Needs careful review of connections
- 4.Restricted to size and weight max 20 T ideally 4 -5 tonne

North Promenade Barmouth - Concrete Structures

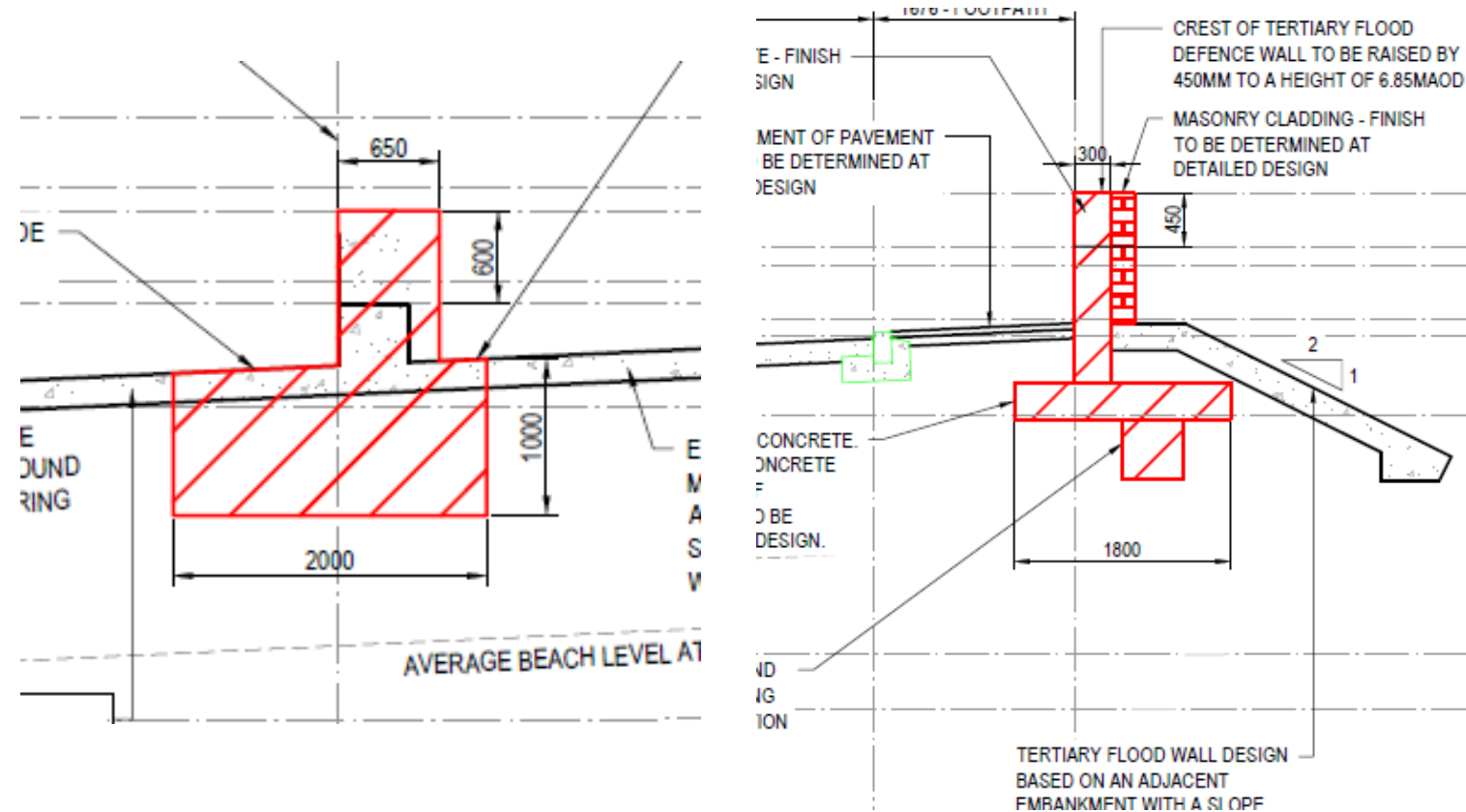
Pre - Cast or Cast insitu Capping Beam



- 1.Requires detailed design to cover every aspect
- 2.Tighter tolerances in initial construction
- 3.Needs careful review of connections since Piles will be prone to twisting
- 4.Restricted to size and weight ideally 4-5 T

North Promenade Barmouth - Concrete Structures

Pre - Cast or Cast insitu Wave Walls



- 1.Requires detailed design to cover every aspect
- 2.Tighter tolerances in initial construction
- 3.Can be precast in various sections
- 4.Restricted to size and weight max 20 T ideally 4 -5 tonne
- 5.Shear key cast insitu?