An Roinn Iompair
Department of Transport

Cumann Lucht Bainistíochta Contae agus Cathrach
County and City Management Association

RSTG Conference 2024 15th May - Day 1

Networking\Exhibition & Coffee Break

We will resume at 11.45 am

Session 2-Asset Management

Chair Pat Dowling

11.45-12.00	Bridge Rehabilitation	Gary Salter
12.00-12.25	Capturing & Managing Pedestrian and Cycling Infrastructure (ATI) on MapRoad AMS	Aidan McClafferty - RMO
12.25-12.45	LA 16 Collision Capture and Reporting Procedure on MapRoad AMS (incl Bridges Module)	Brian Burke - RMO

Join the Q&A session at Slido.com and enter 5812867
Or via the QR Code

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ROADS Services Training Group

LOCAL AUTHORITY ROADS CONFERENCE and EXHIBITION - 2024

Day 1-Session 2-Presentation 1

Gary Salter

Sligo Radisson Hotel, Sligo, May 2024

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County and City Management Association

LOCAL AUTHORITY ROADS CONFERENCE and EXHIBITION

15th and 16th May 2024 in Radisson Hotel, Sligo.

Bridge Rehabilitation

Gary Salter Eur Ing, MSc, BE[Hons], MICE,
Chartered Engineer,
Conservation Accredited Registered Engineer [Care]
Formerly Senior Executive Engineer for c 20years
Structures and Marine Section
Independent Engineer and Trainer

A bridge of National Significance and on a Regional Road

R703 – Carlow/Kilkenny Border –Barrow River

Design attributed to George Smith finished in 1773. An early example of the start of Civil Engineering – application of science and theory

Bridges have global symbolic significance.

Roman bridges and aqueducts c 40 AD

Romanesque C 1100AD

Gothic c1450 AD

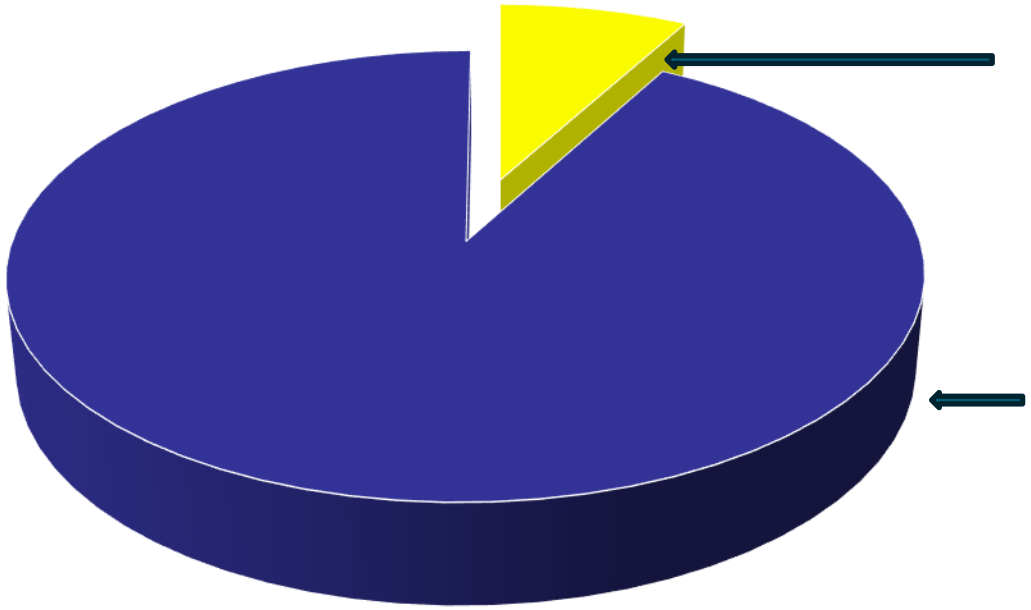
Renaissance C1600 ad

Baroque & Rococco C 1780

Metals c1850

Dot/LA and TII

Road lengths and bridge numbers



Motorway and National road length- circa 6000km [TII]

Regional and Local Road length - circa 95,000 km [LA]

101,000 KM of Public Roads

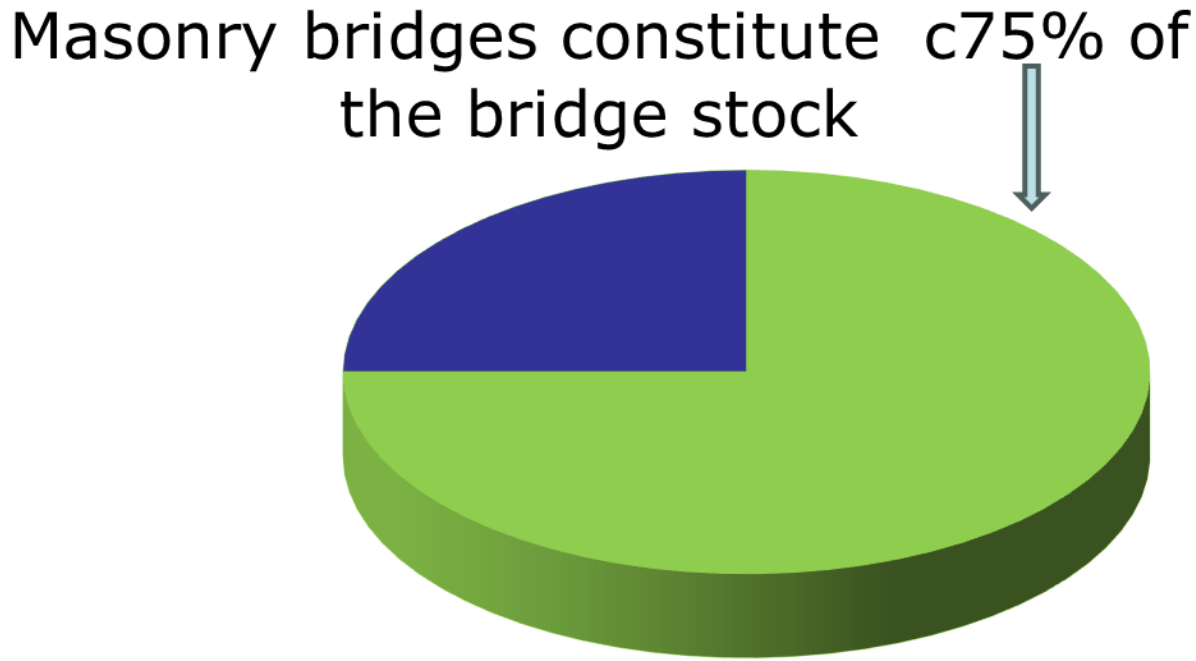
Bridge Rehabilitation.
LA Bridge Stock

- At least **90%** of the nation's road **bridge** stock are on regional and local roads and are therefore the responsibility and in the care of LA's.

- A bridge is defined, in the Bridge Asset Management System for Regional and Local Roads published in 2019, as a structure with overall span of at least 1.2m

- This represents **at least 30,000 bridges**, probably considerably more.

Bridge Rehabilitation.
Our Masonry Bridge Stock



Very few stone bridges were built after 1900

LA's should be custodians of these old bridges, and not demolishing them!

Bridge Rehabilitation --- Stone Arches - Built to Last

- Stone bridge building in Ireland dates back around a thousand years.
- Surviving examples of masonry arch bridges dating between 1200BP and 1700BP are relatively unusual but do exist in most counties.
- Most were built in the eighteenth or nineteenth century
- All have should the test of time

Bridge Rehabilitation.

Stone bridges can be gullets and clappers ie beam or slab decks

But the vast bulk of these are **stone arch bridges**, of various shapes, quality, character etc.

[NB: Brick arches are relatively unusual, but a few do exist].

DoT and LASNTG's Bridge Management Plan

Requirement for a modern national bridge data base for Non-national road bridges comprised of data collected by each LA

Phase 1

1. Produce 'Survey and Inspection Guidelines' for LA's
2. Create a Bridge App [tablet] to input bridge data direct from site to Asset Management System[AMS]
3. Train LA Engineers in the use of the above

DOT and LASNTG Bridge Management Plan

- Every LA has sent engineering staff to the Bridge Inventory Survey [BIS] and Maintenance Inspection [MI] training course, some has sent more than 8, average 5
- On average LA's have 2 Engineers who have passed the Engineering Inspection Course [EI].
- But how many LA's have actually built-up a comprehensive AMS Bridge Data Base?

DoT and LASNTG's Bridge Management Plan

Phase 2

- LA's should continue to populate the AMS bridge data–base with country wide comparable condition ratings of all bridges
- Assess and specify the most appropriate rehabilitation /conservation works for selected/priority bridges
- Projects approved for funding in 2024 must have a valid Bridge Inventory Survey(BIS) and Maintenance Inspection(MI) in accordance with the Bridge Asset Management System for Regional and Local Roads.
- Use the MapRoad AMS for recording repair works

Bridge Rehabilitation.

- Repair is almost aways better and cheaper than replacement
- The estimated cost of totally replacing a 1.5m stone arch and wingwalls, with a modern compliant structure could well be at least €150,000, plus fees, if consultants are involved
- Appropriately repairing it may be half the cost in the hands and a knowledgeable LA Engineer

Bridge Rehabilitation.

Conservation repairs have a lower carbon footprint v replacement,

Because:

- Less plant and machinery required
- Very few new materials; ie substantial reuse
- Less importation of materials from outside the county/country
- Sometimes all the work can be carried out by appropriately trained LA Engineers and outdoor staff, hence less contractors and consultants driving around the country

Bridge Rehabilitation.

Is repair conservation ?

If a repair is carried out with the same style, with the same or similar materials and in a like manner, it is likely conservation.

- It will get a positive response from the public, heritage and conservation officers, planners, nature lovers, tidy towns, heritage groups. etc.
- Pride and a sense of satisfaction can be gained by all those involved in this valuable work

Approach – conservation philosophy
The presumption to conserve is always the starting point

- Requirement to fulfil function as a public road bridge
- Minimum intervention, if possible
- Minimal new/different materials, if possible
- Reversible repairs, if at all possible

2003- DMRB for the first time acknowledged the importance of old road structures with the publication of BD98/03- “The conservation of highway structures”.

AM-STR-06051 Conservation of Road Structures (TII version-2015) defines conservation as:

" ***Work on a road structure which retains its aesthetic merit but can incorporate changes <u>that are in keeping with the original structure</u>.***

Conservation can include preservation, restoration and maintenance."

BD 89/15, an acknowledgement of bridge conservation value.

TII AM-STR-06051 [BD 89/15]

This Standard covers procedures, conservation strategies and application of conservation principles in the management of road bridges and related structures which are;

(i) Protected Structures; (in County Dev. Plans & LAP's)

(ii) Structures recorded by the National Inventory of Architectural Heritage (NIAH), Recorded Monuments or National Monuments; and

(iii) Bridges and other structures which are not Protected but are considered as having historic and conservation merit as agreed by the relevant Local Authority OR the National Roads Authority.

Conservation Principles according to TII -AM-STR-06051 [BD 89/15]

2.1 The principles of conservation are:

(i) Bridges are best kept in use and maintained in their original form and performing the same function and structural action.

(ii) There should be minimal changes to the structure and its appearance.

(iii) Modifications should involve no loss in character, minimal loss of historic fabric, and minimal adverse effect on the setting.

(iv) Modifications should preferably be reversible.

(v) There should be minimal introduction of new material, whether newly produced, modern, or additional to the original fabric.

vi) All work should be undertaken using appropriate materials and methods of application.

TII -AM-STR-06051 [BD 89/15] 2.1 Principles of Conservation

(i) Bridges are best kept in use and maintained in their original form and performing the same function and structural action.

The interventions here are nothing to be proud of. An aesthetic disaster and of questionable benefit?
The old arch is holding up the concrete arch? Also, a nightmare to remove!

(ii) There should be minimal changes to the structure and its appearance. Not in my opinion in this case.

Do such treatments really perform a structurally positive function? They certainly do nothing for the appearance!

(ii) Minimal changes to the structure and its appearance? Here water is trapped inside these structures, degrading the arch stone itself. Reversibility difficult.

(i) Definite ‘change in structural action’ – arch behaviour is altered in a combined arch? The old arch is supporting the concrete add-on!
(iii) Modifications should involve no loss in character, minimal loss of historic fabric; gunite does not meet these requirement**!**

Bridge rehabilitation
Public highway bridges- function v conservation.

An old (historic) bridge supporting a public road must be fit for purpose

Conservation repairs often are adequate, occasionally discrete strengthening.

Widening an old bridge may be necessary for users, H&S, emergency services etc.

The balancing of objectives is required and can usually be realised in a tradition way.

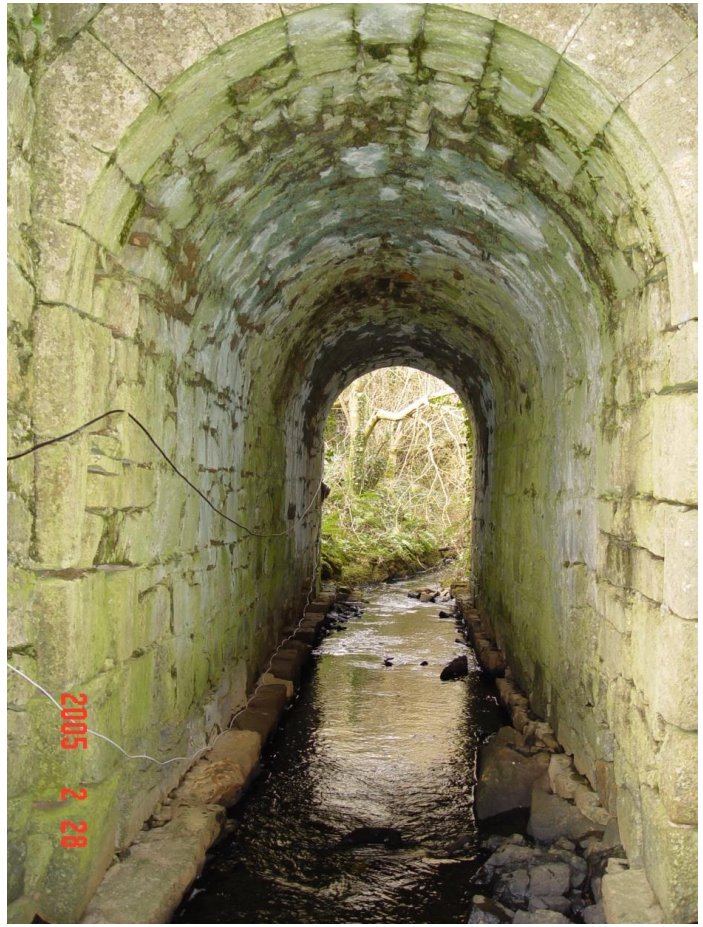
Bridge Rehabilitation

Bridge Repairs

Before and After

Bridge Rehabilitation

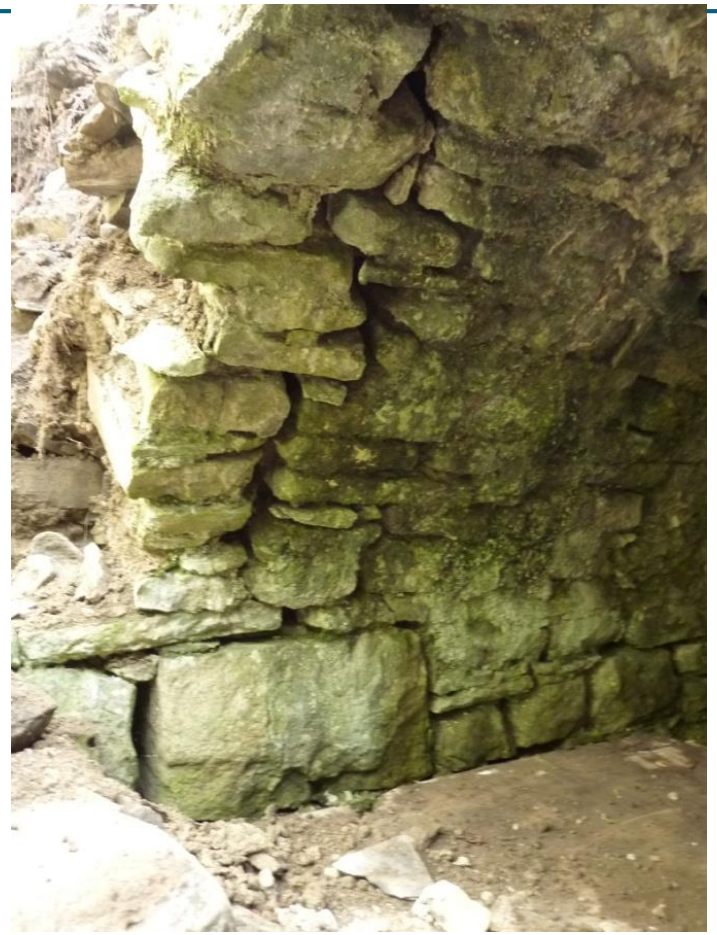
Narrow and tall bridge



Bridge Rehabilitation ----After restoration

Bridge Rehabilitation

Local primary road bridge with substantial retaining wall and unwanted trees!



Courtesy of Sligo Co Co

Bridge Rehabilitation

After. Disassembled retaining wall and rebuilt outer 1.3m of arch

Courtesy of Sligo Co Co

Re-built arch and retaining wall with parapet over and rubbing strip on road side.

Bridge Rehabilitation

Road closed – part of arch re-build plus other repairs cost €35,000 in 2012.

Total replacement with a modern Culvert type solution, fill etc., would cost typically **double** the amount of the repair

Courtesy of Sligo Co Co

Bridge Rehabilitation

Vulnerable pier and stream bed and protection repairs on right

New concrete underpinning and bed protection and new masonry retaining wall & buttress, by SCC. Subsequent flood and bog slide, would probably have caused this bridge to fail without the repairs.

Courtesy of Sligo Co Co

Bridge Rehabilitation

Bed protection breakdown & progressive failure, repairs on right.

Replace stone bed pitching and repair defective parts of bridge, like with like, SCC.

Sligo Co Co acknowledged

Bridge Rehabilitation -

Arch cracks –a serious issue, but what is the cause?

Training and Knowledge is essential – 'establish the cause not the symptom'!

Diagonal and vertical cracks and external ring separation

Stabilise foundations, protect against scour, pressure point arch and install tie bars and pattress plates

Photo courtesy of Sligo Co Co

Bridge Rehabilitation.--Mortar loss, water penetration, general neglect & punching, but repairable

Eliminate water ingress from above, pressure point entire intrados and abutments with lime mortar- the best solution in every sense.

Natural Hydraulic Lime pressure pointing by specialist Contractors, a good job.

Bridge Rehabilitation.

Ivy and shrub growth and vehicular impact.

2012 repairs- removal of vegetation, reconstruction of cutwater, spandrel and parapets, repairs to other parapets

Courtesy of Sligo Co Co

Bridge Rehabilitation

Services! Relocate in a rubbing strip if possible

Bridge rehabilitation

Superstructure and substructure failure of a Clapper Bridge

Major repairs and new structural deck at €52k by DL. A replacement bridge would have cost at least twice as much. Where there is a will there is a way!

Courtesy of Sligo Co Co

Bridge rehabilitation.

Hump backs vehicle lift-off resulting in high impact loads!

Mitigation may be possible.

Bridge rehabilitation
There is a choice

Replace this

With this

Or this

Courtesy of Sligo coco

Bridge Rehabilitation
A win-win scenario.

Or repair– surely no contest from financial, aesthetic, heritage and community standpoints.

Courtesy of Sligo Co Co

Bridge Rehabilitation

Stone Masonry

The good, the bad and the ugly!

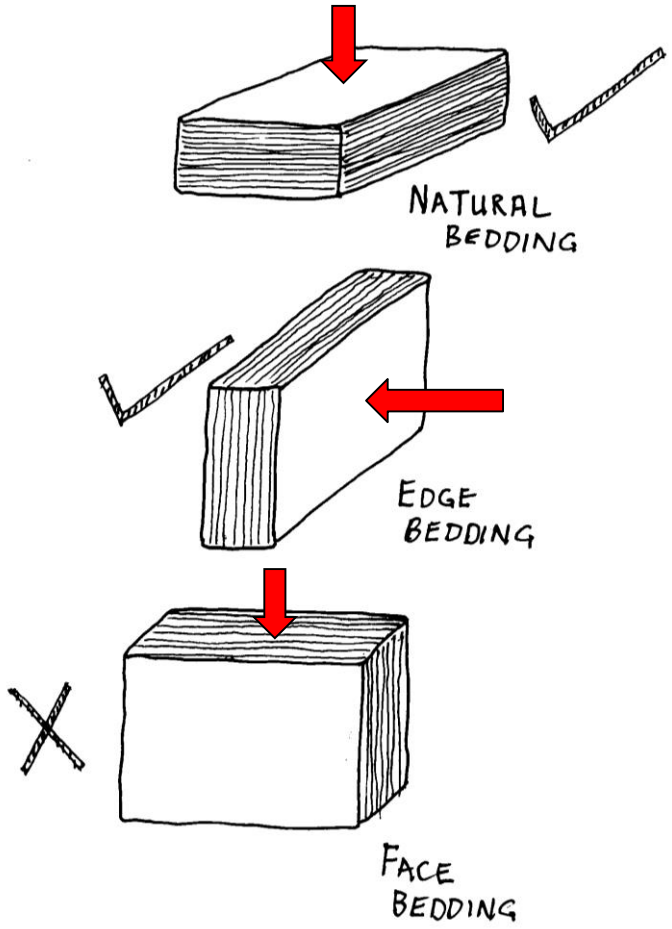
Do not use OPC when repairing or pointing old stone masonry bridges

Bridge Rehabilitation

Stone bedding planes –forces should act perpendicular to the bedding plane

FOR
Sedimentary
Rock

IE
Limestones
Sandstones
Shales



Most elements of masonry bridges eg foundations, abutments, spandrels, piers, wingwalls, parapets.

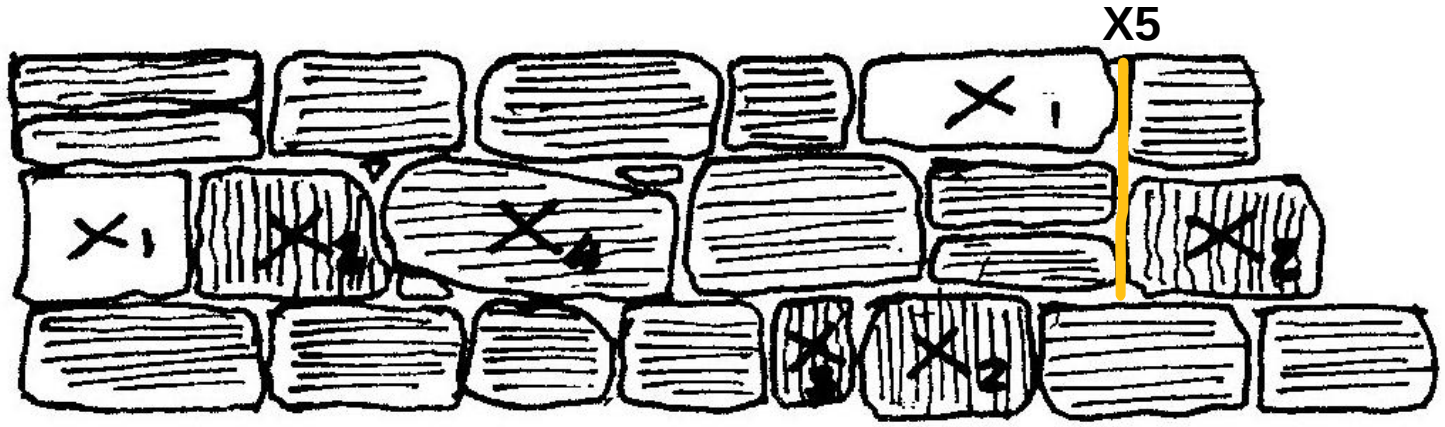
Arch barrel construction and external voussoirs, and some copings of walls, eg cow and calf and soldier, copings.

Face bedding should NOT be used [except in rare cases to match existing original bridge construction].

Bridge Rehabilitation

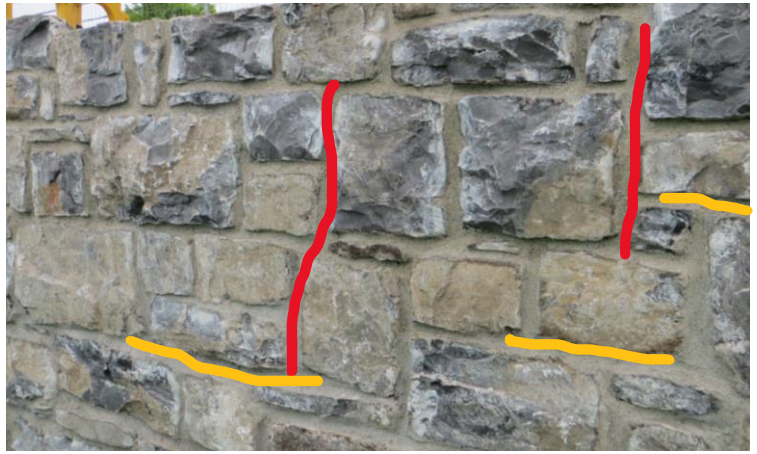
Balance - the art of laying stone, in both a structural and visual sense

Examples of bad practise



LAYING ERRORS
X1 – Face bedded
X2 – Edge bedding
X3 – Wrong orientation- stone higher than its length
X4 – Stone should be laid with bottom edge horizontal
X5 – Vertical [running] joint three stones high [2 max]

Bridge rehabilitation
Bad practises



Red – running vertical joints at least three stones high

Yellow- horizontal joints too thick- reducing strength of the wall

Crazy paving.
No qualified mason would build this as a repair to an old bridge.

Crazy paving masonry- totally inappropriate; it ignores most of the traditional masonry rules.
The limestone here is also *face* bedded and the wall has been constructed in two leaves with cavity infill, again wrong!

Bridge Rehabilitation. Recap

- Engineers – get to know your bridges & study the Guidelines
- Use the AMS MapRoad bridge module to record BIS/MI surveys for projects that are in receipt of funding.
- Use conservation principles in rehabilitate old bridges
- Do the repair the right way – avoid bad practise
- Repair is cheaper and better than replacement in a multitude of ways – a win win scenario

Useful references:

- Bridge Asset Management System [BAMS] for Regional and Local Roads
  [download from www.Roadguidelines.ie]
- TII Publication AM-STR-6002 The Assessment of Road Bridges and Structures, formerly BA 16/14]
- TII Publication AM-STR-6026- The Assessment of Road Bridges and Structures, formerly DB21/14
- TII Publication AM-STR-6051 – The Conservation of Road Structures [BD 89/15].
- Irish Stone Walls by Patrick McAfee. O'Brien Press, Dublin. ISBN 0-86278-478-6

A major conservation project.

EI Engineering Excellence Award 2016 in Heritage & Conservation Category – Sligo Co Co

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Thank You

Questions to be entered through SLIDO when entering your question please direct it to **Gary Salter** and they will be addressed at the end of the session:

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Day 1-Session 2-Presentation 2

Aidan McLafferty

Sligo Radisson Hotel, Sligo, May 2024

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ROADS Services Training Group

LOCAL AUTHORITY ROADS CONFERENCE and EXHIBITION - 2024

Day 1-Session 2-Presentation 3

Brian Burke

Sligo Radisson Hotel, Sligo, May 2024

Slides go here

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RSTG Conference 2024 15th May - Day 1

Networking\Exhibition & Coffee Break

We will resume at 14.25 pm

Session 3- Climate Adaptation, Rehabilitation of Roads Over Peat Guidelines, Regional and Local Roads Safety Statistics

Chair Dominic Mullaney

14.30-14.50	Critical Infrastructure Routes & Climate Adaptation	Brian Cross & XXXXX CARO
14.50-15.10	Revision of the Roads Over Peat Guidelines	James Mc Crum - DoT, Oliver Brennan-Wicklow County Council
15.10-15.30	Road Safety Authority - Stats on RLR Network	Velma Burns – RSA

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