

Lessons learned from one of New Zealand's most challenging civil engineering projects: rebuilding the earthquake damaged pipes, roads, bridges and retaining walls in the city of Christchurch 2011 - 2016.

Bridge of Remembrance community engagement presentation

Story: Bridge of Remembrance and Memorial Arch

Theme: Construction

A presentation prepared by SCIRT's Downer Communication Lead, providing an overview of the community engagement carried out by the Downer Team during the restoration of the Bridge and Arch.

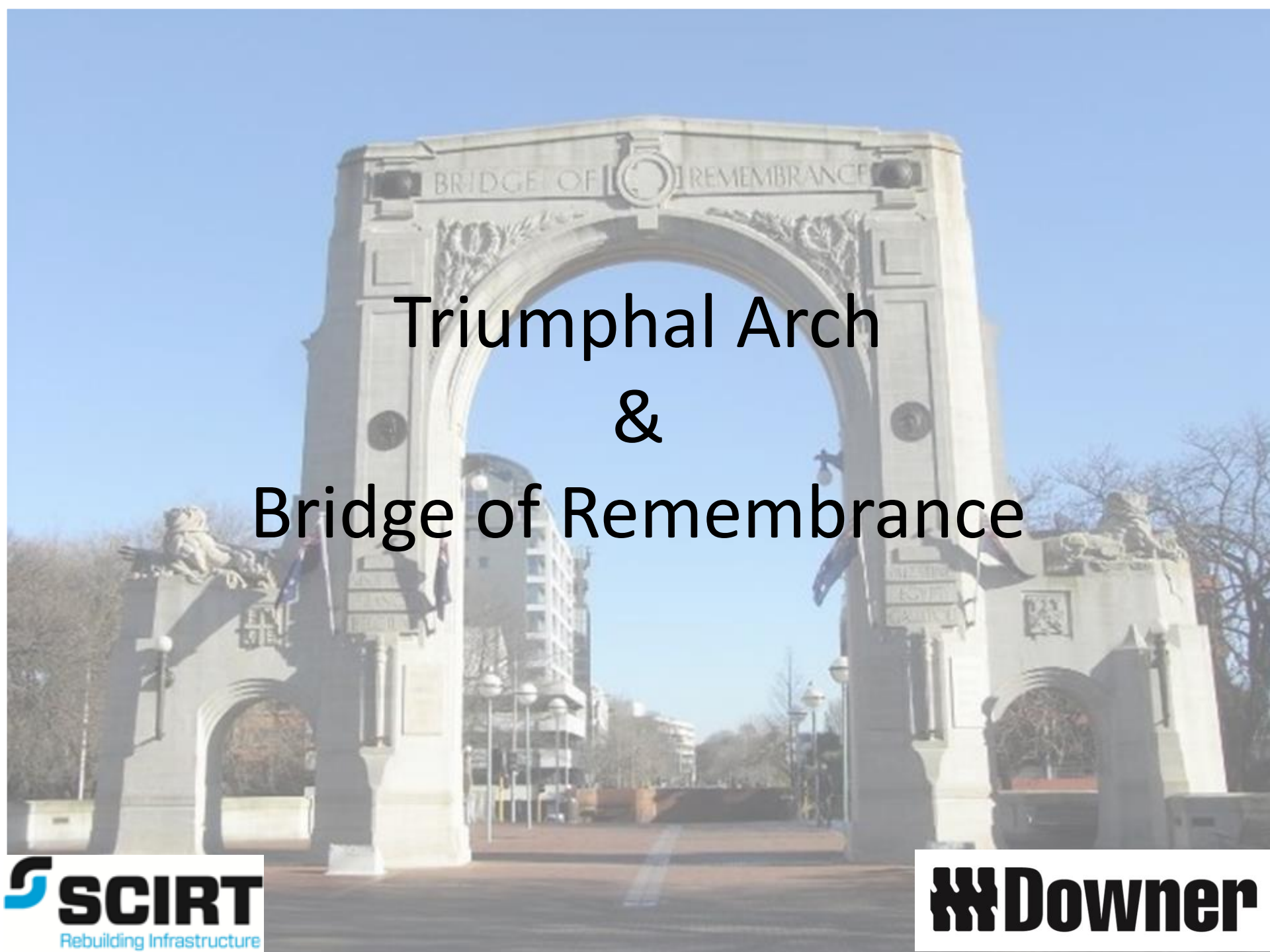
This document has been provided as an example of a tool that might be useful for other organisations undertaking complex disaster recovery or infrastructure rebuild programmes.

For more information about this document, visit www.scirtlearninglegacy.org.nz



This work is licensed under a [Creative Commons Attribution 3.0 New Zealand License](#).

The authors, and Stronger Christchurch Infrastructure Rebuild Team (SCIRT) have taken all reasonable care to ensure the accuracy of the information supplied in this legacy document. However, neither the authors nor SCIRT, warrant that the information contained in this legacy document will be complete or free of errors or inaccuracies. By using this legacy document you accept all liability arising from your use of it. Neither the authors nor SCIRT, will be liable for any loss or damage suffered by any person arising from the use of this legacy document, however caused.

A photograph of the Bridge of Remembrance in London, featuring a large stone triumphal arch with intricate carvings and statues of lions. The arch is set against a clear blue sky, and a city street is visible through the opening. The text "Triumphal Arch & Bridge of Remembrance" is overlaid in the center.

Triumphal Arch & Bridge of Remembrance

Heritage and Historical Significance

The Triumphal Arch and the Bridge of Remembrance are significant, iconic structures.



The Triumphal Arch and the Bridge of Remembrance was constructed in 1923 following the First World War.



Damage to a Significant Structure



From a distance the damage looks minor.

- Significant damage to heritage stonework and the concrete structure behind stone.
- Cracking in both minor and major arches and the lions



Design Considerations

- The current structure is less than 30% of the New Building Standards (NBS) the repair will need to bring the Arch to 100% of NBS.
- Earthquake prone and needs to be strengthened
- How the arch will move in a significant future event
- Ensure the Arch has a capacity to withstand a 1/2500 year earthquake




Triumphal Arch and Bridge Repair Strategy

- Replace damaged stonework
- Install rocking collars
- Internal strengthening to withstand the rocking loads
- Improved foundations by installing piles
- Cut and install sliding joints
- Install post tensioning system

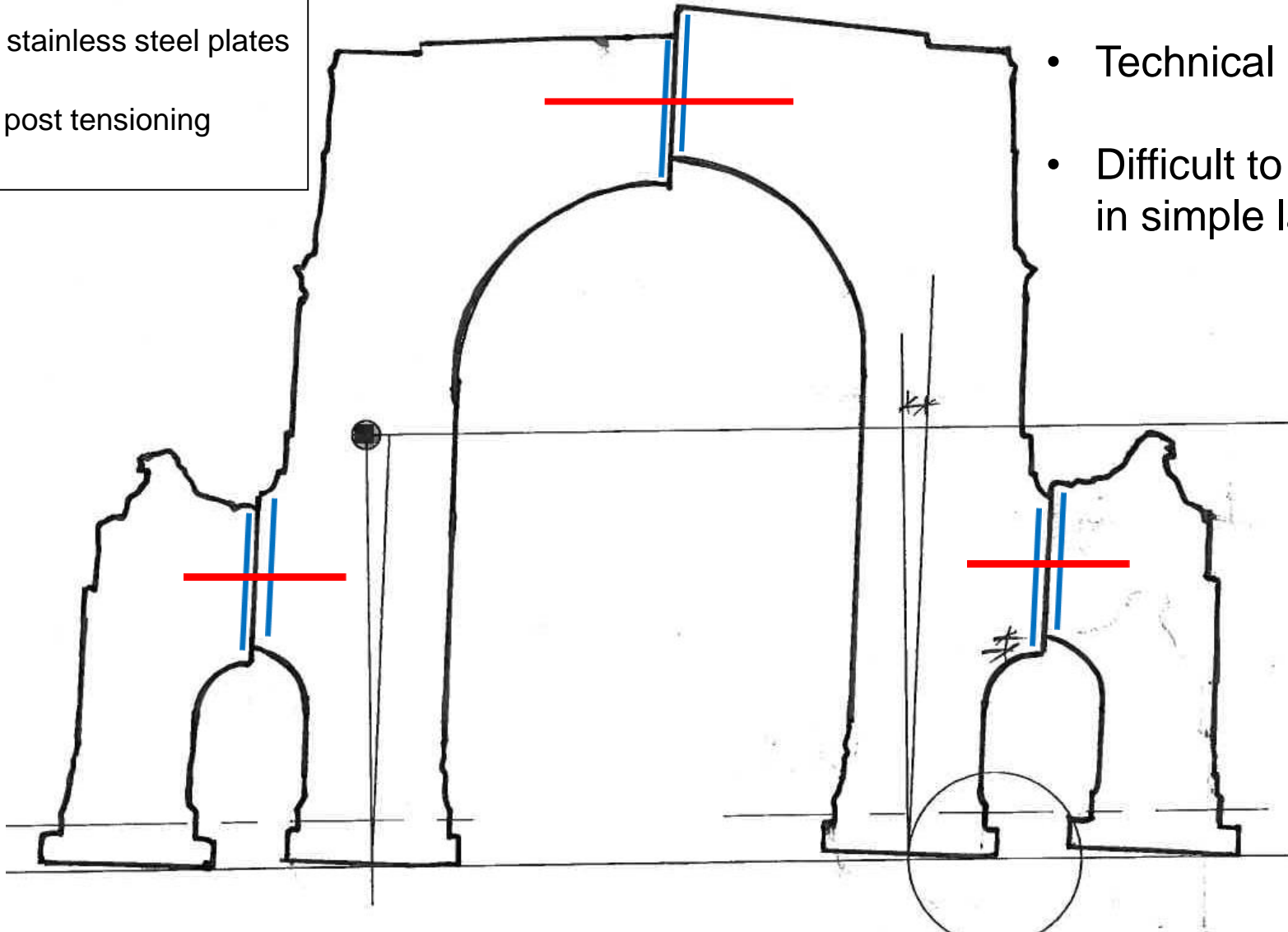
Sliding Joints and Post Tensioning

Key

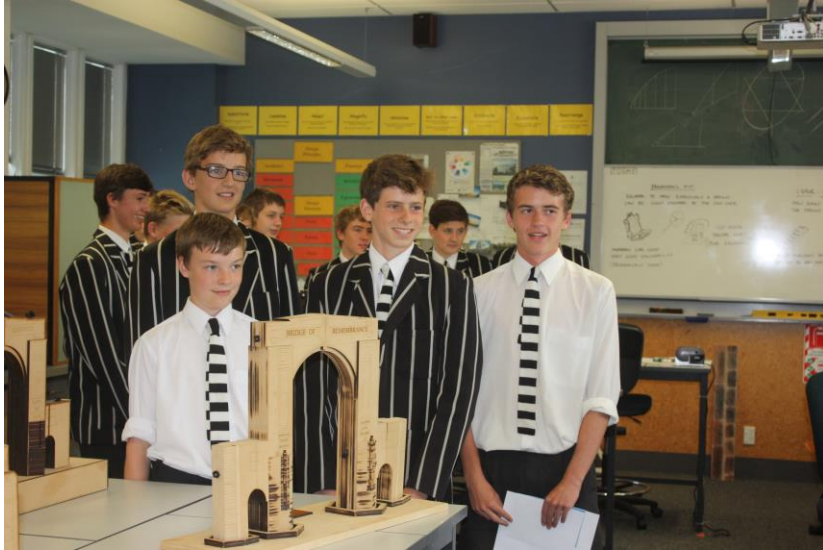
 - stainless steel plates

 - post tensioning

- Technical project
- Difficult to explain in simple language



Communication we are most proud of.....



Collaboration with local secondary school

- Three year 10 technology classes adopted model competition as a real life curriculum project
- Successful event
- Media opportunities
- Tour in partnership with other Delivery Teams
- Collaboration with other businesses.
- On-going involvement

Triumphal Arch Models

Brief for Triumphal Arch model



- Between 400mm and 600mm high from base to top of main arch
- Reasonably to scale of the actual arch dimensions
- Set on a stable base
- A practical working model
- Able to rock about the base in all directions to imitate the 'rocking collar'
- Include a vertical cut at the top of all 3 arches to mimic the 'sliding joint'
- Tied through the vertical cuts to imitate the stressing stands e.g. string, rope...
- Optional: A base that rocks to stimulate a small earthquake, decorative elements, columns shaped as per the actual arch

Triumphal Arch Models



Judging

- Nine models produced over two terms.
- A panel of representatives from SCIRT, Christchurch City Council and Christ's College
- Judging criteria will be in three areas:
 1. A functional model imitating the rocking collar and sliding joints.
 2. Aesthetics
 3. Use of materials
 4. Team work

Triumphal Arch Models and feedback

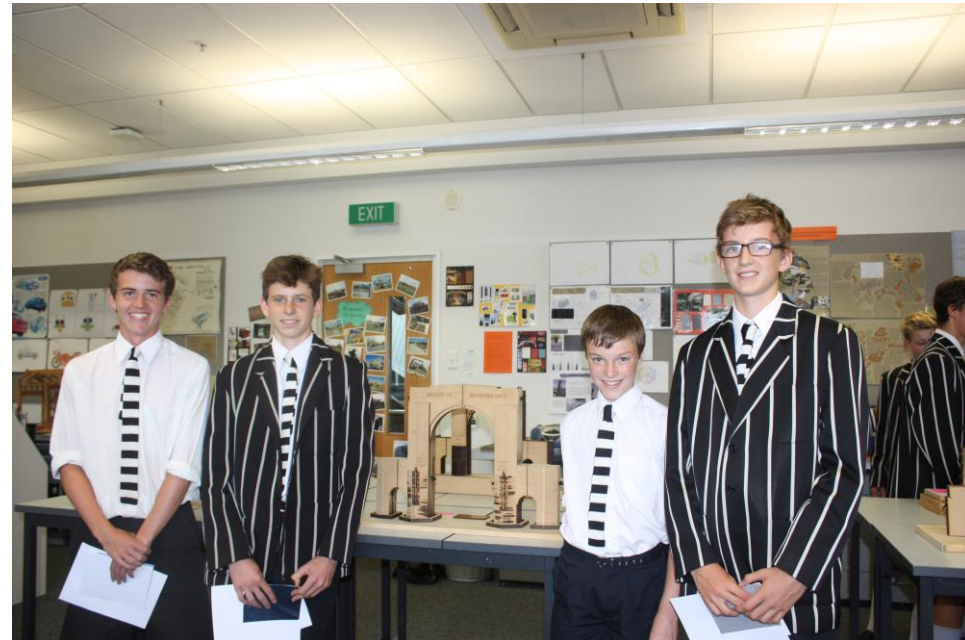


Tony commented that the general consensus from the boys was “they enjoyed all aspects of the project”

“Project gave the students a strong focus for the end of 2013”

“Allowed us to be part of a partnership project with the city.”

Quotes from - Tony Holland HOD Technology Christ's College



Site tour for winning team



Bridge of
Remembrance site
tour

Winning team tours other SCIRT sites



Park Terrace - Fletcher



St Asaph Street -
Downer

Media coverage

NEWS CHRISTCHURCH MAIL, APRIL 3, 2014 11

Student designers' skills impress

Protecting monument

By ANNA PRICE

YOUNG DESIGNERS from Christ's College have been hailed by experts for their winning quake-resistant model of the Triumphal Arch in Cashel St.

Year 11 students Hunter McKenzie, Logan Finlay, Ben Smith and Sam McGuire got to compare their model with the real Triumphal Arch on a site tour at the Bridge of Remembrance.

The landmarks were one of a number of sites the four teens visited to learn more about the real world of infrastructure engineering in post-quake Christchurch.

Seven teams took part in the technology challenge to replicate a model of the strengthened Triumphal Arch, showing how the parts fitted together and how damage would be minimised in any future quakes.

Downer project director Tim Mason described the winning model as "really impressive".

"The detailing is far beyond anything I would have been able to produce at school."

The Christ's College boys said gluing the layers together and lining them up exactly was challenging.

"We were all praying it would all work together," Hunter said.

Jobs were divided up so Logan

did most of the drawing and computer work, but the four also planned as they went along and shared tasks. Teamwork was part

of the judging criteria.

Teacher Tony Holland said the project gave the students a strong focus for the end of 2013 and all

had risen to the occasion. Technology was a popular choice at the school for many thinking of engineering or architecture careers.

The actual arch is part-way through major technical repairs to strengthen it to withstand earthquakes.



On-site: The Triumphal Arch meets its Mini-Me with its designers and makers (from left): Hunter McKenzie, Sam McGuire, Ben Smith and Logan Finlay.

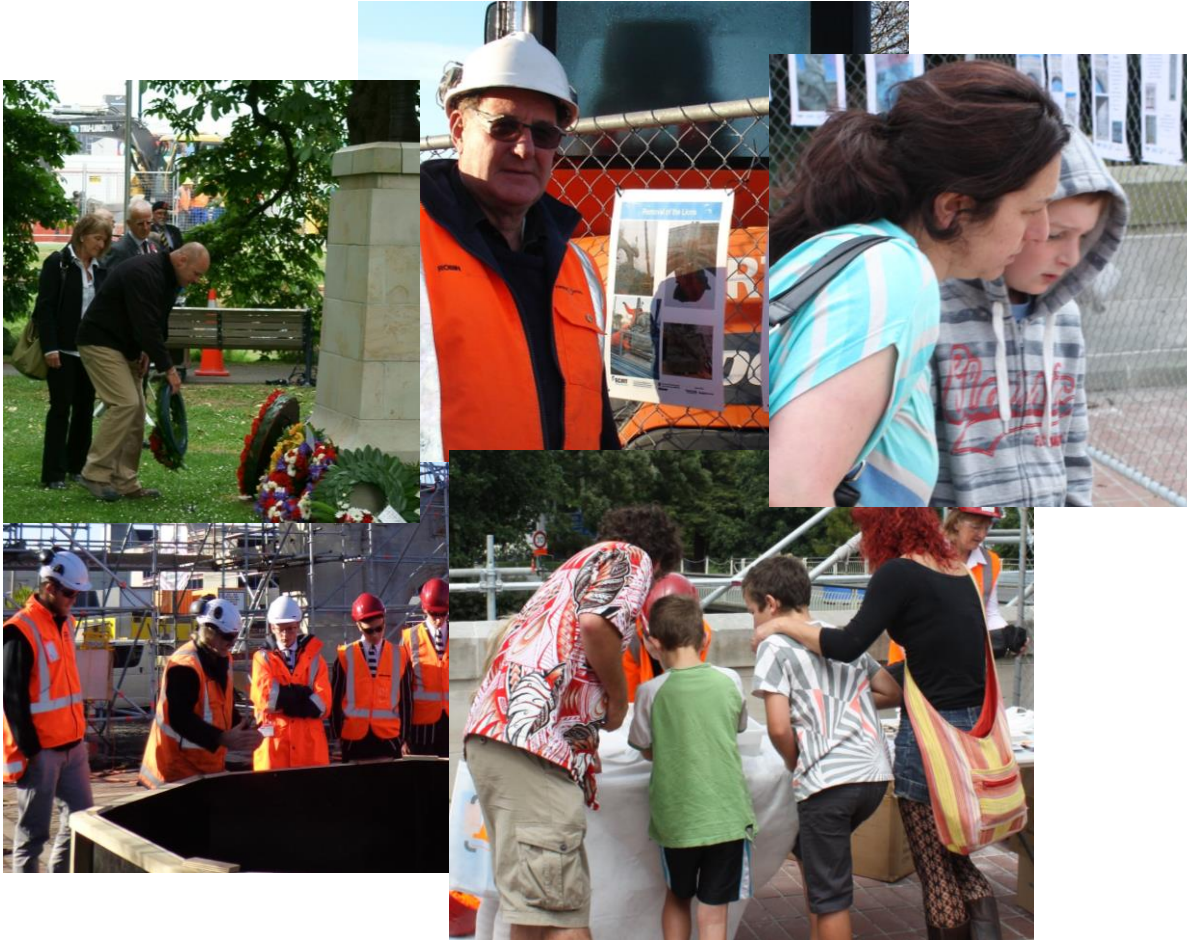
Models on display



- Winning model on displayed in CCC Foyer
- Second place model best demonstrates seismic movement.
- Collaboration with Dynamic Controls engineer, who designed a motor.
- Tour for 2nd place team and DC engineers



Biggest Challenge wide reaching stakeholders



Key Stakeholders

- CCC
- NZ Heritage Trust
- RSA
- Veterans
- NZ Armed Forces
- People of Christchurch
- Central City Business Association
- Other local businesses
- Local residents
- Tourists

Challenge strategies

Ref: 10465



SCIRT is rebuilding the city's earthquake damaged roads, water, wastewater and stormwater pipes.

16/10/2013

Christchurch City Council

Triumphal Arch

Work is progressing well on the Triumphal Arch. Although there has been little visual progress there has been a great deal of investigation work taking place behind the scenes. The investigations have provided new information about the internal structure of both the minor and the major arches.

Investigation work has shown that the internal dimensions vary from the as-built drawings in both the major and minor columns. Concrete 'shelves' have been discovered in the major columns.

The concrete shelves provide no structural purpose and can be safely removed. Changes are required to the internal steel column design.

A modified design is required for the minor arches. On-going discussions with Southern Cross Engineering, the Designer and Downer are progressing. When the redesign is finalised a large scale timber box template will be created and lowered into the columns. Once this test is complete and design approved, Downer will be in a position to order the steel.



Removing the scaffolding from the Triumphal Arch

The scaffolding that was in place for the initial investigation works has been deconstructed. The tiles and coal tar around the base of the arch is now being removed in preparation for piling and foundation work.

On-going work

- Remove tiles around the base of the Triumphal Arch.
- Remove several layers of coal tar beneath the tiles.
- Sub-Contractor, Piletech is preparing a screw pile design for submission to SCIRT designers.



Early testing with a smaller timber box



- Instructed that all communication to go through CCC
- Regular updates to CCC
- CCC posted snippets on face-book
- CCC updates posted on site fences

Challenge strategies



RSA – Communication

- Initial instruction from CCC that all communication with RSA to be via Council communication team
- Now Downer can liaise directly with RSA regarding events



Challenge strategies



Public Open Day

- Over 200 attended including tourists



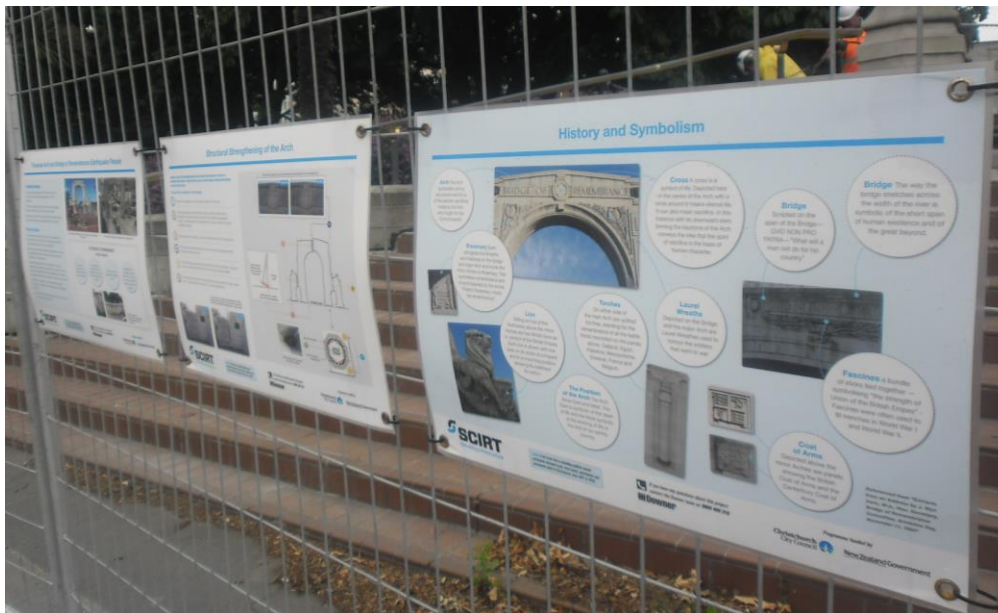
Challenge strategies



Business Day

		Programme funded by   New Zealand Government	
Invitation to Local Businesses		Bridge of Remembrance and Triumphal Arch	
		Date: Wednesday 13 August 2014	
		Times: 8.30am - 9.30am 12.30pm—1.30pm 4pm—5pm	
		Choose one of these times to visit	
		Location: West entrance - Cambridge Terrace.	
		Postponement - If heavy rain or very cold with snow. Please look for postponement signs.	

Challenge strategies



- Posters
- Brochure
- Updates for local business

Project Overview


SCIRT designers are working closely with structure specialists and co-ordinated with Christchurch City Council's heritage specialists to restore the Bridge and Arch back to their former glory.

Downer will be improving the foundations, strengthening the structure and undertaking significant technical repairs to reduce the risk of damage in any future earthquakes.

Downer has engaged the services of Goldfield Stone to source replacement stone with identical characteristics to the original stone. His team will also undertake the delicate and painstaking work of repairing and replacing the damaged and cracked stone throughout the structure.

The purpose of this design is to prevent damage or collapse of the structure and reduce the risk of severe cracking of the heritage stonework.

The complex internal strengthening work will ensure the structure meets the new building standards.




Historic image of Bridge of Remembrance and Triumphal Arch

THE BRIDGE OF REMEMBRANCE

Repairs include:

- Remove the damaged stone and the immediate surrounding stone
- Once the stone is removed grout is injected into any cracks in the concrete behind the stone
- Strengthen the parapets, bridge sides, with 1.2m pins that will be inserted vertically under the capping
- Repair and replace significantly damaged stone



Images of Bridge of Remembrance - significant cracking caused by 2011 earthquakes

If you have any questions about this project, contact the Downer team on 0800 400 310

Downer

SCIRT
Rebuilding Infrastructure

Triumphal Arch and Bridge of Remembrance Earthquake Repair





Earthquake damage

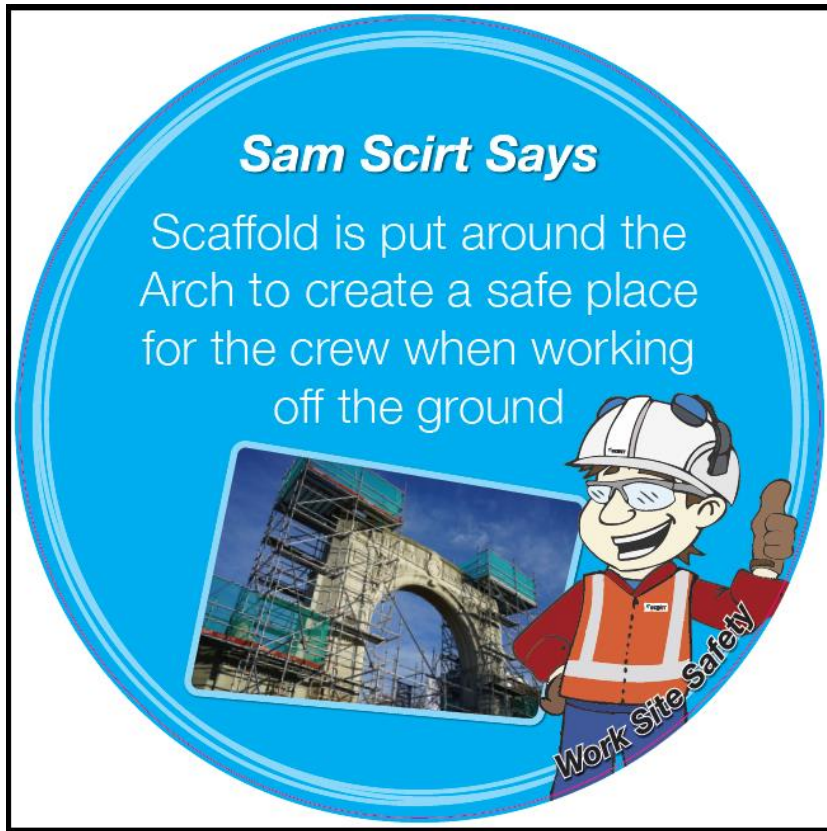
Historic Christchurch landmarks the Bridge of Remembrance and its Triumphal Arch were structurally damaged in the 2010/2011 earthquakes.

The damage includes cracking through the structure and its heritage stonework. The stability of the Arch has been compromised.

Downer, which is part of the Stronger Christchurch Infrastructure Rebuild Team (SCIRT), are repairing and strengthening the Arch and Bridge.

Programme funded by



On-going strategies



- Tour RSA's with model
- Celebrate the lions return
- Kids Corner





Questions