Technical information

Issued: May 2009

TechSpan®

Precast Concrete Arches

Reinforced Earth

Sustainable Technology

TechSpan®, the perfect arch, custom designed

TechSpan® is a three-pin, two-piece, funicular curve shaped arch. It is the leading precast concrete arch system available in Australia and New Zealand. The Reinforced Earth Company (RECO) offers custom-designed precast concrete arches that deliver maximum economy and the flexibility of site-specific clearance envelopes. Each TechSpan® arch is carefully tailored and optimised, structurally and geometrically, to meet the individual needs of the project. The system can be designed to accommodate high fills, heavy live loads, and altering loading conditions often associated with mining applications. TechSpan® arches can be installed over existing roads, live rail or other service, with minimal disruption. The design methodology utilises finite element analysis and funicular curve theory, resulting in minimum use of materials, maximum arch durability, and a cost effective total solution that is simple and efficient to install.

FRONT COVER: A TechSpan® overpass tunnel near BHP Billiton's Mining Area "C" in the Pilbara Region of WA. The arch was constructed over a live rail way line without disruption to iron ore train movements.

THIS PAGE: Placing initial TechSpan® elements, Daunia Mine overpass, QLD.

OPPOSITE: Precast concrete culverts replace steel culverts at Piles and Leask Creeks at Somerby, near Gosford. There was no need to divert waterflow during construction of the TechSpan® culvert and TerraPlus® headwalls.

FAR RIGHT PAGE (left to right, top to bottom): TechSpan® units are stored on their side until being lifted, turned and placed at Yallourn Power Station near Morwell, VIC. TechSpan® arches were used to house conveyors and support a 40m embankment when the Morwell River was diverted to allow access to new coal reserves in 2007.

Placing initial TechSpan® elements, Mining Area "C" rail overpass, Pilbara region, WA.

Ensuring correct position within footing keyway, Hazelwood Power Station conveyor tunnel, VIC.

Hand compaction within 1.5m of the arch, Millenium Mine heavy vehicle overpass, Bowen Basin region, QLD.

Compaction with a vibratory roller, Millenium Mine heavy vehicle overpass, Bowen Basin region, QLD.

Constructing the reinforced concrete longitudinal crown beam, Port Coogee rail overpass, WA.

One piece TechSpan® arch units, Lane Cove Tunnel, NSW.

Why TechSpan®?

- Enhanced concrete durability at competitive cost due to:
  - reduced tensile stresses;
  - reduced shear forces;
  - minimised bending moments in the completed structure which improves resistance to overload.
- Lower footing costs due to reduced horizontal reactions at the arch base.
- Rapid installation.
- Open to through traffic or waterflow during construction.
- Optimised traffic clearance envelopes.
- Any practical arch span and height.
- Increased load-bearing capacity – high fills, high live load, steep slopes.
- Design for special geometric requirements.

TechSpan® specification

TechSpan® arches can be designed to suit state transport authority specifications.

TechSpan® arch system components

Cast-in place concrete footing
The footing serves as a foundation for the TechSpan® elements.

Precast concrete elements
Arch elements may be specifically sized according to their intended location within the structure. Lifting anchors are cast into each unit for handling and lifting purposes. Anchor location and sizes are indicated on the project drawings.

Full width elements. Male and female galvanised steel bearing plates are cast into the top edge of each TechSpan® element to form the pin joint between opposite elements at the crown of the structure.

Half width elements are used to complete the spaces left at the start and end of the structure as a result of the staggered arrangement of full-width units.

Geotextile and impermeable membrane
An impermeable membrane and a layer of geotextile may be applied to all vertical joints between adjacent elements and along the longitudinal joint at crown of the structure as indicated on the drawings.

Crown and footing joints
Cast-in place, reinforced concrete longitudinal beams at the crown, and grout at the footing keyway of the structure.

Backfill
Backfill complying with the RECO specification shall be used within the prescribed zones as shown on the project drawings.

Where is TechSpan® used?

TechSpan® technology has revolutionised construction with wide-ranging uses in transport, mining, industry, energy, water, and military infrastructure. TechSpan® applications include:

- road and rail tunnels;
- reclaim tunnels;
- bridges;
- culverts;
- river crossings;
- conveyor tunnels;
- blast protection bunkers.

TechSpan® arches are frequently used for the construction of rail and road tunnels beneath earthen embankments. They can be constructed over existing railway tracks without closing the line.

TechSpan® arches have also enjoyed rapid acceptance in the mining industry. The custom designed arch gives great flexibility to both designer and mine owner to optimise clearance envelopes. RECO is able to design the arch for the high fills and live loads associated with bulk materials handling. Importantly, the reduced bending moments inherent in the funicular curved arch improves resistance to overload. TechSpan® arches have been widely used for reclaim conveyor tunnels below coal and iron ore stockpiles, some up to forty metres high.

TechSpan® also has applications in culvert and other water crossings. The adaptability of the arch shape allows optimisation of the section while respecting the anticipated water flow. TechSpan® is the solution of choice for these applications, as the prefabricated durable concrete units used are cost-effective and construction can take place without diverting the water flow.

Supply of materials and services

RECO supplies the following:

- design and certification of the precast concrete TechSpan® arch;
- manufacture and supply of the TechSpan® arch elements;
- supply of vertical and longitudinal impermeable jointing material;
- delivery of construction materials to the job-site FOT (free on truck);
- on-site technical advice and guidance.

The contractor is responsible for installation of the arch, and supplying the recommended equipment for arch element lifting, earth backfilling and compaction. The client and contractor should refer to the comprehensive TechSpan® construction manual for a complete list of equipment, tools and miscellaneous items recommended to be used to aid the installation of the TechSpan® arches.

Unloading and storage of components

TechSpan® arch elements are transported on flatbed trailers to site. It is preferable that arch elements should be unloaded from the truck and erected immediately. Where necessary, elements may be placed in a separate storage area for erection at a later date.

Using the correct lifting clutches to suit the anchor size cast into the top edge, elements should be carefully removed from the delivery vehicle and placed on edge on proper hardwood dunnage (two supports only) on firm level ground. Care must be taken to protect the elements from damage or distortion during handling and storage. Improper support will result in structural damage.

Construction summary

1. Set out and construct reinforced concrete footings as detailed.
2. Set out centre line of base of arch elements and longitudinal location of the TechSpan® elements within footing keyway.
3. Off-load and turn TechSpan® elements in the air.
4. Use two cranes to erect the first four units. One crane should retain load until a stable formation is achieved. After this, the second crane may be released.
5. Erect remainder of TechSpan® elements by placing each unit resting against the unit opposite and offset by half a unit width, allowing progressive support for subsequent arch units.
6. Temporarily wire adjacent elements together.
7. Cover vertical joints with impermeable membrane and/or geotextile.
8. Apply bitumen bond break compound to base of arch units.
9. Grout footing keyways.
10. Backfill elements to arch crown.
11. Construct the reinforced concrete longitudinal crown beam.
12. Install joint material to crown beam.
13. Complete backfill to finished surface level.

Please refer to the comprehensive TechSpan® construction manual for a complete construction methodology.

Backfill

Placing and compaction of the select backfill

The backfill is placed and compacted in layers on both sides of the arch. Both sides must be brought up evenly to ensure uniform distribution of loads.

Detailed construction requirements can be found in RECO's TechSpan® construction manual.

The degree of compaction required depends on the function of the structure and is stated in the project specification, but in any case should not be less than 95 percent of the maximum dry density (Standard Compaction).

The backfill should never be placed with a moisture content higher than Optimum Moisture Content.

Choice of select backfill

A granular engineered fill material as specified by RECO is required in a 2m zone around the back of the arch. Generally a minimum of one metre cover of backfill is required over the crown of the arch.

Select, non-plastic, granular backfill material for dry land structures should be used. Three backfill zones (refer to diagram below) are generally required.

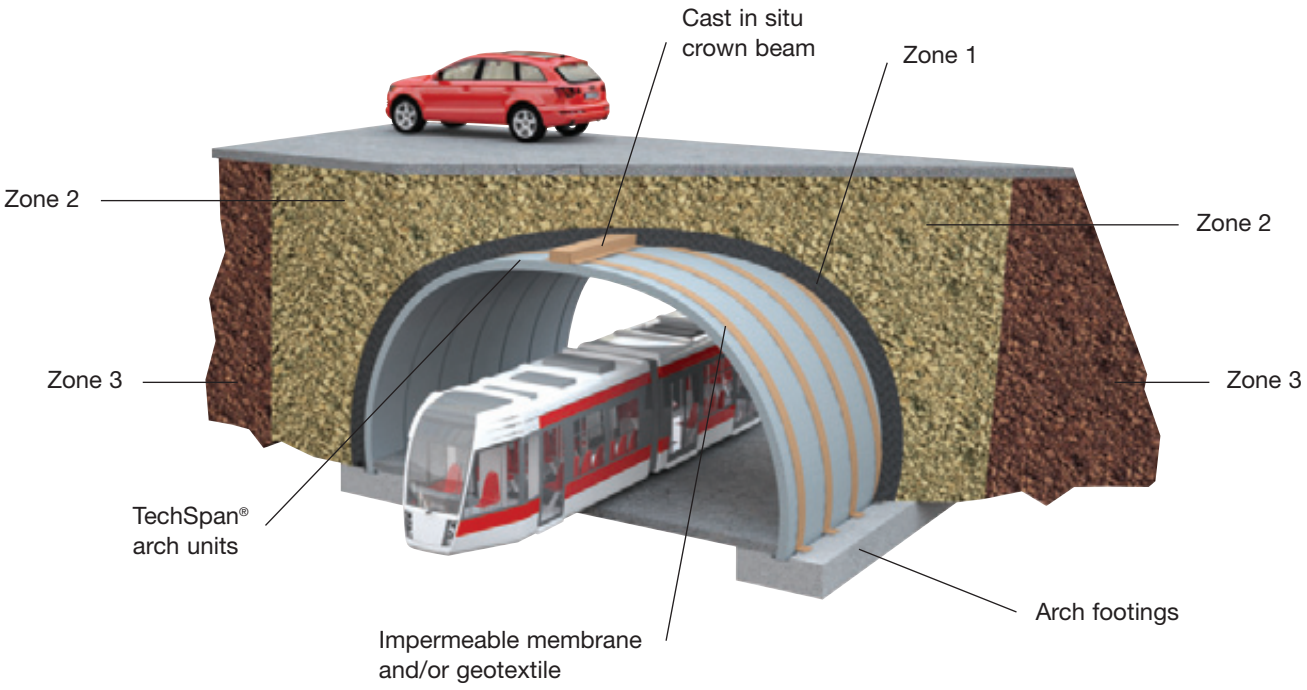
The material properties for each zone can be found in RECO's TechSpan® Technical Specification.

Crew size and production rates

As a guide, a typical TechSpan® erection crew may include:

- crane operator, dog man and rigger;
- two workers to receive and set elements;
- one working foreman/supervisor.

RECO will provide on-site technical training to aid the installer with the first elements until the installer is competent with the technique. With smooth and careful operation by the contractor, it may be expected that 20 to 30 TechSpan® units can be erected per eight hour shift accounting for some 15 to 25m of tunnel, depending on the width of unit designed for the project. Installation rates generally depend on site conditions and should be discussed with RECO's construction coordinator for guidance on particular project requirements.



Reinforced Earth

Sustainable Technology

Reinforced Earth Pty Limited
PO Box 1521
Hornsby Westfield NSW 2077 Australia
Ph +61 2 9910 9910
Fax +61 2 9910 9999
www.reinforcedearth.com.au

Reinforced Earth Limited
PO Box 72_734
Papakura Auckland New Zealand
Ph +64 9 236 3385
Fax +64 9 236 3385
www.reinforcedearth.co.nz

Certified System
Quality
ISO 9001