

Background

The Romans built bridges with spans exceeding 32 meters, examples of which are still standing despite repeated seismic activity. The durability and strength of these structures is based on simple principals, all segments are relatively large in size and all are loaded solely in compression.

There are some technical drawbacks to the Roman method that have precluded modern use.

The first drawback is that massive precise falsework is typically required to support the combined weight of all the sections prior to the insertion of the keystone. This requires a substantial investment in design, material and labour to achieve only temporary support.



The individual voussoirs (arch segments) are not mechanically interlocked relative to each other to maintain alignment while assembly takes place. There is therefore no overall stability of the assembly prior to the insertion of the keystone and the application of the compressive force that occurs when the falsework is removed.

The Roman required precision stone cutting to aid in this alignment of the voussoirs during assembly. Shimming would probably have been required in the joints between voussoirs during assembly to prevent the extrusion of the slow setting mortars that were typical of the time.

United Lock-Block™ now offers Arch-Lock™ which improves the Roman method as follows;

The Arch-Lock™ method eliminates falsework. The copyright protected interlocking key design holds the units together in alignment during and after assembly. The Arch-Lock™ voussoirs achieve geometric and fit tolerances with repeatability through precise precast concrete forming techniques. This precision eliminates the need for the mortar the Romans required to overcome dimensional and geometric variations typical of cut stone voussoirs.

By eliminating these factors Arch-Lock™ can provide the high strength, beauty and durability of a Roman arch bridge or vault at a fraction of the cost and the time required to build a comparable conventional reinforced post and beam concrete structure.

To illustrate the advantages of this approach on a local project consider the ongoing expansion of the Sea to Sky High. If the existing railway line had been covered with a low cost vaulted tunnel, the highway could have been built directly on top of fill placed over this vault. This would have greatly reduced the volume of rock blasting required to widen the right of way in the headland areas of the project.

Another project that could have benefitted from Arch-Lock™ was the cut and cover portion of the Canada Line transit tunnel. Project cost as well as disruption to traffic and business would have been greatly reduced. The required hundred year lifespan could have been easily achieved by eliminating the reinforcing steel from the concrete life cycle equation. A thousand year lifespan would have been possible using the Arch-Lock™ System

For 3P ventures or those seeking an innovative method of producing and maintaining a highway bridge or overpass the advantages of Arch-Lock™ are as follows:

1. Extremely **heavy load carrying capacity**. The weight of increased traffic load merely pushes the sections more forcefully together.
2. **Simple engineering factors** that lend themselves to design and specification templating to further reduce engineering costs.
3. Speed – a bridge vault can **be erected in days**. Fill can be placed on top immediately upon erection.
4. **Elimination of the bridge deck**, the most challenging and costly structure to maintain in concrete construction. The high cost of re-decking is replaced by the low cost of repaving the elevated roadway.
5. **Elimination of the corrosion potential** in the vault as per the Lock-Block™ advantages listed in Part One.
6. **Extremely high seismic resistance** as proven by 2000 year old existing structures in seismically active areas in Europe.
7. Robust sections that are **easily lifted** with conventional excavating equipment.
8. Minimal skilled **on site labour** requirement.
9. **Idiot proof assembly**, if the keystone does not fit, the span is not correct. Minimal engineering inspection requirements reduce cost.
10. **Limited number of pieces required**, there are only four span specific Arch-Lock™ voussoirs required to build a fixed radius vault.
11. Arch-Lock™ voussoirs interlock with standard Lock-Block™ units as well as other span specific Arch-Lock™ voussoirs to form **easily customizable compound arch shapes**.
12. **Aesthetics** – The beauty of classic arches is indisputable. This arch shape could be the identifying hallmark of the Gateway project! Keystones and exterior faces can be customized to suit an overall aesthetic plan that matches the sound barriers detailed in Part One.

There are many logistical and structural advantages beyond those listed above that can be further discussed.