Cintec's
award winning

ARCHTEC

the strengthening,
repair and stabilization
of masonry arch bridges

CINTEC
NORTH AMERICA
SECURING THE PAST FOR THE FUTURE

the cintec system

the cintec commitment

Cintec world wide recognizes and respects the feelings of local communities in respect to what they regard as Heritage or Historic buildings and structures, regardless of whether or not the buildings/structures are formally designated as such. To this end Cintec works to the guidelines of the Secretary of the Interior's Standards for Historic rehabilitations, the principles of the Venice Charter of 1964 and the Burra Charter of 1979.

bridge requirement

In North America there are over 1,000 masonry arch bridges. Europe has many thousands of such structures; 40,000 in the UK alone are in continual use by highways, railways and waterways. Most are well over 100 years old, and as of January 1999 the European directive 96/58/EEC requires that all major (trunk) road bridges be capable of 40 Tonne (89,500 lbs) axle loading.

archtec response

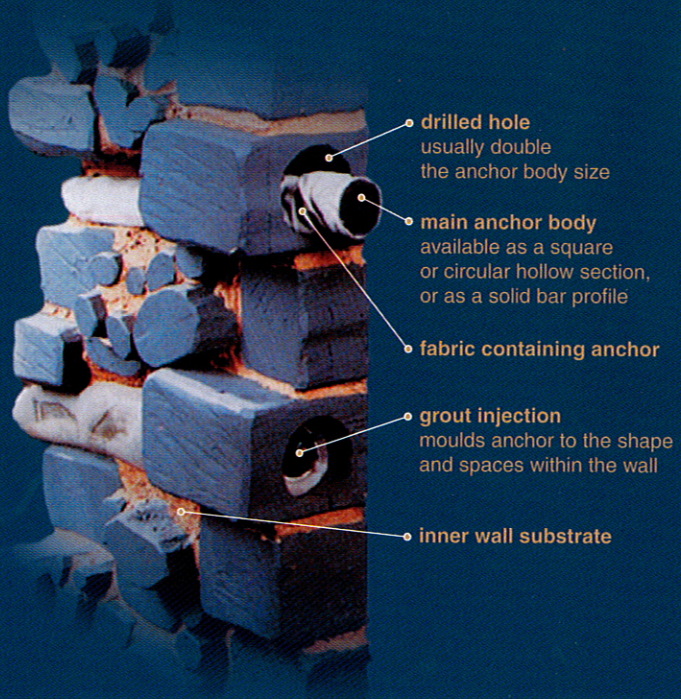
Archtec provides a unique bridge reinforcement system — a complete diagnostic, design and installation service, utilising state of the art technology and drilling methods specially designed to strengthen masonry arch bridges.

how it works

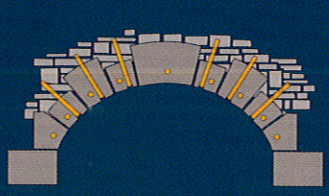
The Cintec Anchor System comprises a steel bar enclosed in a mesh fabric sleeve into which a specially developed grout is injected under low pressure.

Installation is through drilled holes produced by wet or dry diamond coring technology. The flexible sleeve of woven polyester restrains the grout flow and expands up to twice its previous diameter, moulding itself into the shapes and spaces within the walls to provide a strong mechanical bond along the entire length of the anchor. This will often dispense with the need for patress plates on the exterior of the structure.

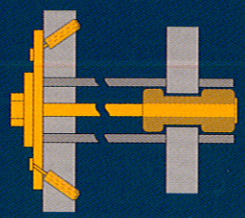
The grout is a Portland cement based product, containing graded aggregates and other constituents which, when mixed with water, produce a pumpable cementitious grout that exhibits good strength without shrinkage.



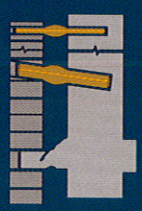
applications



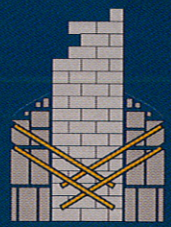
arches and bridges



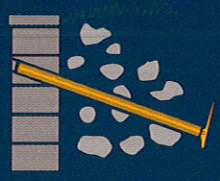
structural reinforcement



hanging walls



viaduct foundation



retaining walls

additional information is available on our web-site

proven performance

The intrinsic qualities of the Cintec Anchor are well documented through years of extensive testing. With each project and each application, from high-rise buildings, to ancient masonry structures, to bridges and retaining walls, Cintec ensures that the physics behind the methodology are proven to be effective.

performance

An independent study carried out by the Building Research Establishment involved accelerated age testing. This simulated a forty-year ageing cycle and confirmed the anchors' long-term performance.

Cintec anchors withstand forty-year ageing cycle simulations

extreme temperature testing shows the Cintec anchor withstanding extreme temperatures of 212° F (160°c) for two hours

durability

freeze-thaw

Following rigorous testing in North America by ArconTEST Incorporated, the report on the Uni-directional Freeze-thaw Performance of Cintec Masonry Anchors (to EN 772) found no loss of grout or encasing brickwork after a full 100-cycle test.

Freeze-thaw testing of Cintec anchors showed no appreciable deterioration after 100 cycles

fire

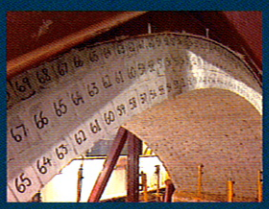
Fire testing at the Building Research Establishment (U.K.) in 1993 confirmed that the Cintec Anchor system, when installed correctly, have a fire period requirement of up to 2 hours, at 212ºF (160º c).

environmental

In many ways, the Archtec system is a wise environmental choice:

- it typically consumes 90% less energy than conventional methods
- it has virtually no impact on the environment and sensitive waterways
- it does not deface the appearance of structures and bridges
- Archtec construction areas have a small "footprint"
- it causes little or no delays or redirection of traffic

Cintec Anchors are dramatically more environmentally friendly than conventional methods



TRL test: from 22.5 Tons (20 tonnes) to 46 Tons (41 tonnes)

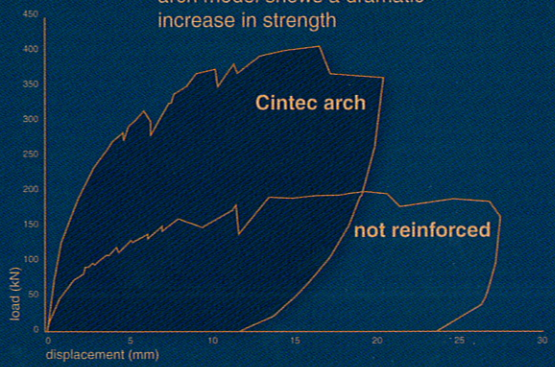
strength and flexibility

Laboratory models of an arch bridge were constructed in brick, based on an original bridge in the UK. The load failure point of one model was 22.5 Tons (20 tonnes). Following strengthening by single-rebar anchors, their precise location being determined by state-of-the-art design, the load failure point was raised to 46 Tons (41 tonnes). Strengthening using newer, multi-bar anchors raised the load failure point to 50.4 Tons (45 tonnes).

Overall, the following results were demonstrated:

- load-bearing capacity of the arch is increased by a factor of 2.05
- the first crack or hinge does not occur under the load-line
- overall, the installed anchors delay the formation of hinges
- the bond between anchors and masonry is sound
- the strengthening is relatively easy to install
- the system demonstrates significant flexibility and increased ductility.

load vs. displacement test of arch model shows a dramatic increase in strength



award-winning technology

Cintec has been honoured with a number of coveted awards for conservation, environment and historic bridges preservation.

ENVIRONMENT AWARD FOR ENGINEERS

THE HISTORIC BRIDGE AWARDS, 2001
The Winston Bridge Strenthening Project

THE INSTITUTION OF ENGINEERS, AUSTRALIA
Engineering Excellence Award 2001

THE HISTORIC BRIDGE AWARDS, 2001
The Coalport Inclined Plane Bridge Strengthening Project

case histories
road bridges

Newcomers Mill Bridge
Maryland, USA

The structure

Newcomers Mill Bridge (route MD 733A) on the old National Highway is close to Frostberg, Garrett County in Maryland. The Bridge is one of seven remaining stone masonry bridges in the county constructed between 1813 and 1850. It is a single span masonry arch bridge over the Savage River and has significant historic value. The arch barrel is constructed from random rubble with squared voussoirs. Spandrell walls and parapets are built from roughly squared rubble.

The problem

At the time of Cintec's inspection (Nov 1999) the southern spandrel wall was in a serious state of disrepair and in imminent state of collapse.

The solution

A submission was made to Maryland State Highway Department and after the installation of over 45 Cintec Anchors, some measuring up to 28 feet (8.53m) in length, masonry repairs and low pressure grouting, this Historic bridge is once again safe.

Snowbridge
Glasgow, Scotland, U.K.

The structure

Hidden in the tranquil gardens of Kelvin Grove Park, Glasgow, Scotland, the Snowbridge was thought by many to have gracefully retired into obscurity. Its past glory of being the main means of disposing of the accumulated snow from the entire main thoroughfares of Glasgow had been superseded decades before by mechanical loaders.

The problem

With its retirement, it suffered, like most obsolete structures, with neglect and lack of maintenance due to the low priority it rated in budgets.

In 1987, CINTEC was asked to provide an estimate to rectify the many years of neglect. Following a complete survey and report from the Engineers Ove Arup and Partners, a comprehensive maintenance and anchoring scheme was presented to the City Council to bring the structure to a safe condition.

The solution

The scheme principally provided for the introduction of square hollow structural stainless steel anchors to the voussoirs and intrados of the arches and spandrel walls. The drilling chosen was wet diamond drilling with core retention to the natural stone structure. This provided that desired drilling accuracy and the need to reduce the vibration to a minimum in the fragile structure.

The proposals were kept in abeyance for several years before work commenced. Indeed, serious consideration was given to demolish the whole structure until it was found to contain optical telecommunications between the USA and the UK.

Bodiam Bridge

Hertfordshire, U.K.

The structure

The site is that of a Roman road, constructed on a twigs and rubble causeway to serve an ironworks. Built in 1797, the bridge is a single track, hump-backed triple arch structure in brickwork and there are signs of various remedial works throughout its life.

The problem

There appear to have been problems with the original construction. There is pronounced twist in the lower courses of brickwork towards the northern end of the bridge, which disappears as the construction continues upward. In recent years, the bridge has suffered from the effects of increasingly heavy traffic exacerbated by the very cold winters of 1986 and 1987. This has led to the cracking of brickwork adjacent to the arch voussoirs, some movement in the spandrel walls and delamination of the wing walls at the south end. The County Council approached Cintec for a proposal to use grout injected anchors to tie across the arch.

The solution

To prevent any further spreading of the arches, it was proposed to tie across the full width of the bridge, staggered from both sides. This ensured that the lateral stresses were not transferred to a single plane nearer the centreline of the bridge causing new cracking at this point. Following grouting of the anchors the holes were made good with coloured mortar to match the brickwork.

Smaller anchors were also used for repair of the southern wing walls where core drilling of bulged portions of the wall showed that a half brick facing skin was delaminating from the full thickness of the wall. High bond capacity allowed an effective anchorage into a single half-brick skin, achieved while still having the end of the anchor recessed into the face.

Broxbourne Arches

Hertfordshire, U.K.

The structure

The strengthening of Broxbourne Arches was carried out in January 2000. It involved work on 14 separate arches. All work had to be completed from underneath in order to avoid interfering with the road traffic on the arches. After the strengthening work, another company worked on the bridge surface to relay pipelines and upgrade the surface.

The problem

The strengthening method was designed by Gifford and Partners. Their assessment was that the crack pattern observed in the arches was not indicative of live load effects and indicated a progressive type of failure. A live load assessment had shown that the structure had sufficient capacity to carry the required live loading of 45 Tons (40 Tonnes) gross vehicle weight, and that the foundations also showed no signs of distress. Records indicated that the arches had, at some stage, been back-filled with mass concrete. While providing the arches with a substantial increase in live load capacity, the issue of thermal expansion had been overlooked. Analysis was carried out to understand the behaviour of the structure under thermal loading, and this confirmed the crack pattern observed on-site. Thermal expansion of the concrete had taken place pushing the arches laterally and producing a domino-like effect. Cracks had appeared where hinges had developed as a result of the lateral forces. Design work was then carried out to stabilize the damaged structure and provide additional capacity across the hinge positions.

The solution

The project involved the excavation of some of the ground in the immediate area of drilling to provide the angle for the insertion of the main anchors. A total of 75 Stainless Steel strengthening anchors were installed, as well as 12 transverse anchors. The project was completed in 5 weeks — the contracted period.