Case stories

Hydrodemolition for Skanstull Bridge repairs

An independent comparison by Stockholm's Streets and Traffic Administration of Conjet hydrodemolition equipment and conventional jack hammers, used for the concrete repairs to the deck and side beams of the city's Skanstull Bridge, has conclusively shown hydrodemolition to be by far the most effective, efficient and preferred concrete removal technique. Controlled laboratory tests of the strength of the bonding between old and fresh concrete on the bridge deck and its eastern side beam, clearly demonstrated that the repairs done with Conjet hydrodemolition equipment where more than four times stronger.

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CE

Conjet technology gains approval from the city's Traffic and Property Management department

The impressive results prompted bridge owner Gatu- och Fastighetskontoret to abandon jack hammers and exclusively use Conjet hydrodemolition equipment for the remaining repairs to the 43 year old bridge's western side beam. The 565 m long, reinforced concrete, multi-span structure, with its 120 m central span over the Hammarby Lock, carries rail, road and pedestrian traffic between the districts of Södermalm and Johanneshov. It was opened for tram traffic in 1947 and later widened in 1952 to carry the adjacent railway track.

The Track builder "Spårbyggarna"

Contractor Spårbyggarna AB was awarded the main bridge repair and renovation contract which included repairing, strengthening and increasing by 200 mm the height of the side beams. This involved first removing a 70 mm layer of concrete from the top of the parapet, to uncover the reinforcement, followed by fixing additional reinforcement prior to placing new concrete. In addition the top 20 mm of the bridge deck was taken off and replaced with fibre reinforced concrete followed by repairs to the deck's main joints. Spårbyggarna had to maintain traffic flow throughout the six week (100 days)contract and carried out the repairs in two phases over two consecutive seasons. One lane of the entire bridge deck, together with the eastern sidebeam, was repaired during the summer of 1990, while the 20 mm layer of concrete from the 2350 m2 deck and 250 m2 from side beam faces in a 9 day contract period.

Vertical boom and rotor

The specialist hydrodemolition contractor NCC Waterjet used two Conjet Robots each with a Conjet 380 Hp Power Pack. One Robot was fitted with a vertical feed beam for removing concrete from the side beam faces. The other Robot was initially equipped with a hydraulic rotor to take off the deck's bitumen sealant. The rotor was then replaced with a standard horizontal feed beam and oscillating nozzle to remove the deck's top 20 mm thick layer of concrete. NCC Waterjet completed the job well within the contract period and to a very high standard. Site personnel agreed that nothing but hydrodemolition could have done the job so fast and so well. As hydrodemolition had proved such a success on the deck and side beam faces the bridge owner decided to test, evaluate and compare the more efficient hydrodemolition repair technique alongside the initially favoured percussive mechanical breakers on top of the eastern side beam. A short test area, using the Conjet Robot to remove the top 70 mm layer of concrete to expose the reinforcement, was completed next to the remaining stretch carried out with breakers. Extra reinforcement and fresh concrete was placed to increase the height of the side beam and left to cure. Core samples were taken from the two areas and tested in Stockholm City Streets and Traffic Administration's laboratory, one of Scandinavia's most modern concrete testing facilities.

Stronger bond with hydrodemolition

Three core samples were taken from the stretch repaired using hydrodemoadjacent lane and western side beam where tackled the following year. Mechanical breakers were originally specified by the bridge owner for removing concrete from the top of the side beams and hydrodemolition on the side beam vertical faces and the main bridge deck. The hydrodemolition was sub-contracted to NCC Waterjet to remove bitumen sealant and the top Surface ready for pouring. Preparation of the sides with vertical attachment. lition and seven cores from the section completed with breakers to determine the comparative tensile strengths of the bond between the old and new concrete. The test results proved that hydrodemolition had produced a very much stronger bond. Test samples in the area prepared by Conjet hydrodemolition equipment produced an average tensile strength of 2.2 Mpa, with the fractures developing in the old concrete. From the additional samples take from the adjacent area prepared by conventional breakers, three did not make it to the testing unit and broke during transport and preparation. The average tensile strength of the remaining four samples was 0.5 Mpa with fracture occurring in all cases at the bonding interface between old and new concrete.

Breakers cracking the concrete

The laboratory concluded that the tensile strength of the concrete in the area conventionally prepared with breakers was very low. This low strength was due to cracking and damage to the concrete left in place which weakened the interface bond. In addition the laboratory stressed that it was vitally important, when removing concrete with breakers, that all the old and damaged concrete be removed and the area carefully and thoroughly cleaned before covering with a new overlay.

The laboratory concluded that hydrodemolition produced a far superior and very high quality repair and recommended its use for similar projects.

Repair of the Western side beam

The experience gained from the comparative tests on the eastern side of the bridge led Gatu- och Fastighets- Kontoret to adopt hydrodemolition as the only solution to obtain a technically acceptable repair for the western side beam. But access to the side beam, which was very close to the adjacent subway track, was severely restricted. Trains could not be stopped during the bridge repairs and the only solution was to modify the Conjet Robot to travel along the top of the beam. Conjet narrowed the Robot's base frame and shortened the feedbeam to match the width of the parapet. In addition NCC Waterjet fitted the Robot with accurate guidance devices to keep the machine correctly positioned.

Distributor/Agent

In addition a special rig fitted with protective sheeting prevented water spray and concrete debris from the subway trains running 200 mm from the hydrodemolition operation. The modified Conjet Robot removed a 70 mm thick strip from the top of the sidebeam leaving a rough, uneven textured surface to accept the fresh concrete. Formwork was erected, reinforcement added and new concrete placed to a depth of 200 mm to complete the sidebeam repair and strengthening.

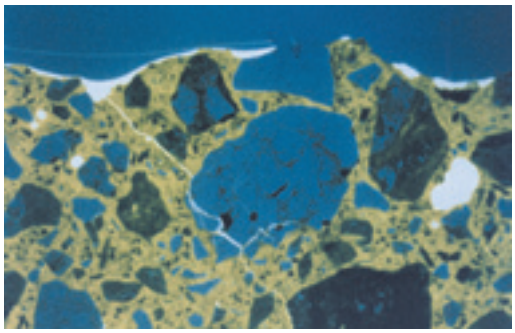
Summary of laboratory tests

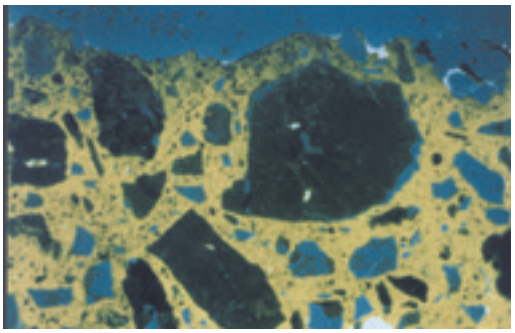
(Tests made by the Swedish Authority ”Materialprovningen”)

Core samples 1-4, indicated in the table opposite, were taken in the area where the side beam was prepared using hydrodemolition. In all these samples the fractures occurred in the old concrete. The results show that the tensile strength of the core samples is approximately four times higher than the cores taken in the area prepared by percussive methods. Cores 5-15 removed from the section where percussive breakers were used indicate very low tensile strength. The fractures have occurred in the bonding zone between old and new concrete. In the area prepared with the percussive breakers the remaining concrete is damaged and soft areas of concrete which have not been thoroughly cleaned. This is confirmed by samples 9 and 11 which broke during transportation to the test room. Sample 5 broke in the laboratory during the preparation for testing.

It is vitally important that the surface is thoroughly cleaned of old residual concrete before the new concrete is poured. The Swedish authority ”Materialprovningen” recommends hydrodemolition for projects similar to the Skanstulls Bridge where high quality concrete repairs are required.

Sample no.	Tensile strength MPa	Type of fracture
HYDRODEMOLITION		
2	1.7	Fracture in old concrete
4:1	2.9	Fracture in old concrete
4:2	1.9	Fracture in old concrete
PERCUSSIVE DEMOLITION		
8	0.6	Fracture in bonding zone
10	0.6	Fracture in bonding zone
12	0.5	Fracture in bonding zone
14	0.4	Fracture in bonding zone
5	<0.1	0.1 Fracture during preparation
9	<0.1	0.1 Fracture during preparation
11	<0.1	0.1 Fracture during preparation





The picture shows a thin sample from the concrete surface that has been prepared for photo purposes. The left sample shows typical damage from jackhammering or milling. The ”white” crack is going from the surface through the cement paste and aggregate down into the concrete structure. The right picture shows a typical sound and uneven surface made with Conjet hydrodemolition equipment. There are no cracks from the surface as when percussive methods have been used.

CE, EMC certified

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