large diameter spiral-wound pipe renewal
Sekisui SPR specializes in innovative solutions for infrastructure renewal. As a wholly owned subsidiary of Sekisui Chemical Co., Japan, we are able to provide our customers with the resources and expertise to meet the requirements of the most technically challenging projects. Founded in 1947, Sekisui Chemical Co. is a global leader in advanced plastics materials and manufacturing. Our core technology is Sekisui's patented SPR Spiral-wound PVC Pipeline Renewal process for large diameter applications. SPR is the preferred large diameter pipeline renewal method in Japan with over 25 years of installation history. We also offer innovative, value-added renewal technologies for use in smaller diameter pipelines, laterals, and manholes. Sekisui SPR's goal is to be the industry leader in providing innovative trenchless infrastructure renewal solutions.
The SPR Method is unique as it can provide a customized solution to aging pipelines. The SPR Method is a spiral-wound trenchless pipeline renewal process that is environmentally friendly and is designed for installation in live flow conditions.
How The SPR Method Works

SPR is a spiral-wound trenchless pipeline renewal process designed for use in large diameter pipelines, typically person entry. SPR is applicable not only to circular pipeline but also box culvert as well as other shapes. SPR utilizes steel reinforced interlocking PVC profile strips grouted in place. The installation equipment can be utilized via standard access points without site excavation. SPR can also be installed in vertical applications such as wet wells, access shafts and other large diameter structures.

1. Prior to installation the pipeline is inspected and cleaned.

2. The PVC profile is unspooled and fed into The SPR Winding Machine. The SPR Winding Machine pulls the SPR profile into place and engages the dual locking mechanism.

3. After winding, bracing is installed to prepare for grouting.

4. After the SPR profile has been locked into place, the annular space is grouted with a special high-strength grout.

5. The frames are removed and the pipe is ready for service.
About The SPR Method

The SPR process is unique as it can provide a customized structural solution to aging pipelines and/or a corrosion barrier and is designed for installation in live flow conditions. It can be engineered to correct hydraulic anomalies as well as restore the slope of the original pipe.

The patented double locking profile creates an impermeable mechanical lock that can withstand strong deformational forces. SPR PVC profiles have a Mannings 'n' Value of .010. SPR PVC materials have been tested in accordance with industry standards and approved to meet the following:


The SPR grout is specially formulated for the SPR process.

- Highly thixotropic
- Strong adhesion to the host pipe and spr pvc profile
- Minimal drying shrinkage
- Little segregation in water
- High compression strength
Tight curve installation

SPR has been used to rehabilitate the curved section of pipelines up to Radius = 10 X Diameter. With the development of a new flexible profile that has an additional elasticity characteristic that enables SPR to accommodate tighter curve sections up to Radius ~ 5 X Diameter.

Profile for Straight Section (up to R=50D)

Profile for Curve Section (up to R=50D ~ 5D)

Outside groove in the curve profile will be spread and inside groove will be shrunk. This mechanism makes it possible for SPR to accommodate tight curve sections.

Earthquake resistance

The SPR wound profile method of pipe rehabilitation produces a composite pipe that is flexible enough to withstand earthquake activity. The SPR profile maintains performance even with a host pipe diameter reduction of 25%.

Corrosion barrier

The PVC material used to manufacture the SPR profile is the same as used to manufacture standard size rigid PVC sewer pipes. Chemical resistance in the sewer environment is excellent.
The SPR Method can renew not only circular shapes, but also other shapes such as square, rectangular, horseshoe and arch. SPR can also be installed in vertical applications such as wet wells, access shafts and other large diameter structures.
Outline of SPR Construction at Los Angeles Sewer

Carson City, California faced an infrastructural problem of deteriorated and corroded sewer pipelines, which is the typical case found around the world. Among those problems was a significantly deteriorated sewer pipeline coated by clay tile in the 1920’s (Los Angeles Sewer). This was the first time the SPR method was selected under U.S. bidding, and the first time Los Angeles County implemented SPR. For the first year, the construction length was separated into two parts in order to compare construction quality between the originally specified rehabilitation method and SPR. Either method could have been selected for the following year’s repairs. Because the SPR method achieved around two-thirds the construction period of the two methods, and had superior construction quality, SPR was chosen the following year to complete the rehabilitation of the whole length.

Outline of the construction:
1. Name of Construction: Joint Outfall "A" Units 2.3A and 3B Trunk Sewer Phase
2. Location: City of Carson, California
3. Owner: County Sanitation District No.2 of Los Angeles County, California
4. Period: 2 years in 2005 and 2006 (Construction Period April 1st ~ October 15)
5. Construction Length: 114" Horse Shoe Shape = 3170ft
   78" Horse Shoe Shape = 472ft
   Total 7648ft
   Construction in 2005: 114" Horse Shoe Shape
   Flexible PVC Lining Method = 2106ft
   SPR Method = 1805ft
   Construction in 2006: 114" Horse Shoe Shape
   SPR Method = 3200ft
   78" Horse Shoe Shape
   SPR Method = 478ft
   (Sharp curve existed in 114" Horse Shoe Pipeline = 3 parts were 65ft)
Construction method for sharp curved pipeline at JOA

The big concern on this job site was how to rehabilitate the curved sections whose radius of curvature is $R=390\text{ft}$. Although acceleration of rehabilitation period was required, three sharply curved sections were a challenge and delayed the construction. To solve this difficult problem, a special profile with an expansive function was wound along the curvature by expanding and contracting the grooved part during the winding process, thus allowing rehabilitation of the curved parts with a smooth surface.
Outline of SPR Construction at Narita Airport

Sekisui SPR method was specified to reinforce the sewer pipelines to achieve the load and quake resistance necessary for the new service of Airbus A380 (gross weight: 560 tons), under the construction allowance of only five hours a day.

Outline of the construction
1. Location: Narita International Airport, Tokyo
2. Owner: Narita International Airport Corporation
4. Construction Dimension and Length: L=1789m

**Section**
- Φ 66 / 91m: L= 279ft
- Φ 64 / 85m: L= 157ft
- Φ 64 / 75m: L= 282ft
- Φ 64 / 55m: L= 648ft
- Φ 59 / 55m: L= 141ft
- Φ 53 / 48m: L= 276ft
Rehabilitation of Extraordinarily Large Cross Section Box Culvert

This is an example of the non-circular SPR method used for the rehabilitation of a sewer line near Toshima Ward, Tokyo whose host pipe had been significantly deteriorated.

The system had passed its assigned product life and was causing increased road cave-ins. The solution was to optimize the use of existing facilities and proceed to rehabilitate the facilities. The inner size of the target host pipe was extraordinarily large at 140 in, and it was the main pipeline in this area. However, it was observed that some part of the concrete inside the pipe was corroded, cement was separated, and aggregate was exposed. This eventually required not only rehabilitating the old pipeline but also resuming the capacity and reinforcing the structural strength for seismic activity.

As a result of these constraints, the SPR method was selected for its ability to conduct construction in the extraordinarily large box shape under live flow conditions, and also to enhance the structural strength to the required resistance level for seismic activity.

Outline of the construction
①Location: Toshima Ward, Tokyo
②Construction Period: Around 5 months
③Composition of Pipeline
   Cross Section A
   - Host Box Culvert: Inner Diameter 141 in (Width) x 112 in (Height)
   - Rehabilitated Pipe: Inner Diameter 132 in (Width) x 105 in (Height)
   - Rehabilitated Length: L=784ft
   Cross Section B
   - Host Box Culvert: Inner Diameter 94 in (Width) x 70 in (Height)
   - Rehabilitated Pipe: Inner Diameter 87 in (Width) x 62 in (Height)
   - Rehabilitated Length: L=371ft
Rehabilitation Example of Horse Shoe Shaped Waterway

This is an example of the non-circular SPR method used for the rehabilitation of an agricultural waterway. The original pipeline was installed in 1938, and the concrete had collapsed causing soil penetration into the pipe. This narrowed the cross section of the waterway and caused overflow from upstream, resulting in significant damage of agricultural land, homes, and roads.

The SPR method for pipeline renewal of non-circular shapes was selected for the following features: (1) the trenchless feature minimizes environmental effects, (2) SPR rehabilitates along the shape of the host pipe and improves water flow capacity due to a Manning coefficient of 0.1, (3) the structural strength of rehabilitated composite is superior, and (4) construction period is relatively short.

Outline of the construction
①Location : Miyazaki Prefecture
②Construction Period : Around 1.5 months (This is only for SPR Construction period, including preparation)
③Composition of Pipeline
   Host Horse Shoe Pipeline
   Inner Diameter: 78in (Width) x 70in (Height)
   Rehabilitation Pipe
   Inner Diameter: 74in (Width) x 64in (Height)
   Construction Distance 259ft

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Diagram of the rehabilitation process showing the location, direction, and completion of the work.
Example of Vertical Rehabilitation

This is an example of rehabilitation by the SPR Method for the purpose of increasing the strength, improving the capacity of gravity flow, and securing the water tightness of a pipeline. The pipeline was the siphon that initially went across the river between open channels. The inner water pressure in the siphon and both edges of the connecting tank part needed to increase due to the adjustment of the inner pressure on the whole pipeline. The SPR method was selected for its trenchless nature and its ability to freely adjust the size of the cross section. The SPR vertical rehabilitation method minimized the size of the specially shaped steel pipe and resulted in tremendous cost savings.

Outline of Construction
1. Location: Hokkaido
2. Construction Period: Around 2 months from November 2004
3. Composition of pipeline
   - Connecting Tank 101in x 101in
   - Diameter of Rehabilitated Pipe φ 84in L=66ft
   - Body Part 66in x 66in
   - Diameter of Rehabilitated Pipes φ 66in L=193ft
Flexible SPR

This is an example of a secondary lining on the inner segment of a steel made tunnel by the SPR method. This new construction created a tunnel between sewage treatment plants and made a rain water collecting pond as well as a pipeline to move water in pressure. One imperative was to keep the water condition clean. The straight section was lined by a synthetic segment, while the curved section was first lined with steel, then the secondary SPR liner was installed.

Outline of the construction
1. Location: Osaka City, Osaka
2. Construction Period: 5 weeks (December 2005)
3. Outline
   - Inner Diameter of the Segment: ∅122in
   - Inner Diameter covered by SPR: ∅117in
   - Distance: L=150ft Construction at the site that is less than 1 mile away from the gate
   - Curvature: R=88ft (1000)

Cross Section
Russian Railroad / Arch Shaped Bridge

Russian Railroad / Outline of Construction under Railroad of Arch Shaped Bridge

When securing the safety of the ninety year old Russian Railroad became a concern, the Russian Railroad Constructing Company selected SPR, with its capability of lining any shape, to address a deteriorated arch shaped bridge (drainage canal).

SPR rehabilitation was the solution to the deterioration of the railroad on the stone bridge located 1700 km east of Moscow on the railroad through Ekaterinburg and Chelyabinsk.

The stone made structures remained arch shaped, but some parts at the bottom had sulk due to erosion caused by water flow. The purpose of rehabilitation was to prevent further deterioration of structural strength from freezing and thawing and increase the strength to endure an increase of load.

Requirements for the SPR method at this construction were: (1) the ability to transport construction materials by train as there was no road to the job site, (2) the need to increase the resistance against load due to the increase of weight carried by train (FEM analysis), (3) the need for the train to be in service during construction, (4) the ability to do construction under water flow conditions, and (5) the ability to prevent the arch shaped structure from further degradation.

Because of these restraints, the SPR method was selected and expected to be implemented for the purpose of railroad infrastructure maintenance all over the Russian Federation.

Outline of Construction
1. Location: Russian Federation Chelyabinsk City
2. Period: Around 1 year
3. Owner: Russian Railroad Company Limited
4. Composition of Pipeline
   - Existing Arch Bridge: 162m (Width) x 146m (Height)
   - Rehabilitated Pipe: Arch: 142m (Width) x 138m (Height)
   - Construction Length: 779m + 2 lanes

![Diagram of Arch Shaped Bridge and SPR Rehabilitation Process]