SEKISUI

SPR

THE WORKS

SPR

Sekisui Chemical Co., Ltd. Urban Infrastructure & Environmental Products Company

Outstanding Work in the World

Contents

Sekisui Chemical Co., Ltd. is the developer of “SPR Method” that is the first trenchless method to rehabilitate sewer under live flow condition. Among 20 years since its development, it has successfully established reliability and achievement in communities.

Its highly outstanding rehabilitation technology is acknowledged worldwide and the developers of SPR Construction Method are awarded the first Japan's Exciting Manufacturing Prize in 2005.

Its technology is well respected in foreign countries as well, and several constructions have been successfully conducted.

This describes SPR Method's highly outstanding technology as well as its history.

Japan's Exciting Manufacturing Prize

The First “Japan's Exciting Manufacturing Prize by Minister of Economy, Trade and Industry” is awarded to the developer of SPR Method.

Picture of the Ceremony

Japan's Exciting Manufacturing Prize was established in 2005 as Prime Minister Award System.
The purpose of this system is to inherit and develop “manufacturing” that support the expansion of Japanese business and culture. The developer of SPR Method was evaluated quite severely with more than 600 candidates and won the category of “Product, Technology Development Area” of Minister of Economy, Trade and Industry.

Interview to Experts in Manufacturing

Mr. Akihiko Takaya
"I thought I knew everything. But, the actual job site sometimes was different from what I thought. Developer should see the actual job site quite frequently."

Step by Step. Currently it is self running and semi-automated. However, the goal is to make it fully automated till the finishing process. This allows workers not have to enter into manhole. Also, it enables to wind the pipe and rehabilitate under full water flow condition. First, make it happen. Theory comes later.

Plastic strip is quite rigid, but still it is flexible. This strip enables to rehabilitate
non-circular shape as well.

Mr. Mitsuhiko Watanabe
Through working with people who were really serious to improve sewer condition, my motivation had been increased gradually and steadily.

Pipeline rehabilitation method that renew old pipeline identical to new one without excavation.

Mr. Yasushi Kitayama
"Even if it is theoretically not feasible, but sometimes it can actually be done once we physically start it"

Always seek and aim for higher level. There is no theory and experience work in such new area."

Developed SPR Method that is the first sewer rehabilitation method without excavation and installation work under live flow condition.

Mr. Hiroshi Sugahara
"Implementing the idea developed at the actual job site can successfully be worked at the site, this makes me extremely happy"
"What need to be developed? The answer always exists at the job site".

Mr. Akira Imagawa
"It was a great fun to discuss ideas at the job site".

Unlimited Potential of SPR

SPR Method can rehabilitate not only circular shape but also other shape such as rectangular, horse shoe shape. Even more, it enables the construction under special condition. Please refer to the following pages to see its outstanding technology.

SPR Method / Original Pipe Rehabilitation

Outstanding water tightness and renew old pipe identical or superior to new pipe in the area of strength and water flow capacity.

Profile is made from rigid PVC that hardly show degradation as time passes. Moreover, its original rib shaped double rock mechanism and sealing gasket show quite strong water tightness characteristics.

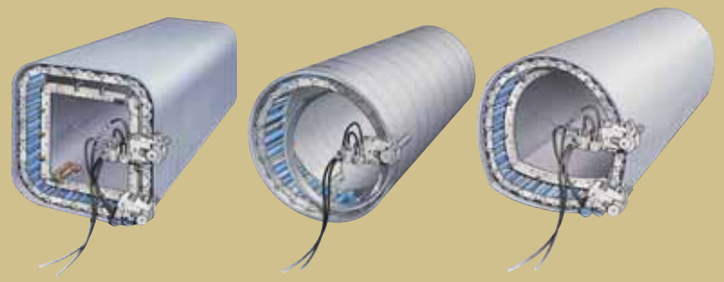
Large diameter pipelines ranging in size like 5,000 mm as well as pipes in different shapes such as circular, horse shoe shape and rectangular shape can be rehabilitated.

SPR Method can surely be used to rehabilitate large diameter host pipe in 5,000 mm. In addition, it can be used to rehabilitate not only for circular shape but also any shape such as horse shoe shape, box shape and so on.

■Box Culvert (Box Shape)

■Circular Shape

■Horse Shoe Shape (Arch Culvert)



Entitled the Construction Technology Review and Certificate by Japan Institute of Wastewater Engineering Technology

Authorized by Japan Sewage Works Association as Applicable Material (2nd Category)

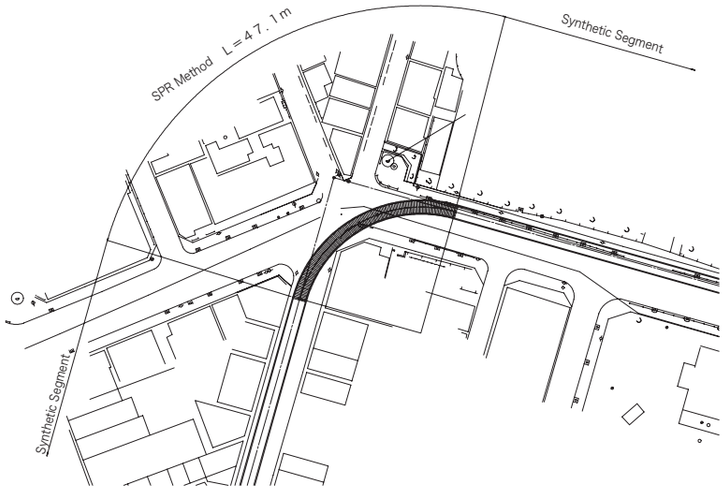
The Ministry of Agriculture "Manual to spread new technology"

It is selected by "Survey and Design for Rural Development" as the recommended method and need to be spread immediately for the purpose of securing the quality and improve Agriculture Village Environmental Condition.

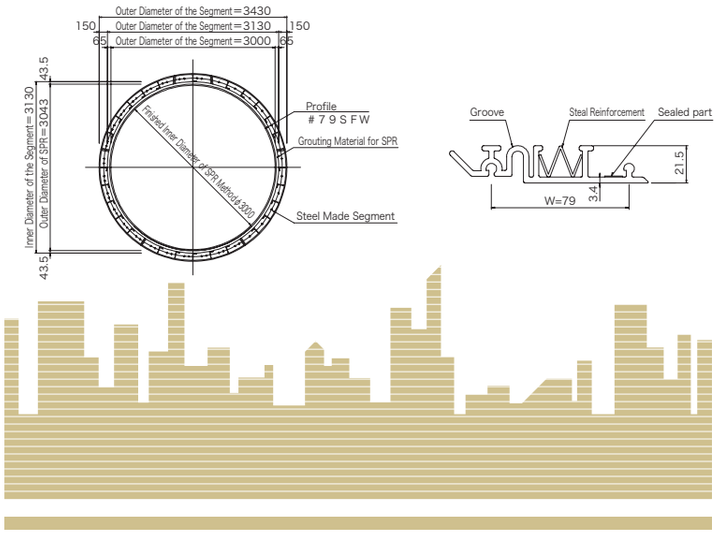
Flexible SPR Method

This is the example of secondary lining on the inner segment of steel made tunnel by SPR method.
This construction was to make tunnel between sewage treatment plants, and make rain water collecting pond as well as construct pipeline to move water in pressure. One purpose was to keep water condition clean.
Straight section was lined by synthetic segment and curve section was lined by steel made segment and SPR Method that was more economic than synthetic segment.

Outline of the construction
①Location : Osaka City, Osaka
②Construction Period : 5 weeks (December 2005)
③Outline
Inner Diameter of the Segment : ϕ3130㎜
Inner Diameter covered by SPR : ϕ3000㎜
Distance : L=47.1m Construction at the site that is 1㎞ away from the gate
Curvature : R=30m (10D)



Cross Section



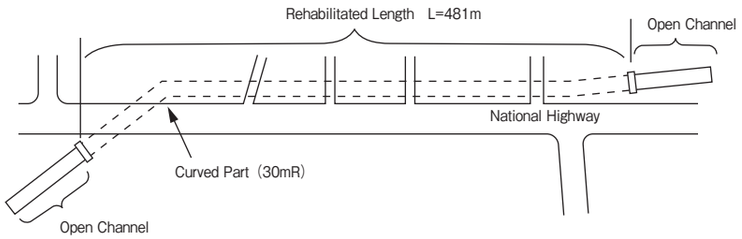
Box Culvert

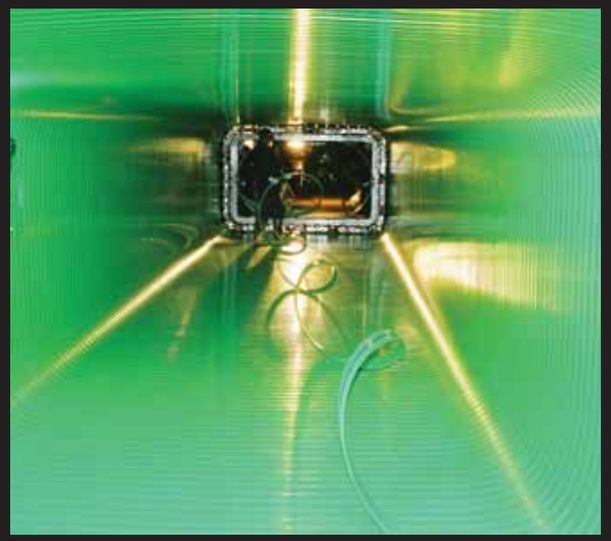
Example of rehabilitation for Box Shape Agricultural pipeline

This is the example for the old agricultural pipeline (Box Culvert) rehabilitated by SPR. That Box Culvert was quite worn out to use after long time passed from its installation. In addition, it was needed to reinforce its strength against the load due to the increase the number of heavy traffic on the ground. However, the ground part of such host pipe was national highway and the volume of the traffic on the ground was too heavy to excavate the ground by stopping the traffic. Moreover, it was required to complete such construction within short period before the season of significant water flow take place, and water flow capacity should not be decreased.
In this case, SPR Method was selected due to its features of (1) trenchless and feasible for short period construction, (2) increase the structural strength, and (3) keep water flow capacity, and so on.

Outline of Construction

①Location	Saga Prefecture
②Construction Period	Around 3 months(This is specifically for SPR construction period only including preparation.)
③Condition of the Host Pipe	At least one steel rebar, etc. is observed to be exposed in the host pipe.
④Composition of the Pipe	
Host Box Culvert Pipe	Inner Diameter : 2750㎜(Width)×1850㎜(Height)
Rehabilitated Pipe	Inner Diameter : 2630㎜(Width)×1730㎜(Height)
Rehabilitated Length	481m(Include curved part of around 30mR)





Extraordinary Large Cross Section Box Culvert

Rehabilitation Example on Extraordinary Large Cross Section Box Culvert

This is the example that non circular SPR method was conducted for the rehabilitation on sewer line near Toshima Ward, Tokyo whose host pipe had been significantly worn out.

Around this area, lots of cave-in of roads had been occurred and pipes that passed its designed product life were increasing. The idea was to optimize the use of existing facilities and proceed to rehabilitate old facilities. The inner size of the target host pipe was extraordinary large as 3600mm, and it was main pipeline in this area. However, it was observed that some part of concrete inside of the pipe was corroded, cement was separated and aggregate was exposed. This eventually required not only rehabilitating old pipeline but also resuming the capacity and reinforcing the structural strength for seismic activity.

Due to these constraints, SPR Method that has the features of (1) being able to conduct construction for extraordinary large box shape under live flow condition and (2) being able to enhance the structural strength till required resistant level for seismic activity, was selected.

Outline of the construction

①Location : Toshima Ward, Tokyo

②Construction Period : Around 5 months

③Composition of Pipeline

Cross Section A

Host Box Culvert : Inner Diameter 3600㎜(Width) x 2880 (Height)

Rehabilitated Pipe : Inner Diameter 3390㎜(Width) x 2690 (Height)

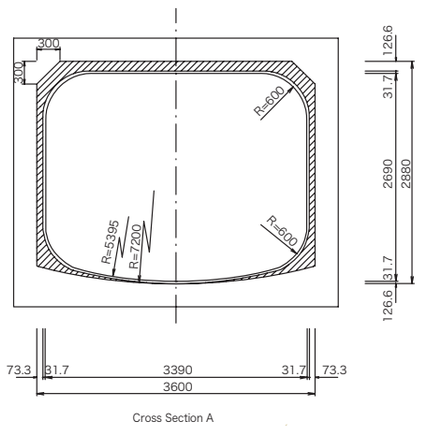
Rehabilitated Length : L=239m

Cross Section B

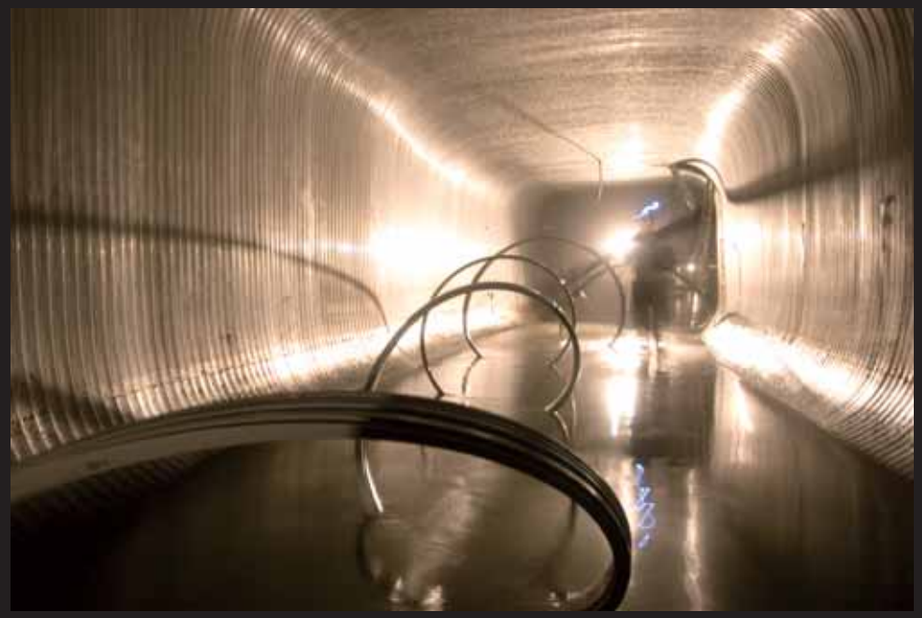
Host Box Culvert : Inner Diameter 2400㎜(Width) x 1800㎜(Height)

Rehabilitated Pipe : Inner Diameter 2240㎜(Width) x 1600㎜ (Height)

Rehabilitated Length : L=174m



Cross Section A



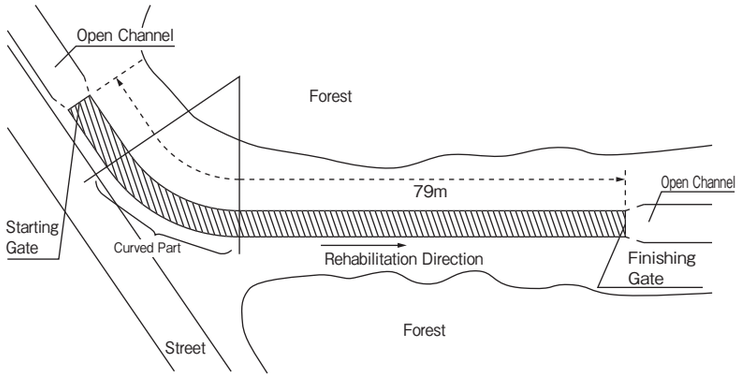
Horse Shoe Shape

Rehabilitation Example on Horse Shoe Shape Waterway

This is the example that non circular SPR method was conducted for the rehabilitation on agricultural waterway.
The original pipeline was installed in 1938. Due to its long period after installation, it became quite old and some concrete and soil were fallen. This narrowed the cross section of waterway and caused overflow from upstream, and resulted in significant damage against agricultural land, people' s house and roads.
SPR Method for non-circular shape has benefits such as (1) being able to minimize the influence for the environment condition due to its trenchless feature, (2) being able to rehabilitate along with the shape of host pipe, and improve the water flow capacity due to the increase of roughness coefficient, (3) the structural strength of rehabilitated pipe is superior to new pipe, (4) durability of rehabilitated pipe is identical to the case new pipe is lined, and (5) construction period is relatively short, and so on.
In this case, SPR Method was selected due to the above features.

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:2000㎜(Width) x 1800㎜(Height)
Rehabilitated Pipeline	Inner Diameter:1890㎜(Width) x 1640㎜(Height)
Construction Distance	79m



Vertical Installation

Example of Vertical Rehabilitation

This is the example of rehabilitation by SPR Method for the purpose of increasing the strength, improving the capacity of gravity flow and securing the water tightness, and so on.

The pipeline was the siphon that initially went across the river between open channels. It was needed to increase its inner water pressure in siphon and both edge of connecting tank part due to the adjustment of inner pressure on whole pipeline. SPR method was selected due to its feature of trenchless and being able to freely adjust the size of cross section. Especially connecting part of tanks, the size of specially shaped steel pipe was minimized and resulted in tremendous cost down by conducting vertical rehabilitation.

Outline of Construction

①Location : Hokkaido

②Construction Period : Around 2 months from November 2004

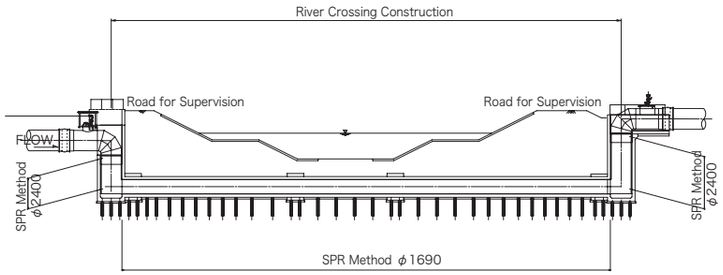
③Composition of pipeline

Connecting Tank 2600 x 2600

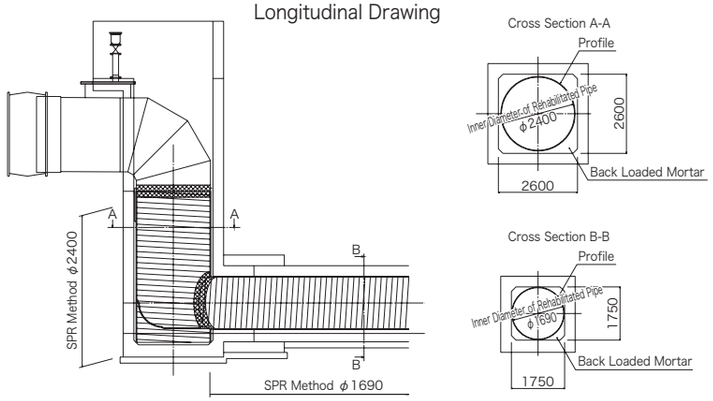
Diameter of Rehabilitated Pipe ϕ2400 L=20.6m

Body Part 1750 x 1750

Diameter of Rehabilitated Pipe ϕ1690 L=58.7m



Longitudinal Drawing



Detailed Drawing

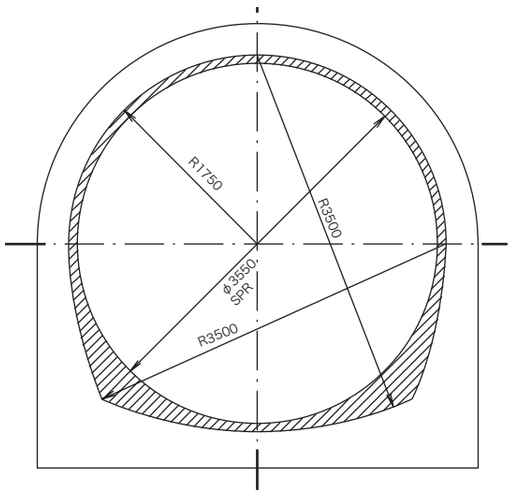
Cross Section

Reinforcement for Seismic Activity (Significantly Large Cross Section)

Example of rehabilitation to reinforce for seismic activity

This is one example that Ministry of Land, Infrastructure and Transport Japan promote for main sewer facilities to secure minimum strength for the purpose against earthquake.
This was quite important pipeline that connect disaster prevention center to sewage treatment plant in sewer located near the center of Fukushima prefecture, and required to keep water flow capacity even under the earthquake as well as quite short construction period with high priority. Although its section was quite large as 2R Horse Shoe =35mm, it was required to be rehabilitated during in service. SPR Method was eventually the only method and selected with the consideration of its achievement and safety.

Outline of Construction
①Location : Koriyama City, Fukushima
②Construction Period : Around 4 months
③Condition of the job site
Under the condition of significant live flow whose height was around 120cm.
④Composition of Pipeline
Host Horse Shoe Pipe 2R Horse Shoe Pipe : 2R = 3500㎜
Rehabilitated Pipe : φ3350㎜
Construction Length : L=90m











Culvert Crossing under Railroad Tracks

Example of culvert rehabilitation crossing under tracks in a railroad station:

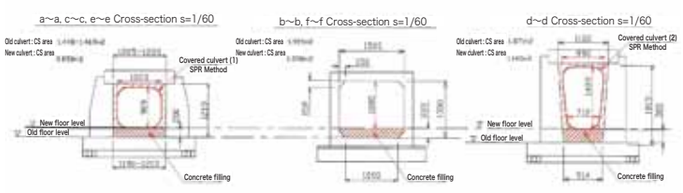
This rehabilitation was effected to box culverts crossing under a railroad station.

Open cut method was impossible, since the culvert was crossing tracks and the station was busy with heavy passenger traffic. Rehabilitation was considered not easy because the culvert was deteriorating by long use and had a few different cross-sectional shapes. The Free Cross-section SPR Method can cope with such difficulty as it can follow the configuration by adjusting the forming frame of the winding machine for individual sections of culvert. In this case, such advantage was indeed necessary and a few forming frames were designed to fit the sections of culvert. The rehabilitated culvert did not reduced the flow capacity very much and eliminated bottom steps.

Aspect of rehabilitation:

①Title of contract : Prevention of culvert wall peeling,
②Location : Within a railroad station in Kansai District,
③Construction period : Less than 4 months,
④Old culvert / rehabilitated culvert dimensions and lengths :

- ●Old : □1205～1220(B)×1219(H)　　L＝5.49m
  Renewed : □1003(B)×909(H)
- ●Old : □1205～1220(B)×1219(H)
  Renewed : □1003(B)×909(H)
- ●Old : □1205～1220(B)×1219(H)　　L＝3.92m
  Renewed : □1003(B)×909(H)
- ●Old : □1160・914×1819(H)　　L＝6.72m
  Renewed : □990・712×1409(H)



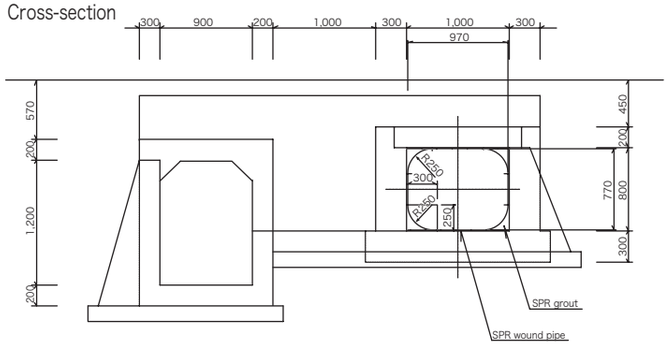
Culvert Crossing under Railroad Tracks

Example of culvert rehabilitation crossing under railroad tracks:

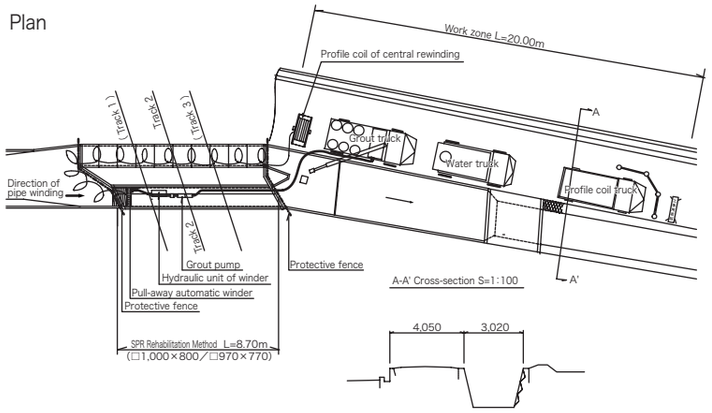
This rehabilitation was effected to an open culvert in upstream, continuing to a covered culvert crossing under railroad tracks. The old culvert was deteriorating by long use and passing under railroad tracks which carry 20 trains an hour or so. The Heart SPR Method which minimizes reduction of cross-sectional area, was considered to be the only applicable method, as renewal by open cut method was impossible and yet there was no margin of flow capacity in the old culvert. The construction was completed without giving influence on the train operation.

Aspect of rehabilitation :
①Title of contract : Culvert rehabilitation,
②Location : Kansai District,
③Construction period : Less than 2 months,
④Old culvert dimensions : □1000×800
Rehabilitated culvert dimensions : □970×770
⑤Length of rehabilitation : 8.7m

Cross-section



Plan



Globally Spreading SPR Method

Aging concrete structure is severe problem not only in Japan but also throughout the world.
The following pages introduce the example of SPR installation outside of Japan.

Russian Railroad / Under Railroad of Arch Shaped Bridge

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

Background

In Russian Federation, Russian Railroad that goes across the large country has passed near 90 years from its installation and to secure its safety becomes quite big concern. Especially, the worn-out of the part under railroad of arch shaped bridge (drainage canal) is serious problem. The method Russian Railroad Controlling Company selected was SPR with its capability of lining for any shape.

This was the construction for the counter measurement against worn out of stone built bridge located 1700km eastside from Moscow city on the railroad going through Ekaterinburg city and Chelyabinsk city.

The stone made structures remained arch shape, however some parts at the bottom of pipe were found to be sunk due to the erosion caused by water flow. The purpose of rehabilitation was to prevent further subsidence, degradation of structural strength by freezing and thawing and increase the strength to endure the increase of the load.

The items required for SPR Method at this construction were (1) being able to transport construction materials by train (there was no road at the job site), (2) to increase the resistance against load due to the increase of weight carried by train (FEM analysis), (3) train can be in service during construction, (4) construction can be done under water flow condition, and (5) being able to prevent the structure such as arch shaped bridge from degradation. From those constraints, SPR Method was selected, and expected to be implemented for the purpose of railroad infrastructure maintenance all over the Russian Federation.

Outline of Construction

①Location : Russian Federation Chelyabinsk City

②Period : Around 1.5 Months

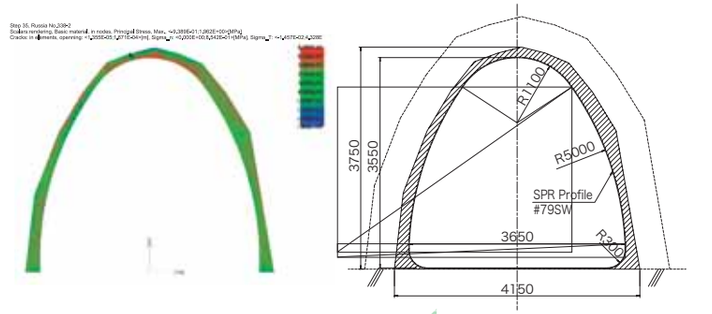
③Owner : Russian Railroad Company Limited

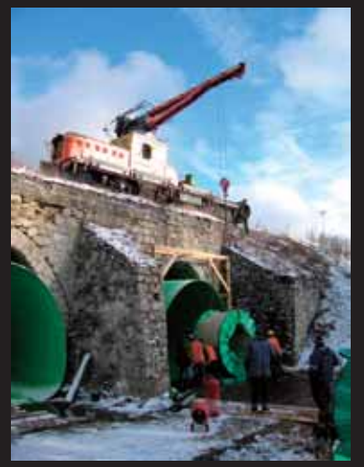
④Composition of Pipeline

Existing Arch Bridge Arch : 4150㎜ (Width)×3750㎜ (Height)

Rehabilitated Pipe Arch : 3650㎜ (Width) x 3550㎜ (Height)

Construction Length L=24m×2 lane





Los Angeles Sewer

Outline of SPR Construction at Los Angeles Sewer

Background

Carson city in California on West Coast of the U.S.A. faced infrastructural problem of sewer pipeline deteriorated and corroded, that is typical case all over the world. Among them, sewer pipeline coated by clay tile in 1920's (JOA Sewer) was significantly deteriorated. Mladen Buntich Construction Co. (MBC) was one of the 5 companies selected for such construction and SPR Method was implemented due to the request from MBC.

This was the first time SPR Method was selected under the U.S. bidding, and this was also the first time for Los Angeles County to implement SPR. For the 1st year, the construction length was separated into 2 parts for the purpose of comparing construction quality between originally specified rehabilitation method and SPR, and either one was expected to be selected for the following year's construction method. SPR Method achieved around two third of construction period compare to another method and superior construction quality. This resulted in the selection of SPR method in the following year and conducted for the rehabilitation of whole length.

Outline of the construction

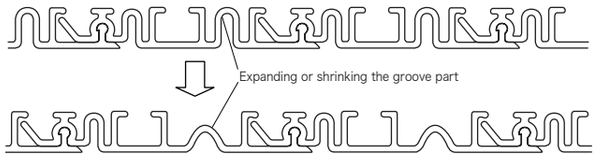
①Name of Construction : Joint Outfall "A" Units 2,3A and 3B Trunk Sewer Phase
②Location : City of Carson, California
③Owner : County Sanitation District No.2 of Los Angeles County, California
④Period : 2 years in 2005 and 2006 (Construction Period April 1st ~ October 15)
⑤Construction Length : 114" Horse Shoe Shape = 7170ft (2185m)
78" Horse Shoe Shape = 478ft (145m)
Total 2330m
Construction in 2005 : 114" Horse Shoe Shape
Flexible PVC Lining Method = 2168ft (660m)
SPR Method=1805ft (550m)
Construction in 2006 : 114" Horse Shoe Shape
SPR Method = 3200ft(975m)
78" Horse Shoe Shape
SPR Method = 478ft (145m)
(sharp curve existed in 114" Horse Shoe Pipeline = 3 parts were R65ft(R18m))

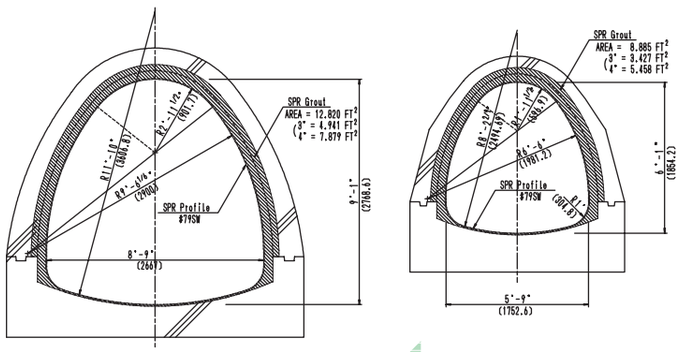
Los Angeles Sewer

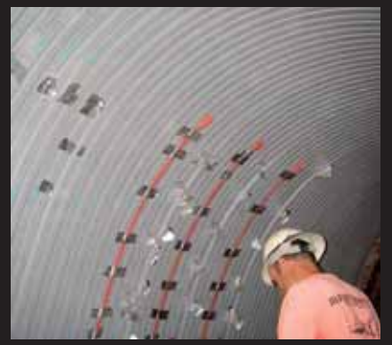
Construction method for sharp curved pipeline at JOA

The big concern on this job site was how to rehabilitate the curve section whose radius of curvature R=18m.

Although acceleration of rehabilitation period was required, 3 sharp curved parts were the constraints and delayed the construction. To solve this difficult problem, special profile whose section has expansive function was used and wound along that curvature by expanding or shrinking the groove part at winding process. This allowed rehabilitating such curved parts with smooth surface.





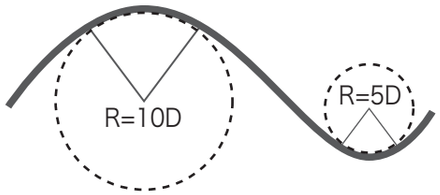


SPR System can be applicable to tight curve section

SPR rehabilitation system is applicable not only to circular pipeline but also box culvert as well as horse shoe shape pipelines.
Development of SPR flexible Profile for the tight curve section made it possible to accommodate any tight curve with continuous winding.

Sample picture of tight curve installation

SPR has been used to rehabilitate the curve section of pipelines that is up to Radius = 10 X Diameter. With the development of new Profile that has additional elasticity characteristic that enables SPR to accommodate tighter curve section 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 sectioned.

Contribution to restoration from earthquake

SPR has superior resistance for the seismic activities. SPR has been used for restoration of Nigata-Tyuetsu earthquake as well as Noto-Peninsula earthquake.

SPR — Moving forward !

Rehabilitated pipelines with SPR provide great structural strength, durability and workability.
This is the reason why SPR system has been widely used and specified in all Japanese prefectures.

SEKISUI

Urban Infrastructure & Environmental Products Company

http://www.eslontimes.com/en/

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THE WORKS

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