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Hynds Hylock Joint Restraint System

Technical Guide D14.2

The Hylock Joint Restraint System for concrete pipes has been developed by Hynds to mitigate excessive joint flexure and extension as a result of significant movement in a seismic event or through differential bedding movement.

Applications

- Areas prone to earthquake
- Pipelines in areas with expected ground movement
- Pipelines requiring joint flexibility

Product Attributes

- Strong, resilient, flexible, versatile
- Provides a continuous connection for a series of concrete pipes
- Chain link effect allows controlled movement at the joints

Approvals/Standards

- AS/NZS 4058
- NZ Patent 615291

Quality/Environment/Health & Safety

- ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018

HYNDS PIPE SYSTEMS

The Hylock Joint Restraint System for concrete pipes has been developed by Hynds to mitigate excessive joint flexure and extension as a result of significant movement in a seismic event or through differential bedding movement.

The Hylock Joint Restraint System is covered by New Zealand Patent 615291.

- The joint will break at pre-determined range of loads in the event of excess joint movement
- Easy to determine the load capacity of the restraint joint
- Incorporates rubber seismic shock absorber mushrooms around the joint that help protect the surrounding concrete at the joints
- Modified collar to provide 20 mm nominal joint gap which allows for greater movement at the joint
- Suitable for spigot and socket RJ pipes DN900–1800 mm and DN1950–2100 mm in-wall jointed pipes
- Suitable for butt jointed jacking pipes
- Can be used to connect to end structures such as manholes and pump stations
- Restraint assembly easy to connect after pipe is laid
- Restraint assembly may be replaced after failure
- Visual inspection possible after a seismic event

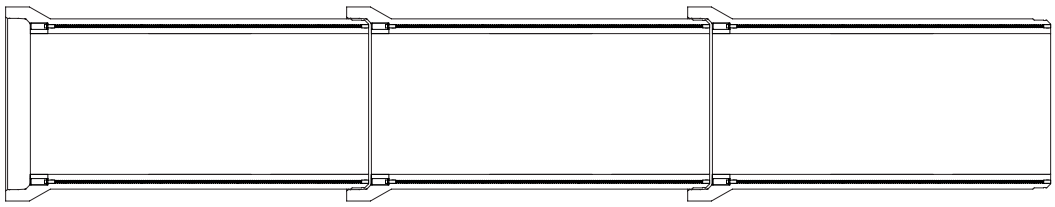

FIG. 1 Hylock Joint Restraint System Pipeline

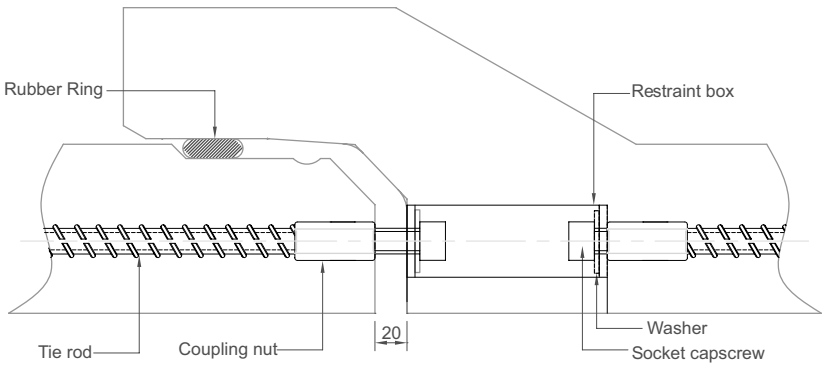

FIG. 2 Hylock Joint Restraint System Configuration

Hylock design features

- The Hylock tie bar and restraint box are cast into the concrete pipe at the time of manufacture.
- The number of restraint assemblies are dependent on the restraint force capacity required for each joint
- Restraint assembly components are hot metal sprayed and the socket capscrews are galvanised for durability
- The number of seismic shock absorber mushrooms can be adjusted
- Increased wall thickness
- Modified collar to provide 20 mm nominal joint gap
- Double circular reinforcement cage

FIG. 3 Pipe with seismic mushroom fitted to collar back wall.

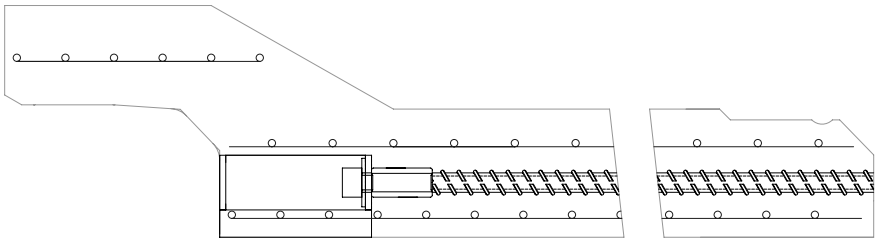

FIG. 4 Double reinforcing cage

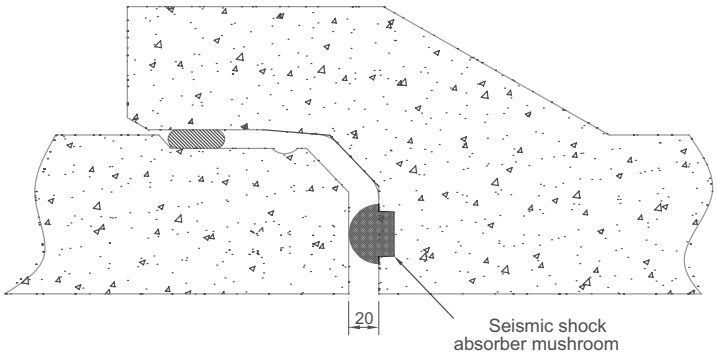

FIG. 5 Seismic shock absorber mushroom

Design

Seismic Design

For conventional seismic designs the fundamental requirement is:

$$\frac{\text{Deformation Capacity}}{\text{Deformation Demand}} \geq 1.0$$

There are two approaches to satisfying this requirement:

1. Increase the Deformation Capacity
2. Reduce the Deformation Demand

The easiest way to reduce the demand is to increase flexibility and lengthen the period. In seismic isolation, a 0.5 sec to 1.5 sec period increase in a SDOF (single degree of freedom) system showed a four-fold reduction in the force exerted*. With the chain-link effect and the restrained flexibility in the joints, it is possible that the period in a system would increase and thus, lower forces exerted on the pipeline. Additionally, the restraint assemblies are likely to increase the deformation capacity. This possible increase in deformation capacity and reduction in deformation demand provided by the Hylock Joint Restraint System would be a huge advantage in seismic conditions.

**** Base Isolation 101, Presented by The New Zealand Concrete Society and The Cement and Concrete Association of New Zealand, Seminar Notes TR54)***

Restraint Force Capacity

The designer can specify the amount of restraint force capacity required for each joint by changing the number of restraint assemblies. The minimum number of restraint assemblies recommended is three per joint. The maximum number of restraint assemblies will depend on the pipe diameter but will likely be six for large diameter pipes.

A weaker 'fuse' connection can be specified at specific points in the pipeline where subsequent repair will be easier to carry out. Also, connections into end structures such as manholes or pump stations can be designed.

The table below shows the strength vs. deformation for the Hylock Joint Restraint System. The design strength is 80kN and the failure range is between 95 – 112 kN.

125 x 75 Restraint assembly	Minimum	Average	Maximum	Design strength
Strength	95kN	106kN	112kN	80kN
Deformation range	18–19.5 mm	21.5–23 mm	23.5–25 mm	14–16.5 mm

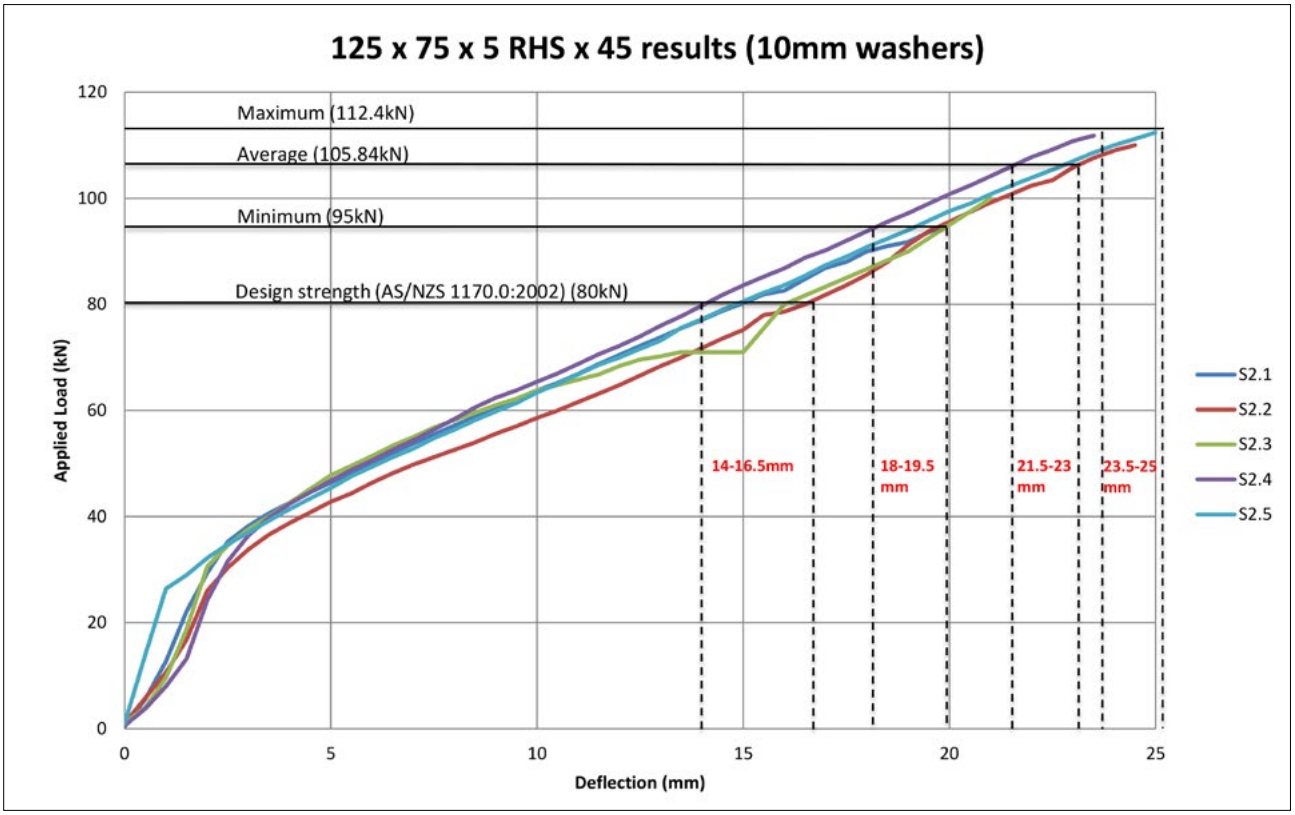

FIG. 6 125 x 75 Restraint assembly test results

Testing

To determine the loading capacity of the restraint assembly in the Hylock Joint Restraint System, several prototypes of the restraint boxes were made and tested to determine the design capacity.

FIG. 7 Testing equipment

FIG. 8 Restraint assemblies after testing to breaking load

Performance in seismic event/differential bedding movement

In compression

Rubber seismic shock absorber mushrooms fitted around the joint perimeter will compress during longitudinal compression of the joint and/or during joint deflection. This will provide some protection to the concrete faces of the joint by minimising concrete to concrete contact

In extension

When the joint gap starts increasing, the energy is absorbed by the deformation of the restraint assembly as it yields.

The restraint assembly will fail at a pre-determined load range and extension, preventing damage to the rest of the joint and helping maintain the joint integrity and hydraulic seal in the event of forces higher than the capacity of the restraint assembly.

After a seismic event / differential bedding movement

The pipe joints can be visually inspected and the joint extensions measured. Joints that have returned to acceptable joint gaps required to maintain the hydraulic seal can have restraint boxes which have yielded/broken replaced to restore the pipeline connectivity.

FIG. 9 Restraint assembly in compression

FIG. 10 Fully compressed rubber seismic shock absorber mushroom

FIG. 11 Restraint assembly in extension

Installation

1. The rubber seismic shock absorber mushrooms can be fitted at the factory or on site prior to installation.
2. Pipes are installed on site using standard practice for concrete pipe laying. Guide lines are marked on the top of the pipe to aid alignment of the pipes and the restraint assemblies.
3. Pipe joint gap set at 20 mm by using suitable spacers whilst mating the pipe joint.
4. Once washers are installed, bolts are tightened ¾ of the way before final alignment/levels are set.
5. Bolt fully tightened once final alignment is set.
6. On completion of the pipeline laying, the restraint assembly at each joint is filled with foam and sealed with epoxy to provide a smooth finish to the inside of the barrel (refer to fig 14 and 15).
7. Quality assurance checklist is provided to ensure system has been installed correctly.

FIG. 12 On-site installation

FIG. 13 Bolts being fitted

FIG. 14 Restraint box filled with foam & partially epoxied

FIG. 15 Fully protected restraint assembly

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