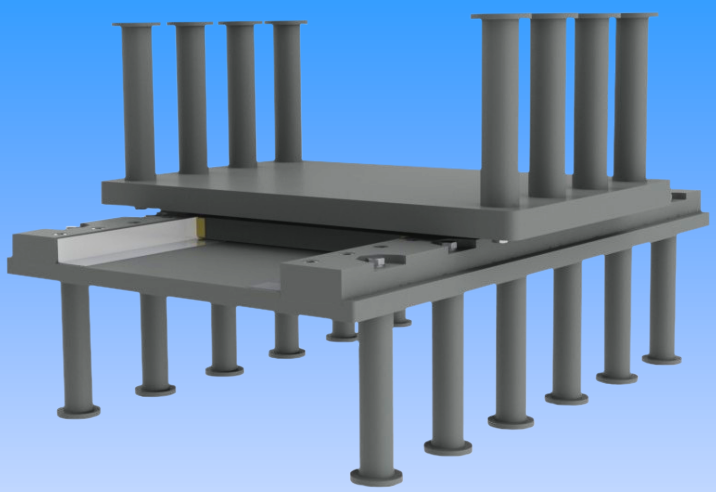
H-MAX BEARINGS



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H-Max bearings

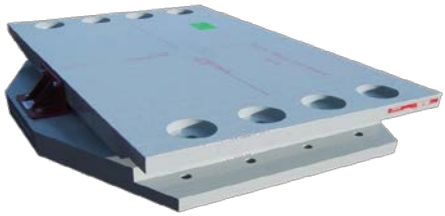
Agom H-Max bearings are designed to carry horizontal loads, allow longitudinal or transversal movements and rotations and they are used in steel and concrete road and railway bridges.

Depending on whether the bearing is fixed or guided sliding, Agom H-Max bearings accommodate horizontal forces, as well as movements in longitudinal or transversal directions.

Agom H-Max bearings can carry very high horizontal loads and in case of special design they can take also uplift vertical loads typically due to overturning effects due to high horizontal transversal

Fixed H-Max HLBF

These bearings consist of a piston inserted in a base plate. The bearings enable rotation in any direction while at the same time the structure is constrained horizontally and all the horizontal forces are transmitted; hence the bearing acts like a spherical hinge to fix the structure.



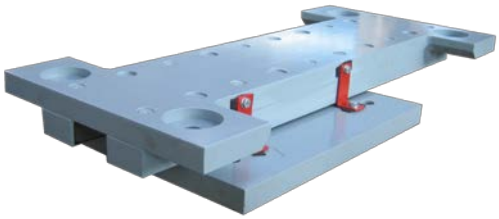
Guided sliding H-Max HLBG

Guided sliding devices are similar in construction to fixed bearings but with the addition of sliding plate and guides in order to allow the motion along one direction. The H-Max HLGB bearings can enable rotation in any direction, allow the movement along one direction and transmit the horizontal load perpendicular to the motion direction.

The bearing acts like a spherical hinge that can move in the longitudinal or transversal direction depending on the guide orientation.

Depending on the required rotation values, the bearing can be composed by two plates with a central guide and two lateral guides (small rotation < 0.005 rad) or by a central piston that allows the functioning as special hinge.

HLBG device suitable for rotation > 0.005 rad



HLBG device suitable for rotation < 0.005 rad

International standards

Agom H-Max bearings are designed and manufactured in accordance with the requirements of a wide range of international standards (European EN1337.8, British BS 5400, Italian CNR 10018, German DIN 4141, French SETRA B.T.4. and American AASHTO). Every single component is mechanically worked and assembled by fully qualified and trained workers at the Agom factory under strict ISO 9001:2008 accredited quality control standards.

Quality of the materials

Austenitic steel sheet

The austenitic steel used for sliding surfaces is X5CrNiMo17-12-2 in accordance with EN 10088-2 1.4401 with a minimum thickness of 1.5 mm

The roughness is Ry5i ≤ 1 µm

The hardness ≥ 150 HV1 and ≤ 220 HV1

CM1 for guides

Agom for the guide sliding surfaces uses CM1 material in accordance to EN1337-2 code.

Friction of the bearings

The reaction of the bearing to the movement can be mathematically calculated by considering friction coefficient between stainless steel and CM1 material, the design friction values are in accordance to EN 1337-2 section 6.7.

Ferrous material:

The structural parts of the devices are manufactured from ferrous material in accordance with EN 10025 standard.

Fixing types

Usually all the H-Max bearings are equipped with suitable anchor bars for anchoring purpose to lower and upper structure.

In case of pre-cast concrete beam the bearings can be provided with upper bolts connection and top subsidiary plate; in case of steel beams the bearings shall be provided with upper connecting bolts.

In case of cast in situ structures the bearing fixing is given by lower and upper anchor bars.

The fixing connection (bolts and anchor bars) are designed to absorb the design horizontal loads and tensile loads that are consequent to the overturning moment due to horizontal load transmission.

Comprehensive Labelling

All the bearings are provided with a metal label detailing the proprieties of the bearings:

- bearing type
- maximum horizontal loads
- rotation
- order number
- date of manufacture

The top face of the bearing gives information on the type of the bearing, the direction of the axis of the bridge, the presetting (if any), the position.

Agom H-Max Bearings accessories

Dust protection

The dust protection around the sliding plate ensure the cleaning of the sliding surfaces to minimize the friction during sliding and guarantee the durability of the sliding material.

Corrosion protection

Steel components exposed to the elements are protected against corrosion. Agom adapts the corrosion protection in accordance to the aggressiveness of the environment in which the bearings are to be installed and to each customer's requirements.

The standard corrosion protection according EN 1337-9 is as follows:

- sandblasting SA2.5 grade
- two components high thickness epoxy zinc paint:
  250 µm

The high resistant corrosion protection (metallization) is as follow:

- sandblasting SA 2.5 grade
- metal spraying to 85 µm with Zn/Al 85/15
- sealing: Epoxy sealer 20-25 µm
- top coat: Polyurethane paint 100 µm

In case of application in high aggressive environment suitable corrosion protection according to

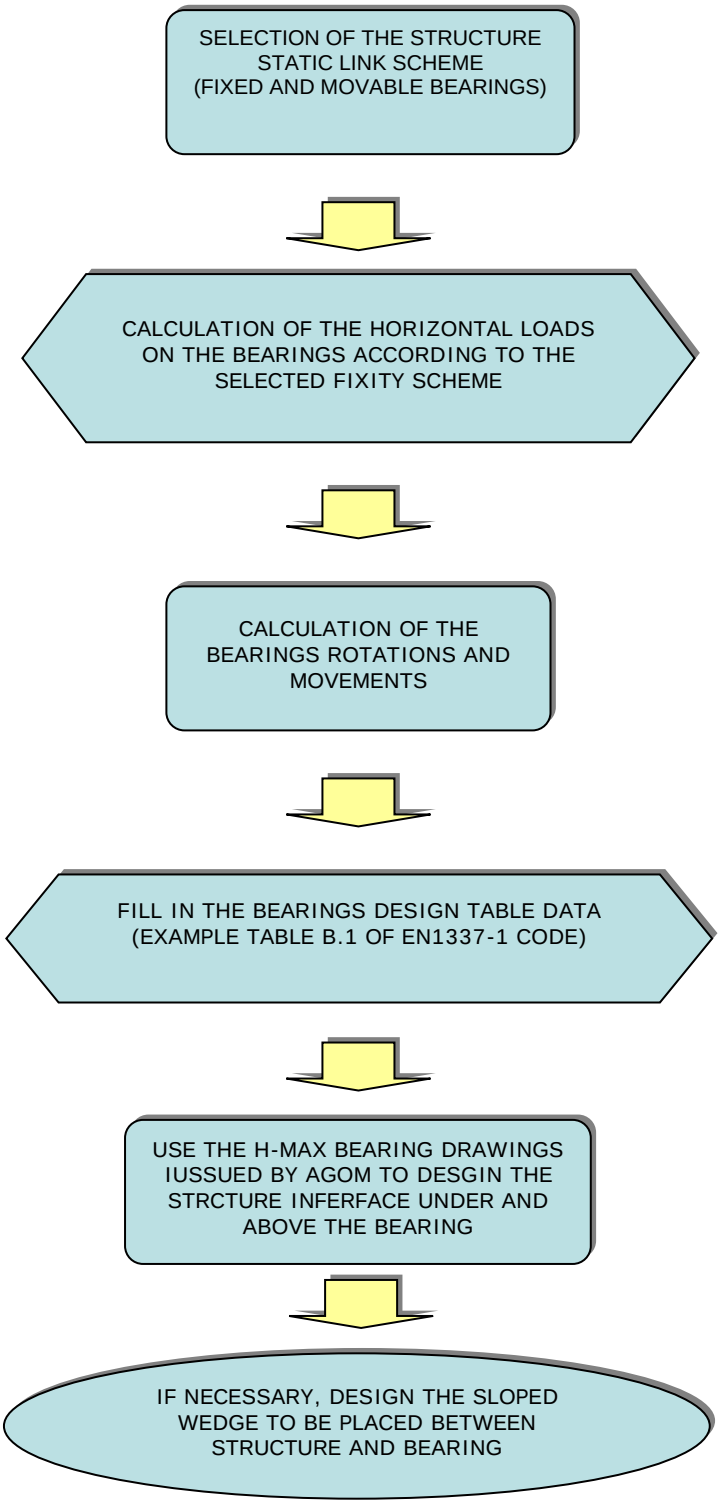
corrosivity category C5-M H Marine Environment can be provided.

Guidelines for the design of a structure with Agom H-Max bearings

In this section a simple guideline for the design of a structure equipped with Agom bearing is presented, the design procedure is summarized in the following steps:

1. Selection of the structure static link scheme (fixed and movable support bearings)
2. Calculation of the loads (horizontal) on the bearings according to the fixity scheme
3. Calculation of the bearing rotations and movements
4. Insert all the bearing design data in to the bearing design table (example table B.1 of the EN1337-1 code attached at the end of the document)
5. Using the bearing drawings provided by Agom design the interface parts between structure and bearings as: the vertical space between lower and upper structure to place the bearing and the upper structure interface where the bearing upper plate will be positioned
6. If necessary, design the slope compensator to be placed between the bearing and upper structure in order to adjust the permanent slope (longitudinal and transverse slopes of a bridge deck). The deck's slope must be always compensated in order to keep the sliding surface in the horizontal plane (normally the slope is compensated above the bearing between its sliding plate and the upper structure). In any case the whole bearing cannot be installed inclined. With H-Max bearing normally a permanent slope of 0.005 rad can be directly compensated by the bearing rotation.

DESIGN OF A STRUCTURE WITH H-Max BEARINGS



Advantages of using Agom H-Max bearings

The Agom H-Max bearings fulfil the following requirements:

a. Transmit the horizontal loads with i**n practise no limitation of the design load**

b. Allow rotation as per a spherical hinge. Standard design is for rotation of ±0.01 rad or ±0.02 rad

c. No limitation for **of horizontal displacement**

d. Suitable for all structures steel and concrete bridges and buildings

e. **High durability and easy maintenance**

f. Since each device is specifically designed for each project, it can be suitably adapted to the client requirement (size, height, position of anchorages, etc..)

NO LIMITS HORIZONTAL LOADS

NO LIMITS HORIZONTAL DISPLACEMENT

HIGH DURABILITY NO MAINTAINANCE

Handling and storage installation and maintenance

This manual gives the main list of the most important operations to correctly install the AGOM bridge bearings.

Under control of the Engineer who designed the bridge, bearings must be installed by expert workers, with precision to meet the bridge and bearing design criteria.

Inappropriate handling, storage and installation will have an adverse effect on the bearing life, usually estimated in more than 50 years providing right maintenance.

AGOM structural bearings are manufactured to close tolerances by skilled technicians working in clean conditions.

To obtain the requisite performance from bearings it is imperative that they are properly handled at the work site and installed with the same care as when they were assembled in the factory.

AGOM bearings are clearly identified and marked on the top plate to ensure correct installation. The typeface on the cover or sliding plate gives information on the type, size and number of the bearing. Moreover, arrows indicate the movement axis and the presetting direction (if applicable).

Every bearing is provided with a steel identification label with all the most important bearing information

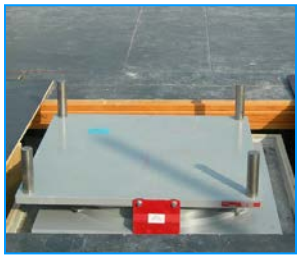
Handling and storage

Care should be taken in storage to prevent contamination and damage to the working surfaces. AGOM bearings should be stored in a controlled environment where they are protected from contamination, misuse and excessive moisture.

Robust transportation devices are fitted to all bearings to ensure that the components are maintained in they correct relative positions before and during installation.
The devices are normally finished in red paint.

Unless special devices have been specified, they should not be used for slinging or suspending the bearings beneath beams.
Due to unpredictable conditions, which may occur during transportation or handling on site, the alignment and presetting (if applicable) of the assembled bearing should be checked against the drawing. Do not try to rectify any discrepancies on site.
Bearing too heavy to be lifted by hand should be properly slung using lifting equipment.

Presetting

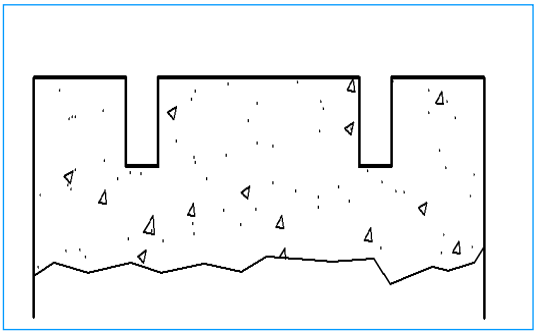


If bearing are required to preset eg. where once only large movements may occur during stressing operations, this should be specified as a requirement and should only be carried out in AGOM prior to despatch.
Do not attempt this operation on site.

Installation

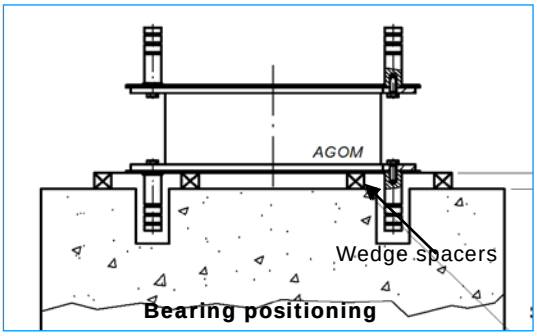
The installation procedure of the bearings generally depends on the structure type. The main steps are:

1. Check before installation.
In order to avoid placements mistakes of the bearings, all the technical and description data, printed on the label, shall be checked and compared with the ones showed in the shop drawings.



2. Casting of the substructures.
Substructures shall reach a level about 30 mm lower then the final level.

In order to install the bearings suitable voids spaces must be provided to insert the bearing lower anchor bars.
An easy way to leave the voids is to use corrugated steel pipes grouted into the concrete with a diameter at least double compared with the diameter of the anchor bars.

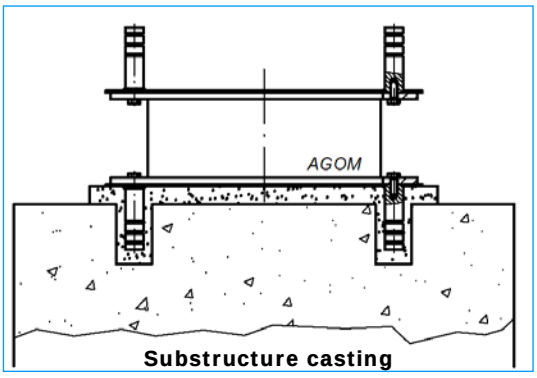


Bearing positioning

3. Bearing positioning and substructure casting.
The bearings are placed at the final exact level supporting it by temporary wedge spacers; the maximum deviation from the horizontal plan does not exceed 0.001 radians.

In order to fix the bearings and anchor bars a formwork around the lower base plate must be provided (normally a wood or steel formwork is used).

To grout the bearing a high strength non-shrink, quick setting cement mortar with compression strength > 45 Mpa has to be used; if the thickness of the mortar exceeds 40 mm a suitable reinforcement shall be provided.



Substructure casting

The temporary wedges used to keep the bearing in right position shall be removed after mortar hardening and remaining voids shall be filled by the same mortar.

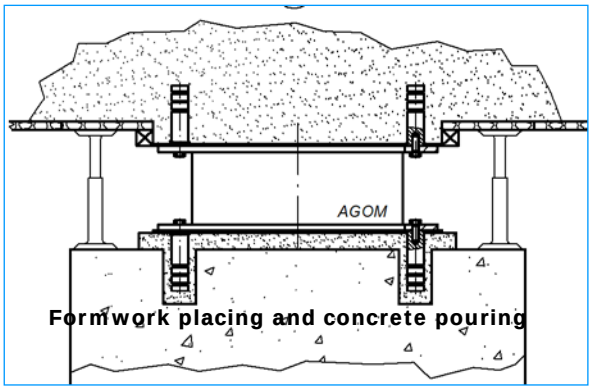
The level of the cement mortar shall not exceed bottom level of the bearings steel lower plate to avoid bearings embedding compromising the eventual future bearing replacement.

4. Casting of the superstructure – cast-in-situ superstructure

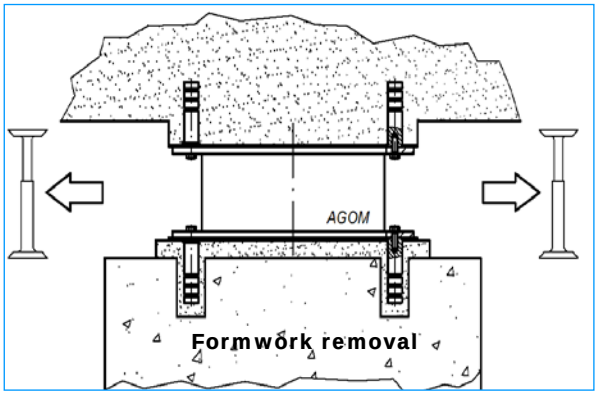
Superstructure formwork must be arranged around the bearing upper steel plate and sealed with adhesive tape or foam to avoid concrete leakage during casting.

The formwork must be arranged in a suitable way to avoid embedding of the bearing upper plate into concrete to avoid bearing embedding compromising the eventual future replacement. The formwork must be supported at the design level during concrete pouring.

When the concrete has reached adequate resistance the supports and formwork have to be removed. At the end of the construction the bearings must be cleaned and the painting of the steel plates repaired if some damages occurred during construction.



Formwork placing and concrete pouring



Formwork removal

5. Casting of the superstructure - prefabricated superstructure

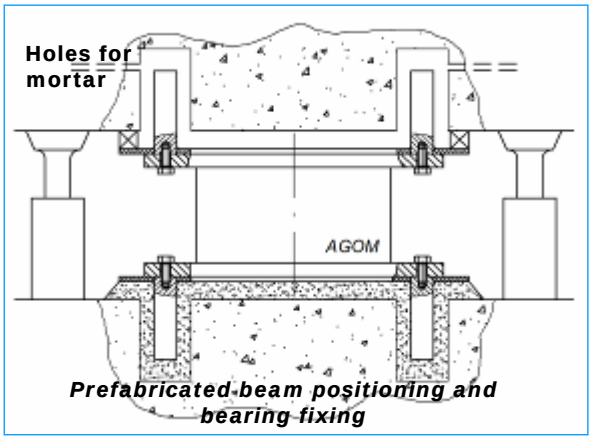
The bearings normally have upper anchorages that must be inserted into the suitable voids of the prefabricated structure.

After the prefabricated beam has been placed in the final position (the beam must be supported on temporary supports), the bearing upper plate must be surrounded by a seal (normally rubber seal with suitable injection and leakage pipes).

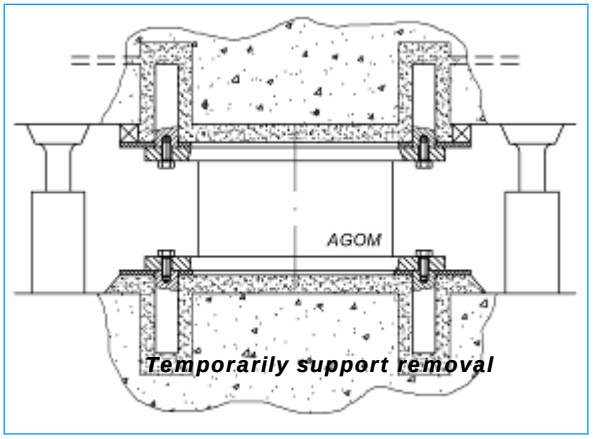
The gap and anchorages voids between plate and beam have to be filled by high strength mortar.

When the mortar has achieved sufficient strength to transmit the weight of the bearings; the temporary supports shall then be removed.

At the end of the construction the bearings must be cleaned and the painting of the steel plates repaired if some damages occurred during construction.



Prefabricated beam positioning and bearing fixing

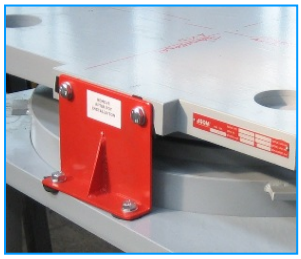


Temporarily support removal

Removal of transport devices

The transport devices, normally painted red should only be removed when the bearing is properly installed and ready for operation.

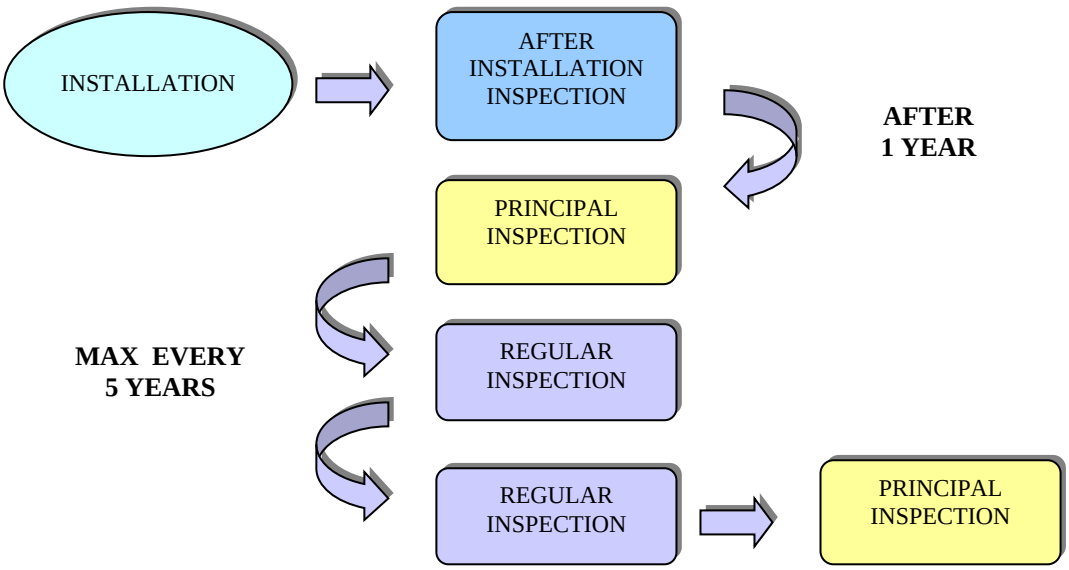
Any tapped holes exposed after removal of transportation brackets etc (coloured red) should be sealed with self-vulcanizing silicon sealant.



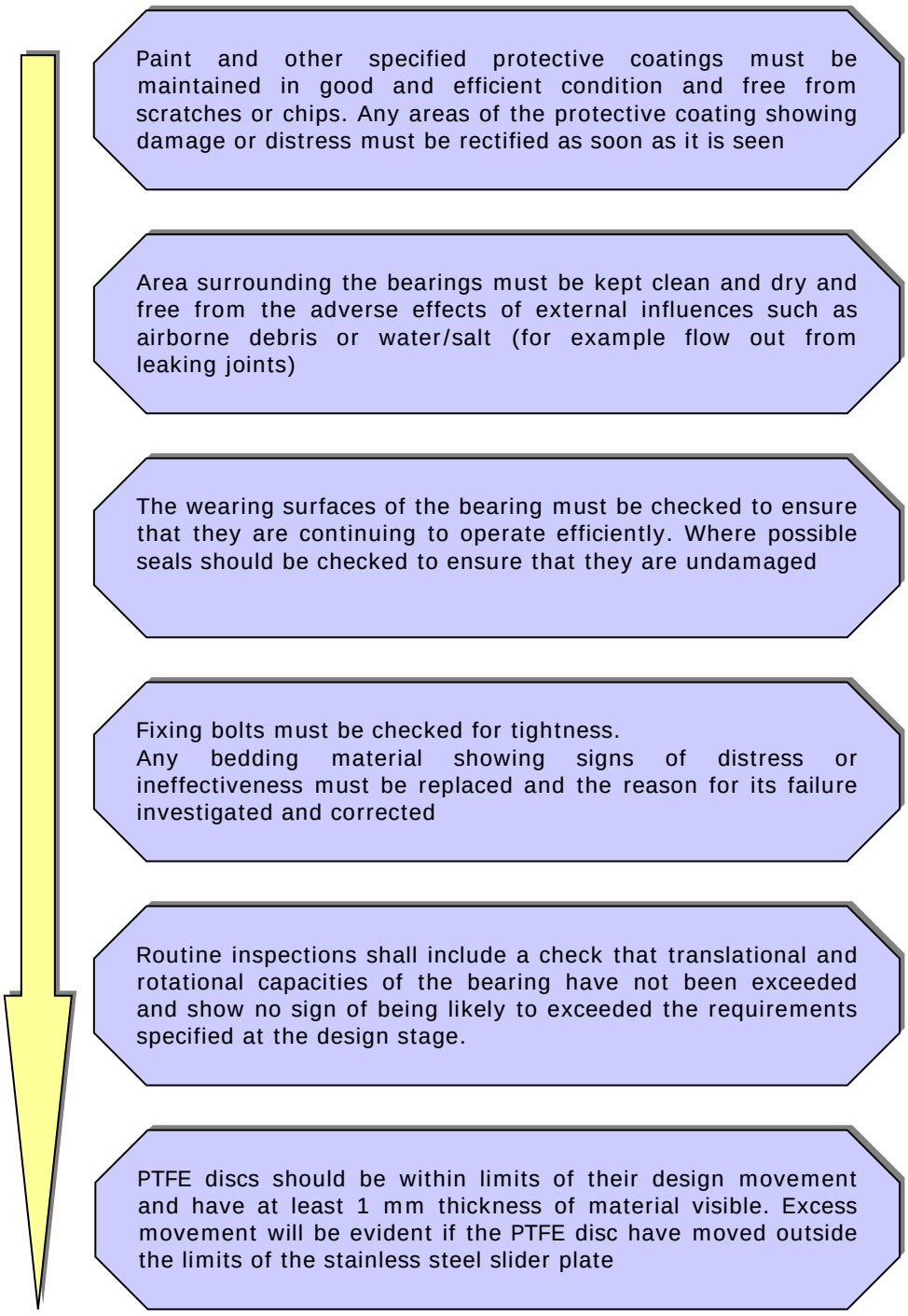
Maintenance of Bearings

The service life of a bearing is usually exstimated in more than 50 years.
The most important thing to assure such a longlife time is a correct and careful maintenance of the bearing, that is usually installed in a severe environment.

The requested bearing inspection and maintenance program that could be adapted and improved by the bridge designer to the specific service conditions of the bridge is fully described in the “Inspection and warranty manual” that can be download from Agom web site www.agom.it .



A typical complete routine check of the bearing installed should be comprehensive of the following activities.

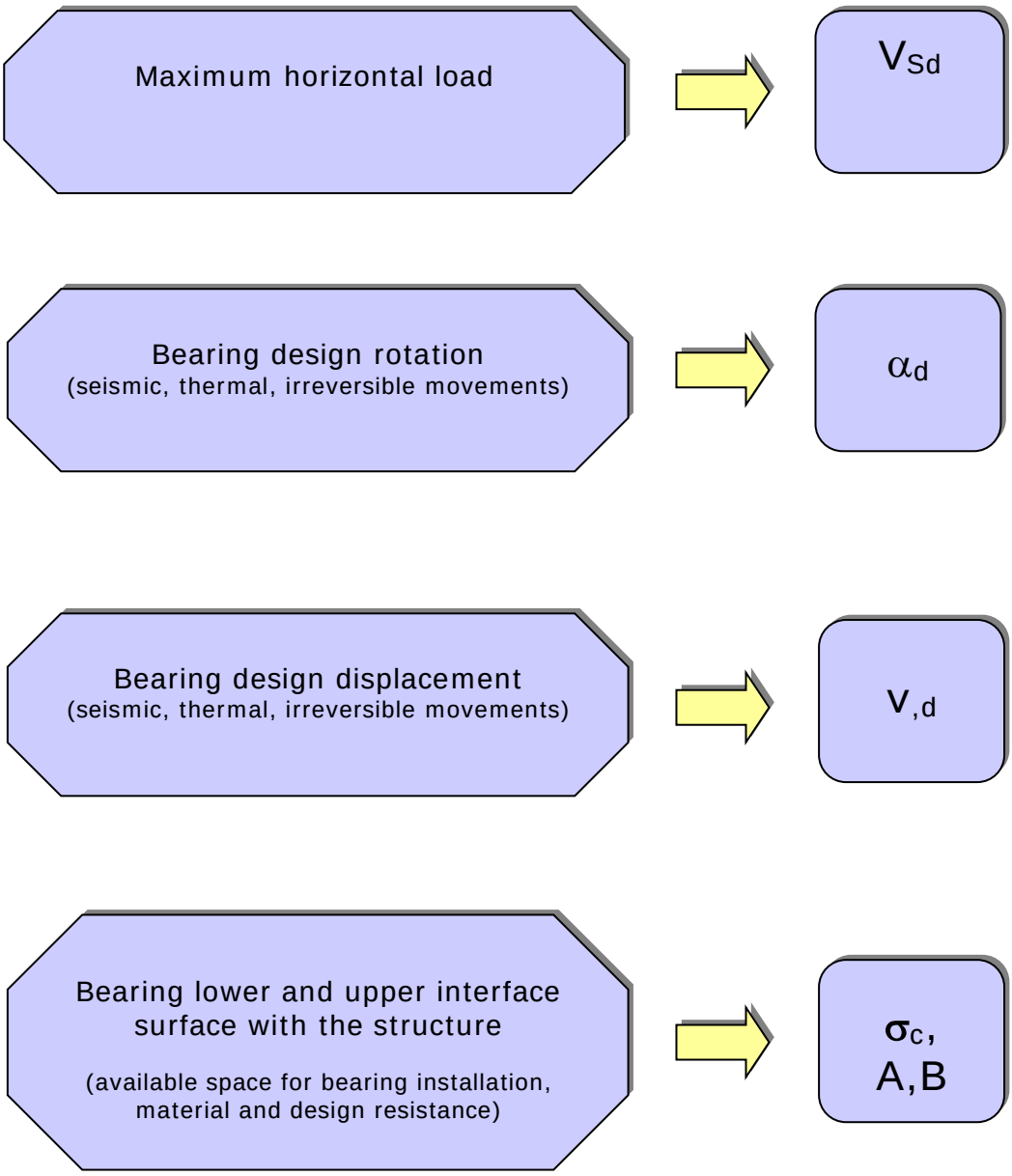


Agom H-Max bearing combined with antilifting system

The Agom H-Max bearing can be equipped with antilifting tool in order to absorb the negative tensile vertical forces due to overturning effect consequent to high transversal horizontal loads.
The antilifting tools can be applied to all the H-max bearing (fixed and guided) with different systems depending on the bearing type and tensile load value.
It is possible to cover a very wide range of tensile loads by suitable design of antilifting tools.
An example of H-max bearing combined with antilifting tools is shown in the following figure:

Agom H-Max design parameters

Normally the required input parameters that the structural designer has to provide to Agom engineers for device design and constructions are the one of the bearing design table for example the table B.1 of EN1337-1 code (attached at the end of this document):


Maximum horizontal load
V_{Sd}
Bearing design rotation
(seismic, thermal, irreversible movements)
α_d
Bearing design displacement
(seismic, thermal, irreversible movements)
$v_{,d}$
Bearing lower and upper interface surface with the structure
(available space for bearing installation, material and design resistance)
σ_c, A,B

Bearing design table according to EN1337-1 code

The purpose of this bridge bearing schedule is to list the information normally required for the design of the bearings for a particular structure. This information should ensure that bearings are designed and manufactured so that, under the influence of all possible actions, unfavourable effects of the bearing on the structure are avoided. A drawing should accompany the schedule showing the layout of the bearings with identification marks, including a typical cross section of the bridge and particular of any special locating requirements. Bearing function should be indicated on the drawing by appropriate symbols.

Every item listed in the “bearing design table” should be considered, but some may not be applicable to a particular bearing. Only relevant information should be given and when an item in the schedule is not applicable this should be stated. Additional information should be added when special conditions exist.

Here above you can find a short explanation of each item listed in the “bearing design table”

BEARING IDENTIFICATION MARK	Bearing with different function or load carrying requirements should be distinguished by a unique reference mark
NUMBER OFF	The required number for each item
SEATING MATERIAL	The materials on which each outer bearing plate bears should be stated as it may affect the design and finish of these plates
AVERAGE DESIGN CONTACT PRESSURE	The pressure of the effective contact area
DESIGN LOAD AFFECTS	The structure designer should give the worst individual values of the design load effects in the schedule. The most adverse combination of these values is usually sufficient for a satisfactory design of bearing. Only in special cases would greater economy be achieved by considering the actual coexistent values of load effects, in which case these should be given in detail.

DISPLACEMENT	Displacement of the structure at a bearing should be determined and factored. Allowance should be made for any movement of the supporting structures. Transverse and longitudinal movements are normally in a direction perpendicular and parallel to the longitudinal axis of a bridge span, respectively. Where there is any likelihood of ambiguity directions of movement should be clearly indicated on the accompanying drawing.
ROTATION	The irreversible and reversible rotations at the serviceability limit state (SLS), which the bearing is required to accommodate, should be given in radians.
MAXIMUM BEARING DIMENSIONS	The maximum sizes of the bearing that can be accommodated should be stated
TOLERABLE MOVEMENT OF BEARING UNDER TRANSIENT LOADS	The movement that can be tolerated at the bearing under transient loads, in directions in which the bearing is meant to provide restraint
ALLOWABLE RESISTANCE TO TRASLATION UNDER SLS [kN.] (if relevant)	In the design of the structure, reaction to displacement movements may be of significance, in which case the acceptable horizontal force generated by the bearing should be given for the serviceability limit state (SLS). The values to be given are those for slowly applied movements at normal temperatures (any necessary extra allowance for low temperatures and rapidly applied movements should be made by the designer of the structure).
ALLOWABLE RESISTANCE TO ROTATION UNDER SLS [kN*m] (if relevant)	In the design of the structure, reaction to rotation may be of significance in which case the acceptable moment of reaction generated by the bearing, when subjected to the critical design load effects, should be given for the serviceability design state.
TYPE OF FIXING REQUIRED	Various means of fixing the bearing to the superstructure and substructure are available, appropriate to different type of bearing. Particular requirements, such as friction, bolts, dowels, keys or other devices, should be stated.

Bearing Design Table

Reference:…… **Date:**……

Bridge Name: …… **Table:** …… **of** ……

BEARING IDENTIFICATION MARK							
NUMBER OFF							
SEATING MATERIAL (e.g. cement, mortar, epoxy mortar, in situ concrete, precast concrete, steel, timber.)	Upper surface						
	Lower surface						
AVERAGE DESIGN CONTACT PRESSURE [N/mm^2]	Upper face	SLS					
		ULS					
	Lower face	SLS					
		ULS					
DESIGN LOAD AFFECTS [kN]	ULS	vertical	Max				
			Permanent				
			Min.				
		Transverse					
		Longitudinal					
	SLS	Vertical					
		Transverse					
		Longitudinal					
DISPLACEMENT [mm]	ULS	Transverse					
		Longitudinal					
	SLS	Transverse					
		Longitudinal					
ROTATION	ULS	Transverse					
		Longitudinal					
MAXIMUM BEARING DIMENSIONS [mm]		Transverse					
		Longitudinal					
		Overall Height					
TOLERABLE MOVEMENT OF BEARING UNDER TRANSIENT LOADS [mm] (If relevant)		Vertical					
		Transverse					
		Longitudinal					
ALLOWABLE RESISTANCE TO TRASLATION UNDER SLS [kN.m] (if relevant)		Transverse					
		Longitudinal					
ALLOWABLE RESISTANCE TO ROTATION UNDER SLS [kN.m] (if relevant)		Transverse					
		Longitudinal					
TYPE OF FIXING REQUIRED		Upper face					
		Lower face					

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- Elastomeric Bridge bearings
- bearings
- Spherical bearings
- Incremental Launching bearings
- Horizontal load bearings
- Special bearings

Seismic Isolators
- High damping rubber bearings
- Lead core rubber bearings
- Multilayer rubber bearings
- Shock transmitters
- Shock absorber
- Rubber dampers

Expansion joints
- Elastomeric joints
- Joints for high movements
- Finger joints
- Buried joints
- Railway joints

Services
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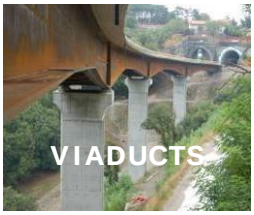
- Consulting
- On site assistance
- Installations
- Tests
- Inspection

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