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A

Anchor Design

1. *Why do you ask for so much information when I ask for your help in designing a connection?*

   Typically when we are asked to design a connection it is between a steel baseplate and a concrete foundation or something similar. The baseplate will have been designed and the location of the holes for the fixings will have been detailed to suit the steel arrangement and a practical size of base plate. Because of the strength of steel the rules for the position of the holes allow the fixings to be close to the edge of the base plate and close to each other. Because concrete is not as strong as steel and is also brittle we need much bigger edge distances and anchor spacings in the concrete to transfer the load successfully.

   We have to take the size and strength of the available concrete and the location of the fixings in the concrete into consideration when we design a connection and this may limit the fastening capacity. Sufficient information is required to be able to determine how we can obtain the best performance from the concrete connection.

   A more detailed explanation about how anchors work and what limits their capacity can be found here

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2. *I need to fix something to a concrete wall but I don't know what load is on the fixing, can you tell me what fixing to use?*

   No. Although we do offer a design service, without the basic information such as the load acting on the fixing we cannot produce a designed solution.

   We can use our experience to suggest a fixing which is often used for this type of application and which may be suitable in your case and we can tell you what to look out for that makes it less likely to work. The more information that you can give us about the problem the greater the usefulness of our answer is likely to be.

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B

Blockwork

1. *Can I use HIT-HY 150 MAX into concrete block walls?*

   Concrete blockwork is more similar to Masonry than to mass concrete and so the design data for HY 150 MAX is not appropriate for use in these blocks. Additionally, many concrete blocks are hollow so it is not practical to use the HIT-HY 150 MAX in them.

   In a solid high strength low porosity block the HIT-HY 150 MAX may give a satisfactory bond but this would have to be proved by testing on site as we do not have sufficient test data to justify its use.

   In many blocks the performance of the fixing is limited by the size and strength of the block and there is little or no advantage in using the very high strength available with HY 150 MAX because the block limits the capacity of the connection. This is particularly true when HIT-HY 70 has been specifically developed and tested for this type of material and is suitable for use with the HIT SC sieves, making a system that is also designed for use into hollow blocks as well as solid versions.

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C

Corrosion

1. *Can I use your standard fixings outside?*

   This depends on how long the fixing is going to be exposed to the weather and other corrosive elements in the atmosphere and also how aggressive the atmosphere is. In general our standard anchors are electro-zinc plated and are intended for use in a dry internal environment,

but they may also be suitable for short term exposure outside. More information about atmospheric corrosion and chemical attack can be found here.

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2. *I need to fix a hot dip galvanized frame to a concrete base, outside. Which anchor should I use?*

   The preferred solution to this would be to use a sherardized anchor (HAS-F HUS or HDA-F or HUS-HF) because the anchor is outside and it avoids problems with dissimilar metals. Alternatively a stainless steel anchor could be used. Further information can be found here.

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3. *Why have I been recommended to use your X-CR nails to fasten stainless steel frame cramps to the steel columns on the project that I'm designing?*

   A small carbon steel nail going through the stainless steel tie in this situation is extremely prone to corrosion and would be likely to fail by contact corrosion. This is the small component that transfers the load from the frame cramp to the steel frame and if it fails the whole connection fails.

   Using a stainless steel moves the point where the corrosion is likely to occur into the massive steel column where the effect on the properties of the column is insignificant.

   More details about Contact Corrosion and X-CR nails can be found here

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Cracked Concrete

1. *The ceiling that I have to hang a heavy air handling unit from doesn't have any obvious cracks in it; can I assume that it is uncracked concrete when I design the fixings?*

   Probably not, the description "cracked concrete" is a short hand description referring to the tensile zone of the concrete structure. Typically the underside of a floor slab or a beam is likely to be situated in the tensile zone of the structure which is where the tensile load is taken by the reinforcement and the concrete is allowed to crack. Typically a crack width of up to 0.3mm is allowed, which is small enough to be difficult to see but large enough to influence the performance of the fixing, so anchors suitable for use in cracked concrete should be used.

   More information about cracked concrete and the tensile zone can be found here.

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D

Dynamic Loads

1. *I am designing the fixings to hold the base of a flag pole on a garage fore court, do I have to design this as a dynamic load?*

   When we consider dynamic loads we are usually referring to

   - fatigue type loads where the fixing will be subjected to large number of cycles of a predictable load,
   - Shock loading where we are typically looking at a large load and frequently only a single event or the special case of
   - seismic loading where there are a small number of high loads followed by a series of smaller loads.

   For your fixing, unless you are considering the possibility of a vehicle impact, I assume that you are thinking about the effect of the wind on the pole and any attached flags. This can't be designed as a fatigue case as the load amplitude and number of cycles cannot be predicted, it is not a shock load and it isn't a seismic load, so is best designed on the assumption that the load is a quasi static load using an appropriate partial safety factor for this.

   More information about our dynamic load design options can be found here.

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DX

1. *Why does your load data for DX fixings to concrete state that a minimum of 5 fixings per fastened unit is required?*

   Because of the way DX and GX fastenings work they have characteristics which are different to those of a drilled in anchor. A single DX fixing has a shallow embedment depth and is small when compared to the large aggregate in the concrete. When an anchor is installed into a drilled hole the process of drilling the hole ensures that the anchor is embedded to the correct depth, that the anchor is straight and is effectively vertical to the surface of the concrete, so in most cases the influence of the coarse aggregate in the concrete is small.

   When a DX nail is driven into concrete the nail is being pushed in with a large force applied to the head of the nail, so the point of the nail will try and take the path of least resistance and if a piece of hard aggregate gets in the way at a glancing angle the nail will bend and try to go round it. This means that the nail may end up with a reduced embedment depth and /or being bent in the concrete, possibly causing a small crater or “spalling”. In extreme cases for an individual nail it is possible that no holding capacity will be developed.

   When a series of anchors are tested to destruction the results will all be similar and will be clustered around an average value and the average is usually large enough that there is only a very small chance of a fixing pulling out of the concrete with a zero load capacity. With a DX fixing the scatter of the results is much larger and the mean value of the results is much lower, with a real possibility that some results will be zero.

   For anchors it is possible to use the statistical concepts of the mean failure load and the standard deviation of the normal distribution curve to calculate a limit with the required probability of failure to give a “safe” fixing with a single point fixing. For DX fixings the mean is too small a value when compared with the standard deviation (a measure of the scatter) of the results to achieve a useable working load. By using computer modelling coupled with some engineering analysis it is possible to produce a working load for a group of fixings where a realistic working load can be determined. This is why that for standard DX fixings we require that a minimum of 5 fixings per part fastened are used for fixings to concrete. There is a more reliable fixing approach, known as DX-Kwik, where the nail is fixed into a pre-drilled hole and because the embedment depth is deeper and the mean load capacity is higher, this requirement is not relevant for DX-Kwik fixings. Further information about how the technical data for DX is determined can be found here and information about how DX and GX fixings work can be found here

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2. *What do you mean by DX Kwik? I can’t find anything about it in your Products and Services Catalogue?*

   DX-Kwik is briefly mentioned in the catalogue, but it is easily overlooked. It is a problem solving technique that increases the capacity of DX fixings considerably and often means that it is possible to make fixings into concrete that has very hard aggregates and which tends to cause standard DX fixings to have an unacceptably large number of installation failures. Another advantage of DX-Kwik is that it enables fixings to be made using only a single nail or stud where a minimum of five fixings would be required using standard DX fixings.

   The process involves using a small cordless drilling machine and a TX-C 5/23 B drill bit (item no. 00028557) to drill a 5mm diameter by 23mm deep hole in the concrete, because of the small size of the hole this takes only a few seconds and then using the pin point accuracy available with our current tools, firing a 48mm long nail or stud into the hole. The sides of the hole give guidance to the fixing as it is installed and increases the embedment depth of the fixing removing problems caused by the fixing bending and by spalling the surface of the concrete.

   More information about the technical background to DX–Kwik can be found here

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E

European Technical Approvals (Assessments)

1. *Why does it matter if your fixings have an ETA approval?*

   Where a fixing has an ETA it means that samples of the fixing have been subjected to comprehensive testing regimes and assessment processes which are designed to establish that the performance of the fixing is appropriate for use with the state of the art anchor design methods which are consistent with the latest Eurocode design methods.

   The test regimes prescribed also confirm that the fixing will work as intended when the anchor is installed correctly under reasonable site conditions. Where the details of the connection are such that a standard configuration as described in the approvals is not possible, the detail of the testing regimes carried out provides an excellent basis for making a judgement about the more complex cases.

   The CE marking process for anchors requires conformance with ETA and requires manufacturing process surveillance by a recognized body which ensures that the product tested and approved is representative of the product supplied.

   The use of CE marked products where possible demonstrates compliance with the Construction Products -Regulations and also helps with demonstrating Building Regulations Conformance.

   The combination of the independence of the approval process and the rigor of the testing process goes a long way to mitigate the liabilities of both specifiers and installers.

   All you wanted to know about ETAs and the ETAG's can be found on the EOTA website here

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F

Fall arrest systems

1. *Can I use your ST127 ringbolt to fasten a lanyard to so that that my guys can work without any edge protection?*

   No! It sounds as though you are using the ringbolt as a fall arrest system and the ST 127 is neither suitable nor has it been tested for fall arrest applications. The maximum load capacity in tension for the ST127 ringbolt is 12.7kN and something like 0.5 kN when loaded transversely. A man falling on a standard lanyard generates peak loads in the anchor point which are well in excess of the breaking load of an ST 127 anchor when loaded transversely so in the event of a fall the broken bit of the anchor would probably follow your operative to the ground rather than save his life.

   If you are using the ringbolt as a tether to attach the lanyards to so as to restrict the movement of your guys and keep them away from an edge then you may be able to demonstrate that the anchor is not a fall arrest system, but this is not something that we would recommend.

   More information about the requirements for fall arrest systems can be found here.

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Filled Holes

1. *What do you mean when you say that the holes must be filled in your Profis anchor calculations?*

   In order for a multi fixing connection to work as intended under the effect of a shear load we need all the fixings and the base plate to be able to move together as a single component. This may not happen if all the fixings are made through clearance holes in the component fastened.

   The clearance hole is necessary in order to be able to produce the fixing on site so we have had to find a way of producing the fixing arrangement as intended by the designer whilst making it practical for the installer to do their job quickly and efficiently. The desired effect can be achieved by filling the annular gaps in the component fastened using a high performance resin mortar such as Hilti HIT-HY 150 MAX.

With an injection anchor is installed through a base plate this is easy to achieve as the surplus mortar in the hole gets displaced as the anchor rod is inserted into the hole and the displaced mortar finds its way out through the clearance hole in the baseplate effectively filling the clearance hole. Where this cannot be done or be relied on we also have a system of washers designed for use in fatigue load situations which allows the mortar to be injected into the clearance hole after the fixing has been installed. This is called the “Dynamic Set” and we have a data sheet here giving details and a method statement showing how the system is used.

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Fire

1. *How do I design an anchor that needs to support a load with a 2 hour fire resistance?*

   There are a couple of options available to you, the easiest is to use Profis Anchor and to set the fire conditions under the load tab and then to proceed in the usual way. The fire design model is relatively simple, very conservative and restrictive about the allowable position of the anchor in the concrete.

   Alternatively, assuming that you are confident about the condition of the concrete in a fire, you can design the anchor in the normal way and then carry out a final check to ensure that the load in each individual anchor does not exceed the 2 hour fire resistance data that we publish in our Fastening Technology manual, More details about anchors in fire can be found here.

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H

Hollow core floor panels

1. *What can I use to suspend a pipe from a hollow core floor?*

   There are several possible ways of doing this but it is important to remember that the main function of a floor is to provide access to the space above rather than to be used for hanging things from, so it is important to make sure that anything attached to the floor does not weaken the structural integrity of the floor. This means that fixings have to be made in such a way that the tendons in the panel are not damaged by the fixing process. As the tendons run in the solid part of the panel between the cores then typically the fixings have to be made under the cores or the embedment depth of the fixing has to be severely restricted (typically to a maximum of 20mm).

   This can be achieved by using our DX Fixings and further information concerning this can be found here.

   If the position of the cores in the slab can be determined either by visual inspection or by the use of one of our detector systems (details here) then there are several anchors that may be used. These include:-

   HKD-S/SR which give a maximum recommended load of 1.3kN for a 25mm web thickness and 1.7kN for a 35mm web thickness (Sizes M6 x25, M8 x 30 and M10 x 30)

   HUS-I 6 HUS-P 6 which for a maximum recommended load of 0.5 kN for a web thickness of 25mm, 1.0 with a web thickness of 30mm and 1.4kN with a web thickness of 35mm.

   HIT-HY 70 injection system for masonry can also be used to produce strong fixings into the hollow cores for instance the M8 and M10 anchor rods used with a HIT-SC 16 sieve and a 50mm embedment depth will have a maximum recommended load of 2.0kN in tension and an M12 Rod with a HIT SC22 sieve will give a maximum recommended load of 2.5 kN with a 27.5mm wall thickness.

   HRD 10 may also be used for fixing attachments to precast pre-stressed hollow core slabs and both the **DBZ wedge anchor** and the **HPS-1 impact anchor** have been used for fixings to hollow core panels and are likely to be suitable for suspended ceilings and similar applications

   Note The loading data above is to be used for product selection only, for critical fixings in a specific panel type the fixings should be proved by test rather than relying on the data above.

   The loads above are taken from tests carried out on representative commercially available panels which may not always have the same properties as those that you have.

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L

Lifting Systems

1. *Please can you tell me what fixing I need to lift a 2 tonne concrete slab?*

   Regrettably not, as a company we commonly choose not to supply lifting components, but we do supply anchors -that are able to resist a certain applied load and it is up to the customer or engineer responsible to decide if this resistance is suitable for your purpose.

   Lifting eyes and other components should be appropriately certified for lifting and sourced from a specialist company and then secured to the concrete with fixings that are able to resist the applied loads.

   Please take care to ensure that the loads are calculated taking into consideration the angle of the applied load and appropriate safety factors to allow for both the dynamic nature of the load and the possibilities of unforeseen additional loads being applied during the lifting process.

   Note that for safety critical applications we strongly recommend proof loading the fixings to an appropriate proof load before use.

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Loads

1. *Do I need to use factored or unfactored loads in Profis anchor?*

   In principle you can use either factored or unfactored loads however Profis anchor uses design (factored) loads for calculations and in the reports, If you enter the loads by double clicking on the loads on the opening diagram then you need to enter factored loads however if you enter the load tab and then enter loads you can enter unfactored loads and select the partial safety factor that you want to use. If in doubt accept the default values. Where unfactored loads are input into the program both the unfactored loads and the partial safety factors that are applied will be shown in the report.

   If you need further help with any of the Profis software speak to our support Engineers on 0161 886 1144 and they'll do their best to help you.

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M

Masonry

1. *How do I design a connection to transfer a heavy load to a brick wall?*

   Unlike concrete, masonry walls are not a uniform base material, the strength of bricks varies from something like 10 to somewhere in excess of 100 N/mm^2, they comprise of physically small units which may or may not have voids and frogs in them. They are built into a wall using mortar of unknown and variable strength and which may or may not be present around all the sides of the bricks. The outer face of the brick in the wall is intended to look uniform and often to colour match with other parts of the structure and so gives very little information about the properties of the brick units behind even when it can be inspected.

   The uncertainties don't even end there, the location of the fixing in the wall, top, edge etc. may also effect the performance, for instance, is the wall a single leaf of stretcher bonded brickwork acting as a brick cladding panel tied to a structural inner leaf by relatively flimsy wall ties and frame cramps, or is it a more substantial section? As Brickwork is often used externally and for earth retaining structures, is the masonry dry, damp, wet or water saturated?

   These factors all influence the properties of the fixings and make it practically impossible to produce reliable design data that can be used in most types of brick work, so published data can only give a guide as to what may be achieved.

   As you want to transfer a large load you need to ensure that the masonry is sufficiently robust to transfer the applied load back to the foundations of the structure. You then need to be able to distribute the applied load over a sufficiently large area of the brickwork not to cause the bricks / blocks or the mortar bond that holds them in place any distress.

For heavy duty fixings to masonry, commonly the best option to use is our HIT-HY 70 resin mortar with an appropriate anchor rod or threaded insert, these are commonly used with a gauze sieve to retain the mortar and form a mechanical key into any voids that are encountered when installing the fixing.

Typically one fixing should be made into the middle of a brick in the centre of the brick face, the limiting condition for the performance of HIT HY70 resin mortar fixings into brick is generally the load required to pull a single brick out of the wall (The allowable load can be calculated using the equations given in ETAG 029 annex C) so increasing the number of fixings into an individual brick will not increase the capacity of the fixing. There is a reasonably extensive body of test data in our Fastening Technology Manual that will give you a guide to the sort of performance that you can expect.

For critical fixings particularly where there are a lot of fixings to be made it is probably more productive to invest in carrying out some site tests to evaluate an appropriate fixing rather than putting a lot of effort into trying to design the fixing.

When you have a solid wall or similar thick brickwork structure it is often possible to use a resin anchor embedded through several layers of bricks in order to significantly increase the tensile capacity of the fixings if the bricks are solid and there are no voids between the bricks it is sometimes possible to use an higher strength anchor material but this can only be done on the basis of site tests to assess the suitability of the fixing for the application.

If you want to use a mechanical fixing you can also consider using the HUS screw anchors, the HAM Sleeve anchor or the HRD Frame anchors.

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P

Profiled metal decking supporting cast in situ concrete

1. *What fixing should I specify to attach an air handling unit to a Ribdeck ceiling?*

   It is difficult to give you a recommendation without knowing any details about the location of the fixing points or the loads that you are trying to resist. The concrete in the Ribdeck is restrained by the metal deck so it is possible to use a small anchor in the ribs without too much concern, the alternative may be to use a length of MM or MQ strut shot fired to the underside of the deck to give you a choice of fixing position (a minimum of 5 fixings per length of strut will give you a capacity of 2kN per strut.). Although there is a metal deck present the thickness means that the fixing is still being made into concrete rather than steel.

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R

Rebar

1. *Can I use your injection resins to fix new rebars to extend a reinforced concrete slab?*

   Yes, you can use our HIT resins to connect rebar into the existing slab, Not only is it possible, but the resins have been extensively tested and ETA approvals have been granted for the application. In order to make your life easier you can download our Profis rebar software from here and it will carry out the design for this and other arrangements for you. If you have any difficulties trying to use the software then please don't hesitate to call our Support Engineers on 0161 886 1144 and they'll be pleased to guide you through them.

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Redundant fixings

1. *For some of your anchors you quote different loads for redundant fixings, what do you mean by this?*

   The redundant fixings design approach may be used to design fixings using multiple fasteners in such a way that a failure of an individual fastening does not result in failure of a complete fixing point. This design concept is used both for DX/GX direct fastenings and is also incorporated into the ETA approval process in ETAG 001 part 6 for non- structural fixings (this means they may be used for fixing components which do not contribute to the stability of the structure.

Under the ETA process anchors may be approved which are smaller than the minimum size required by the ETA approval process for single point fixing. These anchors may have a smaller embedment depth than those used for single point fixings and so are a valuable option when fastening to hollow core floors and other situations where contact with the reinforcement in the concrete is not allowed.

Anchors being used in a redundant fixing application must be fastening a component that is able to transfer the load from one anchor to the remaining anchors in the group if the first one fails.

A redundant fixing can be used with a rectangular arrangement of fixings or a linear arrangement, for instance fixing a length of MQ channel and with 4 fixings being made in accordance with the space and edge distance requirements a maximum of 3kN may be applied to the channel, (A row of 3 anchors would allow only a maximum of 2 kN to be applied to the channel.)

Note with redundant fixings to concrete for DX/ GX fastening (also known as standard DX fastening to concrete) a minimum of 5 fixings are required in a group and the loads on the connection are lower.

More details can be found here.

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S

Screws

1. *I need to fix some aluminium cladding rails to 10mm thick flanges on steel beams do you have a screw to suit?*

   Because of the combination of metals that you have here, you need to use a stainless steel screw, and because of the thickness of the steel you are fixing into you need a type 55 drill point with a 12mm maximum drilling capacity, the head options are a bit limited but the SMD 55S may be suitable depending on the thickness of the cladding rail.

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T

Testing

1. *Do Hilti do site testing for anchor bolts?*

   In general we prefer not to carry out site testing, although we do have the capability and the expertise to do it when the situation warrants it.

   Site testing is both time consuming and expensive so there have to be good commercial reasons for us to do it.

   Most of our fixings have a wealth of independently verified technical information available that has been obtained under carefully controlled laboratory conditions designed to ensure that the published data is representative of site conditions. It is clearly inappropriate to discard this information on the basis of a few tests carried out with relatively basic equipment under site conditions.

   We would also avoid testing to confirm the quality of the installation (proof testing), since in this case we may be seen to have an “interest” in the results and so in the event of any dispute arising between the contractor and client any confirmation that we issue to say that the quality of the installation is satisfactory, is unlikely to be seen as independent and so the report is of little value to the customer.

   As a responsible company we will of course test our fixings when they are to be used in a critical application where we do not have any technical data to confirm the suitability of the fixing for the application and of course we will carry out tests where it appears as though one of our fixings has failed if there is any question about the quality or suitability of the fixing.

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2. *Can you recommend somebody to carry out site testing for us?*
   Where we are not carrying out the site testing ourselves we can supply a list of testing companies that either are approved under the CFA approved tester scheme or who are companies we know of who have been carrying out site testing for a number of years. This is not however a recommendation and you need to assure yourself of their competence.

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