

TECHNICAL PAPER TD160797 **EXTERNAL DOORS - OPERATION AND PERFORMANCE**

To achieve adequate performance from an external, outward opening hinged doorset, it is necessary to give some consideration to wind loading.

When operating domestic external hinged doors, wind loading is not normally considered separately, as domestic properties are usually in established groupings and afford protection to each other due to their positioning, so design wind loadings are therefore lower. (Typically, 0.718kN/m^2 - 15lbs/ft^2)

In addition to this, domestic doorsets are smaller and are usually installed to open inwards.

However, on commercial and industrial applications, external steel hinged doorsets are larger (up to 1200mm wide in single leaf configuration).

The doors are generally required to open outwards, as they are used as a means of final escape from the building, and the general wind loading requirements for the site will be higher, as commercial/industrial buildings tend to be dispersed over a large site and afford little protection to each other.

In some instances, the positioning of buildings may actually increase the wind loading on individual buildings, due to prevailing winds being 'funneled' into certain zones.

Commercial wind loading for doors is normally based on $.96\text{kN/m}^2$ (20lbs/ft^2) which would equate to approximately 1.62 kN (360 lbs) load on a door leaf (based on a 900mm x 2100mm opening).

Coastal applications or 'open-field' sites can be 20-30% higher than this, so it is essential to keep the door leaf size to a minimum, whilst providing the required access.

Opening sizes.

Tall doors may have been specified, simply to fill an opening that already exists, with little thought given to the actual operation of a hinged door with such a large "sail area".

As an example of this problem, a 2400mm wide x 3000mm high double doorset would have a wind loading of 3.46kN (780 lbs) on each leaf.

Standard friction stays & door closers cannot cope with this kind of loading and careless use of this doorset in windy conditions would damage the doorset, by allowing it to whip round onto the building structure.

More importantly, it can cause injury to personnel.

A caution notice should therefore be applied to large doors, warning personnel of the risks of operation in high wind conditions.

It would be better to fit conventional-height doors and a separate overpanel, which would significantly reduce the loading on the doors, reducing the risk of damage or injury.

If the full opening height is required occasionally for access & maintenance of large plant and equipment, the over panel can be arranged to allow removal, thus satisfying the access requirement whilst still reducing the wind loading on the leaves.

In many situations it is therefore possible to fill the opening and provide a safe operational solution.

Function

Even 'conventional-sized' doorsets should not be allowed to swing freely when opened, because of the risk of injury to personnel and damage to the door caused by impact with other parts of the building structure.

Some form of restraint should therefore be provided to control the speed of operation. This control is also necessary on the closing cycle, to prevent slamming of the door whilst allowing the door to latch correctly.

Restraint would normally be achieved by friction stays or door closers.

Friction Stays

These usually consist of a pivoted arm, attached to the frame header, with its opposite end terminating in a bush which is retained in a slotted slide-track attached to the inside face of the door leaf.

When the door is operated, the bushed end of the arm travels along the slide-track as the pivot arm arcs outwards and they are normally designed for 90° - 95° opening.

The speed of operation is controlled by inducing friction into either the pivot, or the slide arm.

The 'pivot' type usually incorporates a rubber bearing block in the pivot, which is compressed by tightening the pivot bolt. As this rubber block is compressed, its diameter increases, applying increasing friction to the sidewall of the bearing.

The 'slide arm' type will usually include fibre washers on each side of the bush which runs in the slotted slide-track, retained by a clamping bolt. As the clamping bolt is tightened, the fibre washers increase their grip on the slidetrack.

On both types, the friction is adjusted to increase the 'drag' as required, which is then constant throughout the opening and closing cycle.

There are two disadvantages to this type of restraint device.

- 1). Because they are in constant friction every time they operate, the fibre/rubber components wear down, requiring periodic adjustment.
- 2). Because the friction is the same on the opening and closing cycle, any 'drag' induced in the door must be absorbed by the other hardware to allow the necessary opening or closing force to be applied.
If the friction stay is tightened to suit windy conditions, then operation of the door will require extra effort.

If the door has conventional sash locks with bolt-through lever handles, the extra effort required to operate the door should not present too many problems. However, if the door is fitted with a panic device this

extra effort may apply forces onto the hardware which it was not designed to take.

The extra effort required on the panic bar will still be acceptable on the opening cycle, but if the door must be closed from the inside, it will have to be pulled.

Panic bars, when operated, are retained in the actuated position by spring-loaded triggers which are 'tripped' by the frame, allowing the rods to re-engage.

The extra pull force required on the panic bar will increase the loading on the spring-loaded triggers and the operating cams in the main mechanism.

The triggers tend to be machined steel components, but in general, the operating cams in the mechanisms are alloy castings and it is therefore these cams which are likely to become overloaded and fail.

Door closers

For the purposes of this report, the term 'door closer' refers to conventional surface-mounted rack & pinion hydraulic door closers.

These are available in various strengths, (Size 1-6) and are normally quoted to suit different widths of doors, but ignore the door height or "sail area".

This is usually acceptable on internal doors unless the rooms are pressurised, but as shown in the previous pages, "sail area" is very important on external doorsets.

Relatively low-powered closers (fixed or adjustable up to size 4) are sold for use on door leaf widths up to 1100mm but these would not be suitable for external applications.

Closers are normally mounted on the 'pull-to-open' side of the door leaf with the arm mounted on the frame header. This is the position for maximum efficiency and power delivery. However, on external, outward-opening doors, this mounting position would leave the door closer outside the building, which is impractical.

The closer is therefore mounted on the 'push-to-open' side of the door leaf in a configuration known as "parallel arm".

Because of the geometry of the arm, the closer loses approximately 30% of its power. This means that a more powerful closer must be selected when using this configuration on external doors.

Again, because of the wind loading problem it is advisable to select a closer with "back-check" facility.

This consists of an additional bleed valve on the hydraulic cylinder which restricts the flow of the hydraulic fluid and therefore restricts the speed of operation of the door.

Basically, the faster the door is operated, the greater the resistance provided by the back-check valve.

This will prevent 'wind snatch' and will also prevent operational abuse when the door is opened, but it does not affect the closing cycle.

Door closers are therefore preferable on higher cyclage external applications as they allow independent adjustment of:-

"Back-check" - the arc of opening travel beyond approx.85°.

"Sweep speed" - The main arc of closing from 180° - 10°.

"Latching action" - The final closing force 10° - 0°.

Recommendations

If the doors are only intended for emergency escape or very occasional use (low cyclage), a friction stay would be adequate, as it can be set to relatively low friction due to the reduced probably of wind loading during use.

The fibre/rubber components in the friction stay will not be subjected to high usage and would therefore not require constant adjustment or replacement and the other hardware on the door will remain within its design capabilities.

If higher frequency operation is required, it will be necessary to fit a door closer with power adjustment up to Size 6 and with a 'backcheck' facility.

Please note.

This document is issued for general information only and is not intended as a substitute for information contained in any relevant British Standards.

As Standards are under constant re-appraisal, it is essential that the full document be consulted.

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