

A STUDY ON GRATING CUT-OUTS

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Abstract— Grating is used as a flooring material in many industries as well as for drainage and for platforms around vessels and columns. It is also used as a pit and drain covers where heavy haul vehicle movement is expected. Though design of grating panels is not considered a high end engineering activity, but proper management of the whole process of grating engineering, fabrication and installation is crucial to the success of the project.

In one of the recent project engineered by Fluor Daniel India, about 10000 sq. meter of grating was laid. The paper discusses the various issues that were faced in the entire course related to provisioning of grating, starting from engineering to installation. These issues pertain to design of gratings with large opening, management of changes in cutouts post issue of drawings. Standard way to provide supporting arrangements for those new cut-outs in the erected grating panel would hamper cost baseline and schedule baseline. A fast and economic way to tackle the problem was implemented.

To achieve a rapid and economical solution, the paper presents solutions that were given at site to take care of the huge number of modification required so as to effectively reduce construction time.

Keyword— Grating components, Surface Treatment, Grating Cutouts, Grating Cutouts challenges.

I. INTRODUCTION

Steel gratings are small weight holding units with a long life (holds physical stress and environmental impacts extremely well) and fit both indoors and outdoors. Grating panel can be used in stairs, bridges, walk-ways, buildings, light and heavy engineering, and chemical and mining operations. Also, in the modern era it finds place in the interiors and exteriors on architectural, landscape and exhibition centre.

Quick mounting, ability to take any geometrical shape and easy interchangeability of defected grating panels make grating a widely used product for floor applications.

Based on the manufacturing process and material of construction, various types of grating are prevalent. Few of them are listed as under:

1. Fibreglass reinforced Plastic Grating.
FRP grating are manufactured in the molds by combining fiberglass rovings and thermosetting resin to form strong, one piece molded panel which are light weight and are resistant to corrosion. These electrically and thermally non conductive panels are prepared either by molding process or pultrusion process.
2. Metal Gratings.
Metal gratings could be of mild steel or stainless steel each providing its unique benefits.
 - a. Expanded steel floor grating.
Expanded grating is produced from heavier gauge low carbon steel plates. Strands and the openings are considerably large and ideally used for pedestrian traffic, but can accommodate heavier loads if properly supported.

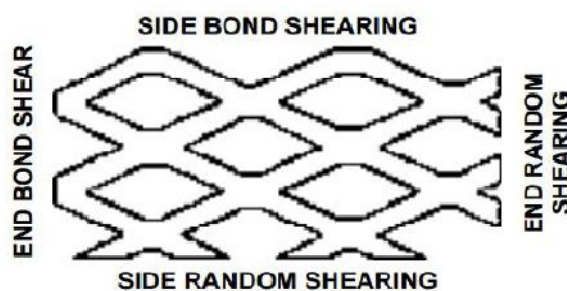


Fig.1- Expanded steel grating

b. Welded steel bar grating.

Commonly used in industries, welded steel bar gratings are prepared by press welding the cross bars to bearing bar in a regular criss-cross arrangement.

II. GRATING PANEL COMPONENTS & SURFACE TREATMENT

BEARING BAR are the parallel flat bars supported on both ends and used to transmit the forces induced by the load coming upon grating panel. **Unidirectional Anti-slip arrangement** also known as the serrated grating panel is introduced by providing grooves on the flat bar.

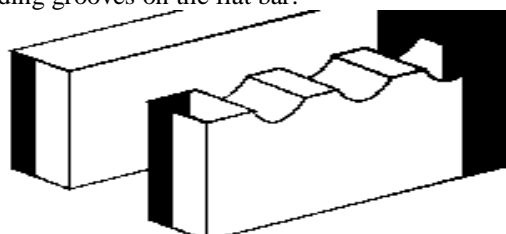


Fig.2- Regular and serrated bearing bars.

CROSS BARS are used for the positioning and providing stability to the bearing bars. Generally,

6mm square twisted bars are press welded in perpendicular direction to the bearing bars to achieve the purpose.

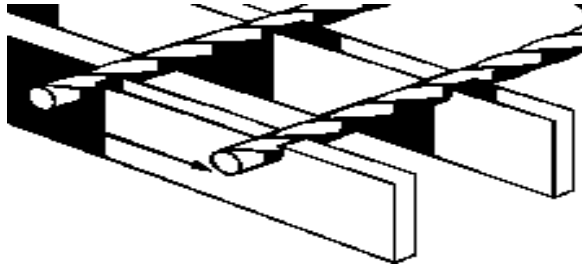


Fig.3- Cross bars for holding bearing bars.

BANDING BARS are flat bars welded on the periphery of the panel to hold and provide stiffening.

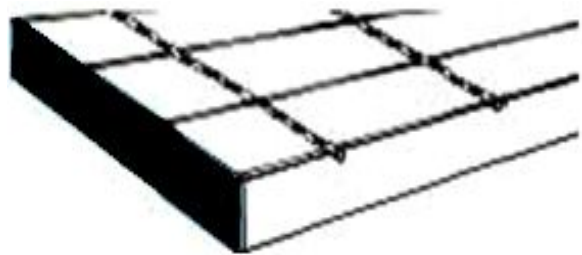


Fig.4- Banding bar (highlighted)

SURFACE TREATMENT is given to grating panels to provide protection against environmental conditions and physical stress. Some of the methods are listed below.

1. Hot Dipped Galvanization, where grating is dipped in the molten zinc.
2. Epoxy Varnish.
3. Zinc chromate Primer or Shop primer
4. Bitumen paint.
5. Stainless steel grating can be shot blasted, pickled or electrolytic ally treated to produce good surface finish.

Although, sometimes grating panel has to be modified at site due to which the protective layer has tarnish. To provide protection, zinc rich paint is done locally at site.

III. GRATING PANELS SIZING & DESIGN

Dimension of Grating panel and elements are precisely monitored to achieve the uniform distribution of load over all the grating area. Grating panel standard width is kept around 1000mm with evenly placed bearing (loading) bars of height "C" ranging from 25mm to 40mm and pitching "A" at 30mm~50mm. These bearing bars are supported on each end over the bearing structure through which the load is transmitted. The cross bars are welded perpendicular at spacing "B" around 100mm to provide lateral stability of the bearing bars. Because of this arrangement, grating panel is shaped with a mesh size calculated as the adjacent distance between the bearing bar and cross bars.

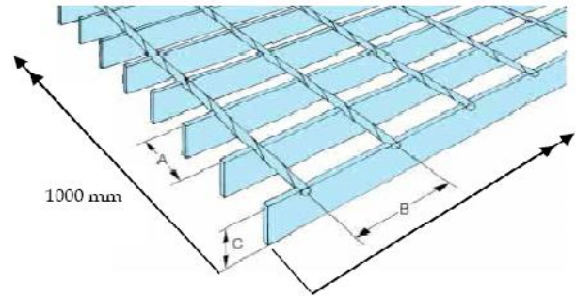


Fig.5: Dimensioning of Grating Panel

Design of grating is a simple affair by limiting the span of grating referring to the deflection/stress tables given in PIP STE05530 based on design load.

The grating layout drawings with the required cutouts marked for all penetration/pipe supports expect for those required for structural column are provided to the grating fabricator and the grating fabricator then releases grating panel layouts drawings in which the grating is broken into appropriate panels. The layout of panels is done carefully considering all the cutouts and other constrains such as maximum size of grating panel. Gratings are essential elements of the safety measures during erection/ construction of framing steel. The endeavor is to cover floors with grating as soon as possible as part of the construction safety measure. This requires that the grating drawings are released within reasonable time after releasing of main steel drawing so as to receive fabricated grating at site in time.

Cut-outs of different shapes may be required for pipe/ support/ cable/ structural member penetration. Cutouts pose a challenge for grating by breaking load transfer. Grating has to be designed carefully to acknowledge those issues. However, the fast pace of projects sometimes leads to releasing of gratings before the penetration requirements have been well frozen, leading to the change in the cutouts even after the grating panels have been dispatched to site.

In a current project, a standard grating panels of 1500mm (maximum spanning) with a width of 995mm were used and cut-outs were planned in-line with PIP STF05530 (Detail-1 through 10). Cutouts less than 150mm were specified to be located and cut at site. Large openings were engineered for appropriate banding around cut-out up to 300mm (PIP STS05130- detail STS05130-01), and secondary supports are required to support grating having opening more than 300 mm.

IV. CUT-OUTS- CHALLENGES

Because of pipes re-routing, locations of grating cut-outs shown in released structural general arrangement drawings were required to change, and also sizes of some released grating cut-outs were increased, causing huge rework in construction site as most of the grating panels were fabricated. To minimize the changes to already fabricated grating panels, some innovative ideas have been introduced.

All the options were monitored closely by making cases and solutions have been worked out as listed below.

4.1 Extending Limits of Cut-outs

Cut-Outs to be planned on the single panel were reanalyzed by creating and analyzing a FEM model considering 5 KN/m² live load, and it was found that the opening size in grating panel could be extended up to 400mm square without any stiffener requirement when the effect of collar plate is considered. Collar plate helps in transferring the load to adjacent bearing bars, making possible to increase the cut-out size up to 400mm square.

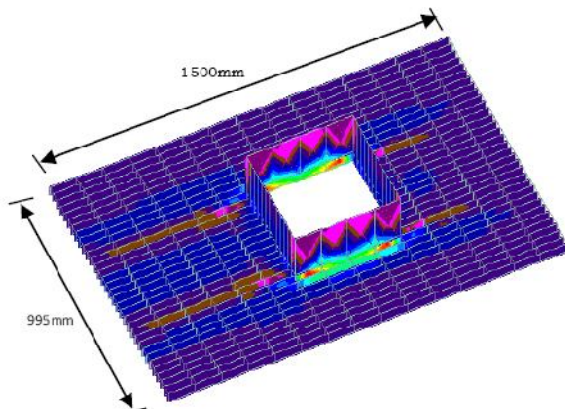
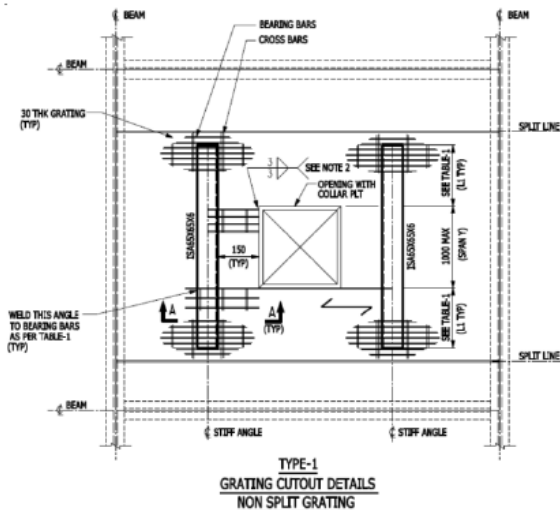


Fig.6: Stress Diagram for FEM Model of 400mm square

4.2 Proposed Solutions

1. Cutouts located within a single grating panel

Strengthening of the grating panel was proposed by welding stiffening member of ISA65x65x6 to the bearing bars from the lower side of grating. The member was planned to distribute the live load coming on the bars (cut due to the opening) to the adjacent bars. This arrangement was proposed to avoid any scaffolding requirements at site which would have been necessitated if secondary support beams were given.



TYPE-1
GRATING CUTOUT DETAILS
NON SPLIT GRATING

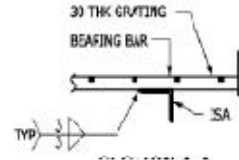


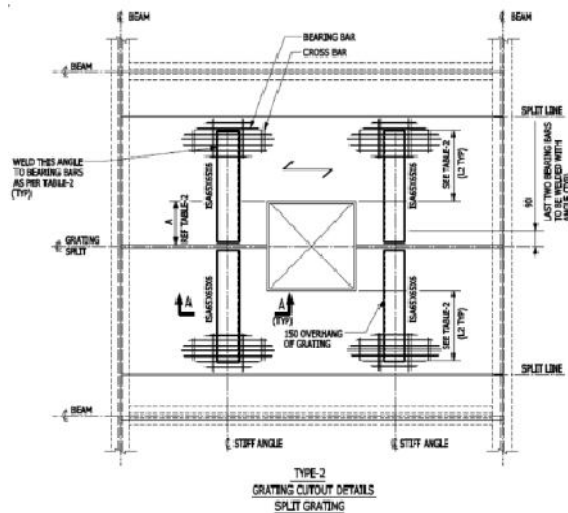
TABLE-1
(FOR TYPE-1)

SL NO	SPAN (Y)	NUMBER OF BEARING BARS TO BE WELDED	PROJECTED LENGTH OF ANGLE (L1)
1	400 TO 500	5	160
2	500 TO 600	6	190
3	600 TO 650	7	220

Fig.7: Cutouts located on single panel

2. Cutouts located on the Edge of grating panel

Similar arrangement of stiffening member was proposed for the cut-outs located at edge also, but number of bearing bars welded to the strengthening member was increased.



TYPE-2
GRATING CUTOUT DETAILS
SPLIT GRATING

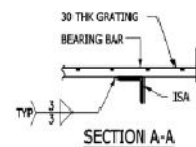


TABLE-2
(FOR TYPE-2)

SL NO	A	NUMBER OF BEARING BARS TO BE WELDED	PROJECTED LENGTH OF ANGLE (L2)
1	UPTO 150	8	300
2	150 TO 225	12	410
3	225 TO 300	16	525

Fig.8: Cutouts located on edge of panel

4.3 Closing of Grating Cut-outs

Due to the relocation of the pipes, few grating cut-outs which were already provided were remain unused and were required to be closed for safety

reasons. The covers were painted with safety sign on the top.

1. The oversized cut-out cover of 6mm plate was welded on the top of collar plate as shown in figure-10 for holes coming on single panel.

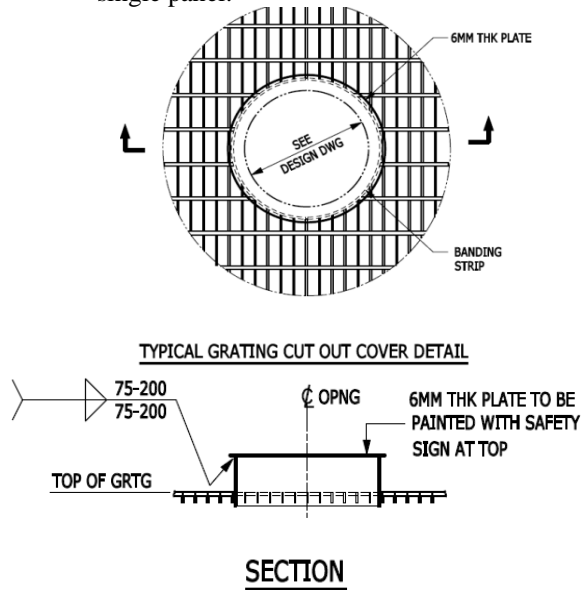


Fig.9: Details for closing of existing cutout

2. The cut-out cover plate of 6mm plated was welded only on the collar plate of the largest panel and simply resting on the remaining 3 panels to ensure the flexibility of changing any panel in case required.

CONCLUSION

The philosophy of strengthening of grating panel near the cut-outs by welding stiffening members has reduced the construction work. Thereby,

- Avoid the requirement for the fixing/ removing of scaffolding in the running plant.
- Saved the quantity of secondary members up to 30%.
- Avoid end to end members.
- Stiffening members are easy to weld by taking out the small panels.

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