EFRC Training Workshop

Foundation design for reciprocating compressors

Compressor skid design

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What is a Skid or Package?

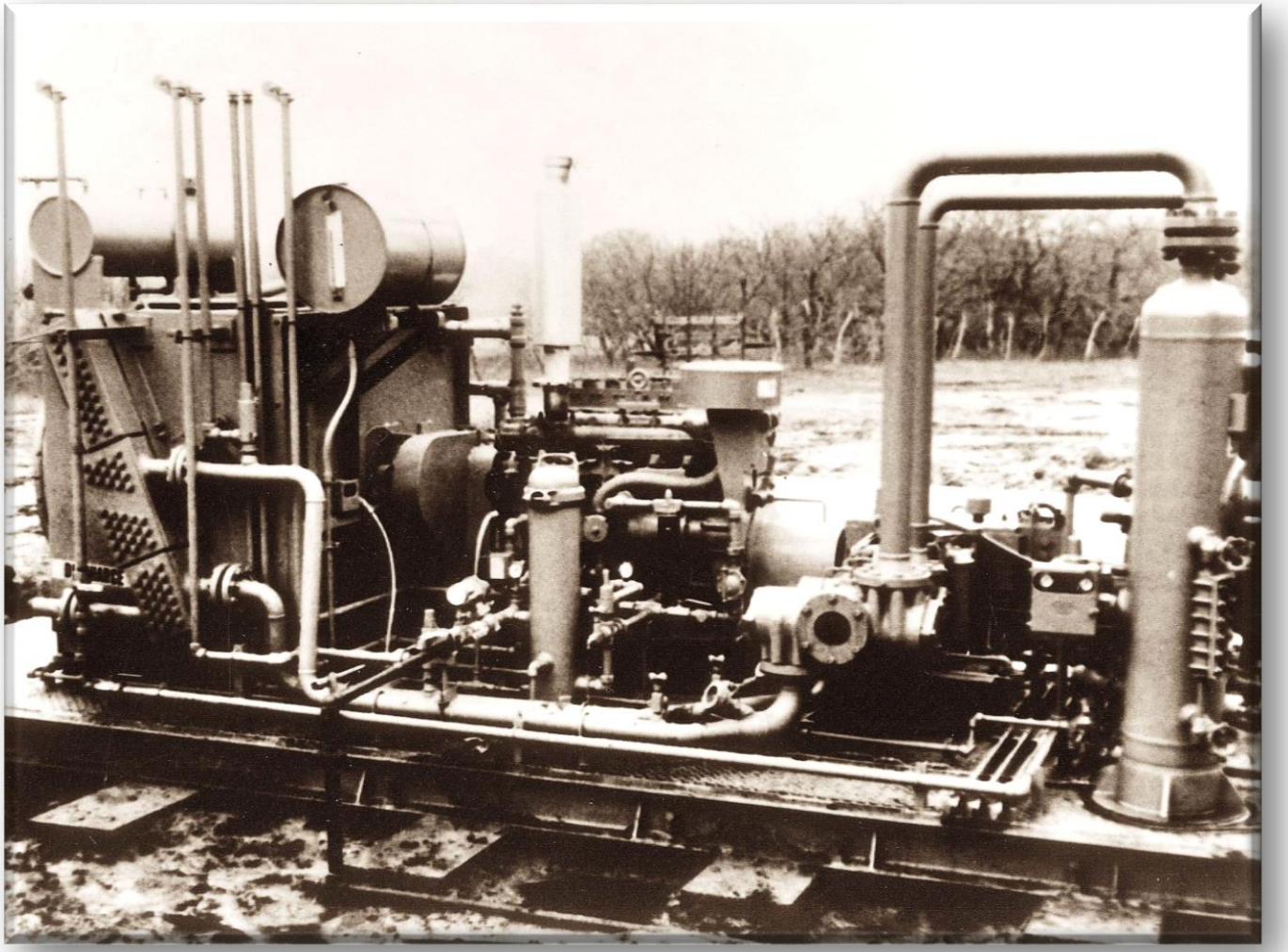
Skid *(noun) - A low mobile platform on which various items are placed for ease of handling, moving…etc.*

Package *(noun) – A finished product contained in a unit that is suitable for immediate installation and operation. (verb) – combining various products for sale as one unit*

Introduction

Reciprocating gas compressor packages/skids have been in production for over 50 years.

Though compressor packages in the beginning were basic in design and application, they fulfilled the need at that time effectively.



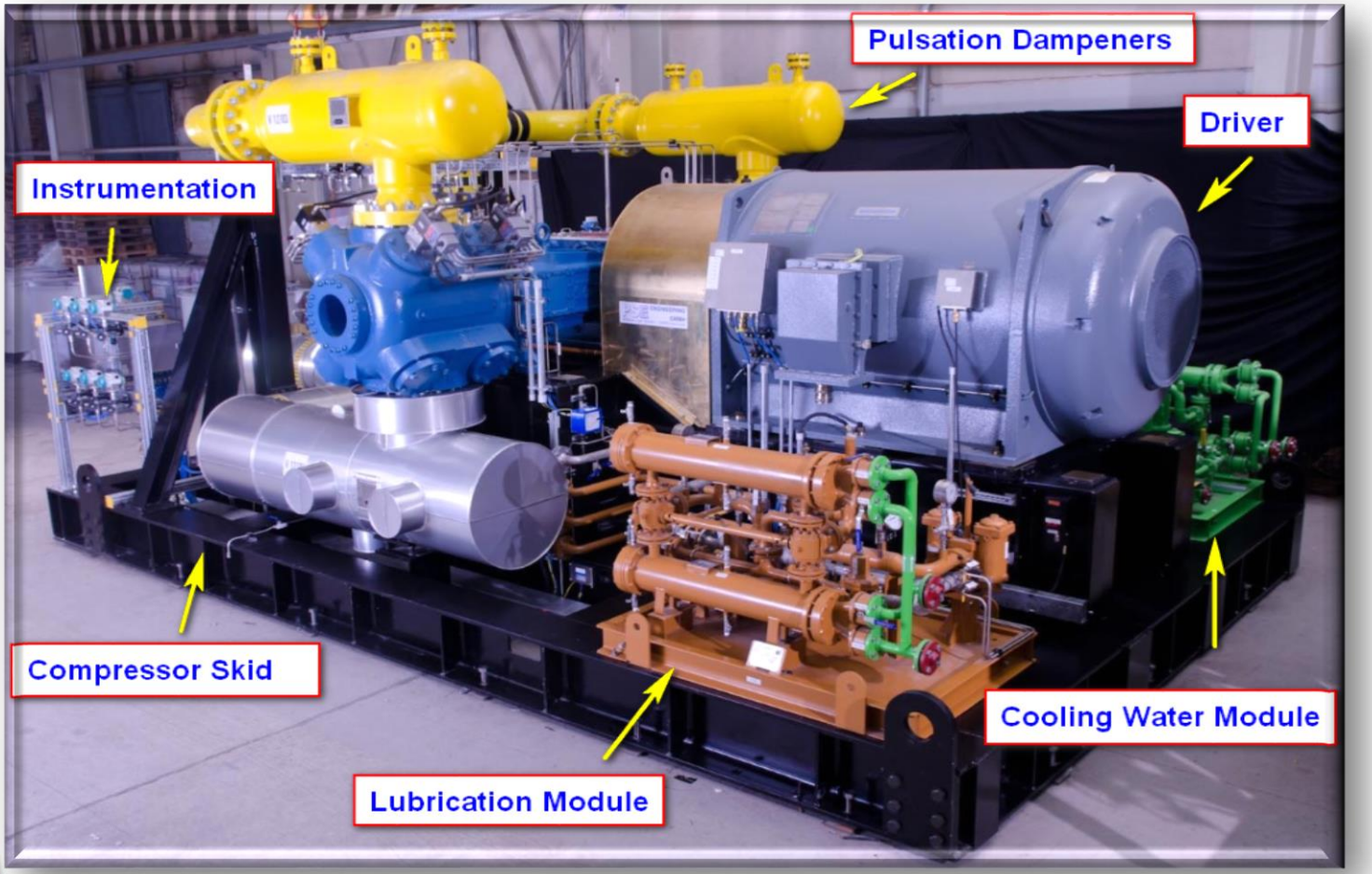
As the demand for reciprocating compressor packages increased, so did the research and development, to meet the needs of the clients and varying applications.

We've Come a Long Way

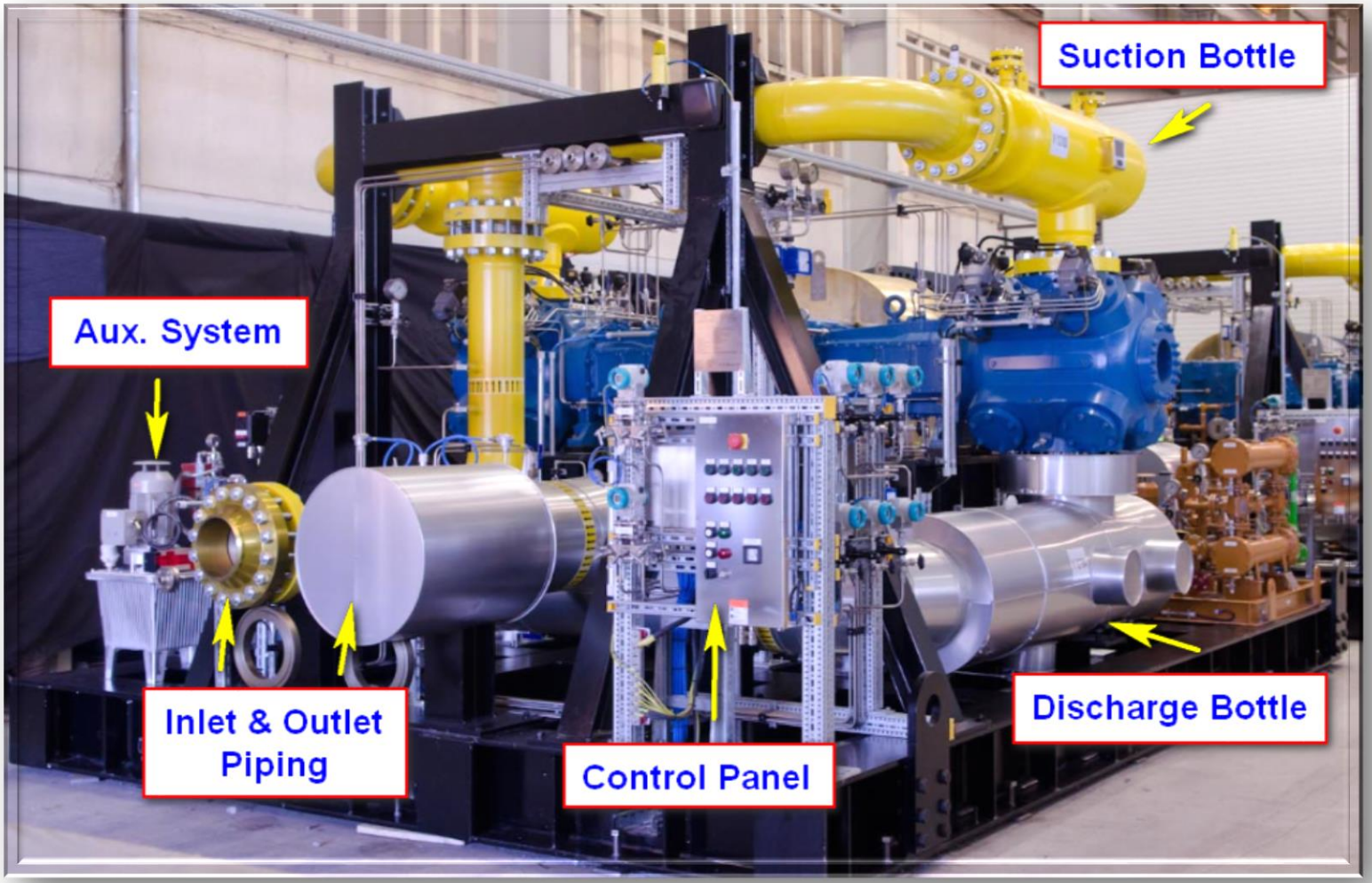
Through constant research and development, gas package technology has made many advances, but there is always room for improvement.

Components of a Package

With proper planning, engineering procedures and construction practices, there is no limit to the component that can be installed on a skid.

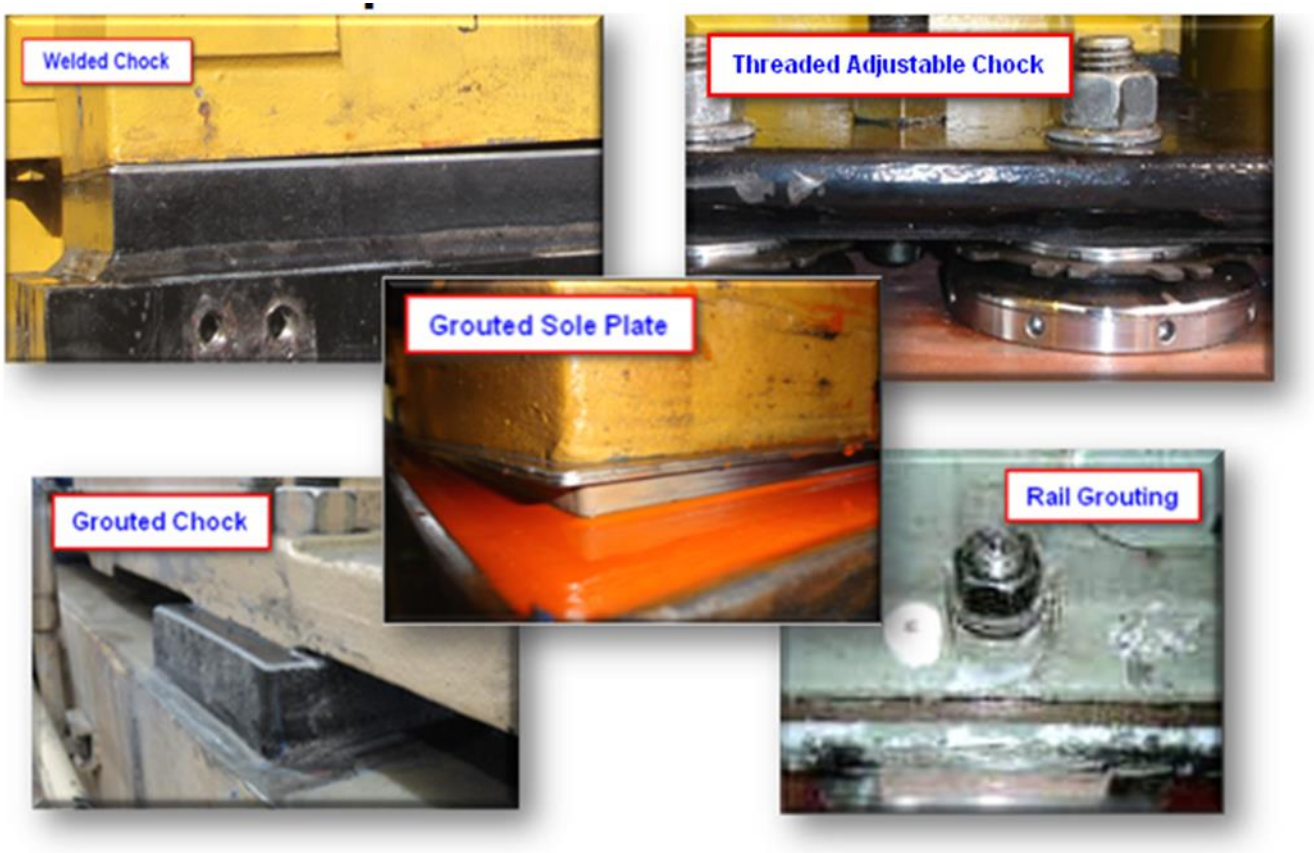


With the installation of multiple components on a skid, you develop into a "*plug & play*" attitude.

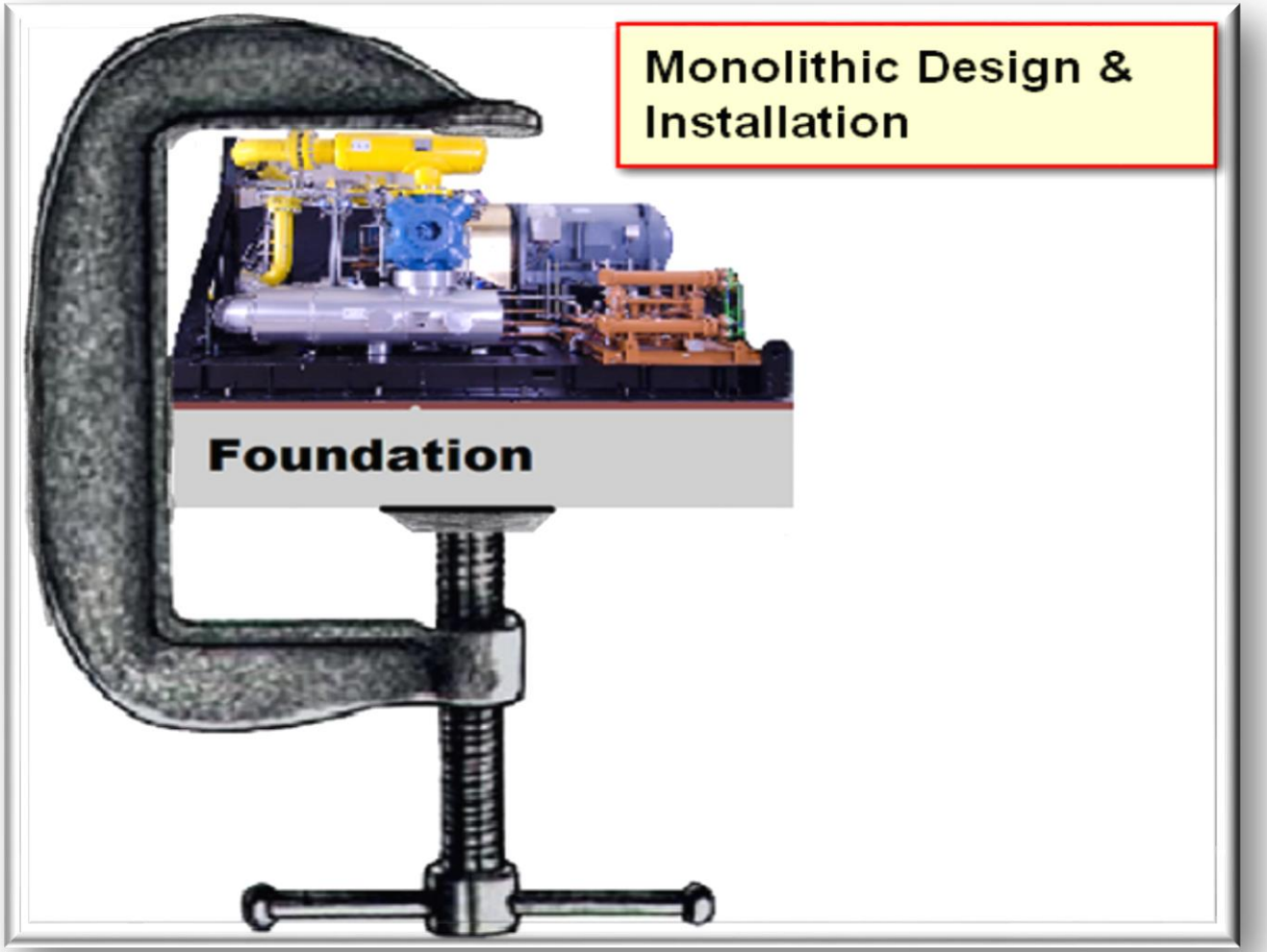


Mounting Techniques

Each type of mount has certain challenges, design specifications and cost, the best mount is one that meets the requirements of all three.



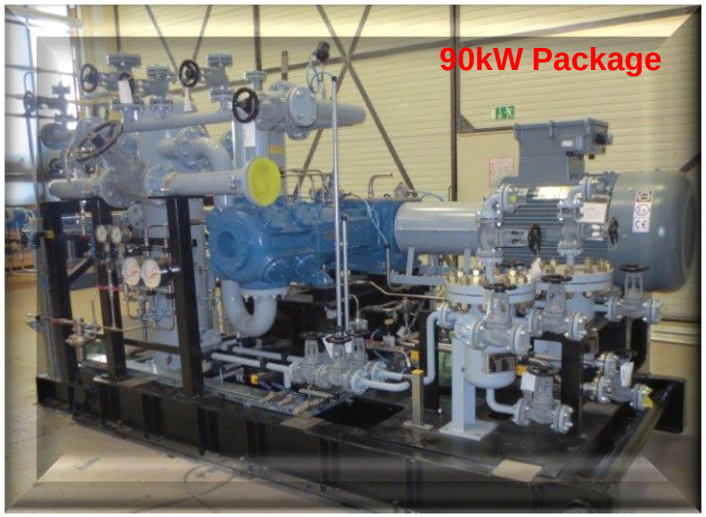
With proper engineering, construction and installation procedures, you can achieve a monolithic attitude.



With reciprocating compressors ranging in sizes up to 10,000 hp. (7457 kw) you have unlimited possibilities for skid designed applications.

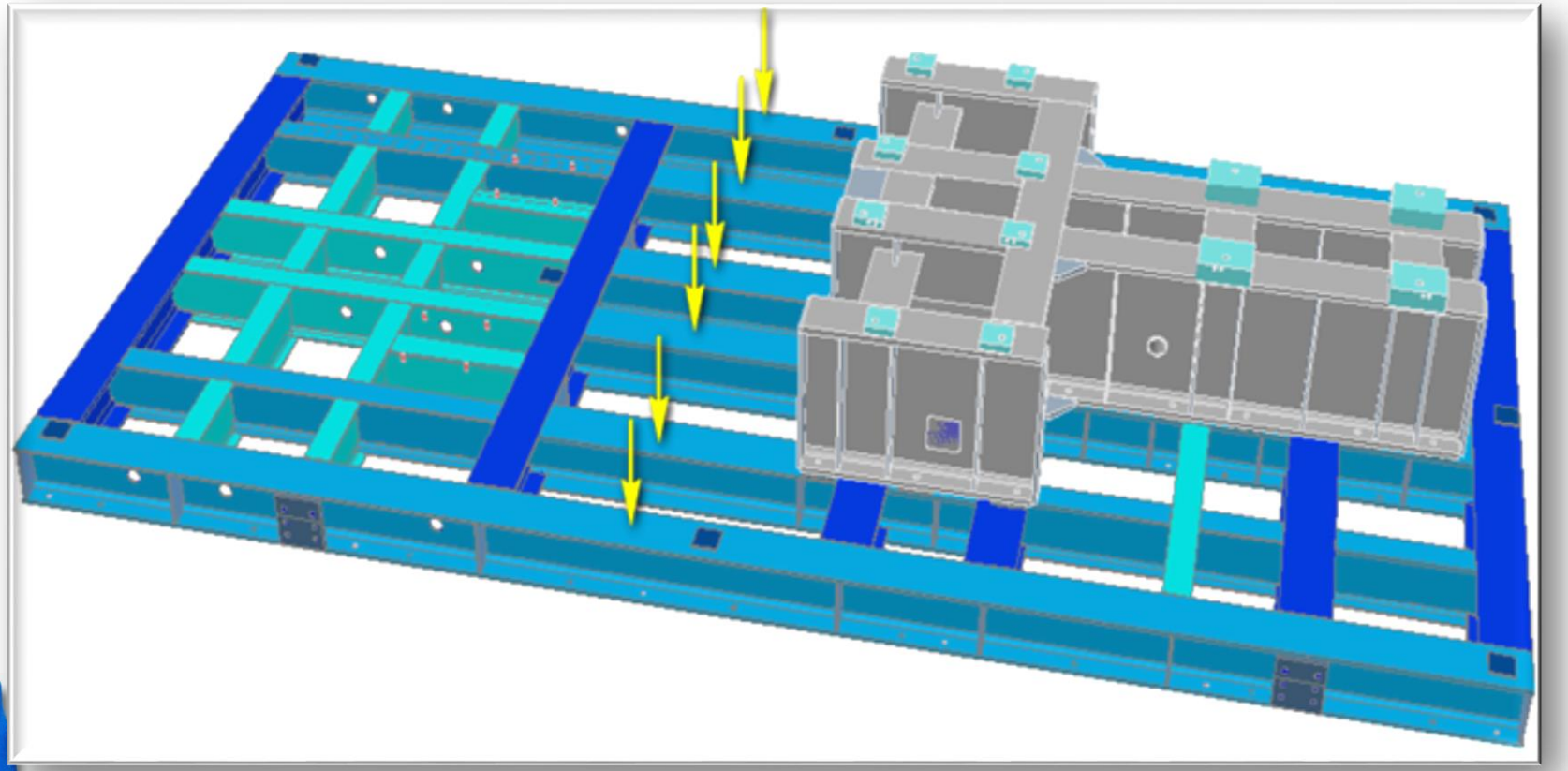
Number of throws	4	6
Rated power, BHP	6667	10000
Rated power, kW	4972	7457

Number of throws	2	4
Rated Power, BHP	252	504
Rated Power, kW	188	376



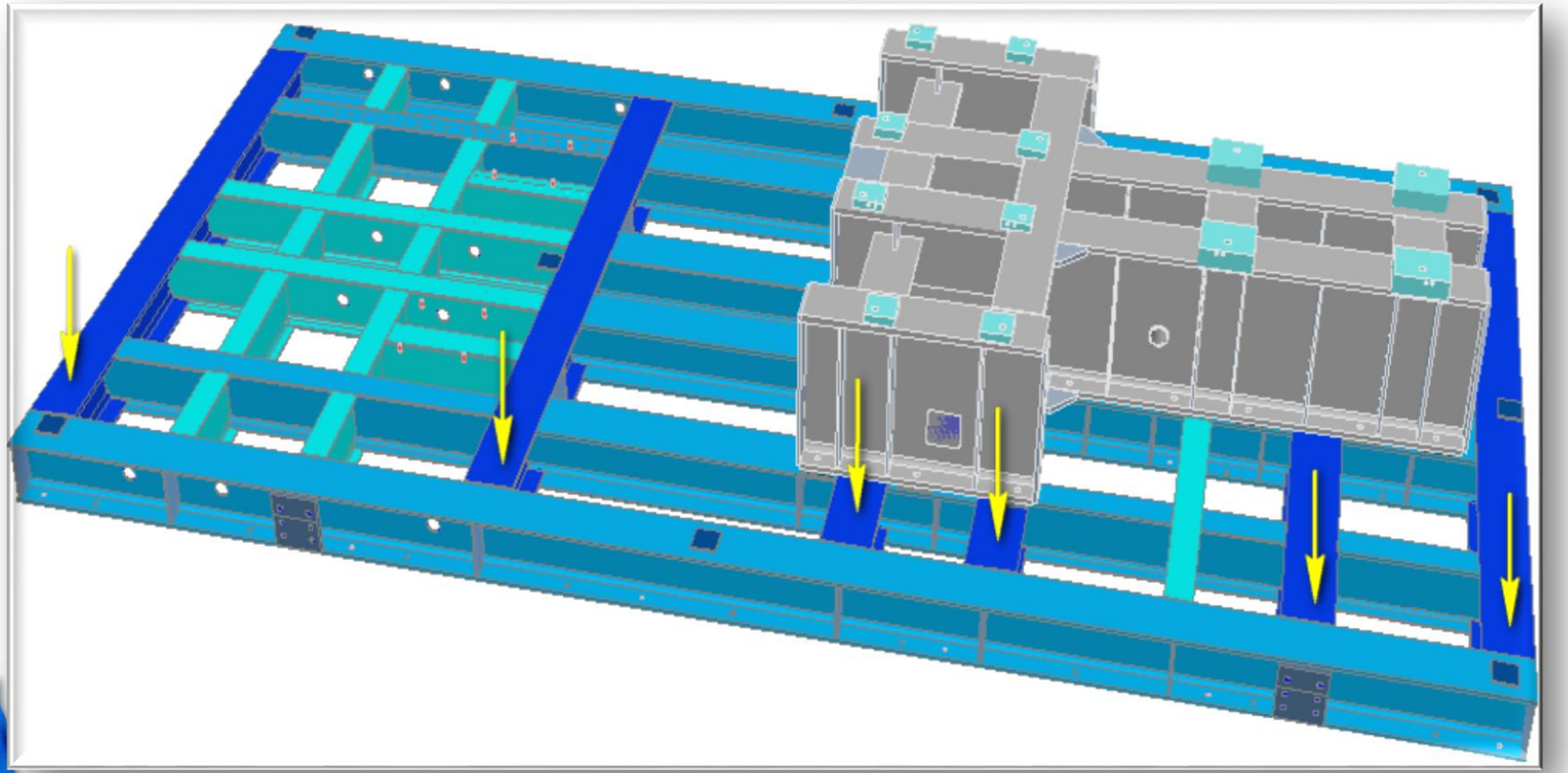
Primary Skid Beams

The primary skid beams support the pedestal and auxiliary systems and also provide the anchoring points to the foundation, which act as a pathway for energy to be dissipated.



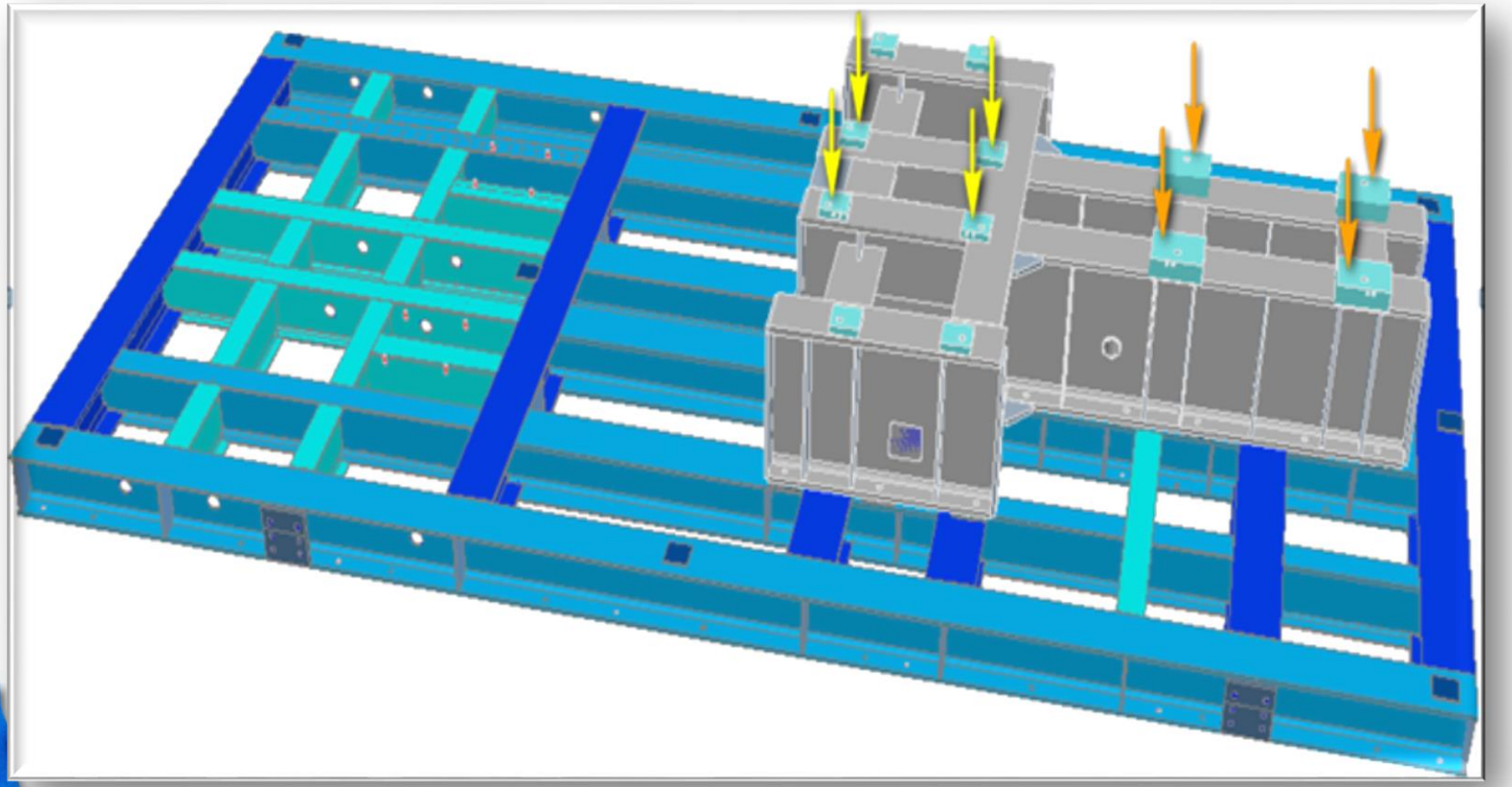
Auxiliary Skid Beams

The auxiliary skid beams provide stiffening to the primary beams and provide additional support to the skid and components and also are location of additional anchor and jack bolts.



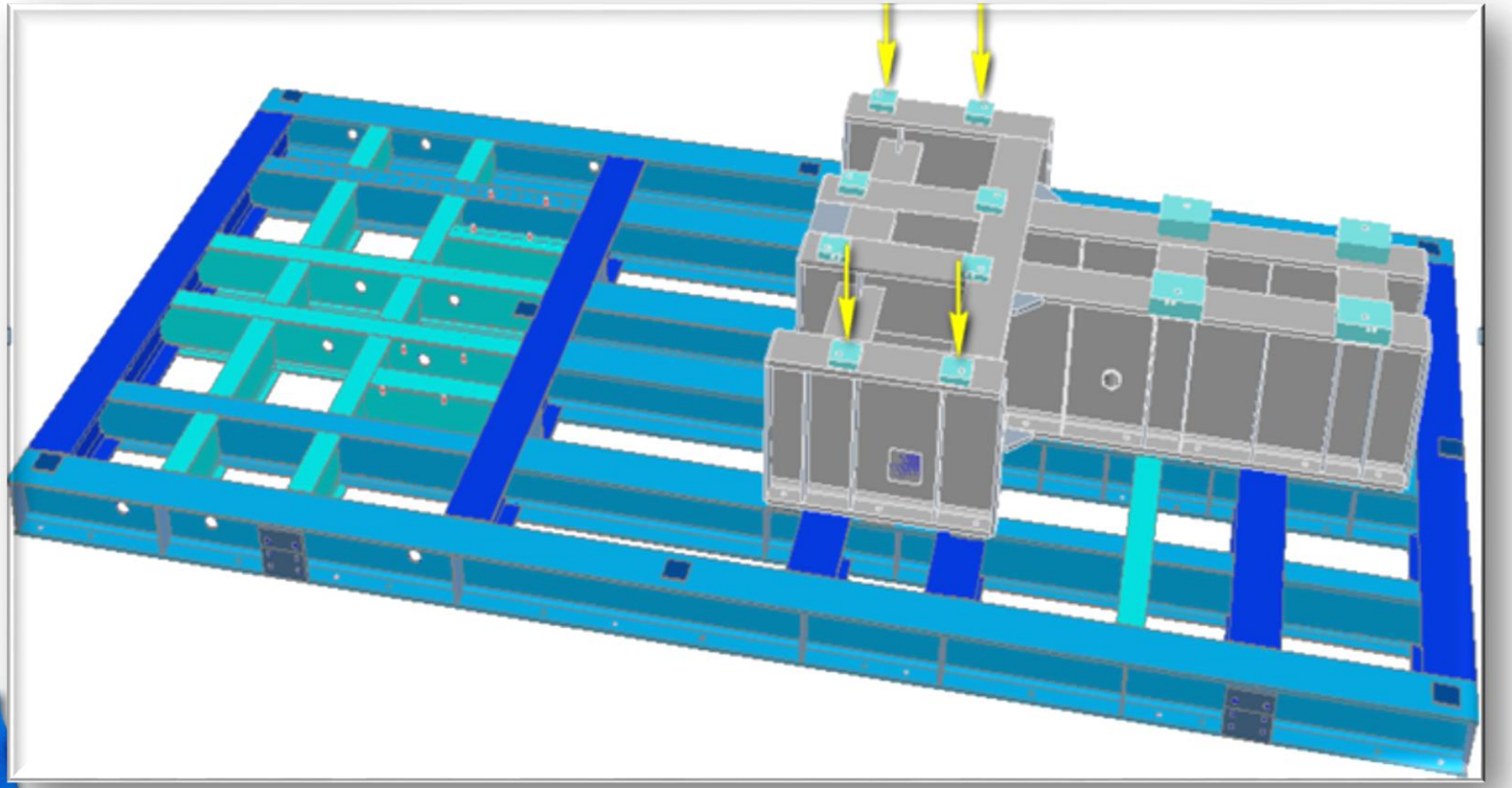
Driver & Compressor Mounting

They provide a precision mounting point for the installation of the compressor and the driver to the pedestal.



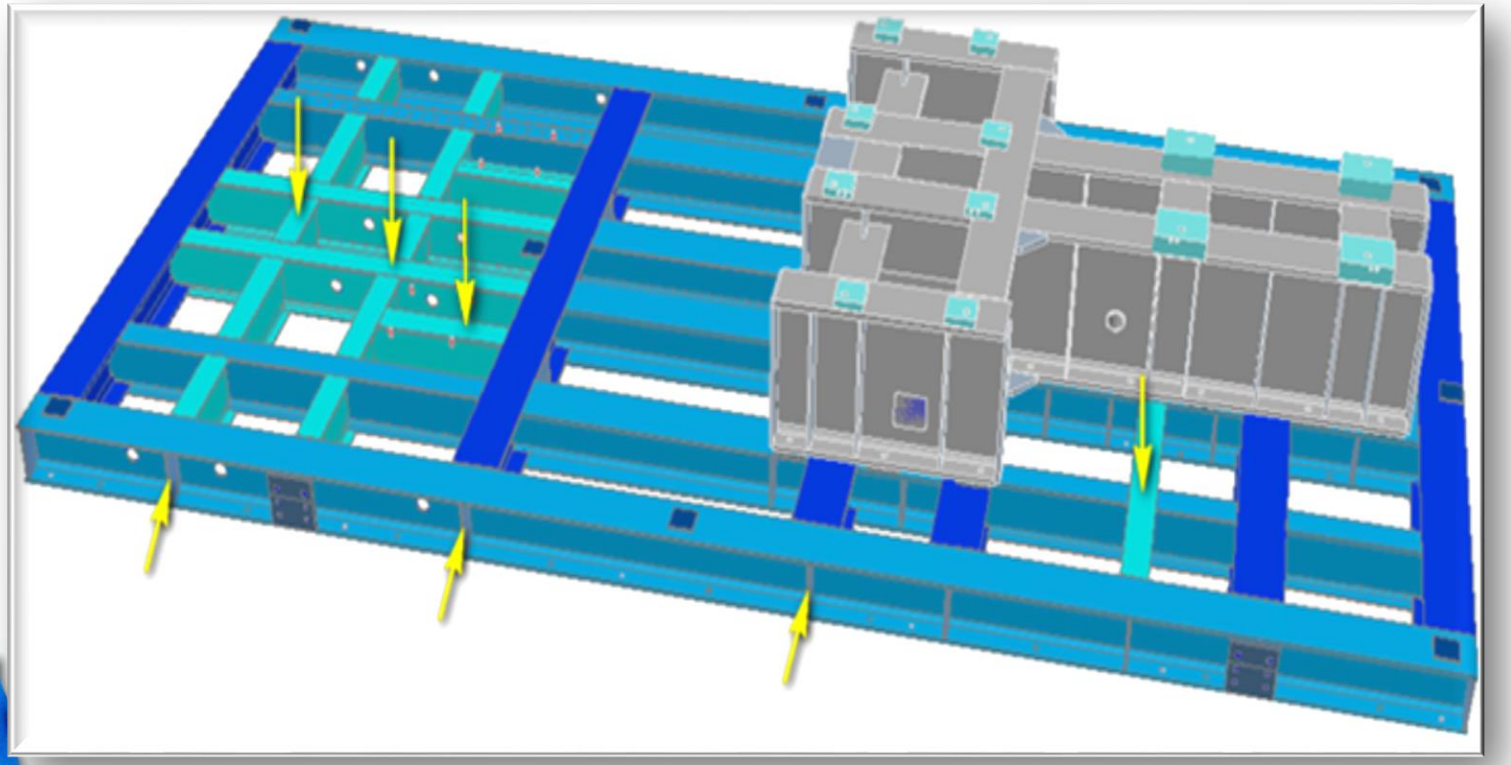
Cross Head Support

Should provide vertical support to the cross head guide, and also prevent horizontal movement.



Auxiliary Systems & Gussets

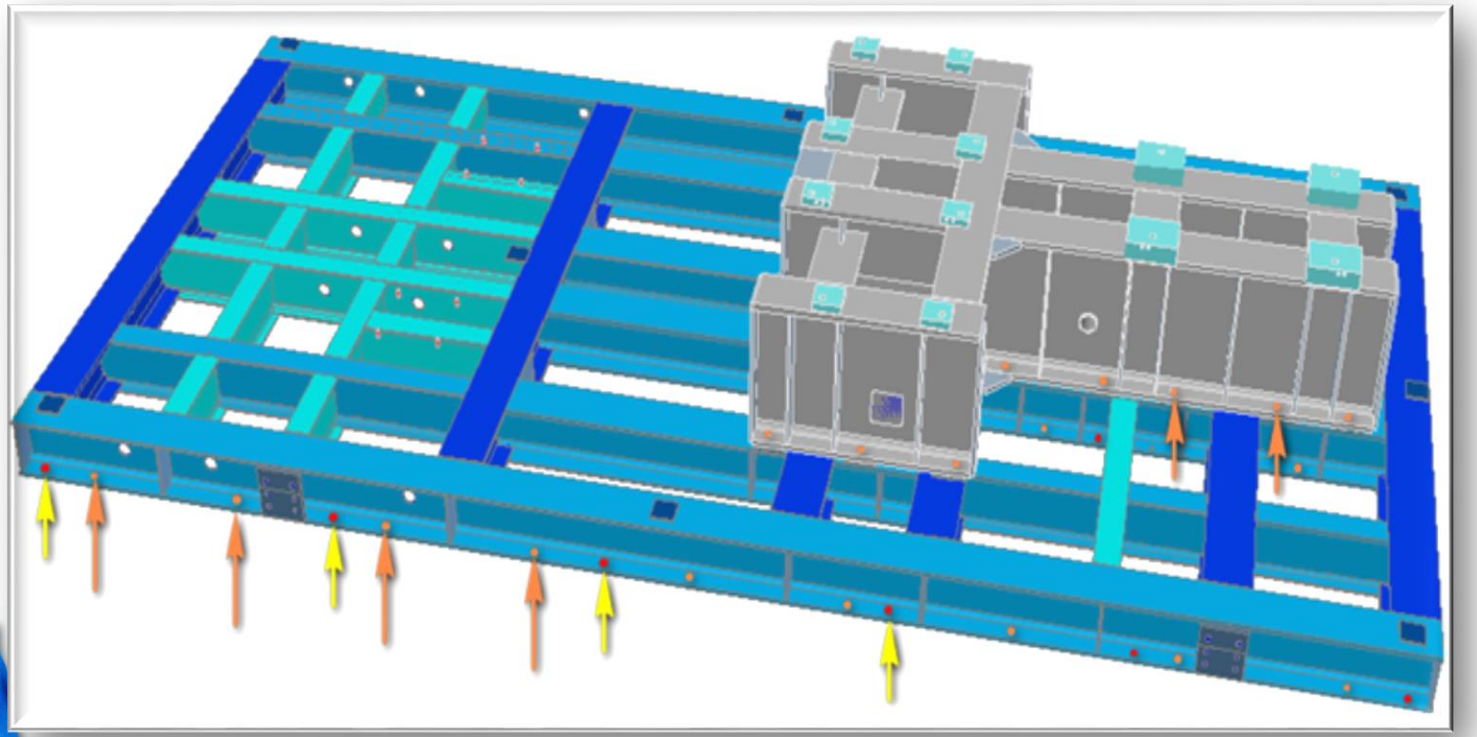
The mounting areas for the auxiliary systems should be designed to withstand the forces introduced by that system or component. The gussets and other stiffening plates are used to increase the shear capacity of the beam, and to prevent the beam from twisting or rolling.



Anchor Bolts & Jack Bolts Locations

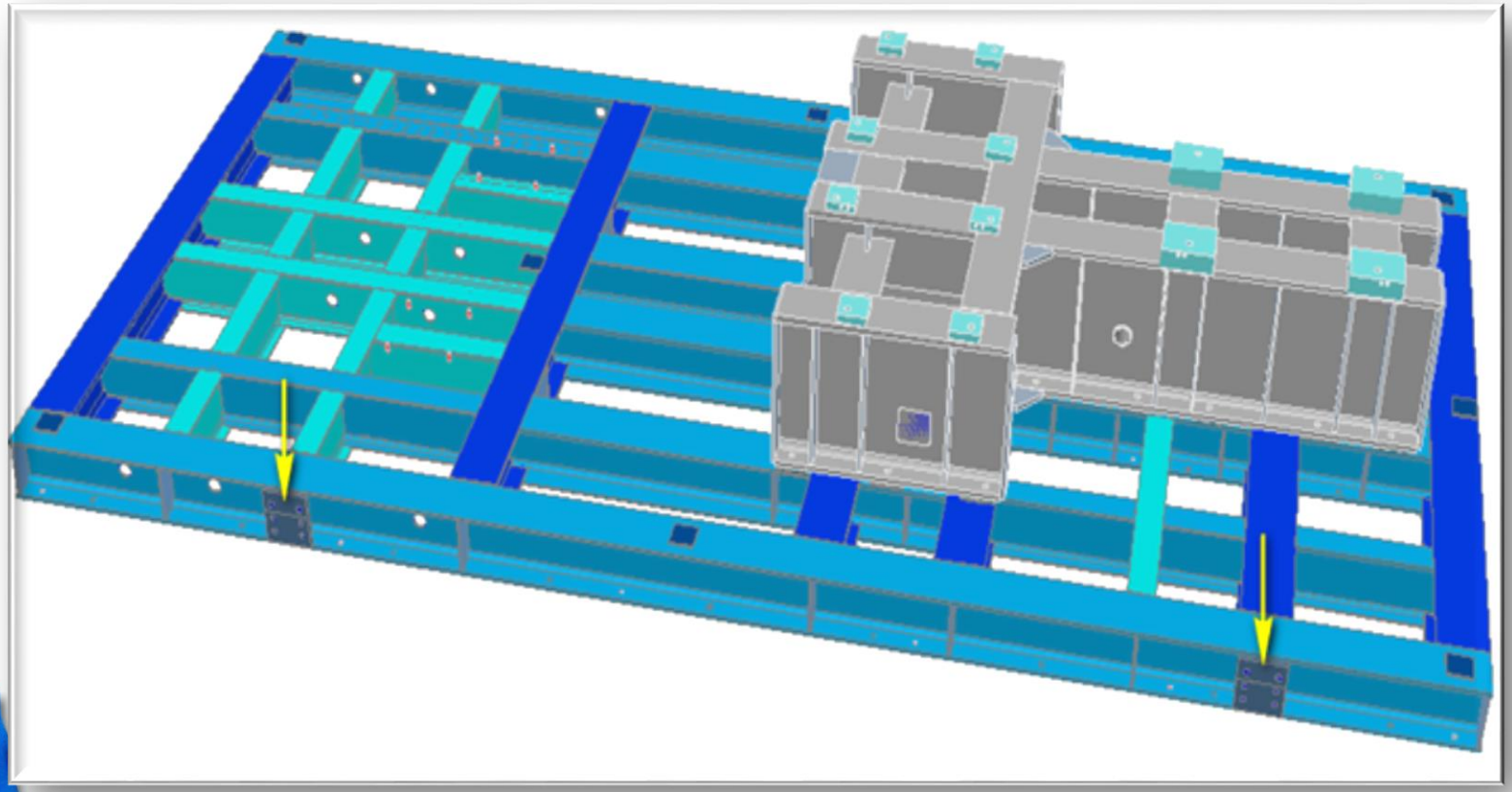
The location of the anchor bolts (orange arrows) are critical, since they provide the primarily means of connection to the foundation.

Jack bolts (yellow arrows) are used for the leveling and support of the skid until the skid is grouted. Jack bolts should be located on either side of anchor bolts and in locations of heavy loads.



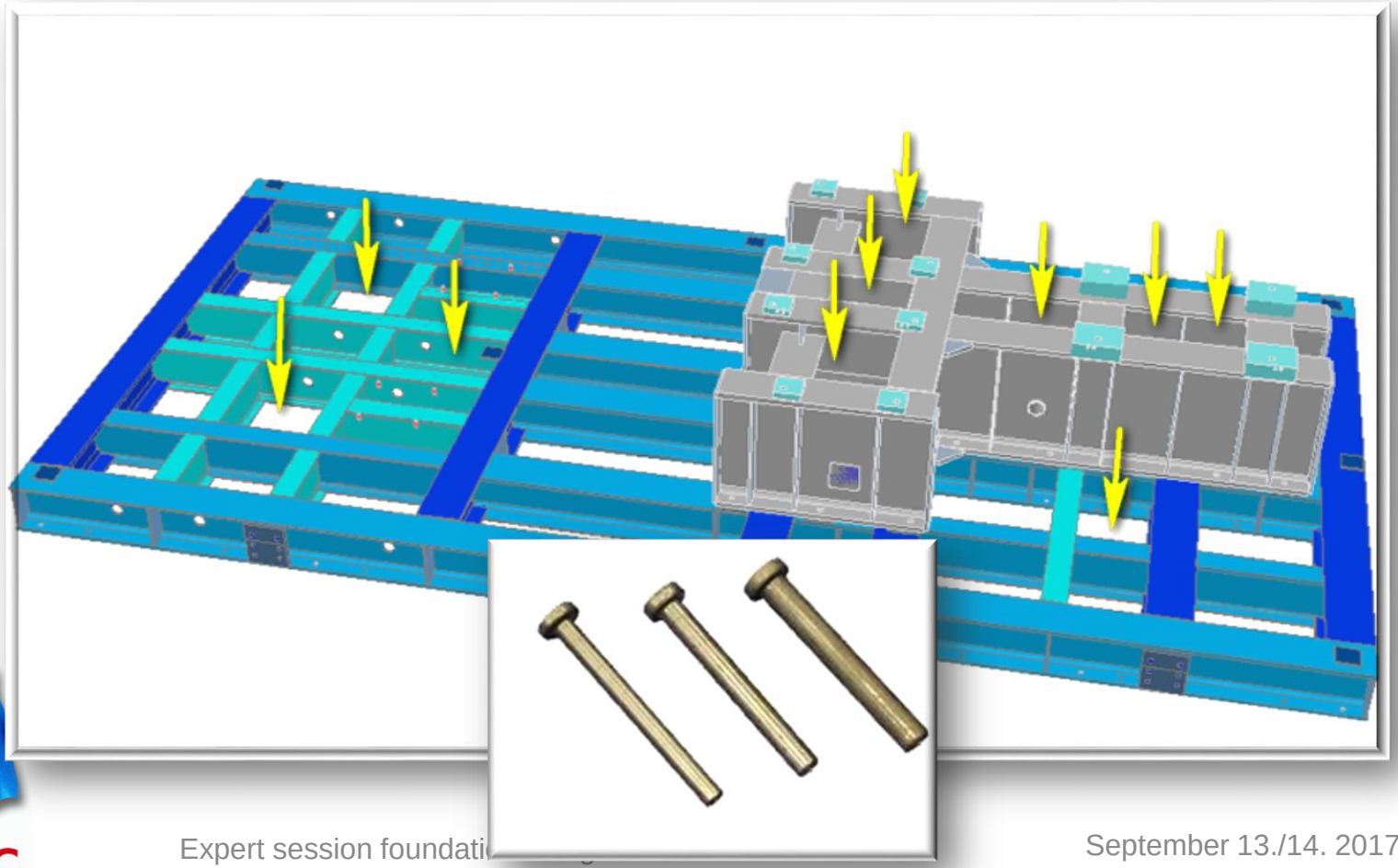
Lifting Points/Lugs

The location of the lifting lugs, with consideration to the center of gravity, is critical to the portability of the completed compressor package.



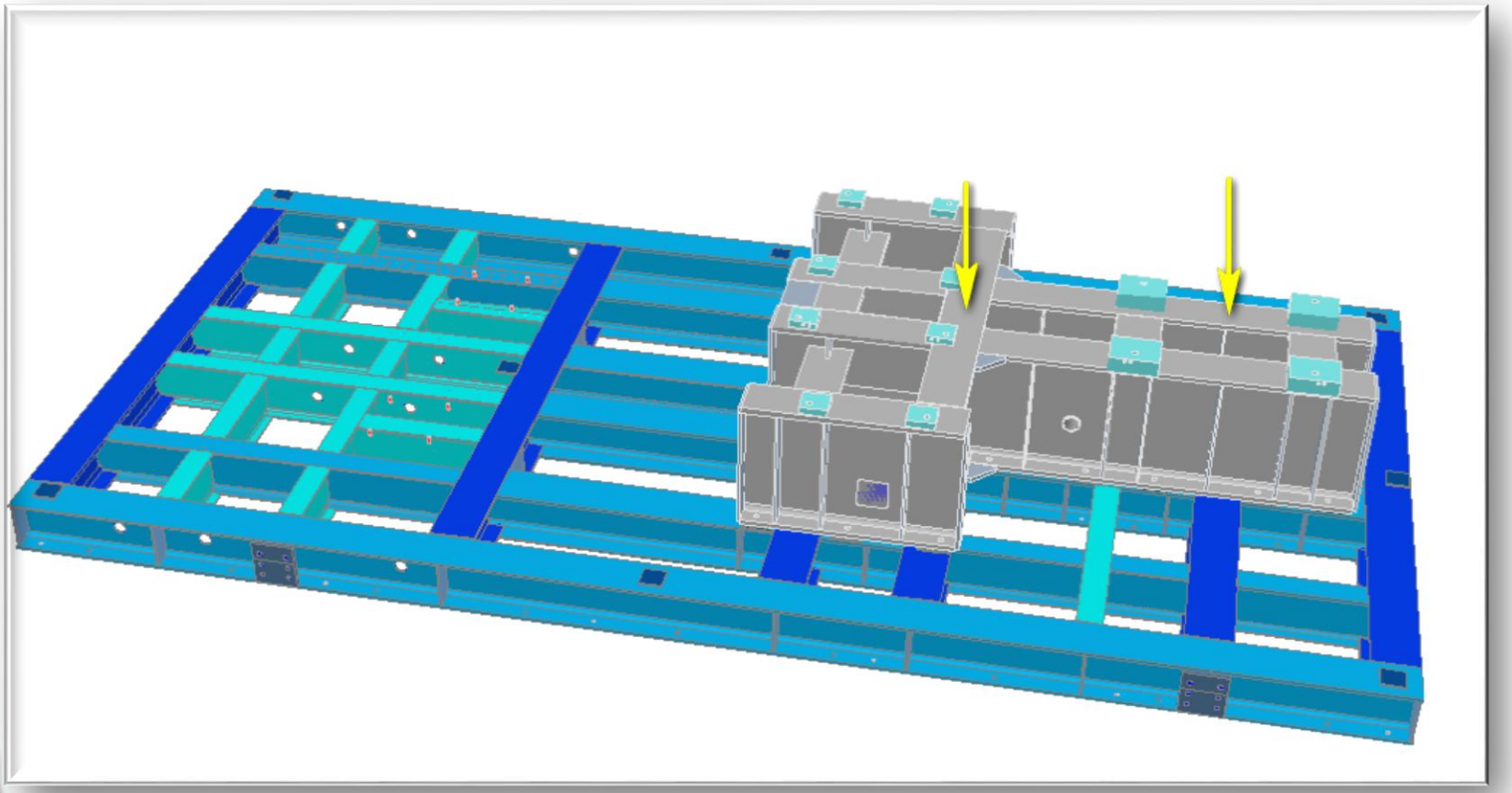
Concrete Fill Locations & Nelson Studs

By filling specific locations of the skid with concrete it will provide additional dampening and added stiffness to the frame. Nelson studs or equivalent should be use to help promote a bond between the beams and the concrete.



Compressor & Driver Pedestal

Provide precision mounting points for the reciprocating compressor and driver and should also provide adequate support.

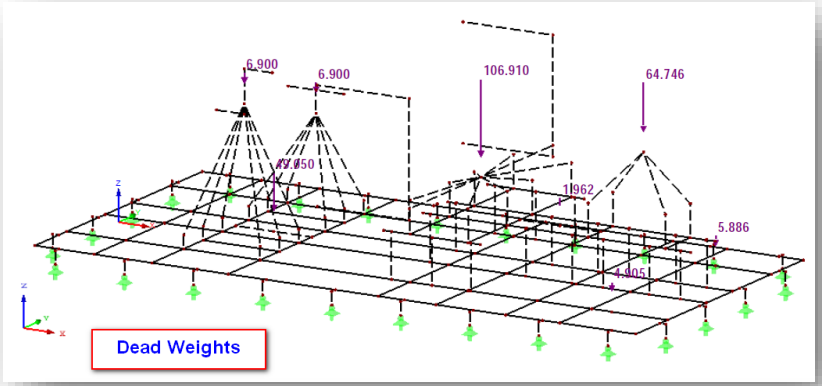


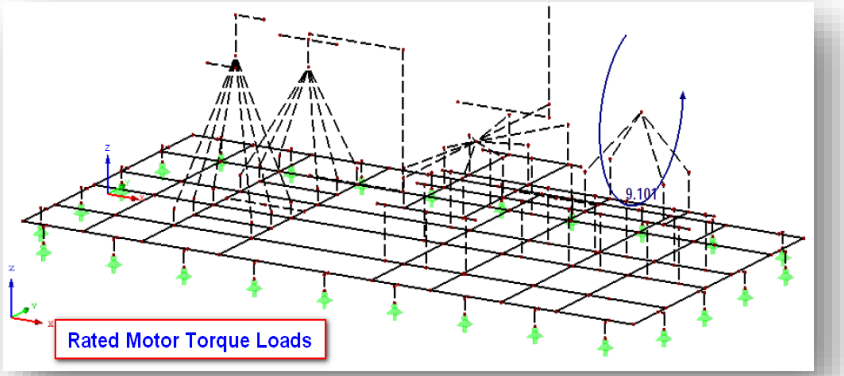
Anchor Bolt/Foundation Stress Study

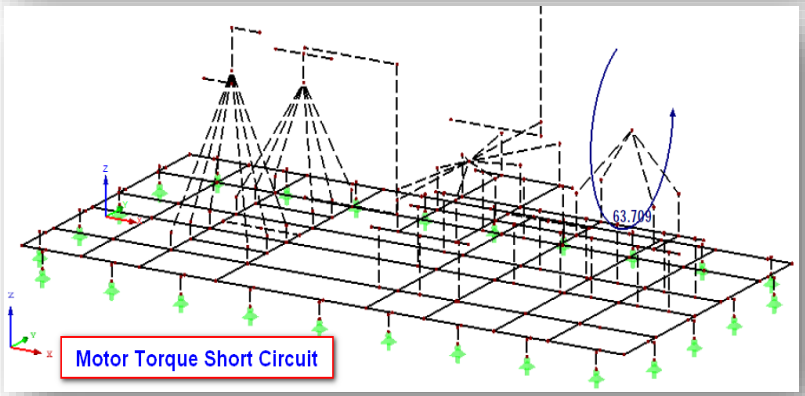
By completing stress studies of the skid design you are able to see the functionality of your skid, through varying loads and stresses.

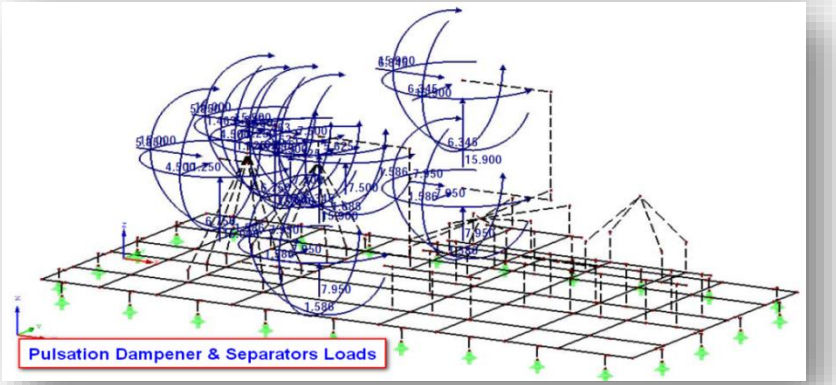
Some of the common variables used during these stress studies are…

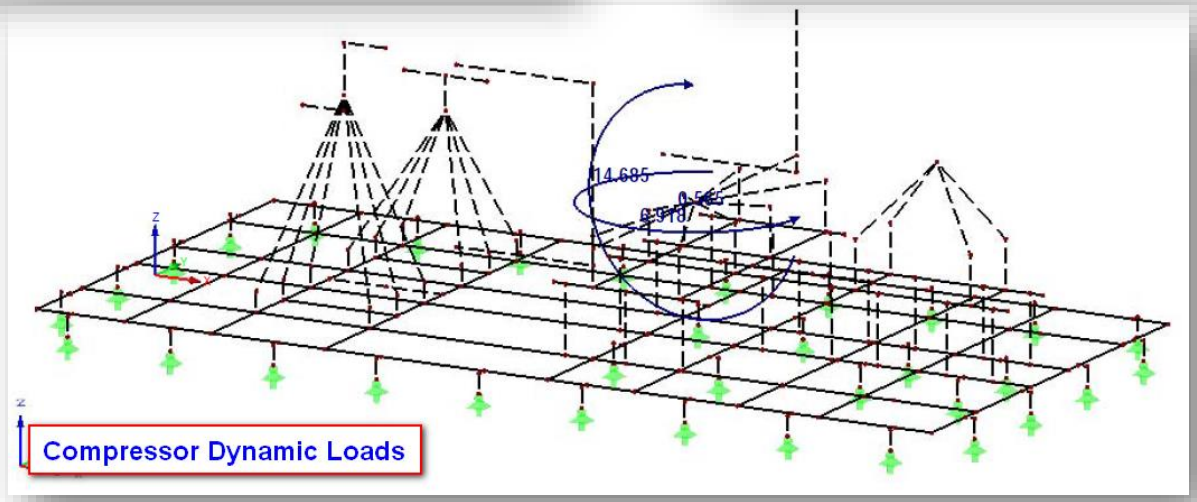
- **Dead Weights of Components**
- **Rated Motor Torque Loads**
- **Motor Torque Loads (short circuit & phase opposition).**
- **Piping Loads (dynamic)**
- **Compressor Loads**

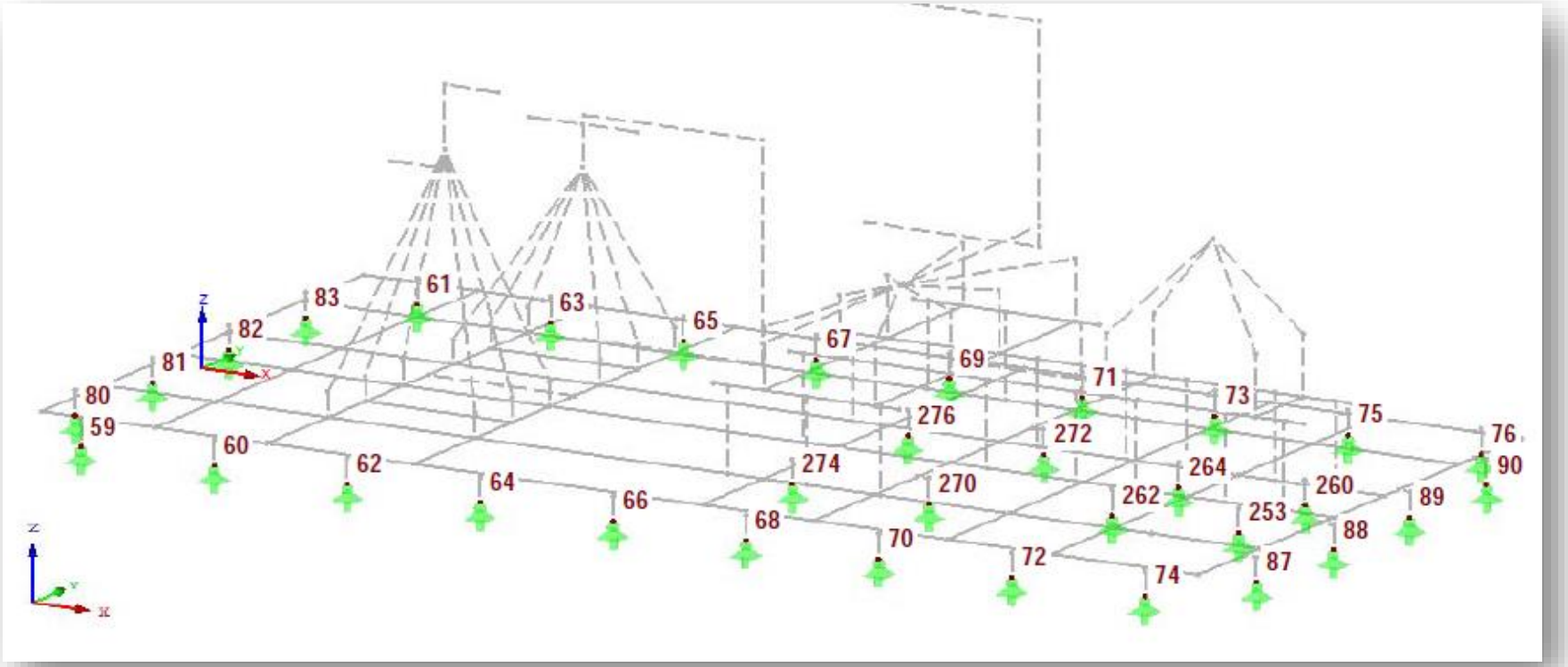

6.900
6.900
106.910
64.746
1.962
5.886
Dead Weights


9.101
Rated Motor Torque Loads


63.709
Motor Torque Short Circuit


15.900
Pulsation Dampener & Separators Loads


14.685
Compressor Dynamic Loads

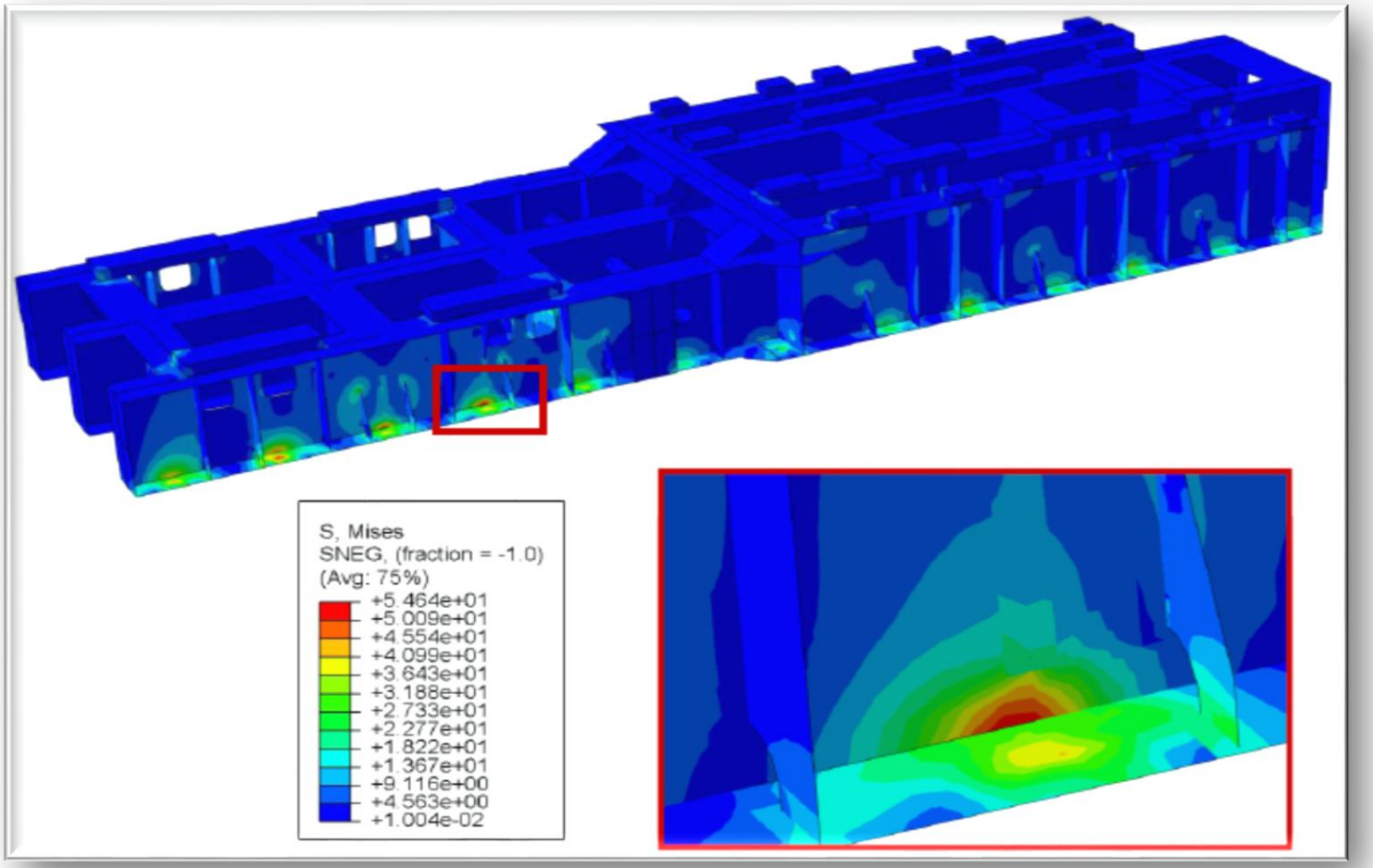


Nr.		$P_{X'}$	$P_{Y'}$	$P_{Z'}$
59	Max $P_{X'}$	**7,32**	**0,04**	**-1,08**
	Min $P_{X'}$	**-4,24**	**-5,76**	**-8,42**
60	Max $P_{X'}$	**15,89**	**9,14**	**14,01**
	Min $P_{X'}$	**-14,45**	**-25,96**	**-42,76**
61	Max $P_{X'}$	**7,21**	**5,45**	**-1,91**
	Min $P_{X'}$	**-3,99**	**0,26**	**-7,71**
62	Max $P_{X'}$	**16,77**	**5,98**	**10,00**

260	Max $P_{X'}$	**38,38**	**38,67**	**48,32**
	Min $P_{X'}$	**-44,98**	**-21,73**	**-80,33**
262	Max $P_{X'}$	**86,60**	**-17,79**	**-24,48**
	Min $P_{X'}$	**-53,52**	**-50,71**	**-104,18**
264	Max $P_{X'}$	**88,23**	**51,05**	**-23,28**
	Min $P_{X'}$	**-55,23**	**17,45**	**-105,48**
270	Max $P_{X'}$	**58,05**	**29,46**	**9,32**
	Min $P_{X'}$	**-5,12**	**-18,60**	**-127,31**

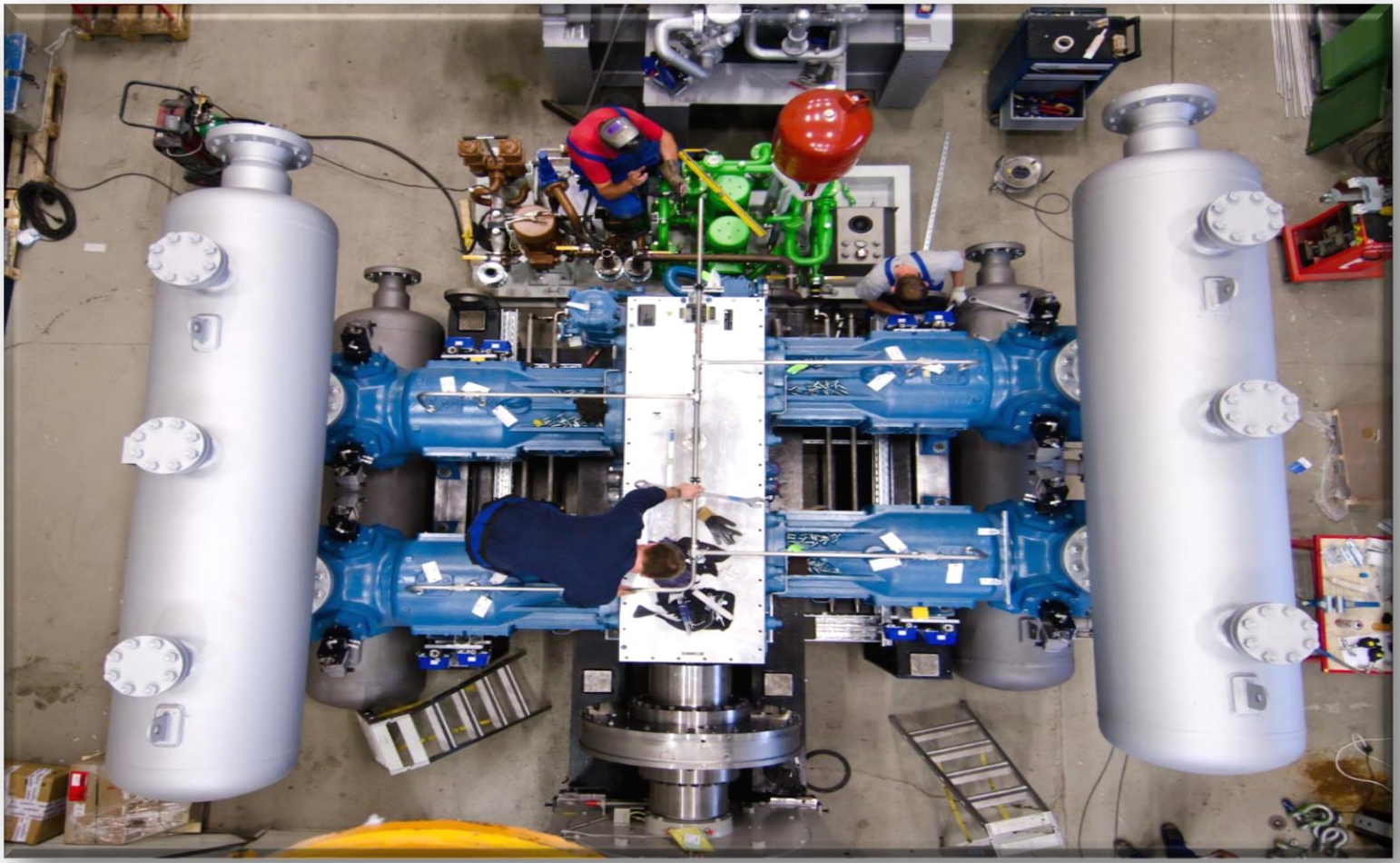
FEM Study

Is a study using variational methods to minimize an error function and produce a stable solution.



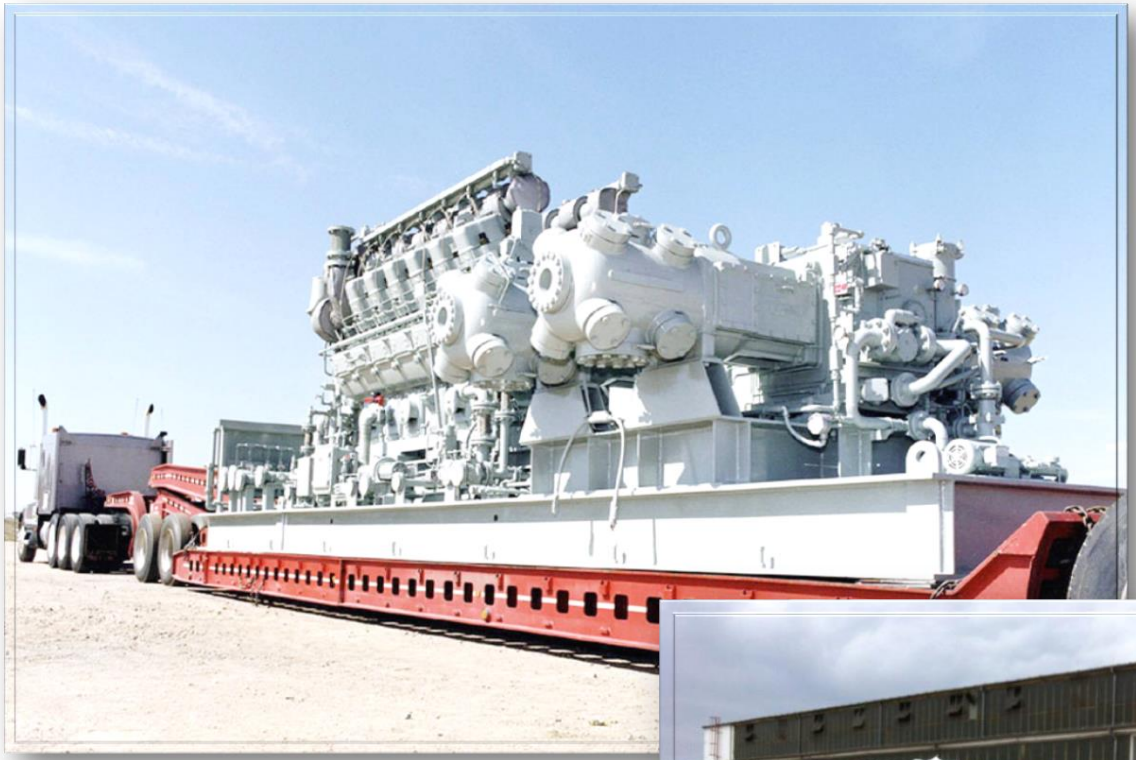
Benefits of Skid Mounted Reciprocating Compressor Packages

Higher Quality and Reliability Ensured, & Single Source Accountability



Complete Package on Delivery

Portability and Ease of Transportation



Skid Mounted Compressor are Versatile

Review

The development of reciprocating gas compressors have been an evolution over the last 50 years.

With proper planning, engineering practices and construction procedures, multiple components can be installed on the skid effectively, to create a “plug & play” package.

Reciprocating compressors come in a variety of sizes to meet the needs of most clients.

Detailed planning and engineering is essential in designing a skid that will meet and address all of the forces introduced by the compressor package.

Advantages of skid mounted reciprocating compressor are, higher quality and reliability, single source accountability, complete package on delivery, ease of transportation and portability and extremely versatile.