

Interfaces and Connectivity in Diana

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1 Introduction

An interface is a type of connection in DIANAIE, used to define the interaction between boundaries of two or more shapes present in the model. This tutorial presents the definition of an interface in DIANAIE and subsequent checks to ensure desired connectivity using a fictitious wall-slab model. Since the focus of this tutorial is interface connections, only the steps pertaining to defining and checking interfaces are presented in detail. The other steps related to creating the geometry and assigning properties are not presented. For detailed information on Interfaces and connections please see the *DIANA Documentation*.

2 Model

The model presented in Figure 1 consists of three shapes - two horizontal slabs and one vertical wall. We shall seek to define a connectivity, such that the slab is continuous and there is an interface between the slab and the wall. Each shape has one clashing edge, which contributes to the connectivity between the shapes. Depending on the definition of interaction between these clashing edges, DIANAIE interprets the connectivity for mesh generation. In order to enable the generation of the mesh we need to assign properties to the shapes. In this case we use regular curved shell elements and linear elastic concrete properties.

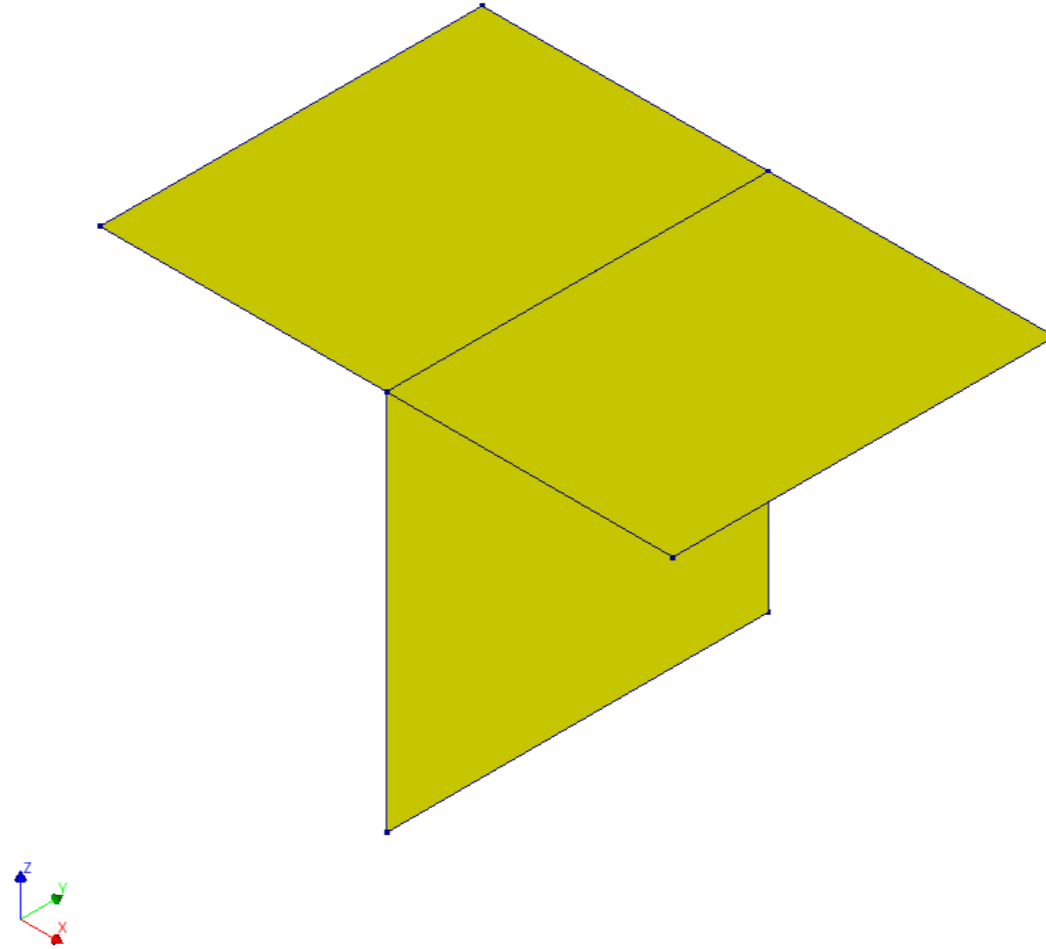


Figure 1: Geometry of the model

The coordinates of the shapes are listed in Table 1.

```
slab1coords = [[ 0, 0, 0 ],[ 0.75, 0, 0 ],[ 0.75, 1, 0 ],[ 0, 1, 0 ]]
```


Table 1: Coordinates of shapes

	<i>X</i>	<i>Y</i>	<i>Z</i>
Slab 1			
	0	0	0
	0.75	0	0
	0.75	1	0
	0	1	0
Slab 2			
	0.75	0	0
	1.5	0	0
	1.5	1	0
	0.75	1	0
Wall			
	0.75	0	-1
	0.75	1	-1
	0.75	1	0
	0.75	0	0

2.1 Interface Connection

For a better visualization and easiness of selection of edges we use virtual transformation of shapes as seen in Figure 2.

DIANAIE

Main menu → Geometry → Modify → Virtual transformation  [Fig. 2]

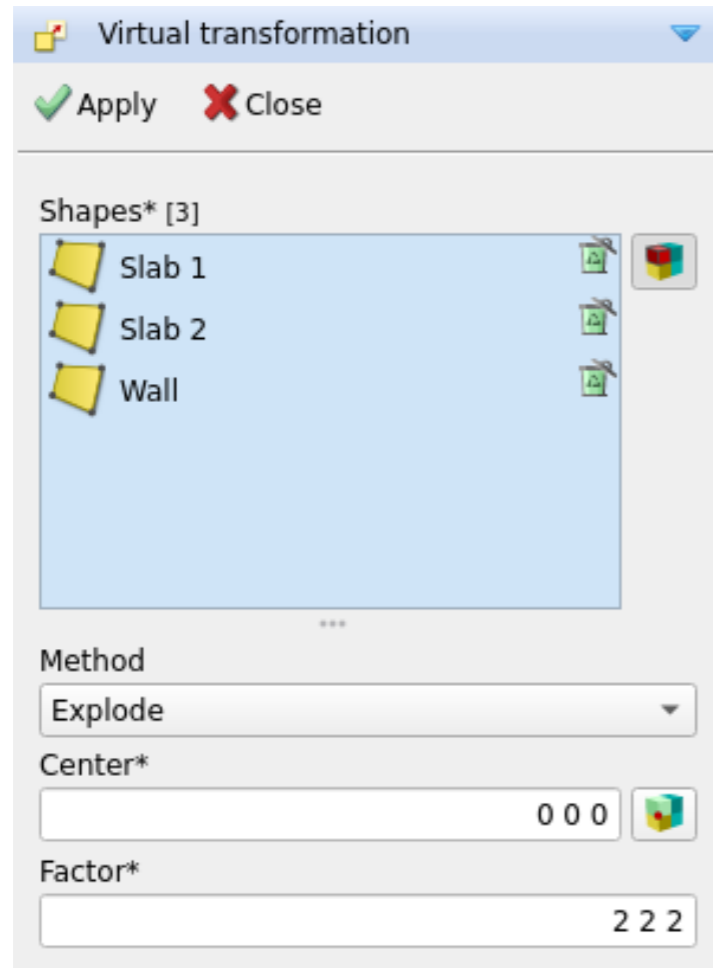


Figure 2: Virtual transformation of shapes

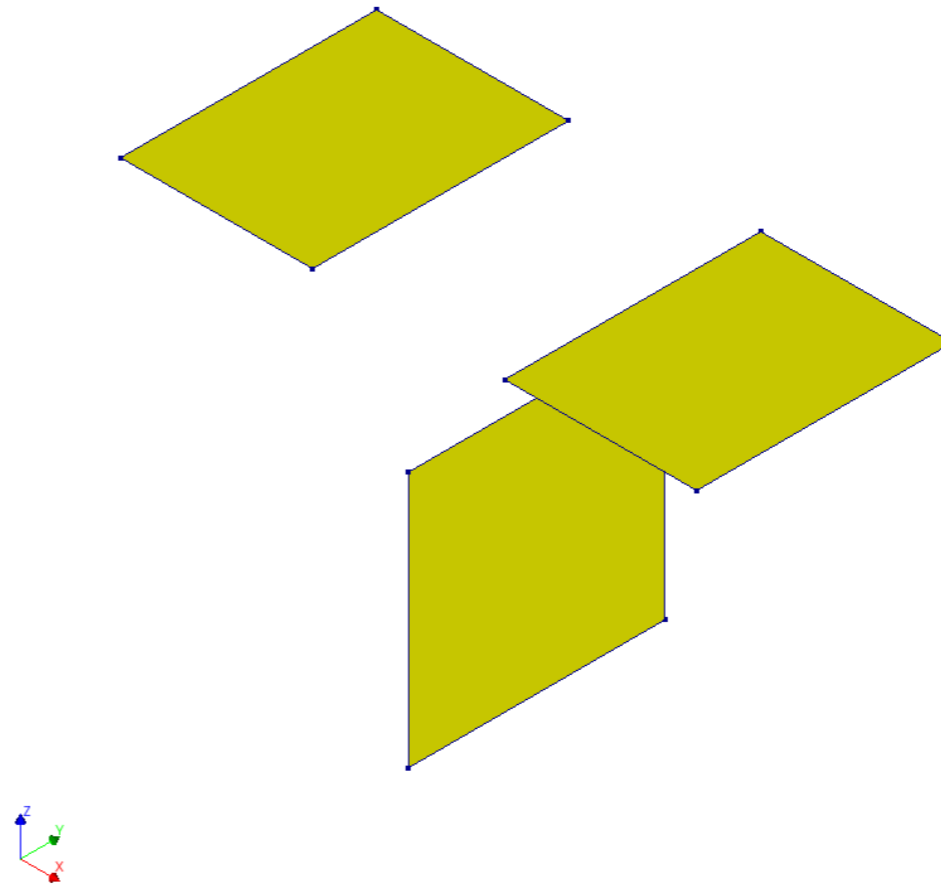



Figure 3: Geometry after virtual transformation

We begin with the definition of an interface between the wall edge as *source* and the slab edges as *target* [Fig. 4 to 5]. We define material and geometry properties [Fig. 6 to 9].

Main menu → Viewer → Selection mode → Edge selection 

Main menu → Geometry → Assign → Connections  [Fig. 4] - [Fig. 9]

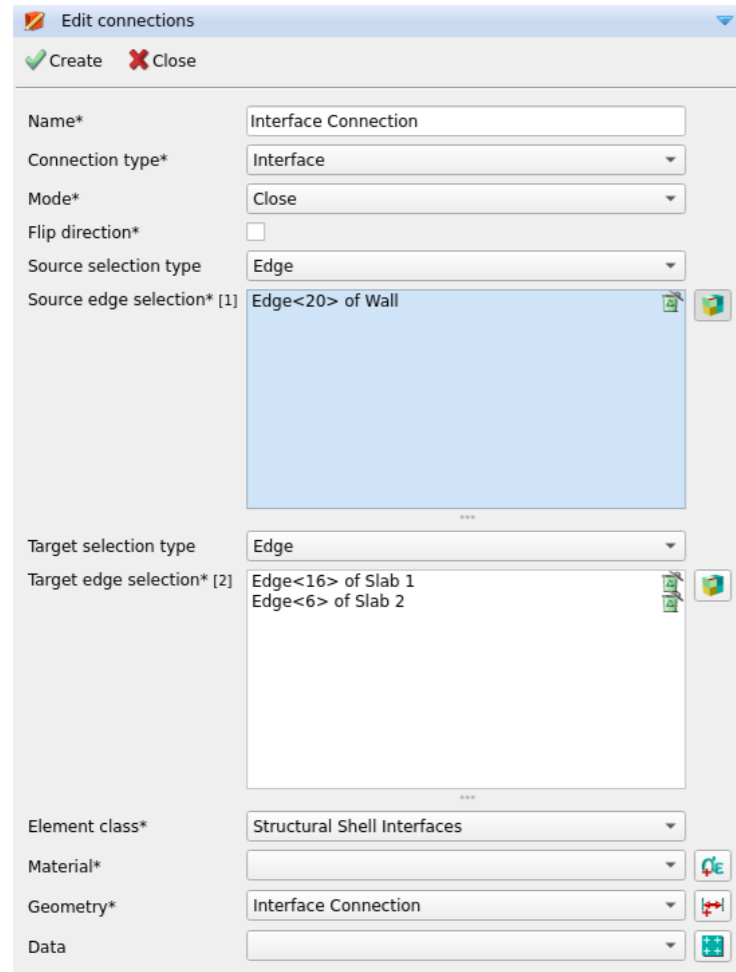


Figure 4: Connection assignment

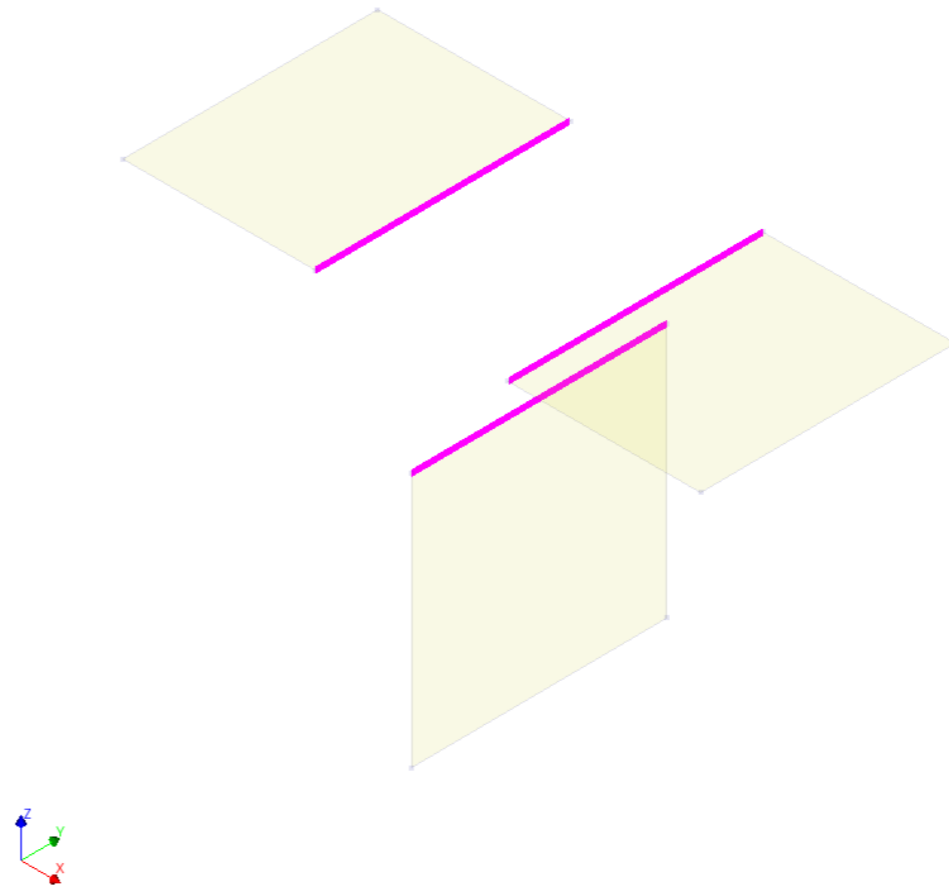


Figure 5: Geometry view - edges for connection

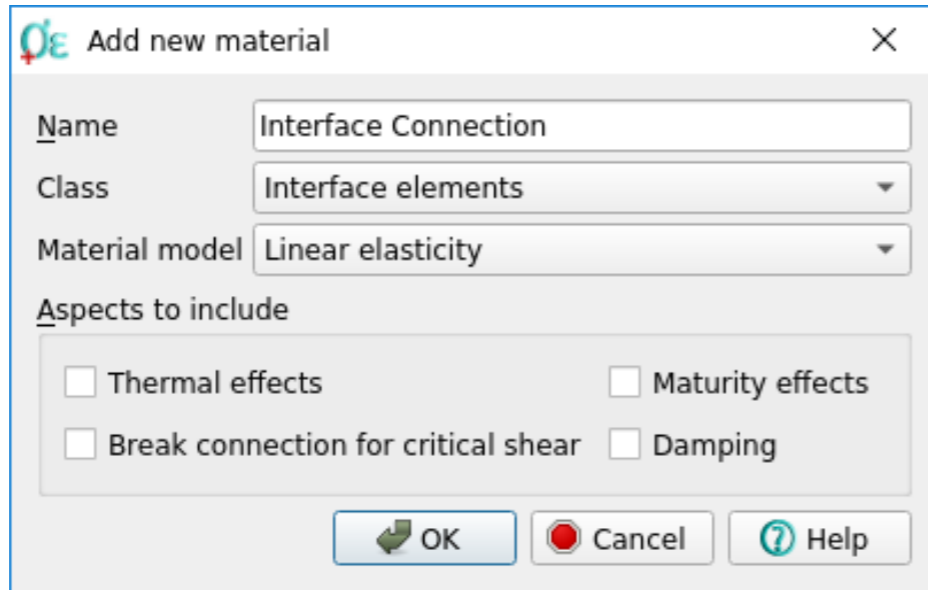


Figure 6: Add interface material

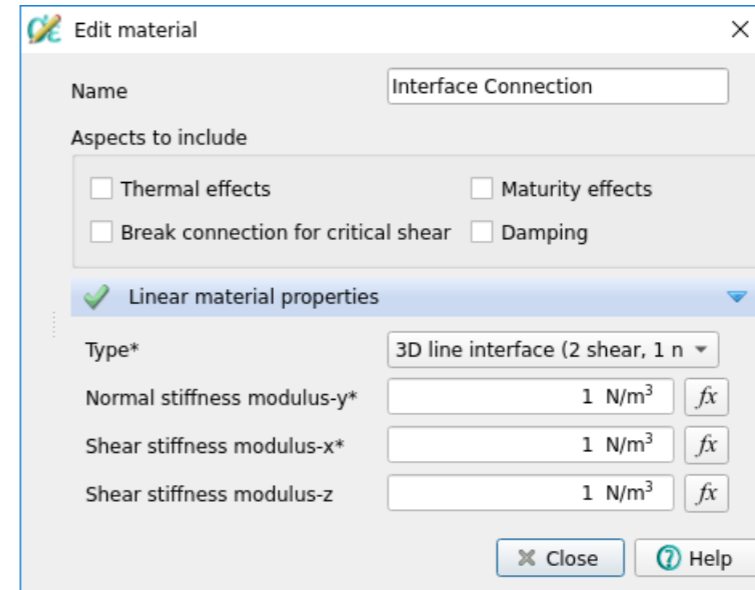


Figure 7: Edit interface material

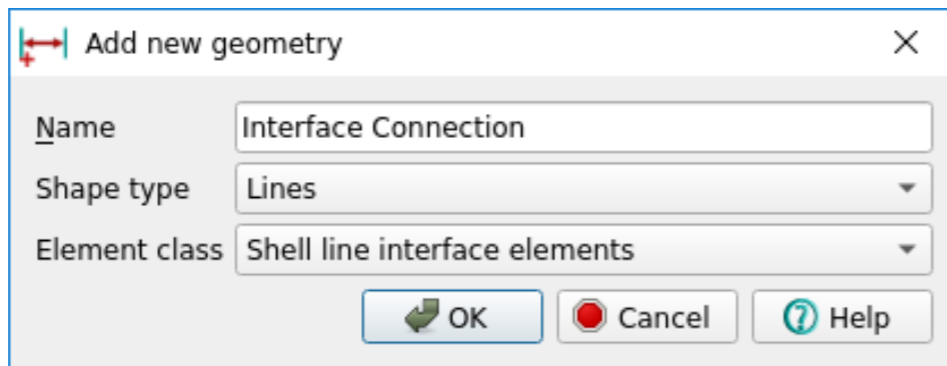


Figure 8: Add interface geometry

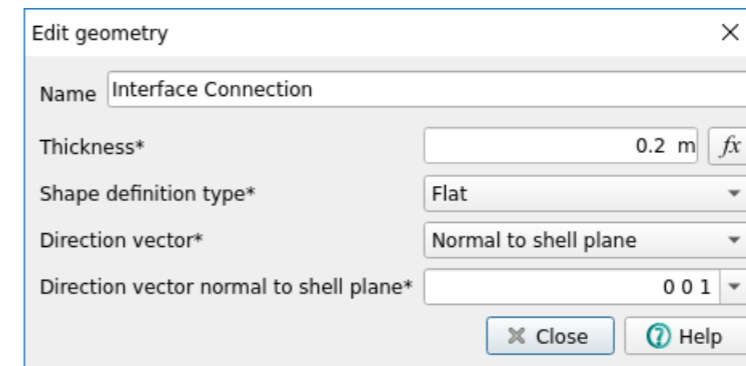


Figure 9: Edit interface geometry

We then create the connection by clicking *Create* in Figure 4 to obtain the view seen in Figure 10. In DIANAIE, the *sources* of a connection are marked in red and the *targets* in blue.

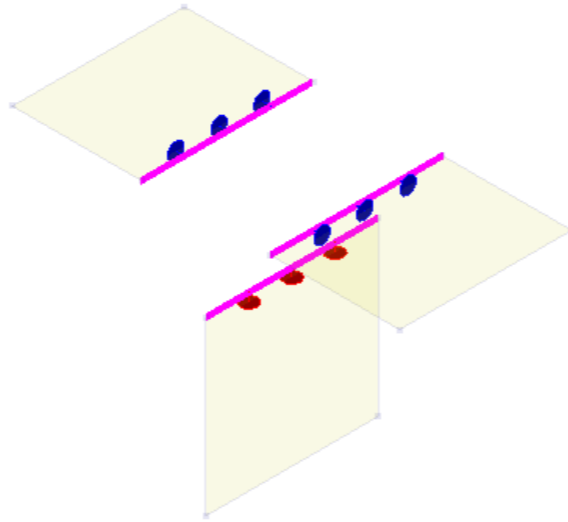


Figure 10: Geometry view - connection


2.2 Check Connectivity


We now check the connectivity as a result of the interface definition. In order to do so, we first generate the mesh. Then we use the locate tool to check if the desired connectivity is obtained. In this case we check for 3 coincident nodes in the model. This means that no nodes are shared between any shapes in this location.


Alternatively we can select a node as seen in Figure 12 and the count of nodes at this point, is displayed in the property panel [Fig. 13] (3 in this case).

So, the interface is defined between the wall and slab parts since they have their own nodes, but the slab parts are disconnected from each other since they do not share any common nodes. This occurs because of the way DIANAIE interprets connectivity of two or more shape parts. If a connection is defined for a particular shape part, DIANAIE interprets that shape part to be disconnected from all other shape parts, unless explicitly defined. Therefore, in order to achieve our desired connectivity we need to perform a unite operation between the slab shapes.

DIANAIE

Main menu → Geometry → Mesh → Generate mesh 

Main menu → Viewer → Locate  [Fig. 11]

Main menu → Viewer → Selection mode → Node selection  [Fig. 12] [Fig. 13]

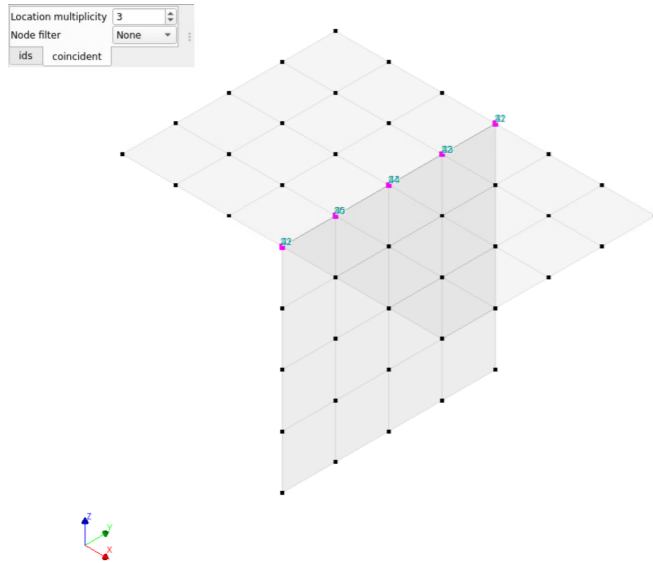


Figure 11: Location of multiple coincident nodes

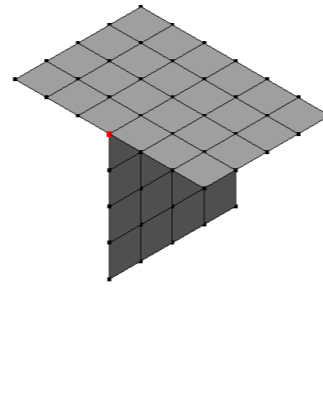


Figure 12: Point selected for checking node count


Description	Value
Count	3
Nodes	2 21 42
Elements	1 15 40 41 45
Element sets	Interface Connection,Slab 1,
Bounding box min	0.750000 0.000000 0.000000
Bounding box max	0.750000 0.000000 0.000000
X coordinate	0.750000
Y coordinate	0.000000
Z coordinate	0.000000

Figure 13: Properties panel - node count

We now assign a unite connection between the two slab shapes as shown in Figure 14, generate the mesh and verify the node count again. With the location tool we see where in the model we have 2 coincident nodes [Fig. 15]. Also, the node count at the same point is now 2 as seen in Figure 16. One node belongs to the wall and the other is the common shared node by slab shapes, thereby achieving the desired connectivity.

Main menu → Geometry → Assign → Connections  [Fig. 14]

Main menu → Geometry → Mesh → Generate mesh 

Main menu → Viewer → Locate  [Fig. 15]

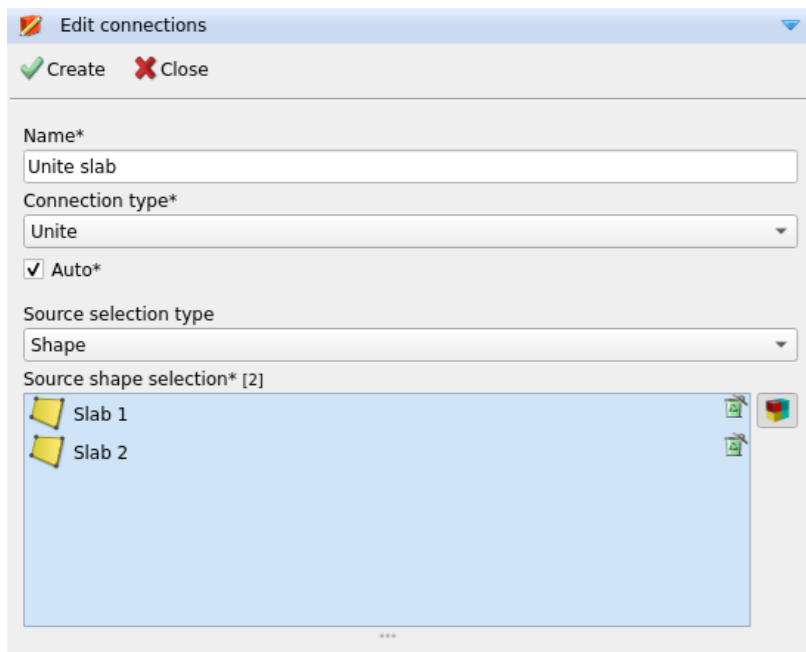


Figure 14: Unite between slab shapes

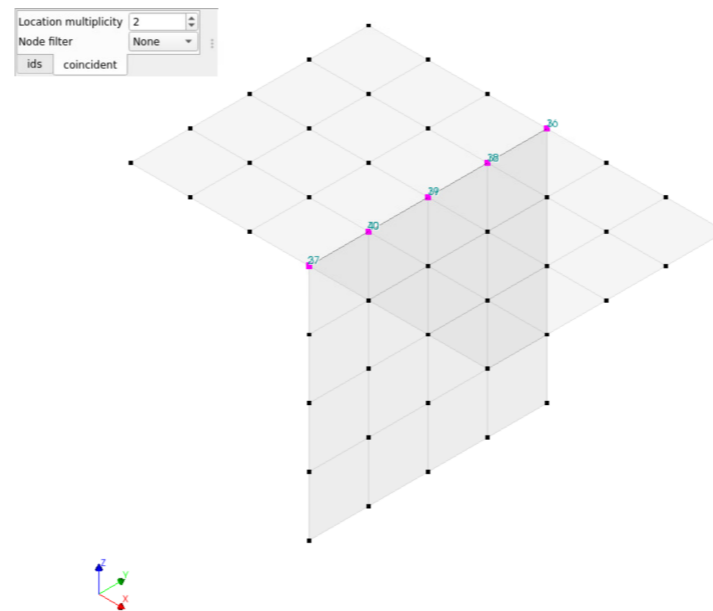


Figure 15: Location of multiple coincident nodes

Description	Value
Count	2
Nodes	2 37
Elements	1 15 40 41
Element sets	Interface Connection, Slab 1,
Bounding box min	0.750000 0.00000 0.00000
Bounding box max	0.750000 0.00000 0.00000
X coordinate	0.750000
Y coordinate	0.00000
Z coordinate	0.00000

Figure 16: Properties panel - node count

Appendix A Additional Information

Folder: Tutorials/InterfaceConnection

Number of elements \approx 48

Keywords:

ELEMEN: curved interf l16if q20sh shell struct.

MATERI: elasti isotro.



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Disclaimer: The aim of this technical tutorial is to illustrate various tools, modelling techniques and analysis workflows in DIANA.
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