# NUMERICAL MODELLING OF SOLIDIFICATION

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## §1. INTRODUCTION

In this paper we shall report on some preliminary investigations into numerical schemes for the two phase Stefan problem in two space dimensions. Interest in this problem has arisen in the course of trying to model the cooling and solidification of foundry castings. In the foundry industry a major design objective is the avoidance of shrinkage cavities and other forms of porosity in castings. These kinds of flaws can seriously affect the mechanical strength of the casting. They can however largely be avoided by ensuring that the solidification of the molten casting takes place in such a way that at any time the regions of still molten material remain connected to the feed points. If this is the case, molten material is able to flow freely from a feed point throughout the still molten region and make up for any local shrinkage caused by contraction of the material as it solidifies. Two of the most important design choices that are available to try to achieve this goal are the placement of the feed points (called "risers" in foundry terminology), and the positioning of "chills". Chills are metal inserts placed in the mould to remove heat very quickly from the casting, thus increasing the speed of local solidification.

A model casting arrangement is shown in Fig. 1. This could represent the cross section of a casting of an I-beam. The casting is being fed from the top. There is clearly the possibility that the narrow neck A could solidify before the lower part of the beam completely solidifies. If this were to occur, there would be an isolated still molten region in the lower part of the beam. No molten material could subsequently reach it from the feed point, and shrinkage