

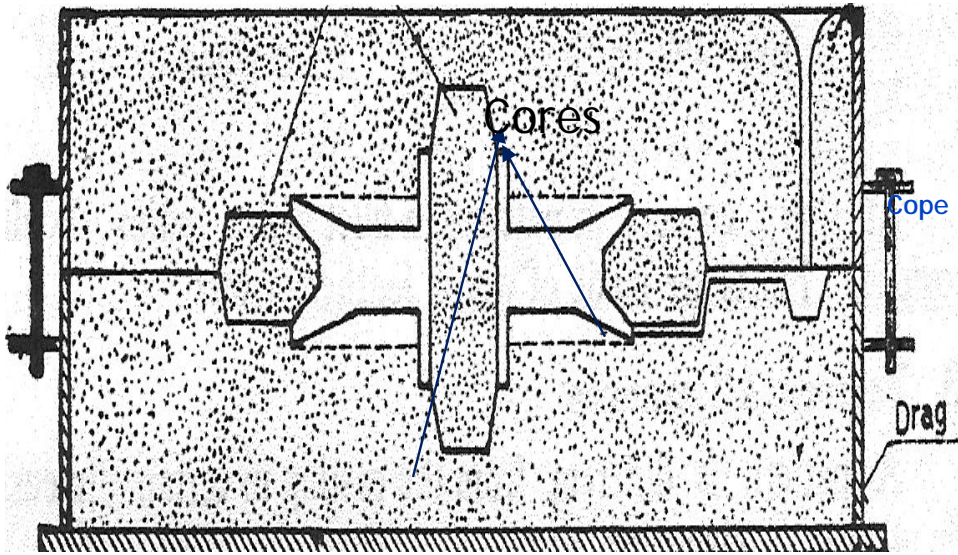
ADVANTAGES OF CENTRIFUGALLY CAST BIMETALLIC ROLLS



WHAT IS VERTICAL CENTRIFUGAL CASTING

- IN VERTICAL CENTRIFUGAL CASTING PROCESS
 - ❖ A PERMANENT MOLD IS ROTATED ABOUT ITS VERTICAL AXIS
 - ❖ THE MOLD IS SPUN AT HIGH SPEEDS (USUALLY 50 TO 100 TIMES GRAVITY FORCE)
 - ❖ AS THE MOLTEN METAL IS POURED, THE MOLTEN METAL IS CENTRIFUGALLY THROWN TOWARDS THE INSIDE MOLD WALL
 - ❖ THE OUTSIDE OF THE MOLD IS COOLED BY WATER , THUS PROVIDING “DIRECTIONAL SOLIDIFICATION” FROM OUTSIDE TO INSIDE.

DIFFERENCES BETWEEN THE STATIC AND CENTRIFUGAL CASTING PROCESS

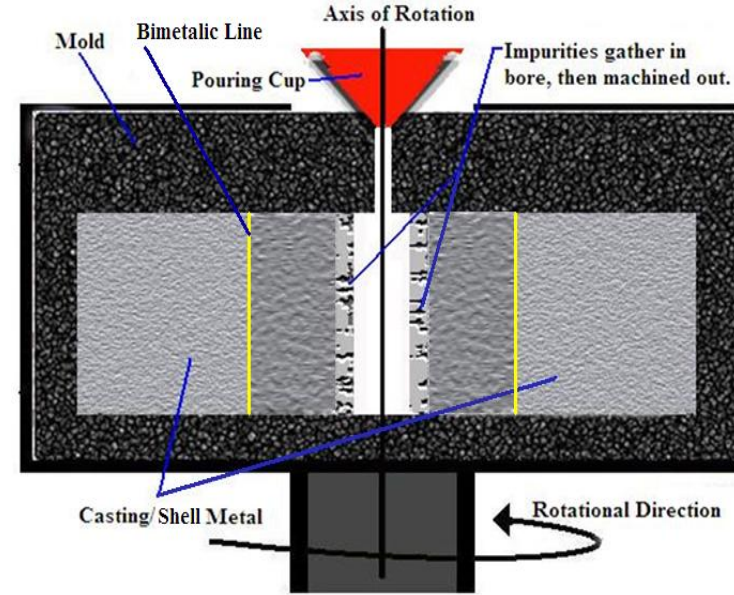


STATIC (SAND CASTING)

A pattern, metal delivery system (gates and risers) is constructed out of hardwood.

Sand containing bonding material is packed around the pattern

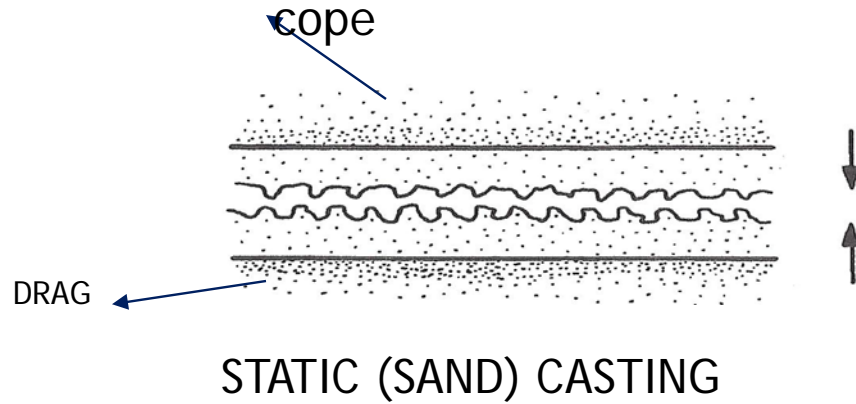
Molten metal is poured into the cavity and the metal solidifies. The sand is removed through a shakeout process.



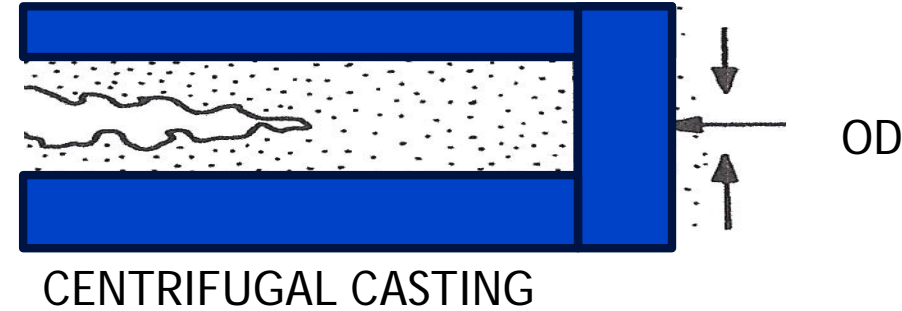
VERTICAL CENTRIFUGAL CASTING

- ❖ A permanent mold is rotated about its Vertical axis
- ❖ The Mold is spun at high speeds (Usually 50 TO 100 times GRAVITY FORCE)
- ❖ the molten metal is poured. The molten metal is centrifugally thrown towards the inside mold wall,
- ❖ THE OUTSIDE OF THE MOLD IS WATER COOLED .

DIFFERENCES BETWEEN HOW METALS SOLIDIFY : CENTRIFUGAL CASTING VS STATIC (SAND) CASTING



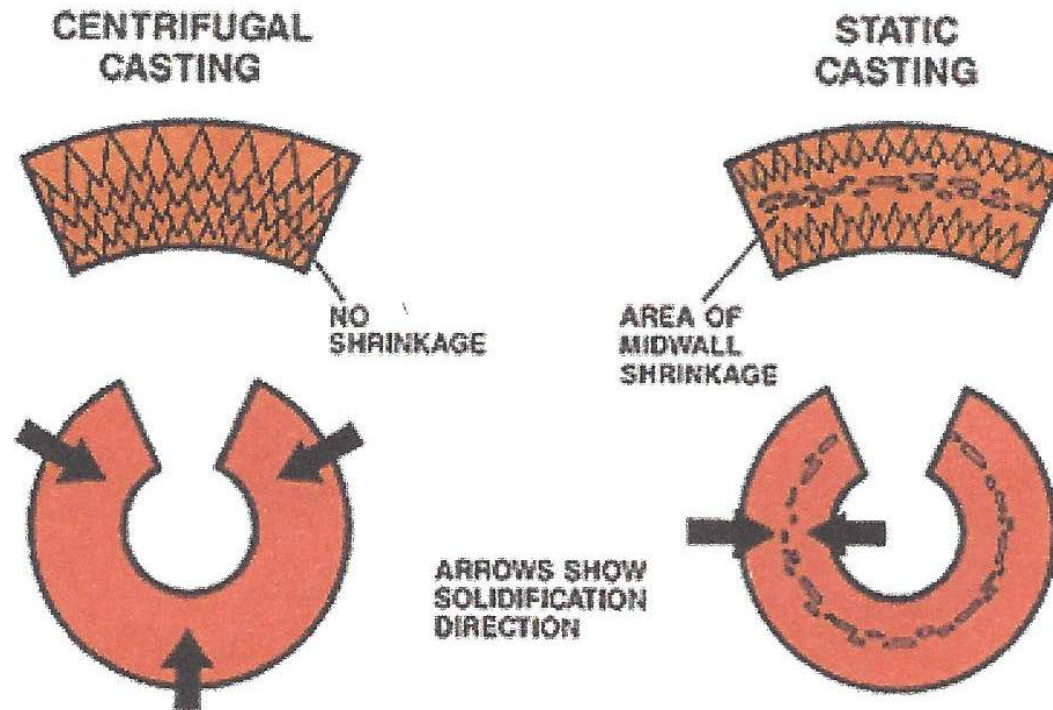
METAL START TO SOLIDIFY
FROM THE MOLD TOP AND
BOTTOM
LEADNG TO CENTERLINE
SHRINKAGE IN THE CASTING



SOLIDIFICATION STARTS AS A THIN LAYER
AT THE OUTSIDE DIAM.
BUILDS LAYER BY LAYER TOWARDS THE
HOLLOW BORE
DUE TO DIRECTIONAL SOLIDIFICATION,
SHRINKAGE VOIDS MOVE TO THE BORE

SHRINKAGE POROSITY COMPARISON

Casting Soundness Comparison



FEEDING METAL : CENTRIFUGAL CASTING VS STATIC CASTING

CENTRIFUGAL CASTING

- AS METAL SOLIDIFY, THE SOLIDIFICATION IS FED BY A HUGE SURFACE AREA OF HIGH PRESSURE MOLTEN METAL .

RESULT

- SHRINKAGE VOIDS AND GAS ENTRAPMENT MOVE TOWARDS BORE AND ARE ELIMINATED IN CENTRIFUGALLY CAST ROLLS

SAND CASTING

- AS METAL SOLIDITY, MOLTEN METAL IS FED THROUGH A COMPLEX NETWORK OF NARROW GATES AND RISERS.

RESULT

- POTENTIAL FOR SHRINKAGE VOIDS AND GAS HOLES IN THE CASTING

GRAIN SIZE DIFFERENCE : CENTRIFUGAL CASTING Vs SAND CASTING

CENTRIFUGAL CASTING

- ⦿ SINCE CENTRIFUGAL CASTING MOLD IS STEEL OR GRAPHITE, THEY PROVIDE HIGHER HEAT EXTRACTION (DUE TO HIGHER CONDUCTIVITY) THAN SAND
- ⦿ THE MOLD IS WATER COOLED, PROVIDING ADDITIONAL COOLING (CHILL) TO THE OUTSIDE DIAMETER (WORKING SURFACE OF THE ROLL)
- ⦿ RESULT: MUCH FINER GRAIN STRUCTURE

STATIC CASTING

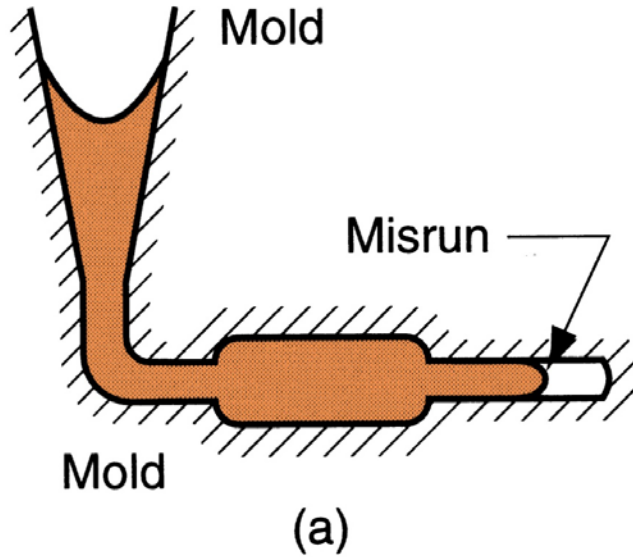
- ⦿ THE SAND AND OTHER BINDER MATERIAL USED ARE POOR CONDUCTOR OF HEAT.
- ⦿ DUE TO GATING AND RISER NETWORK, A HIGHER POUR TEMP IS REQUIRED
- ⦿ RESULT: COARSE GRAIN STRUCTURE

CENTRIFUGAL CASTING “G” FORCE

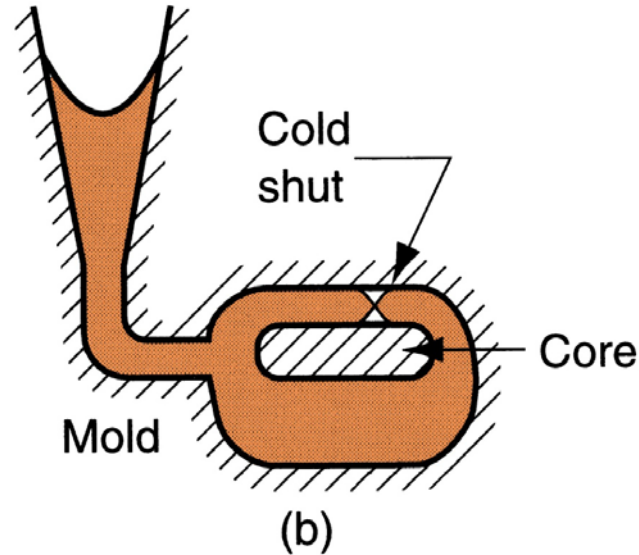
WHAT IS G- FORCE

- ◉ JUST AS THE AMUSEMENT PARK RIDE FORCES RIDERS UP ITS WALLS, IN CENTRIFUGAL CASTING MACHINE , THE METAL IS PUSHED OUTWARD UNDER FORCES MANY TIMES THAT OF GRAVITY, CALLED “G- FORCE”
- ◉ THE HIGH G-FORCES (50- 100 TIMES THE GRAVITY) APPLIED TO THE MOLTEN METAL IN THE SPINNING ALLOWS, LESS DENSE MATERIALS LIKE SLAG, IMPURITIES, GAS TO “FLOAT” TO THE I.D. WHERE IT IS SUBSEQUENTLY REMOVED BY MACHINING.
- ◉ METAL SOLIDIFY UNDER PRESSURE, FROM THE O.D. TO THE I.D., LEAVING A DEFECT-FREE STRUCTURE WITHOUT CAVITIES OR GAS POCKETS

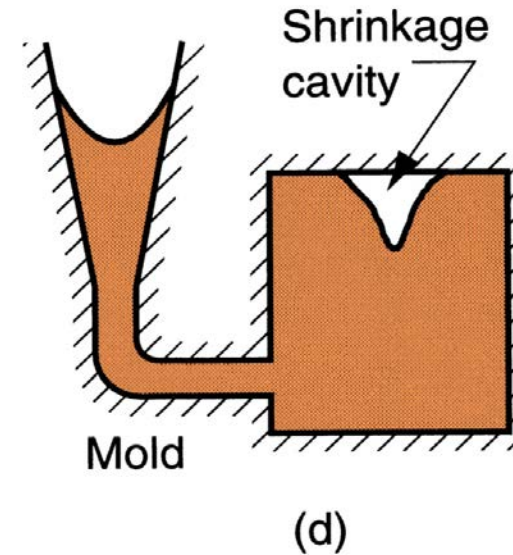
DEFECTS UNIQUE TO STATIC SAND CASTING



Metal solidified before filling the mold cavity



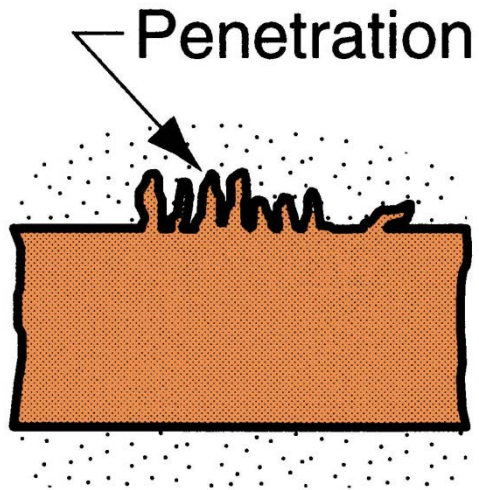
Two Portions of metal flow Together from different directions, but there is lack Fusion



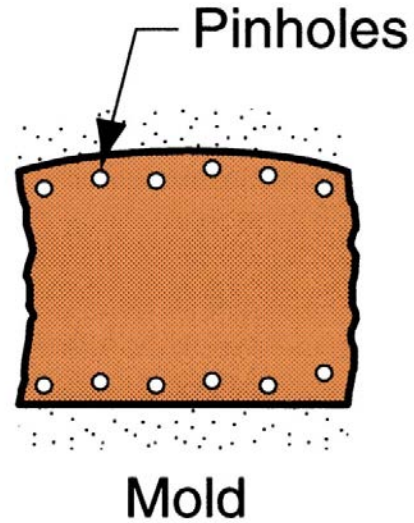
Internal void caused by Solidification shrinkage

CENTRIFUGALLY CAST ROLLS WILL HAVE NO SUCH DEFECTS

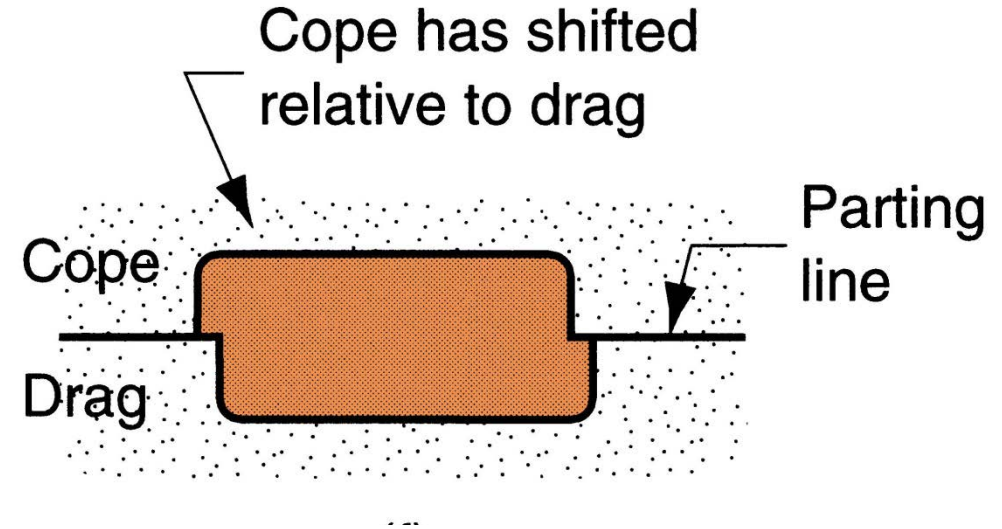
DEFECTS UNIQUE TO STATIC SAND CASTING



Metal Penetrated in Sand mold or core



Gas holes slightly below the surface of the casting



A step in the casting at the parting line due to shifted cope and drag

CENTRIFUGALLY CAST ROLLS WILL HAVE NONE OF THESE DEFECTS

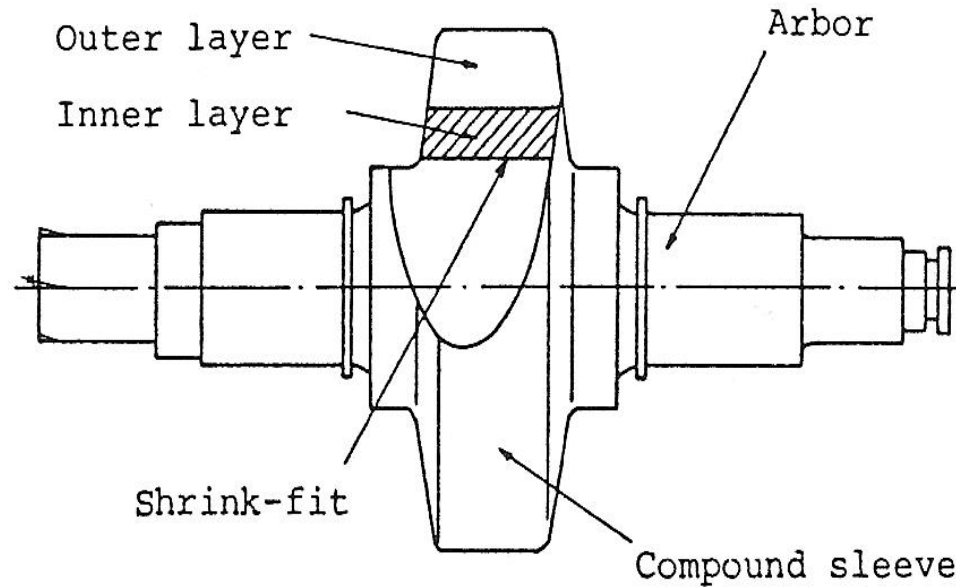
CENTRIFUGALLY CAST ROLLS - ADVANTAGES SUMMARY

- ❖ HIGHER MECHANICAL PROPERTIES DUE TO FINE GRAIN STRUCTURES
- ❖ BUILDING A METAL COMPONENT IN THE CENTRIFUGAL METHOD IS LIKE BUILDING A HOUSE; YOU START WITH THE FOUNDATION AND GO UP.
- ❖ OF COURSE, THE FOUNDATION OF A HOUSE IS BUILT NOT WITH IRREGULARLY SHAPED STONES BUT VARIOUS IDENTICALLY SHAPED BLOCKS. THE GRAIN STRUCTURE OF A CENTRIFUGAL COMPONENT HAS THE SAME TRAITS.
- ❖ SINCE METAL SOLIDIFIES UNDER PRESSURE, A DENSE METAL STRUCTURE IS PRODUCED
- ❖ FREE OF IMPURITIES AND GAS HOLES DUE TO HIGH G- FORCE DURING CASTING
- ❖ FREE OF SHRINKAGE VOIDS DUE TO DIRECTIONAL SOLIDIFICATION
- ❖ SINCE NO SAND, GATES OR RISERS ARE REQUIRED, DEFECTS UNIQUE TO STATIC SAND CASTING (SUCH AS MISRUN, COLD SHUT, SURFACE PIN HOLES, SAND DEFECTS, ETC) IS VIRTUALLY ELEMINATED.

WHAT IS A BIMETALLIC SLEEVE

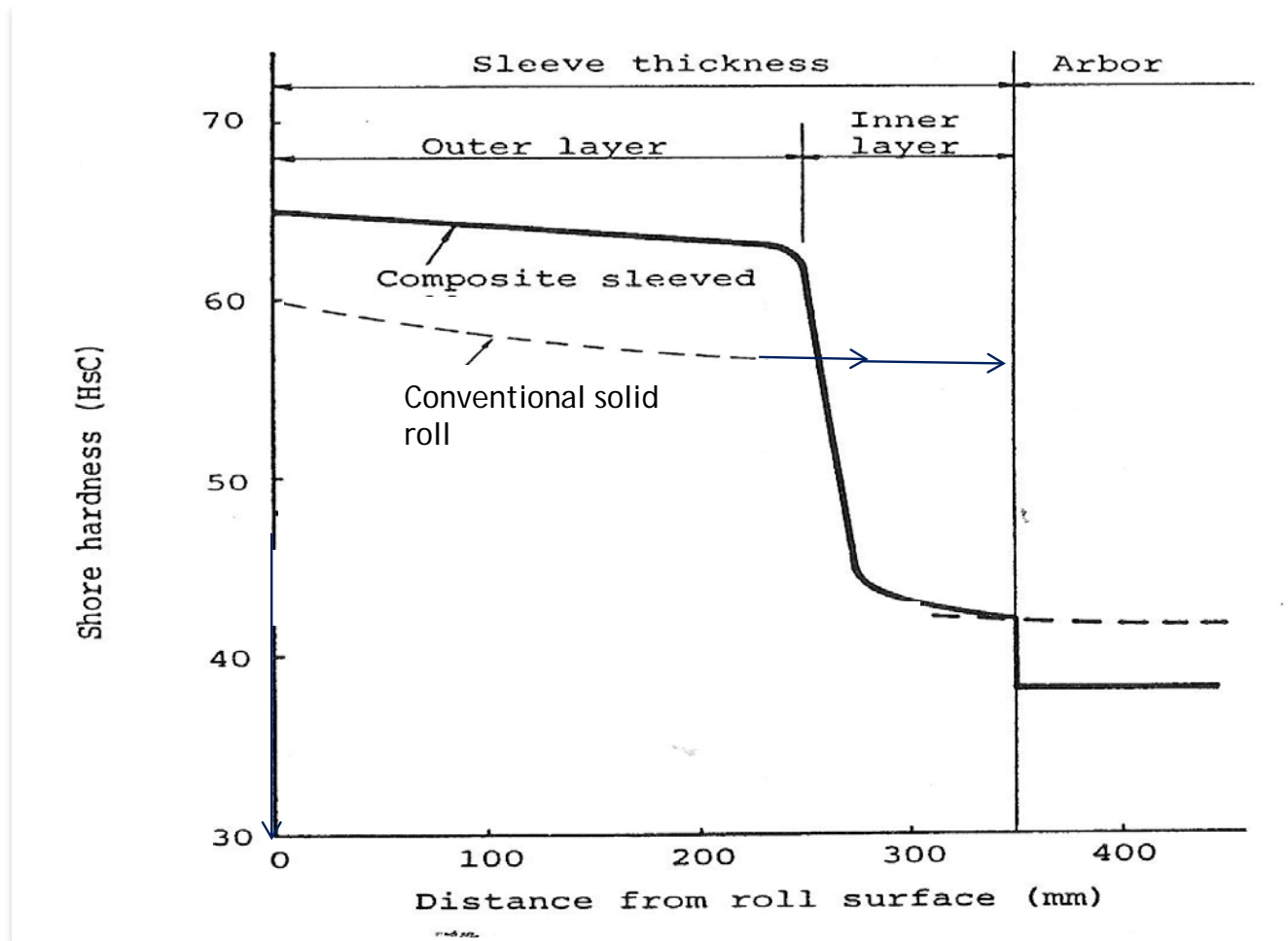
- ❖ A BIMETALLIC SLEEVE HAS A HARDER SHELL (OUTER) MATERIAL AND A SOFTER CORE (INNER) MATERIAL.
- ❖ REASON
- ❖ STEEL MILL ROLLS NEED TO BE “ HIGH WEAR RESISTANT” AND AT THE SAME TIME NEED BE IMPACT RESISTANT TO AVOID BREAKAGE
- ❖ THIS IS POSSIBLE WITH BIMETALLIC SLEEVES BY CASTING OUTER LAYER WITH HIGH WEAR RESISTANT ALLOY AND INNER LAYER RELATIVELY HIGH IMPACT RESISTANT ALLOY

WHAT IS A COMPOSITE BIMETALLIC SLEEVE ROLLS



- A COMPOSITE BIMETALLIC SLEEVE ROLL HAS A "BIMETALLIC SLEEVE" SHRINK FITTED ON TO AN ARBOR.

HARDNESS PROFILE OF BIMETALLIC SLEEVE & CONVENTIONAL MONOBLOC



ADVANTAGES OF CENTRIFUGALLY CAST BIMETALLIC SLEEVE COMPOSITE ROLLS

“ WEAR RESISTANCE AND BREAKAGE RESISTANCE ARE
CONFLICTING REQUIREMENTS”

- ❖ WITH COMPOSITE BIMETALLIC SLEEVE ROLLS, IT IS POSSIBLE TO IMPROVE BOTH WEAR AND BREAKAGE RESISTANCE
- ❖ BY CHOOSING A CENTRIFUGALLY CAST BIMETALLIC SLEEVE WITH HIGHER SHELL HARDNESS AND LOWER CORE HARDNESS AND CHOOSING HIGH TOUGHNESS ARBOR .
- ❖ CENTRIFUGALLY CAST BIMETALLIC SLEEVES PROVIDE FINE GRAIN, METALLURGICALLY SUPERIOR MECHANICAL PROPERTIES
- ❖ THEREFORE CENTRIFUGALLY CAST BIMETALLIC SLEEVE/FORGED ARBOR COMBINATION PROVIDE SUPERIOR WEAR RESISTANCE WITH LESS CHANCES FOR BREAKAGE.

