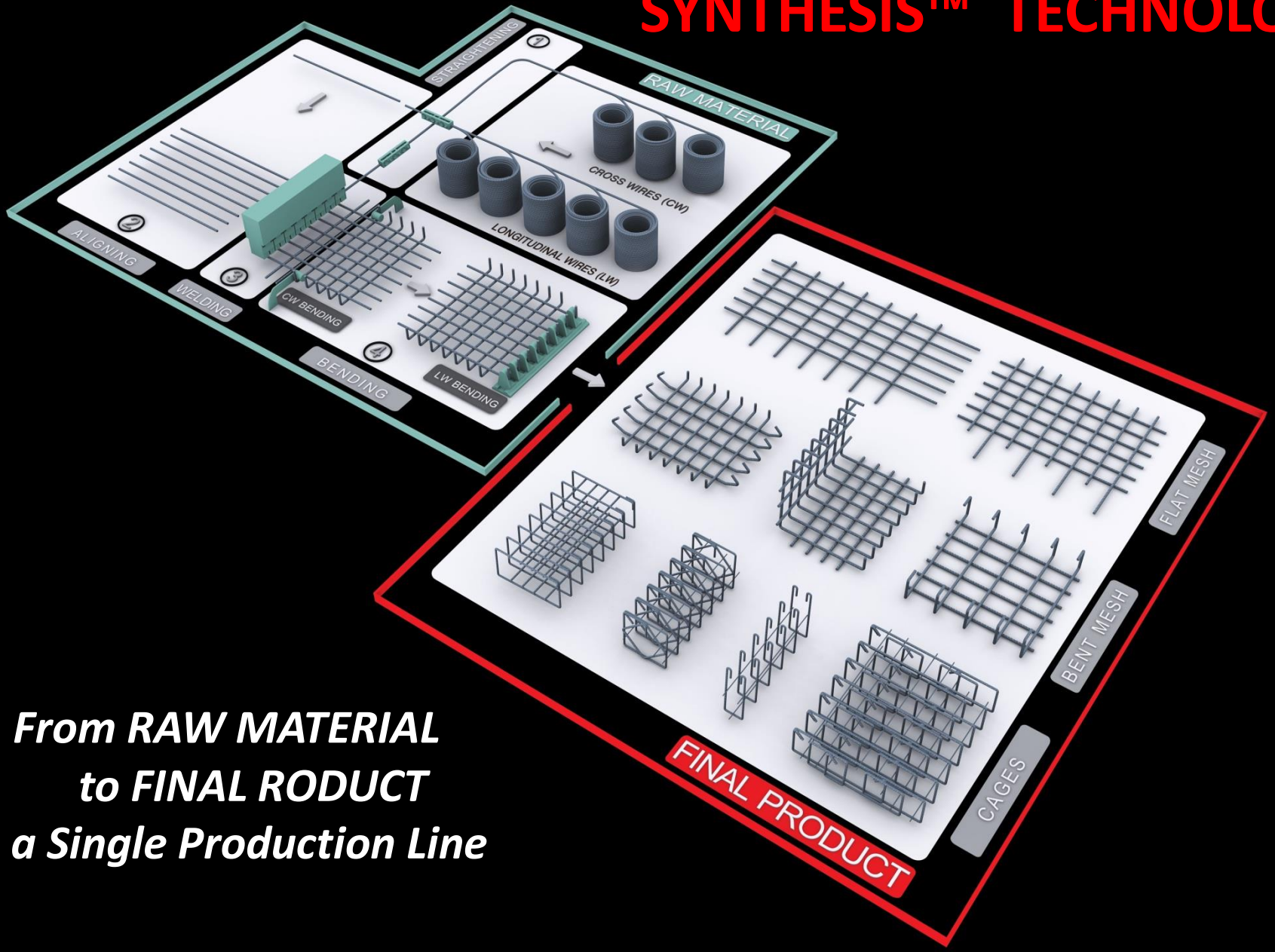
Prefabricated SYNTHESIS™ Systems for Precast Concrete Elements

Dimos Kalteziotis, Civil Engineer MBA, MSc
SIDENOR GROUP DIRECTOR

SYNTHESIS™ MACHINES

SYNTHESIS™ TECHNOLOGY



From RAW MATERIAL
to FINAL RODUCT
in a Single Production Line

What is Synthesis™ ?

Synthesis™ is a technology for prefabricating reinforcing steel for concrete in an industrial manner.

It is a totally flexible (no minimum order requirements exist), fully industrial manufacturing technology utilizing minimum personnel.

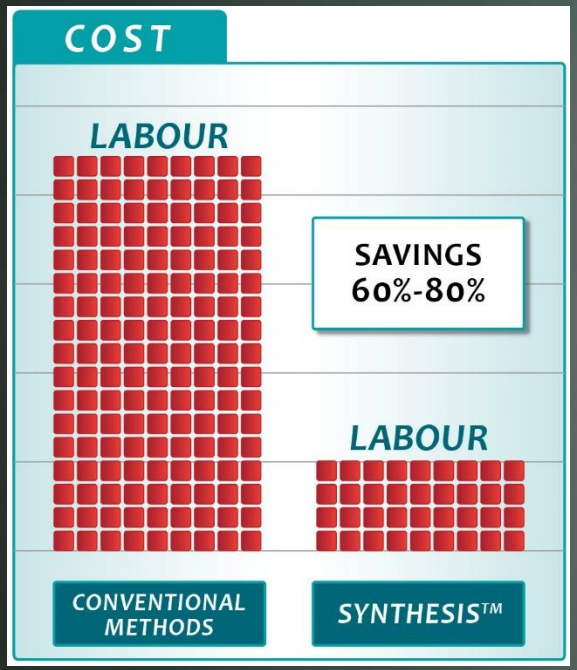
It starts from raw material and ends with a final or semi-final product.

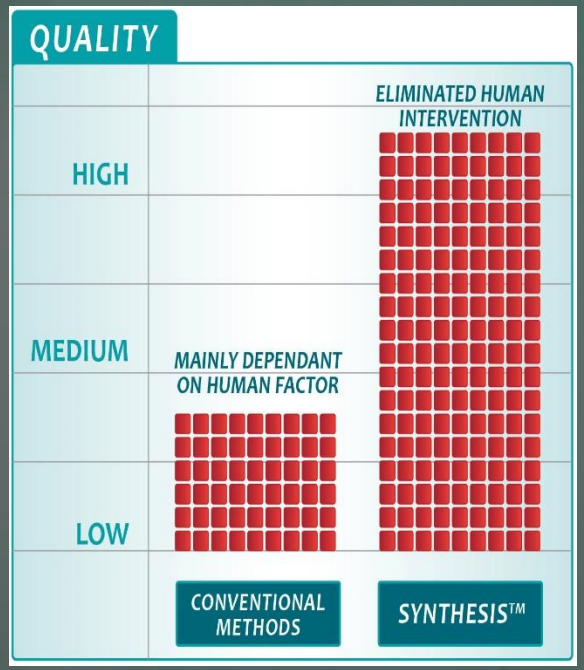
The technology consists of
- state-of-the-art machinery and
- sophisticated software.

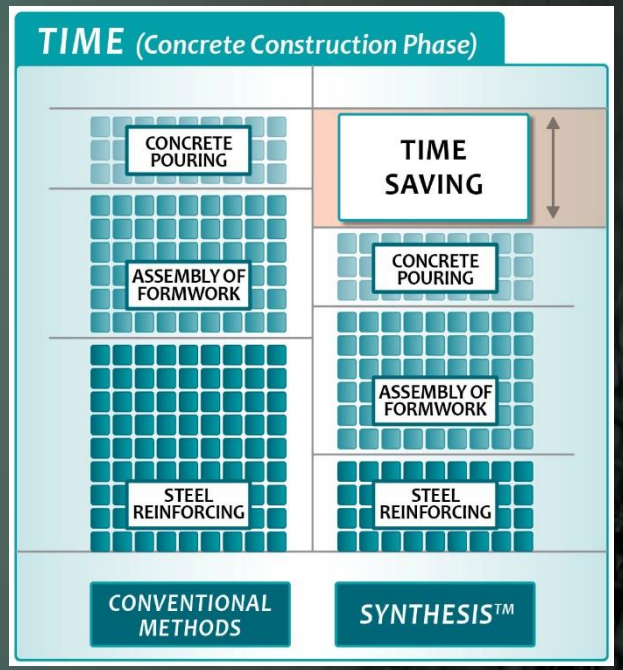
3d Bent Mesh

Complex Stirrup Cage

INDUSTRIAL PREFABRICATION







Industrial Prefabrication expands the use of prefabrication to every construction project, including precast elements, achieving much better results in cost, time, quality and safety.

PRECAST MARKET CHARACTERISTICS

- ✓ Exact replication of design
- ✓ High accuracy required in the reinforcement's geometrical characteristics
- ✓ Flexibility
- ✓ Timely supply

With its immense capabilities and just-in-time character, Synthesis™ provides a complete repertoire of prefabricated solutions to the precast market and successfully addresses all the above considerations

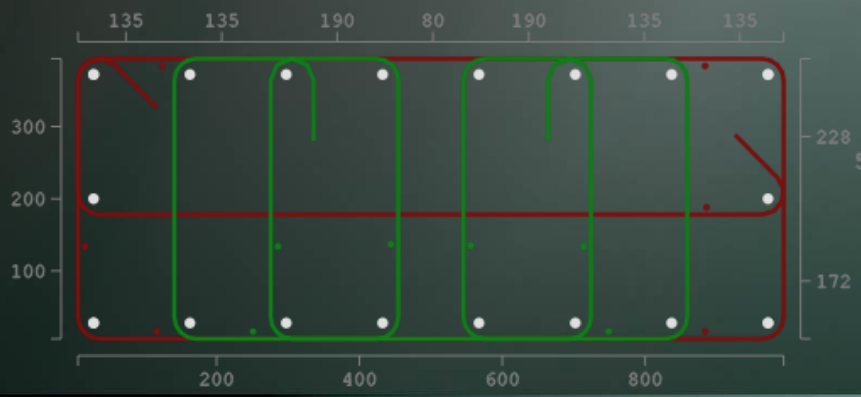
SYNTHESIS™ FEATURES – FLEXIBILITY

SYNTHESIS™ FEATURES – HIGH COMPLEXITY

SYNTHESIS™ FEATURES – MULTI-ASSEMBLY

DESIGN SOFTWARE - SYNTHECAD

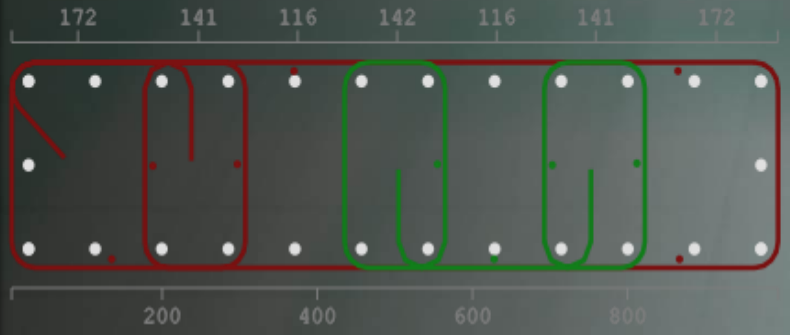
A PRACTICALLY LIMITLESS LIBRARY OF PRODUCTS IS SUPPORTED BY THE MACHINE AND THE SOFTWARE



SYNTHESIS™ MACHINES

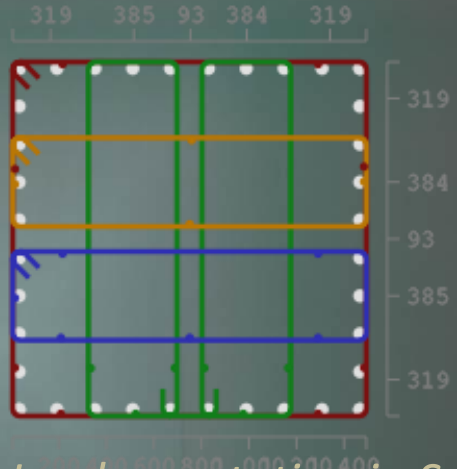
DESIGN SOFTWARE - SYNTHECAD

Design in SyntheCAD



Implementation in Synthesis

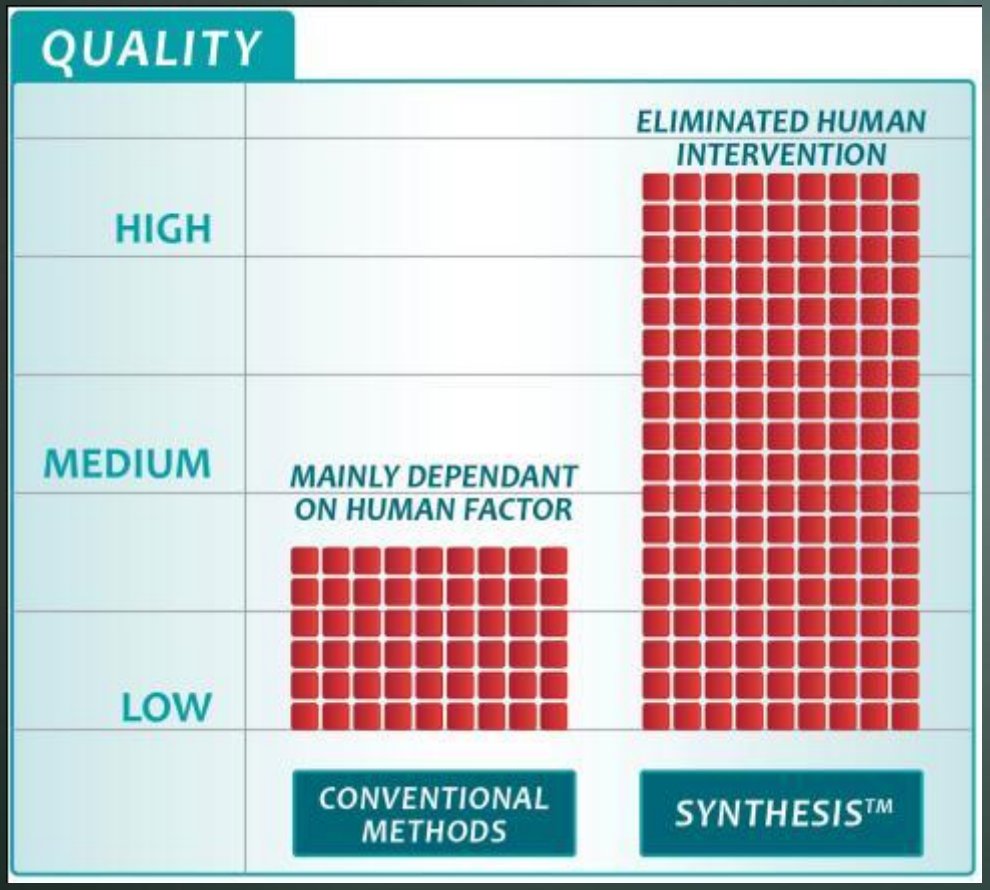
Design in SyntheCAD



Implementation in Synthesis

SYNTHESIS™ MACHINES

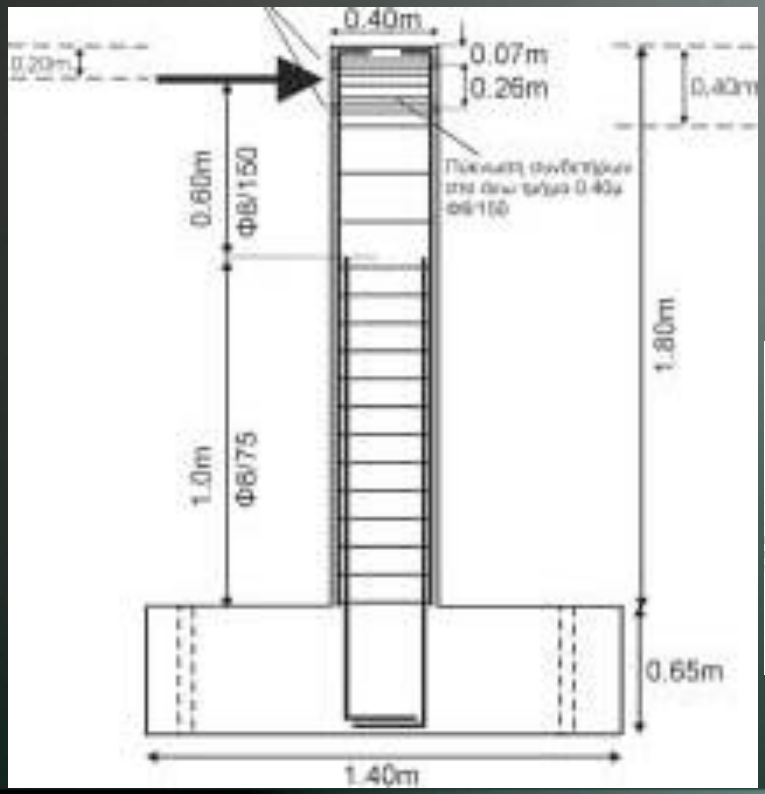
TECHNICAL BENEFITS - GEOMETRY

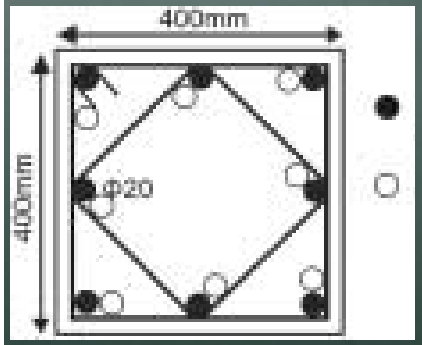


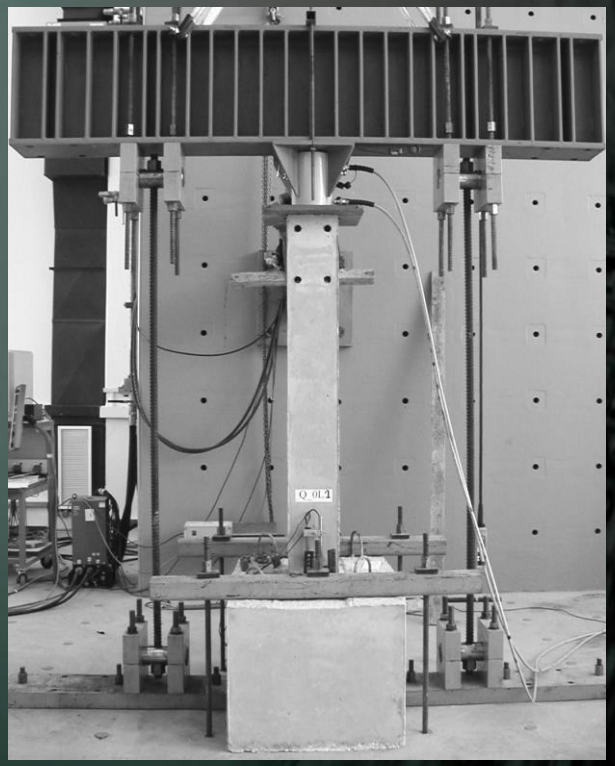
- ✓ **Sides and angles exactly as designed**
- ✓ Required **spacing** always **ensured**
- ✓ **Sturdy products**
- ✓ **Verticality and contact** between transverse and longitudinal bars **guaranteed**

TECHNICAL BENEFITS - EXPERIMENT

"The effect of the construction method of transverse reinforcement in the seismic response of reinforced concrete columns"







TECHNICAL BENEFITS - EXPERIMENT

To investigate the **seismic response** of an **RC vertical member** by measuring its deformation capacity under cyclic loading.

- **12** reinforced columns were tested
- The **transverse reinforcement was N8**, at **75mm** spacings in the lap region and at **150mm** in the remainder of the column.
- The **longitudinal reinforcement was N20**
- The **lap length was 1,0m** ($=50N_{longitudinal}$)
- The **section** under investigation was a **40cm x 40cm** square column.

TECHNICAL BENEFITS - EXPERIMENT

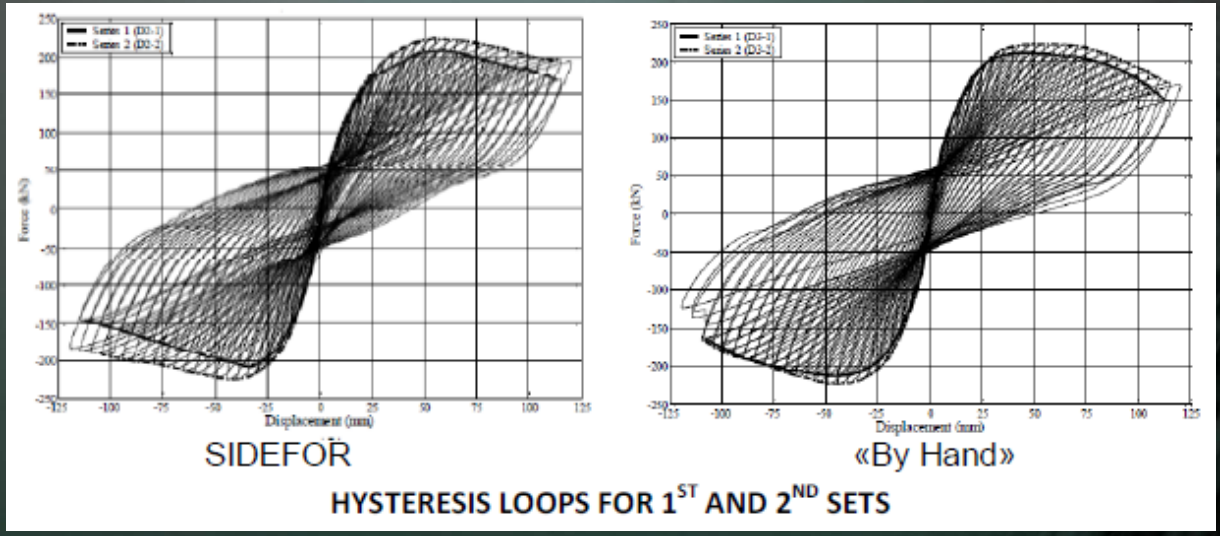
TECHNICAL BENEFITS - EXPERIMENT

The 4 prevailing methods of stirrup construction in Greece were chosen:

1. Stirrups derived by manual mesh bending (specimens D1)
2. SIDEFOR cages / **industrially-made 3D cages** (specimens D2)
3. Traditional stirrups **"by hand"** (specimens D3)
4. Spiral reinforcement (specimens D4)

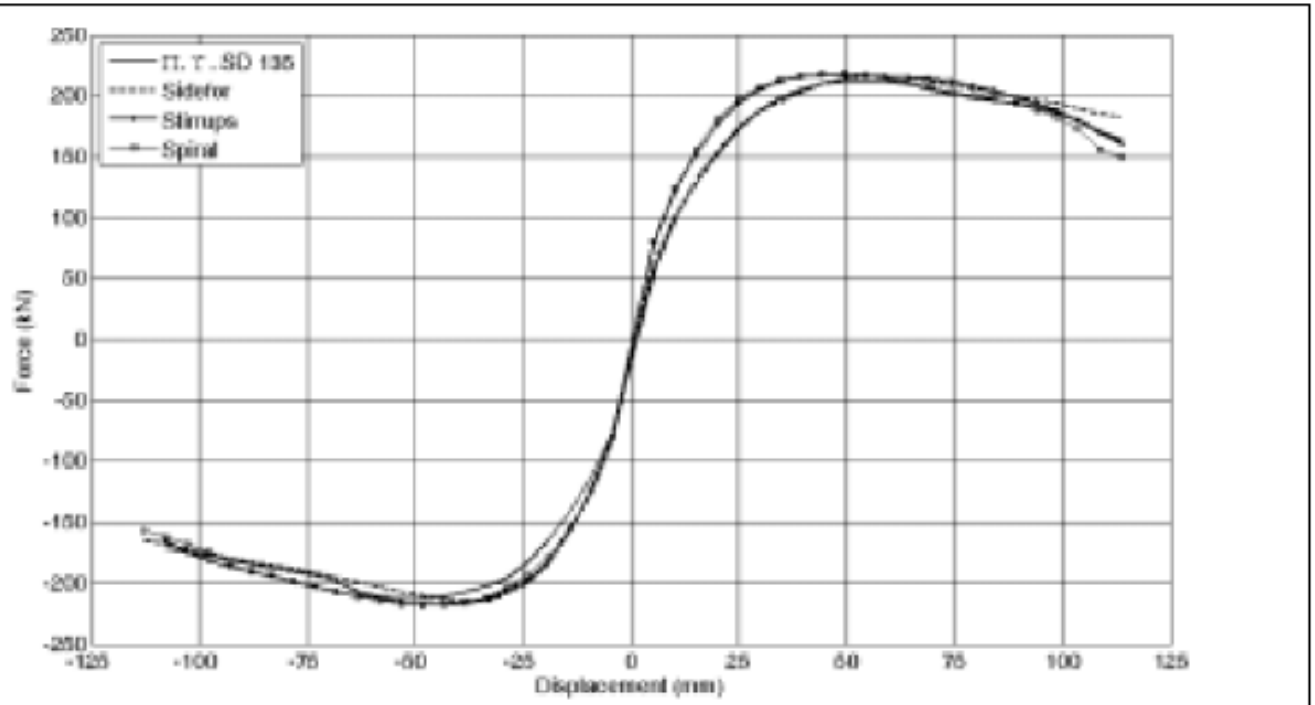
The 2 first sets of specimens were subject to **increasing cyclic loading** with step of 5mm until collapse.

Axial load was **stable** throughout the whole test (v-0.21-0.26)



HYSTERESIS LOOPS FOR 1ST AND 2ND SETS

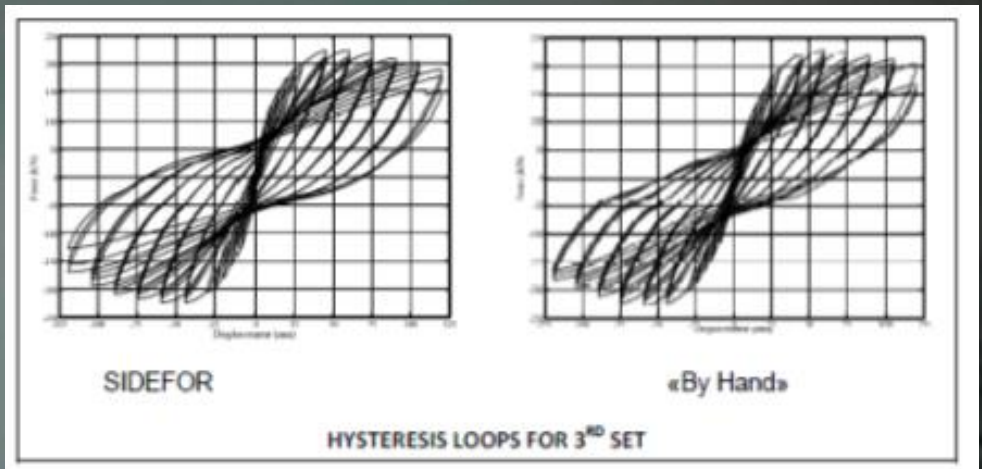
TECHNICAL BENEFITS - EXPERIMENT



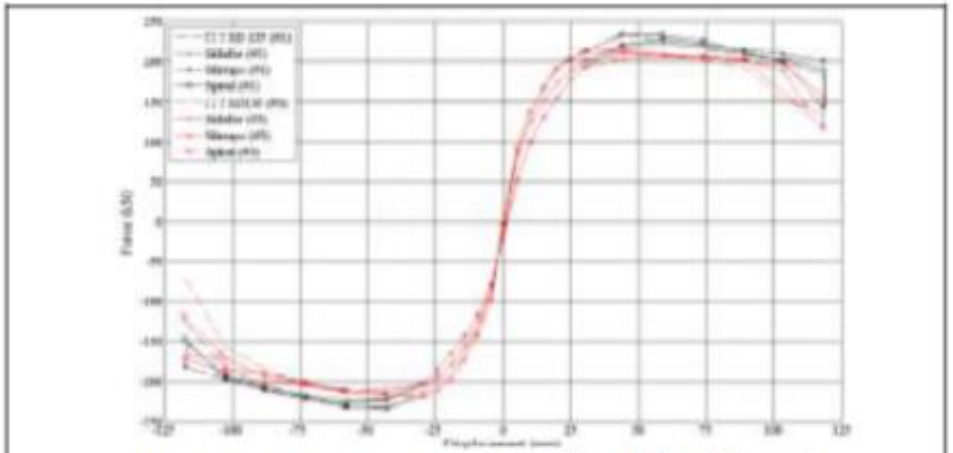
ENVELOPES OF HYSTERESIS LOOPS FOR 1ST AND 2ND SETS (AVERAGES)

TECHNICAL BENEFITS - EXPERIMENT

3rd set:
The cycles of horizontal displacement were increasing with **a 5mm step up** to the displacement cycle of 30mm.
Above that the horizontal displacement was increased with a **15mm step** for each displacement level, the cycle was imposed 3 consecutive times.



HYSTERESIS LOOPS FOR 3RD SET

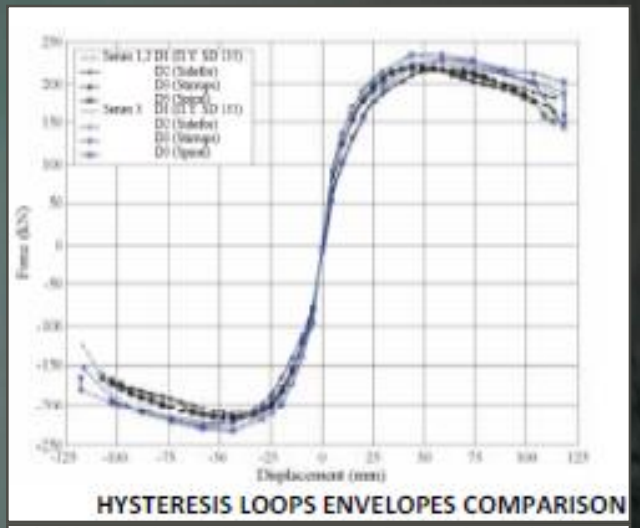

ENVELOPES OF HYSTERESIS LOOPS FOR 3RD SET (1ST and 3RD CYCLE)

TECHNICAL BENEFITS - EXPERIMENT

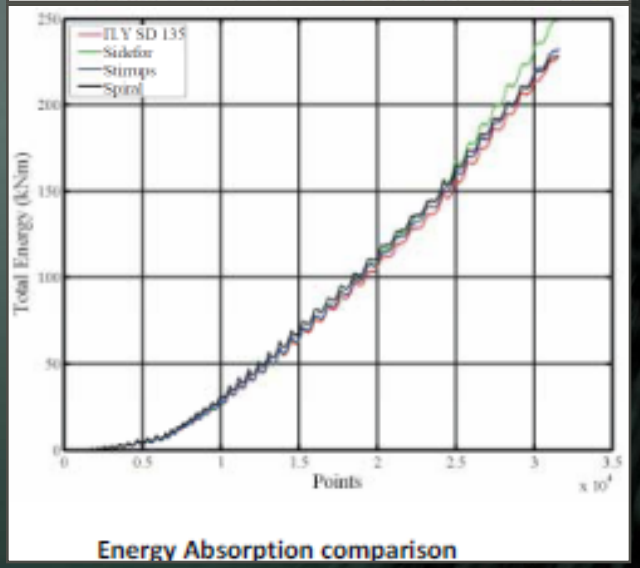
Conclusions:

1. In all 12 tests the transverse reinforcement **never failed.**
2. All specimens showed a **similar seismic behavior,** regardless of the different stirrup construction methods. Any difference between the force-displacement curves and the energy absorption curves were statistically insignificant.
3. The measured deformation capacity of the specimens was measured **25 to 30% more than the anticipated one,** for all specimens.

Being fully industrial, SYNTHESIS™ technology always guarantees a constant behavior of its products, because it can replicate them at all times with the same level of accuracy



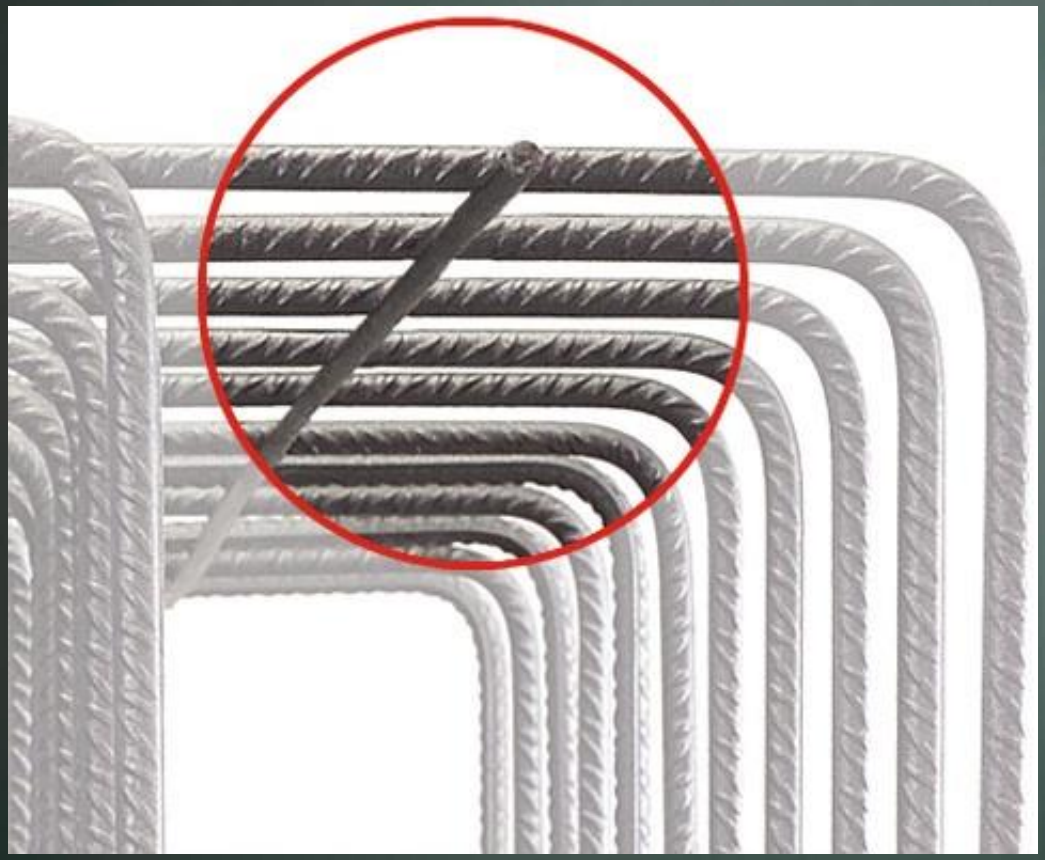
HYSTERESIS LOOPS ENVELOPES COMPARISON



Energy Absorption comparison

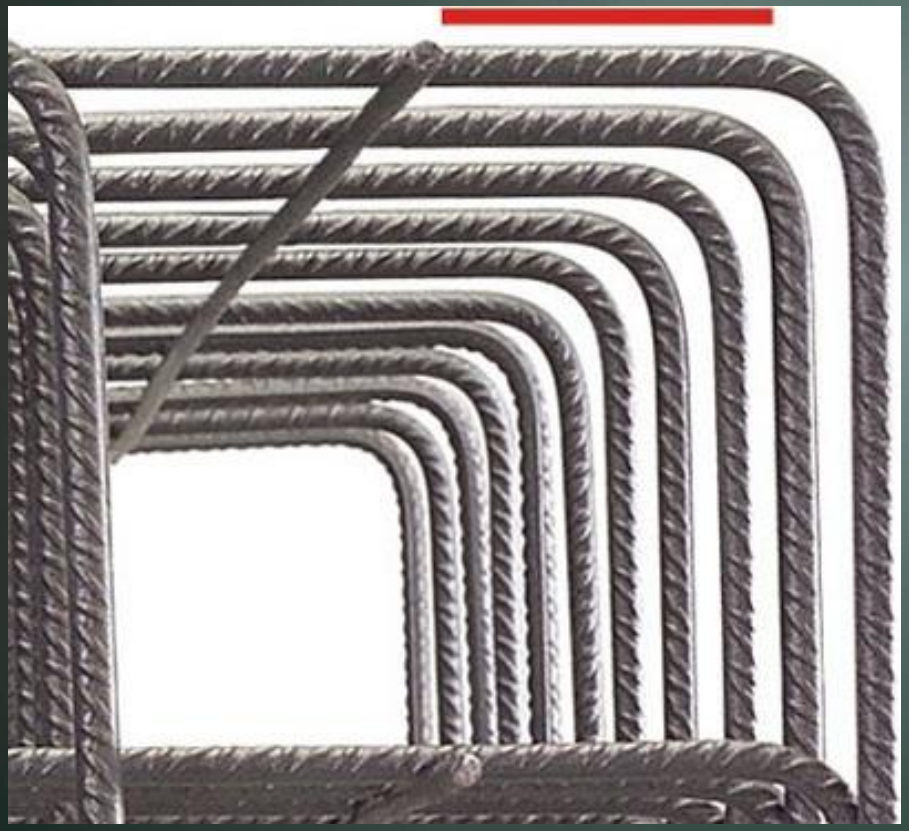
SYNTHESIS™ MACHINES

CROSS WIRE ORIENTATION



- Cover is never encroached

DISTANCE BETWEEN WELDING AND BENDING

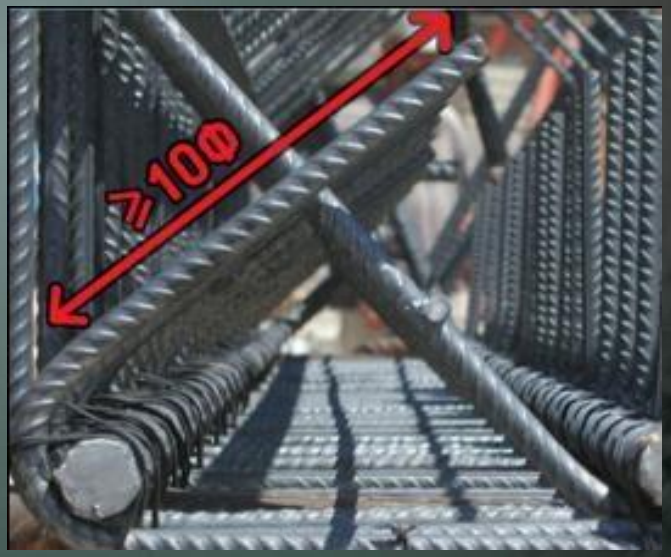


- Synthesis™:
  Distance =
  C + PIND/2 + Ø

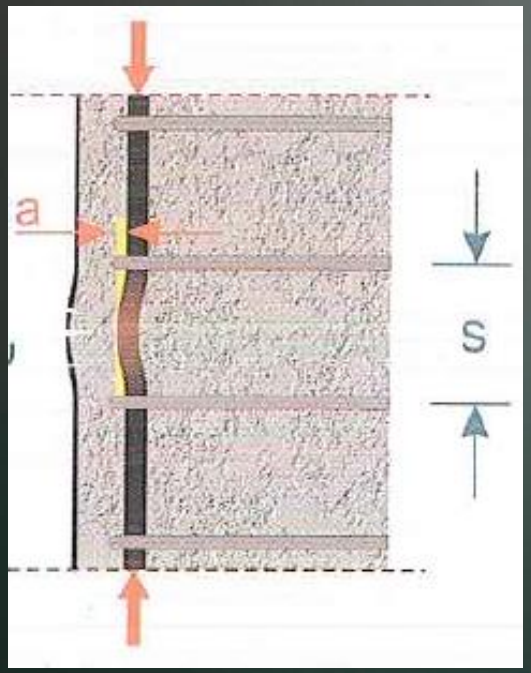
  Where C is parameterized in Synthesis™ Software.

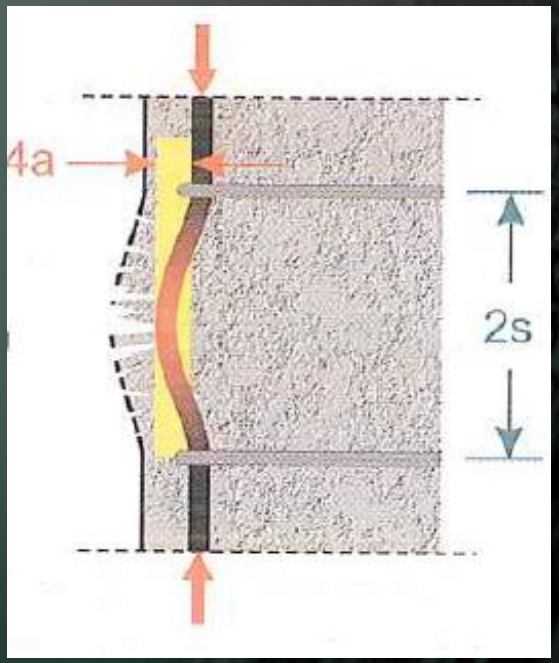
HOOKS

Fully customizable by Synthesis™ software



TECHNICAL BENEFITS – PEREFECT GEOMETRY





FINANCIAL BENEFITS

LOW PRODUCTION COST

- Compact machine
- No semi-finished products
- Minimum personnel
- High output in tonnes/hr

LOW FIXING COST ORIGINATING FROM SYNTHESIS™

- Labour savings are achieved when compared to manually-tied steel

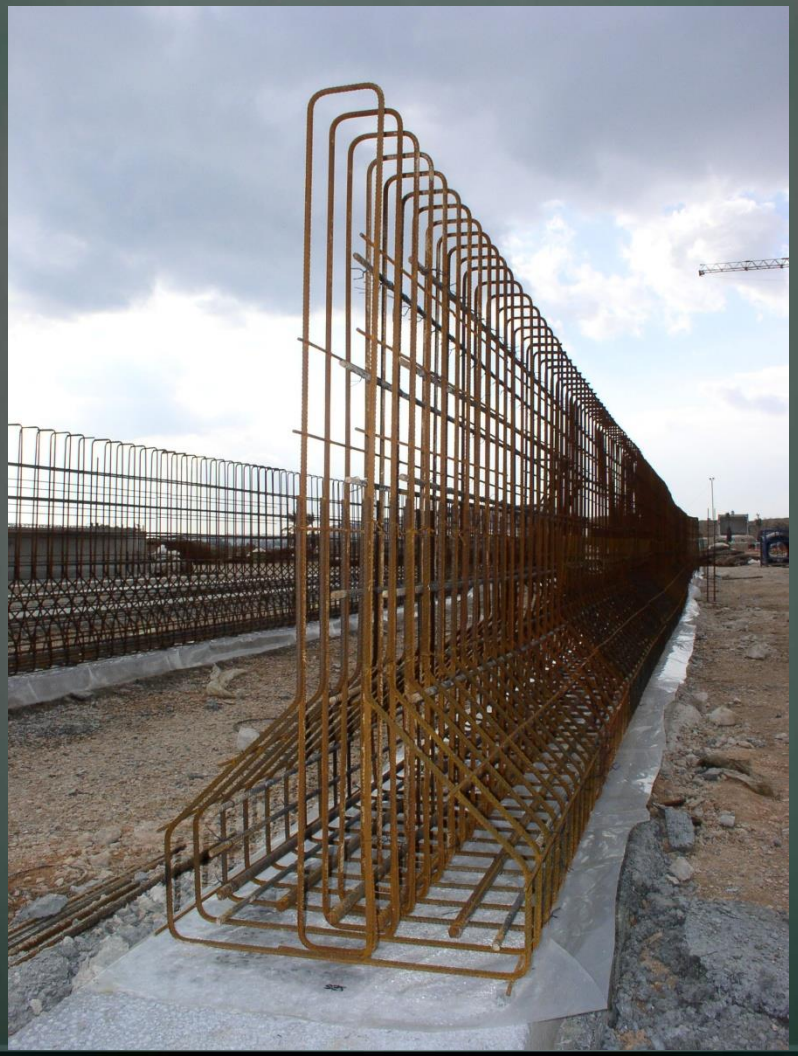
OTHER SAVINGS

- Synthesis™ Software package saves detailing time and optimises facility operations

PRECAST MARKET EXAMPLES – BRIDGE BEAM

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES – BRIDGE BEAM



SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES – BRIDGE BEAM

PRECAST MARKET EXAMPLES – BRIDGE BEAM

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES – BRIDGE BEAM

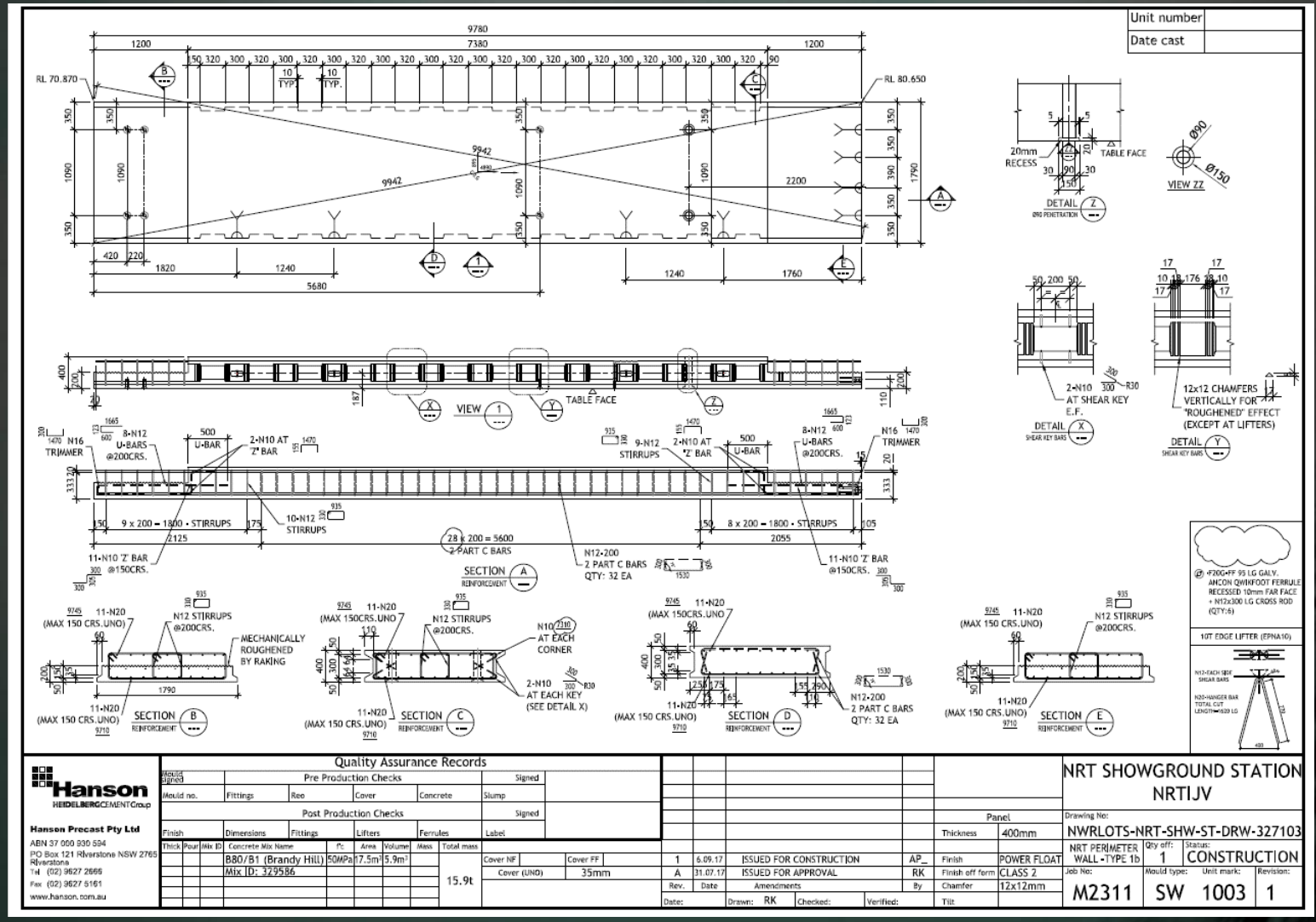
SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES – BRIDGE BEAM

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES – STADIUM STAND

PRECAST MARKET EXAMPLES - WALL



Hanson HEIDELBERGCEMENT Group

Hanson Precast Pty Ltd
ABN 37 000 930 594
PO Box 121 Riverstone NSW 2765
Riverstone
Tel (02) 9627 2666
Fax (02) 9627 5161
www.hanson.com.au

Quality Assurance Records

Mould signed	Pre Production Checks				Signed
Mould no.	Fittings	Reo	Cover	Concrete	Slump
	Post Production Checks				Signed
Finish	Dimensions	Fittings	Lifters	Ferrules	Label

Thick	Pour	Mix ID	Concrete Mix Name	f'c	Area	Volume	Mass	Total mass
			B80/B1 (Brandy Hill) Mix ID: 329586	50MPa	17.5m²	5.9m³		15.9t

Cover NF | Cover FF
Cover (UNO) 35mm

Rev.	Date	Amendments	By
1	6.09.17	ISSUED FOR CONSTRUCTION	AP_
A	31.07.17	ISSUED FOR APPROVAL	RK

Date: Drawn: RK Checked: Verified:

Panel
Thickness 400mm
Finish POWER FLOAT
Finish off form CLASS 2
Chamfer 12x12mm
Tilt

#20G+FF 95 LG GALV. AMCON QWIKFOOT FERRULE RECESSED 10mm FAR FACE + N12x300 LG CROSS ROD (QTY:6)

N12-EACH SIDE SHEAR BARS
N20-HANGER BAR TOTAL CUT LENGTH=6520 LG

NRT SHOWGROUND STATION
NRTIJV

Drawing No: NWRLOTS-NRT-SHW-ST-DRW-327103

NRT PERIMETER WALL - TYPE 1b | Qty off: 1 | Status: CONSTRUCTION

Job No: M2311 | Mould type: SW | Unit mark: 1003 | Revision: 1

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES - WALL

PRECAST MARKET EXAMPLES - WALL

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES - WALL

PRECAST MARKET EXAMPLES - WALL

PRECAST MARKET EXAMPLES - WALL

PRECAST MARKET EXAMPLES - WALL

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES - WALL

PRECAST MARKET EXAMPLES - WALL

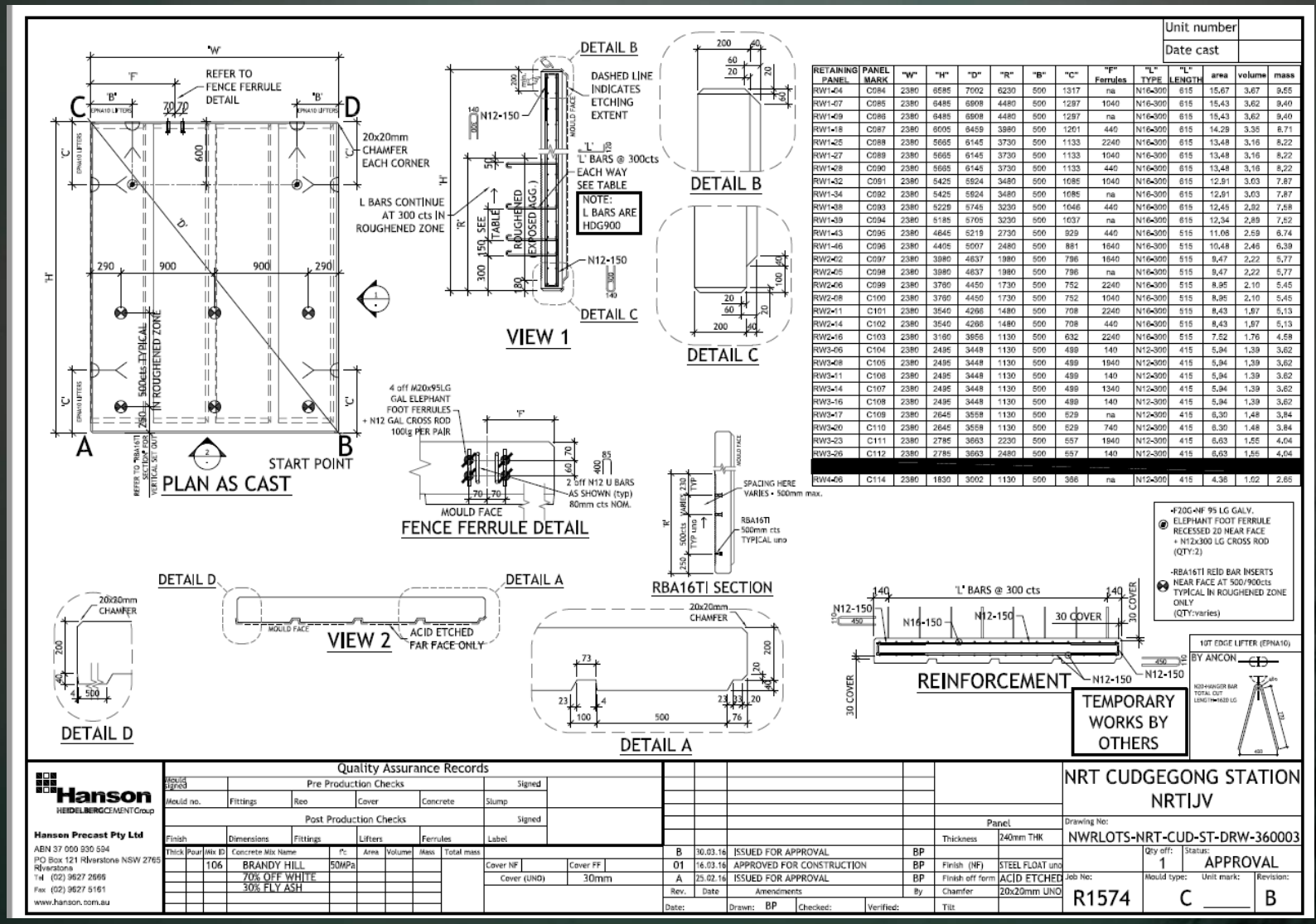
SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES - WALL

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES – BEAM SHELL

PRECAST MARKET EXAMPLES – RETAINING WALL



RETAINING PANEL	PANEL MARK	"W"	"H"	"D"	"R"	"B"	"C"	"F" Ferrules	"L" TYPE	"L" LENGTH	area	volume	mass
RW1-04	C084	2380	6585	7002	6230	500	1317	na	N16-300	615	15.67	3.67	9.55
RW1-07	C085	2380	6485	6908	4480	500	1287	1040	N16-300	615	15.43	3.62	9.40
RW1-09	C086	2380	6485	6908	4480	500	1287	na	N16-300	615	15.43	3.62	9.40
RW1-18	C087	2380	6005	6459	3980	500	1201	440	N16-300	615	14.29	3.35	8.71
RW1-25	C088	2380	5665	6145	3730	500	1133	2240	N16-300	615	13.48	3.16	8.22
RW1-27	C089	2380	5665	6145	3730	500	1133	1040	N16-300	615	13.48	3.16	8.22
RW1-28	C090	2380	5665	6145	3730	500	1133	440	N16-300	615	13.48	3.16	8.22
RW1-32	C091	2380	5425	5924	3480	500	1085	1040	N16-300	615	12.91	3.03	7.87
RW1-34	C092	2380	5425	5924	3480	500	1085	na	N16-300	615	12.91	3.03	7.87
RW1-38	C093	2380	5225	5745	3230	500	1046	440	N16-300	615	12.45	2.92	7.58
RW1-39	C094	2380	5185	5705	3230	500	1037	na	N16-300	615	12.34	2.89	7.52
RW1-43	C095	2380	4845	5219	2730	500	929	440	N16-300	515	11.06	2.59	6.74
RW1-46	C096	2380	4405	5007	2480	500	881	1640	N16-300	515	10.48	2.46	6.39
RW2-02	C097	2380	3980	4637	1980	500	796	1640	N16-300	515	9.47	2.22	5.77
RW2-05	C098	2380	3980	4637	1980	500	796	na	N16-300	515	9.47	2.22	5.77
RW2-06	C099	2380	3760	4450	1730	500	752	2240	N16-300	515	8.95	2.10	5.45
RW2-08	C100	2380	3760	4450	1730	500	752	1040	N16-300	515	8.95	2.10	5.45
RW2-11	C101	2380	3540	4268	1480	500	708	2240	N16-300	515	8.43	1.97	5.13
RW2-14	C102	2380	3540	4268	1480	500	708	440	N16-300	515	8.43	1.97	5.13
RW2-16	C103	2380	3160	3956	1130	500	632	2240	N16-300	515	7.52	1.76	4.58
RW3-06	C104	2380	2495	3448	1130	500	499	140	N12-300	415	5.94	1.39	3.62
RW3-08	C105	2380	2495	3448	1130	500	499	1940	N12-300	415	5.94	1.39	3.62
RW3-11	C106	2380	2495	3448	1130	500	499	140	N12-300	415	5.94	1.39	3.62
RW3-14	C107	2380	2495	3448	1130	500	499	1340	N12-300	415	5.94	1.39	3.62
RW3-16	C108	2380	2495	3448	1130	500	499	140	N12-300	415	5.94	1.39	3.62
RW3-17	C109	2380	2645	3558	1130	500	529	na	N12-300	415	6.30	1.48	3.84
RW3-20	C110	2380	2645	3558	1130	500	529	740	N12-300	415	6.30	1.48	3.84
RW3-23	C111	2380	2785	3663	2230	500	557	1940	N12-300	415	6.63	1.55	4.04
RW3-26	C112	2380	2785	3663	2480	500	557	140	N12-300	415	6.63	1.55	4.04
RW4-06	C114	2380	1830	3002	1130	500	366	na	N12-300	415	4.36	1.02	2.85

Hanson HEIDELBERGCEMENT Group
Hanson Precast Pty Ltd
ABN 37 000 930 594
PO Box 121 Riverstone NSW 2765
Riverstone
Tel (02) 9627 2666
Fax (02) 9627 5161
www.hanson.com.au

Quality Assurance Records

Pre Production Checks — Signed
Mould Signed | Mould no. | Fittings | Reo | Cover | Concrete | Slump

Post Production Checks — Signed
Finish | Dimensions | Fittings | Lifters | Ferrules | Label

Thick	Pour	Mix ID	Concrete Mix Name	f'c	Area	Volume	Mass	Total mass
		106	BRANDY HILL	50MPa				
			70% OFF WHITE					
			30% FLY ASH					

Cover NF | Cover FF
Cover (UNO) 30mm

Rev.	Date	Amendments	By
B	30.03.16	ISSUED FOR APPROVAL	BP
01	16.03.16	APPROVED FOR CONSTRUCTION	BP
A	25.02.16	ISSUED FOR APPROVAL	BP

Date: | Drawn: BP | Checked: | Verified:

Panel
Thickness 240mm THK
Finish (NF) STEEL FLOAT uno
Finish off form ACID ETCHED
Chamfer 20x20mm UNO
Tilt

NRT CUDGEGONG STATION
NRTIJV
Drawing No: NWRLOTS-NRT-CUD-ST-DRW-360003
Qty off: 1 | Status: APPROVAL
Job No: R1574 | Mould type: C | Unit mark: | Revision: B

PRECAST MARKET EXAMPLES – RETAINING WALL

PRECAST MARKET EXAMPLES – RETAINING WALL

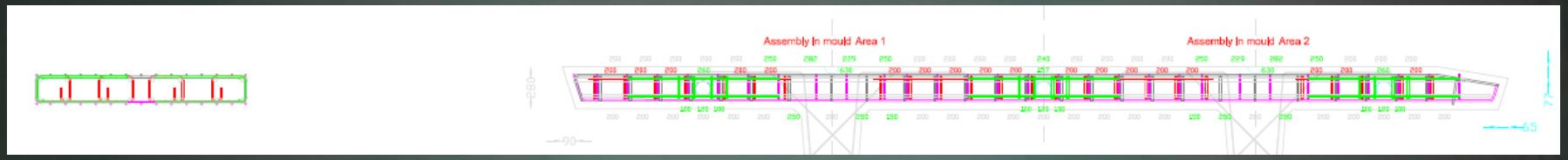
PRECAST MARKET EXAMPLES – RETAINING WALL

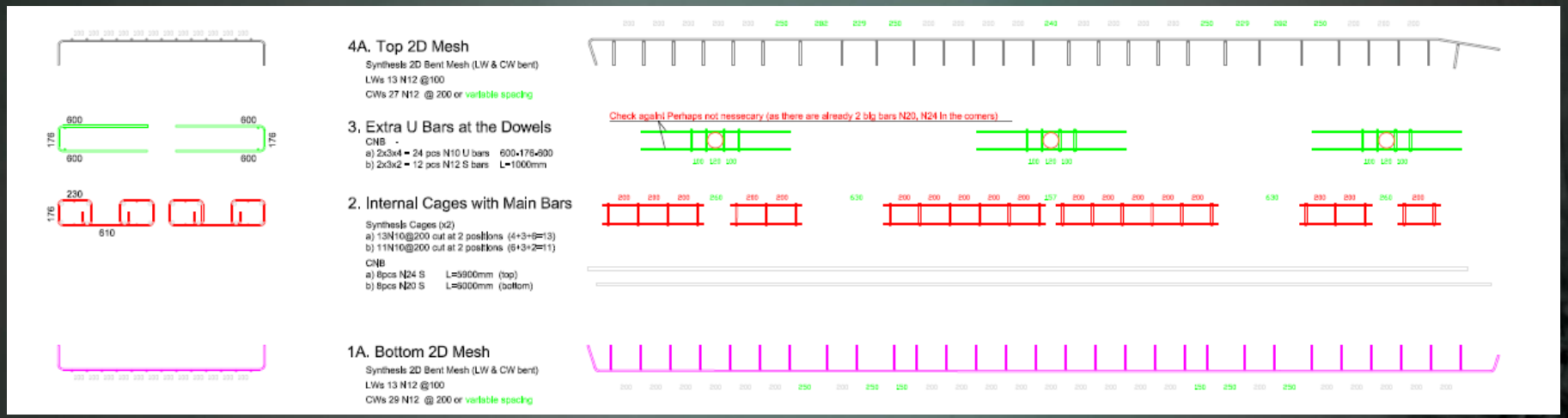
PRECAST MARKET EXAMPLES – RETAINING WALL

PRECAST MARKET EXAMPLES - COLUMN

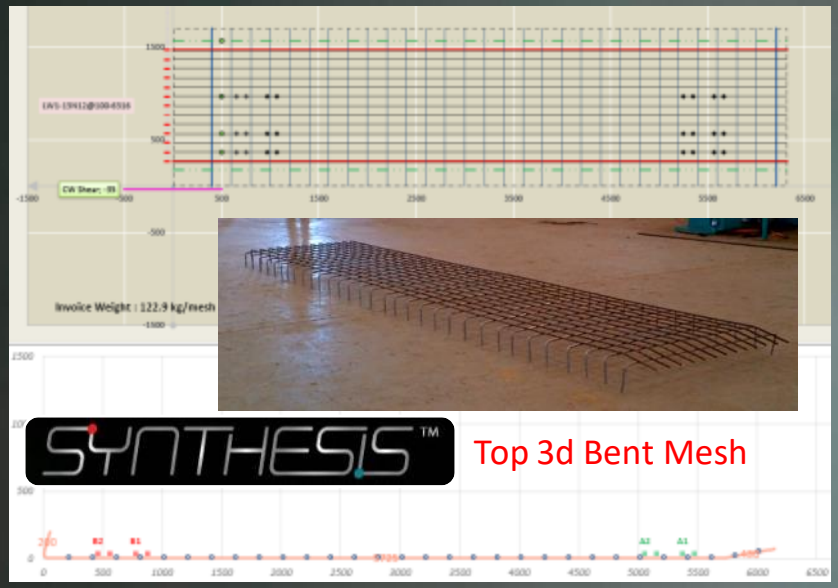
PRECAST MARKET EXAMPLES - COLUMN

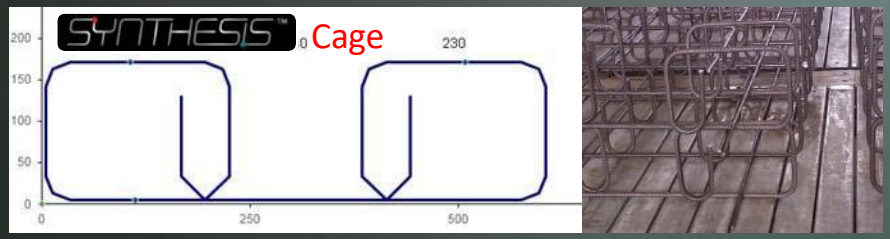
PRECAST MARKET EXAMPLES - DECK





PRECAST MARKET EXAMPLES - DECK



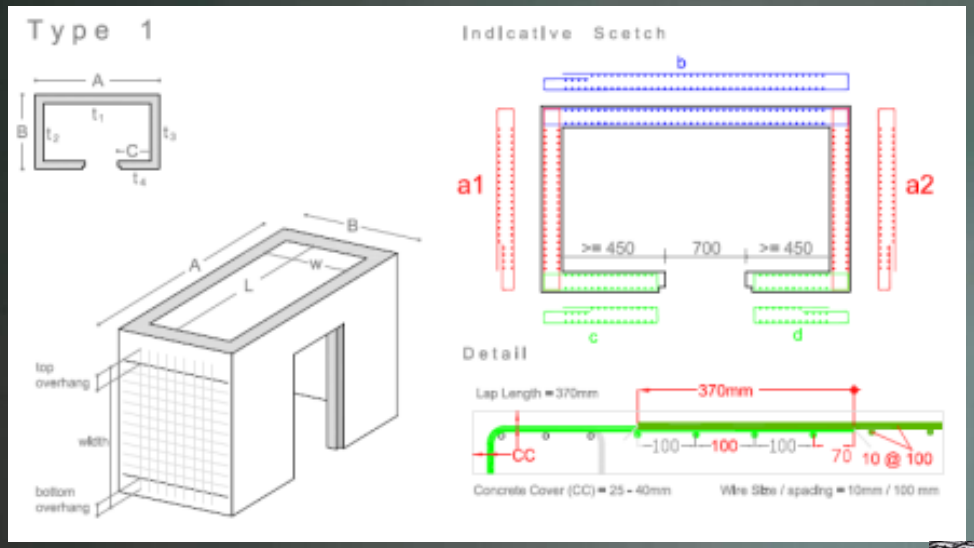


	PROD_TYPE	SIMPLE_LIB_TYPE	PCS	UOM	DESCRIPTION	PART TAG ID	COMMENT	CSV 1 NAME	INDEX	INVOICE_WEIGHT TOTAL	N10	N12	N16	N20
1	CAGE		2	EA	610x176-4X1_b- No MBs - 12N10 - Elevation A - 2400	W414-1				16.60	16.60	0.00	0.00	0.00
2	BENTMESH		1	EA	CWs (T):400-29N12@200/0-1700 LWs :235-13N12@100/0-6316	W414-2	BOTM	COMBO_517 PART_2.0001		121.33	0.00	121.33	0.00	0.00
3	BENTMESH		1	EA	CWs (T):400-30N12@200/0-1700 LWs :235-13N12@100/0-6316	W414-3	TOP	COMBO_517 PART_3.0001		122.90	0.00	122.90	0.00	0.00
4	CNB		2	EA	N12; Pin : 65; ShapeCode= empty	W414-4	TOP EXTRA BARS	COMBO_517_N12_65.0002	200;108;5725;9;430;0;0;0;0;0;Z6323	5.87	0.00	5.87	0.00	0.00
5	CNB		2	EA	N12; Pin : 65; ShapeCode= empty	W414-5	BTM	COMBO_517_N12_65.0002	200;70;6000;70;140;0;0;0;0;0;Z6295	5.86	0.00	5.86	0.00	0.00
6	CNB		3	EA	N12; Pin : 65; ShapeCode= empty	W414-6	EXTRA CWS	COMBO_517_N12_65.0003	175;90;1390;90;175;0;0;0;0;0;Z1668	1.61	0.00	1.61	0.00	0.00
7	CNB	S_	8	EA	N20; Pin : 100; ShapeCode= S_ - A=5900	W414-7	MAIN	COMBO_517_N20_100.0008	5900;0;0;0;0;0;0;0;0;0;Z5895	15.14	0.00	0.00	0.00	15.14
8	CNB	S_	8	EA	N16; Pin : 65; ShapeCode= S_ - A=6000	W414-8	MAIN	COMBO_517_N16_65.0008	6000;0;0;0;0;0;0;0;0;0;Z5995	9.85	0.00	0.00	9.85	0.00
										505.64				

80% Synthesis
20% Simple C&B
Easy Assembly

SYNTHESIS™ MACHINES

PRECAST MARKET EXAMPLES – SHELTER WALL



SYNTHESIS™ MACHINES

SYNOPSIS

- ***The need for higher productivity to reduce dependence on manual labor is becoming increasingly important across the whole construction market.***

- ***Enhancing mechanization and best practices in the construction sector (including the precast sector) is more a necessity now than ever before.***

- ***Synthesis™ technology provides a breakthrough service to the precast market by introducing prefabrication solutions that offer technically and economically viable reinforcing alternatives to customers***