

# SARCEA

**SOUTH AFRICAN REINFORCED CONCRETE ENGINEERS' ASSOCIATION**

*Providing the  
Integrity in  
Reinforced  
Concrete*



## CORRECT CONCRETE COVER TO REINFORCEMENT

Correct cover to reinforcing steel not only affects the durability of the concrete but also the extent and severity of cracking under working loads. In conditions of fire the amount of cover also governs the time scale before damage to the reinforced concrete elements occurs. Attention to **correct detailing practices**, which include making allowances for permissible tolerances of **both reinforcing and formwork** the maintenance of good construction practices and the specification and use of the correct number and type of reinforcing cover devices will ensure that the rebar can be placed and maintained in the position intended. Nominal cover required should be clearly shown on all relevant drawings. The amount of nominal cover is dependant upon the size and type of the structural member, the environmental conditions to which it will be exposed (including fire), the class of concrete and the type and size of reinforcing bar which will be used.

Actual cover obtained on site should never be less than the minimum nominal cover by the relevant authorities, nor more than the minimum, plus variations as specified. Positive tolerances on cover are as important as negative. To ignore them would invalidate design assumptions relating to effective depth and would also influence the width of surface cracks under design loads.

### Correct Covers:

- Ensures protection of the Rebar from the environment by providing a physical barrier
- Ensures that concrete completely encircles Rebar allowing passivation
- Ensures that concrete completely encircles Rebar allowing complete bond to develop
- Allows the Rebar to assume position and act as designed
- Prevents staining
- Provides a time lag in cases of fire

The engineering and detailer should specify and schedule the correct number and type of cover devices required (SABS 0144)

### EXAMPLE OF BAR SCHEDULING TO SABS 82: 1997

1	2	3	4	5	6	7	8	9	10	11	12	13				
Member	Reinforcement					Bending dimensions for shape codes (SABS 82)						Fixing and non-standard bending details				
Mark, size & No. Of	No. in each	Type & size	Bar mark	Total No.	Length <sup>1</sup> mm	Shape Code	A <sup>2</sup> mm	B <sup>2</sup> mm	C <sup>2</sup> mm	D <sup>2</sup> mm	E <sup>2</sup> or r <sup>2</sup> mm					
	Masses	Nom. size	6	8	10	40	Total	R=Mild steel bars (250 MPa) to SABS 920 Y= High yield steel bars (450 MPa) to SABS 920 Z= Cold drawn wire rod  1) Specified in multiples of 25 mm 2) Specified in multiples of 10 mm  This schedule complies with SABS 82				Sheet title	Project No.	Schedule No.		
		M.S.										Project	Ref. Drawing	Revision suffix		
		H.T.														
		Total														

## SOME PRACTICAL COST SAVING HINTS

- Every bend adds cost so keep it simple
- Consider stock lengths as every offcut adds cost
- Rework is costly so recheck the schedules
- Transporting bars that were left off the schedules can be very costly indeed
- Shortcuts taken in the drawing office can lead to delays and increased cost on site
- Prefabrication can ease the programme and significantly reduce fixing costs.
- Enlarged details of complicated sections can save time on site and reduce costs. Remember that a Y25 deformed bar needs a space of at least 32mm to pass through
- If bending creep is deducted, ensure that the total length is sufficient to allow the bending machine to grip the bend
- It would be beneficial for aspirant detailers to conclude their training by spending a few months cutting, bending and fixing steel. This would greatly enhance their ability to produce good detailing to produce good detailing during the rest of their careers.

## MASS AND AREA TABLES

Table 1. Sectional areas of groups of bars (mm<sup>2</sup>)

Number of bars										
Bar size mm	1	2	3	4	5	6	7	8	9	10
8	50.3	100	151	201	251	302	352	402	452	503
10	78.5	157	236	314	393	471	550	628	707	785
12	113	226	339	452	566	679	792	905	1018	1131
16	201	402	603	804	1005	1206	1407	1608	1810	2011
20	314	628	942	1257	1571	1885	2199	2513	2827	3142
25	491	982	1473	1964	2454	2945	3436	3927	4418	4909
32	804	1608	2413	3217	4021	4826	5630	6434	7238	8042
40	1257	2513	3770	5026	6283	7540	8796	10050	11310	12570

Table 3. Mass of groups of bars (kg/m)

Number of bars										
Bar size mm	1	2	3	4	5	6	7	8	9	10
8	0.395	0.79	1.19	1.58	1.98	2.37	2.77	3.16	3.56	3.95
10	0.617	1.23	1.85	2.47	3.09	3.70	4.32	4.94	5.55	6.17
12	0.888	1.78	2.66	3.55	4.44	5.33	6.22	7.10	7.99	8.88
16	1.58	3.16	4.74	6.32	7.90	9.48	11.06	12.64	14.22	15.80
20	2.47	4.94	7.41	9.88	12.35	14.82	17.29	19.76	22.23	24.70
25	3.85	7.70	11.55	15.40	19.25	23.10	26.95	30.80	34.65	38.50
32	6.31	12.62	18.93	25.24	31.55	37.86	44.17	50.48	56.79	63.10
40	9.86	19.72	29.58	39.44	49.30	59.16	69.02	78.88	88.74	98.60

Table 2. Sectional areas per metre width for various bar spacings (mm<sup>2</sup>/m)

Number of bars										
Bar size mm	75	100	125	150	175	200	225	250	275	300
8	670	503	402	335	287	251	223	201	183	168
10	1047	785	628	524	449	393	349	314	286	262
12	1508	1131	905	754	646	566	503	452	411	377
16	2681	2011	1608	1340	1149	1005	894	804	731	670
20	4189	3142	2513	2094	1795	1571	1396	1257	1142	1047
25	6545	4909	3927	3272	2805	2454	2182	1964	1785	1636
32	10720	8042	6434	5362	4596	4021	3574	3217	2924	2681
40	16760	12570	10050	8378	7181	6283	5585	5026	4570	4189

Table 4. Mass per square metre for bars in one direction at various spacings (kg/m<sup>2</sup>)

Number of bars										
Bar size mm	75	100	125	150	175	200	225	250	275	300
8	5.261	3.946	3.157	2.631	2.255	1.973	1.754	1.578	1.435	1.315
10	8.220	6.165	4.932	4.110	3.523	3.083	2.740	2.466	2.242	2.055
12	11.84	8.878	7.103	5.919	5.073	4.439	3.946	3.551	3.228	2.959
16	21.04	15.78	12.63	10.52	9.019	7.892	7.015	6.313	5.739	5.261
20	32.88	24.66	19.73	16.44	14.09	12.33	10.96	9.865	8.968	8.220
25	51.38	38.53	30.83	25.69	22.02	19.27	17.13	15.41	14.01	12.84
32	84.18	63.13	50.51	42.09	36.08	31.57	28.06	25.25	22.96	21.04
40	131.5	98.65	78.92	65.76	56.37	49.32	43.84	39.46	35.87	32.88

## APPLICABLE STANDARDS

SABS 82 - 1997	Bending Dimensions of Bars for Reinforced Concrete.
SABS 920 -1985	Steel Bars for Concrete Reinforcement.
SABS 0100 Series	The Structural Use of Concrete.
SABS 1200 Series	Standardized Specification for Civil Engineering Construction.
SABS 1778	Reinforcing Cover Devices.
ARP 040 : 1997	The Use of Reinforcing Cover Devices for Reinforced Concrete.
SABS 0144 - 1995	Code of Practice for Detailing of Steel Reinforcement for Concrete.
ISO 9000 - 1994	Quality Management Systems.

## Standard System Of Management

**Steel Reinforcement should be measured by mass and separate items should be provided for each diameter**

**Standard System of Measuring Building Work**

Association of South African Quantity Surveyors.

**Measurement of Civil Engineering Quantities.**

South African Federation of Civil Engineering Contractors.

## **THE IMPORTANCE OF GOOD DETAILING AND SCHEDULING**

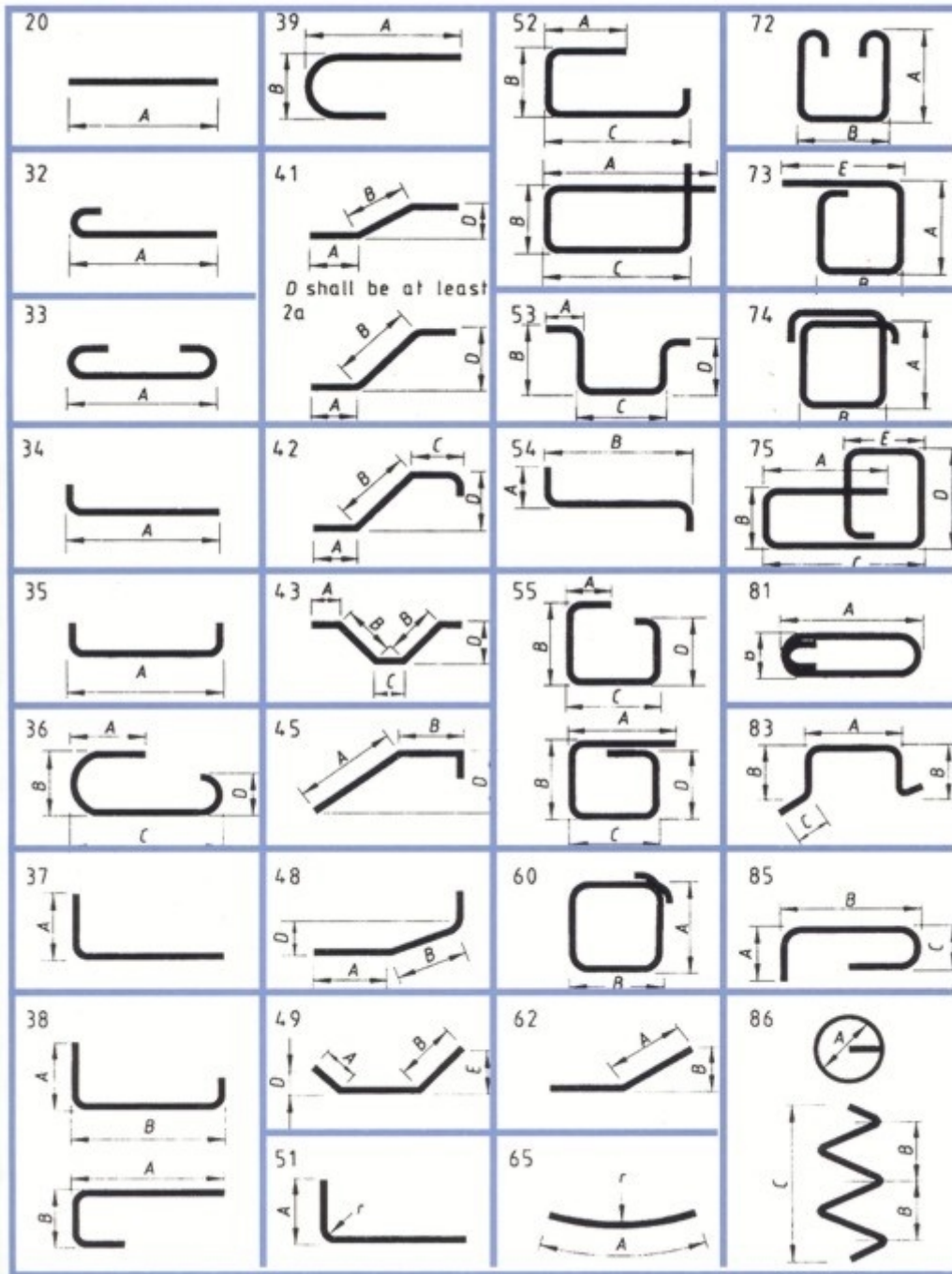
Good detailing and scheduling of reinforcement helps the construction process considerably by minimising costs, delays and disputes, by easing the steelfixer's task and by providing the contractor with a certain amount of flexibility both in fixing and in construction staging. Poor detailing and scheduling, on the other hand, can prove extremely costly and detrimental to construction. Site checking is also a great deal easier if details are kept simple.

## **DETAILERS CHECKLIST OF DRAWINGS AND SCHEDULES**

- Can the reinforcement as detailed be fixed?
- Does the detailing permit sensible location of construction joints, staged construction and scheduling of reinforcing deliveries?
- Is the reinforcement congested? Will this affect fixing or proper compaction of concrete?
- Would alternative detailing (e.g. staggered laps, bars reversed, two lapped bars replacing a single bar) provide greater flexibility or ease of fixing?
- Is there scope for prefabrication? Is this desirable?
- What is the (best) fixing sequence?
- Is the reinforcement detailed to provide sufficient rigidity and stability of cages during concreting?
- Are set-up bars, bracing bars, chairs, spacers, etc. Detailed and scheduled?
- Are bars of a weight that can readily be handled?
- Do schedules agree with drawings e.g. numbers, types, sizes of bars?
- Does reinforcement in one member clash with that in an adjacent member (e.g. at a beam/column junction)?
- Do numbers of bars or sheets of fabric allow for two faces and not just one?
- Are scheduled bending dimensions compatible with member dimensions and specified concrete cover?
- Are starter bars detailed (and scheduled) with the concrete element in which they are first cast?
- Starter bars are frequently the last to be fixed to ensure positional accuracy. Does the detailing permit this?
- If closed links (or similar) are detailed, do they cause problems by requiring threading through of main bars during fixing?

## **PRE-CONCRETING CHECKLIST**

- Check inherent rigidity of the cage or mat
- Check correct numbers of bars have been fixed
- Check adequate provision of continuity reinforcement or connection to previous starter bars
- Check that any bars temporarily repositioned have been returned to their correct positions
- Check that starter bars, starter boxes, void formers, fixing etc. to prevent and in correct locations
- Check correct use of adequate cover blocks, reinforcement spacers, etc. to prevent cage movement during concreting
- Check for damaged reinforcement (particularly coated bars); repair or replace as necessary
- Check cover to reinforcement is correct at all locations
- Check that the cage is in the correct position (either line and level or relative to previously checked formwork)
- Check that all twisted ends of ties are bent inwards away from concrete faces
- Ensure adequate access for concrete compaction (e.g. by poker vibrator)
- Ensure overall cleanliness of formwork (removal of water, tie clippings etc.)
- Ensure that harmful chemicals have not been used anywhere



**Notes:**

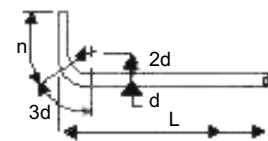
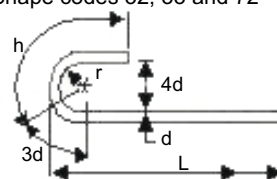
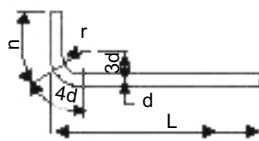
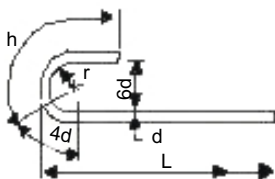
1. Use shape code 99 for all other shapes. A dimensioned sketch of the shape shall be given in the bending schedule
2. Radii of all bends are standard unless r is given in the bending schedule
3. All dimensions are external (outside) dimensions

Minimum hook, bend and radius allowances for high yield stress steel bars and cold-worked steel bars that comply with SABS 920

Minimum hook, bend and radius allowances for hot-rolled mild steel bars that comply with SABS 920

Semi-circular hooks  
Shape codes 32, 33 and 72

Bends that form end anchorages  
Shape codes 34, 35 and 42



Cutting length of bar equals L+h

Cutting length of bar equals L+n

Cutting length of bar equals L+h

Cutting length of bar equals L+n

Dimensions in millimeters							
Nominal size of bar d	10	12	16	20	25	32	40
Hook allowance h	180	210	240	280	340	400	480
Bend allowance n	130	130	150	170	190	220	250
Radius r	30	36	48	60	75	96	120

Dimensions in millimeters								
Nominal size of bar d	8	10	12	16	20	25	32	40
Hook allowance h	100	140	170	190	210	240	290	360
Bend allowance n	100	100	100	120	130	150	180	200
Radius r	16	20	24	32	40	64	50	80

## SARCEA

### Reinforced Concrete

Concrete has been used as a construction material for centuries because most parts of the where early civilizations were established had natural cement deposits. In Mediterranean countries there are many remains of Roman concrete construction. Early in the 19th century, the artificial cement, Portland Cement, consisting chiefly of clay and limestone chalk, was invented. This allowed for a more uniform and economic cement to be manufactured almost anywhere in the world. Relying on the great strength of concrete in compression, numerous splendid concrete structures were built.

It was only in the latter of the 19th century that the weakness of concrete in tension was overcome. The tension areas were reinforced by imbedding steel in the concrete to carry the tensile stresses. The development of this technology has resulted in the construction of all the wonderful sophisticated concrete structures, all over the globe, that we take for granted today. "**Encyclopedia Britannica**"

### History

In January 1934, four reinforcing firms were admitted to the Witwatersrand Master Builders Association. Later that year a fifth member was admitted. In due course, however the steel reinforcement firms, who were specialist engineering contractors operating both in the building and civil engineering industries, felt that the interests of the industry would best be served by their affiliation to the Steel and Engineering Industries Federation of South Africa (SEIFSA).

An Association was constituted on 15 October 1942 with a membership of eight firms. Today most reputable reinforcing steel suppliers are members of SARCEA. This association was registered with the Industrial Registrar in April 1944 and re-registered with the Industrial Registrar under the Labour Relations Act 1995 (Act 66 of 1995). "**Fifty Years in Construction**", **SARCEA 1992**.

### Goals

Established as a nonprofit trade association, SARCEA exists to preserve the good name of the industry; to protect the interests of members; to encourage fair and equitable trading conditions; establish optimum standards of design, workmanship and service and to ensure fair conditions of employment for all employment in the industry. In brief, SARCEA's efforts are aimed at **Providing the Integrity in Reinforced Concrete**.

Membership is open to any company in the Republic of South Africa involved in the design, supply and placing in position of reinforcing steel and can maintain the required quality standards. Associate membership is also available to companies in neighbouring countries.

### Today

The reinforcing industry has advanced technologically, particularly in the handling, quick and efficient cutting, bending and placing in position of reinforcing bars. Members still face challenges similar to those faced by previous generations. Today however, the problems are more complex.

### Skills Training

SARCEA fully supports the aims of the recently enacted Skills Development legislation, having participated in the Career Path Pilot Projects sponsored by the Department of Labour and Metal and Engineering Industries Education and Training Board. The highly successful SARCEA Training Scheme is at present being adjusted for integration into the National Qualification Framework.

SARCEA remains fully committed to these training projects in the knowledge that their success will not only benefit the industry, its clients and the general public, but will also have a significant impact on the well being of all employed in the industry.

### Management Training

SARCEA provides a number of sponsorships for promising candidates from member companies on supervisory management courses.

### Steel Detailing Lectures, Video and Yard Visits

In order to promote a fully professional approach to the detailing of reinforcing steel, SARCEA has for many years provided lectures, assisted by video material and backed by site and steel yard visits, to final year University, Technikon and Draughting School students. A member of consulting engineers have also made use of this service.

