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WELDED WIRE REINFORCEMENT

THE ELEGANT REINFORCEMENT SOLUTION FOR INDUSTRIALIZED CONCRETE CONSTRUCTION IN INDIA

It is an established fact that by mechanization or industrialization any and every productive activity invariably benefits in all respects of quality, efficiency of time and energy and elegance of human effort . The application of technology to any process helps achieve accurate control on all the required parameters. Reinforced Concrete Construction which is the backbone to any infrastructural project depends for its performance on its prime elements namely Concrete and Reinforcement. Just as mechanization of concrete production namely Mix design, Auto batching plants , Ready Mix technology and automated casting techniques have raised the standards and strengths of concrete to remarkable levels, the same is essential for reinforcement. It is high time we stopped doing the handicraft work of tying up individual bars . Usage of WELDED WIRE REINFORCEMENT (WWR) is the easy and correct solution for achieving the requirements of quality, reliability, speed and efficiency.

WELDED WIRE REINFORCEMENT (WWR) is a prefabricated reinforcement consisting of a series of parallel longitudinal wires with accurate spacing welded to cross wires at the required spacing. The welding of the wires is achieved by electric resistance welding with solid-state electronic control and all the spacings are controlled by an automatic mechanism of high reliability. There is no foreign metal added at the joint and the intersecting wires are actually fused into a homogeneous section thereby ensuring permanency of spacing and alignment in either direction.

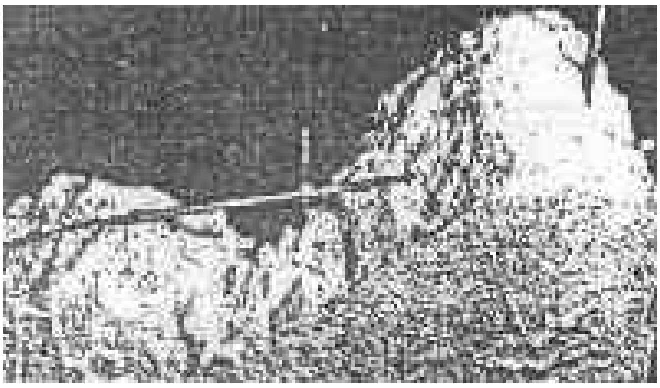
The wires used in the fabric are cold drawn from controlled quality mild steel wire rods with carbon content generally less than 0.15%. The cold drawing through a series of tungsten carbide dies results in a high tensile strength and increased yield strength material of accurate dimensions . Further, each section of the wire gets inherently tested by the process itself for its characteristic physical properties thereby offering a systematic reliability of material . The cold drawing operation unlike the cold twisting used in HYSD bars also doesn't sacrifice the ductility of the material in any major way. The wires conform to IS:432-Pt II/1982 which specifies an ultimate tensile strength of 570 N/mm2 and a characteristic strength of 480 N/mm2. Wires used for manufacture of fabric are generally manufactured in the range of 2 mm to 12mm diameter.

WWR is manufactured conforming to IS:1566-1982 with long and cross wire spacings varying from 25 mm to 400 mm. Each of the rigidly welded intersection is capable of withstanding shear stresses upto 210 N/mm2(IS:4948/1974) on the reference area of the longitudinal wire. The fabric can be manufactured in widths upto 3000mm with lengths limited by transportation considerations. When supplied in ready to lay flat sheet form the standard length is 5500mm. Otherwise the fabric can be supplied in roll form in standard lengths of 15m,30m or 45m.

ADVANTAGES OF WELDED WIRE FABRIC

1) **The VALUE OF TIME SAVED :** Welded Wire Reinforcement becomes even more relevant in these times where Time saved has significant financial value due to the higher component of the fixed asset (real estate) value which can be unlocked that much earlier.

2) **BETTER BONDING BEHAVIOR:**The bonding behavior of WWR is significantly enhanced and different from that of HYSD or Plain Mild steel bars. As against the peripheral surface area which is responsible for bonding to concrete in the case of individual bars, the rigid mechanical interconnections by means of welds to cross wires are primarily responsible for stress transfer from concrete to steel and vice-versa in the case of WWR. Each of the rigid welds capable of resisting upto 210 N/mm2 ensure quick and complete stress transfer within 2 welded joints from the critical section. This behavior of positive mechanical anchorage is acknowledged in specification of much lower lap splice lengths for WWR. A lap splice or a development length consisting of 1 cross-wire spacing comprising 2 welded intersections plus additional 100mm subject to a minimum of 150 mm total length is sufficient to develop a full strength lap. This aspect can result in savings of steel vis-a-vis HYSD bars by making easy the option to use a combination of fabrics/ steel areas provided to achieve curtailment of reinforcement with easy and short splices.



3) **BETTER AND ECONOMIC CRACK RESISTANCE WITH THINNER WIRES AND CLOSER SPACINGS:**
The behavior of strong mechanical anchorage of the welds at each the intersections is further responsible in imparting an immense deal of homogeneity to the R.C.C section as a whole. The two dimensional uniform stress distribution of the fabric with the concrete achieves better plate behaviour in the slab. Further, WWR usage affords the possibility of using thinner wires at closer spacings. This serves most effectively in countering the non-load phenomena or strain induced stresses due to Shrinkage and Temperature changes. The close spacing of thinner wires and the two-way behavior of WWR minimizes the crack widths and preserves structural integrity of the slab. This is particularly true for large span and large area structural and ground slabs. Further in cases where a designer is constrained to provide more than minimum reinforcement from the maximum bar spacing criteria, WWR affords enormous savings by providing reliable fabric with thinner wires at closer spacings.

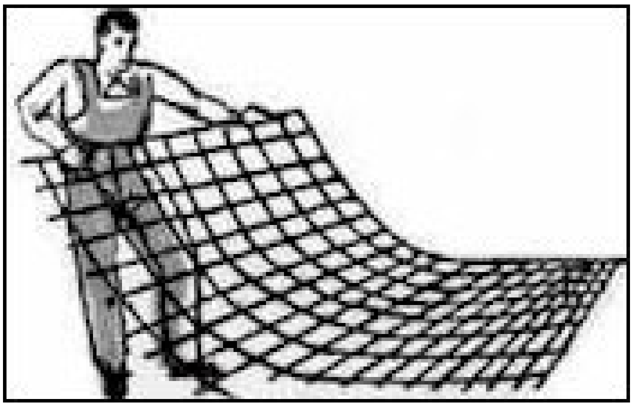
For instance consider very common cases in residential slabs where load stresses are low but where minimum thicknesses of 75 to 125mm are used

Slab Depth	Min steel. reqd.@ 0.12%	HYSD Steel provided at 3 x eff.depth max. spacing	Welded Wire Steel Fabric Close spacing	%Savings of steel
75 mm	90 mm^2/m	Y8 @ 165c/c= 303mm^2/m	125 x125-4mm dia = 100 mm^2/m	67%
100 mm	120 mm^2/m	Y8@ 240c/c= 209mm^2/m	100x100-4mm dia = 125 mm^2/m	40%
125 mm	150 mm^2/m	Y8@310c/c= 162mm^2 /m	100x100-4.4mm dia =152 mm^2/m	6.2%

from serviceability or other reliability criteria,

The above aspect can be exploited to achieve savings in various cases of even designed steel area zones by providing minimum steel of suitable thinner WWR over all the zones and then adding extra layers of thicker designed steel WWR in the stressed zones of a slab.

4) **SAVINGS OF LABOUR, TIME AND BINDING WIRE:** The most obvious and clinching advantage in the use of WWR is the immediate and positive savings in labour and time. It is complete freedom from all the mundane fitter's jobs. There is no cutting of bars, no marking and spacing them out , and above all no laborious tying of binding wires. There is saving of skilled fitters manpower and saving of helpers to cut and tie.



The fabric is available ready to lay on the shuttering. It is also ready for casting as the need for supervisors/ engineers to check the bar sizes & spacings is eliminated. The enormous savings in man-days and the associated cost vary from project to project depending upon the scale of the job and the repeatability of design. In repair jobs of critical nature where the structure is in service, the boon of time saving with WWR cannot be understated. In return to all savings , the builder is always doubly benefited because he is assured of the job being done much more reliably and with much better quality. The designer too has lesser nightmares since he is assured that no bars have been missed or altered. Apart from savings in labour and time, there is direct savings in the consumption of binding wire. This consumption saved works out to about 2 to 5% of the reinforcement used in terms of cost of steel saved. Besides, the added benefit is avoidance of those dangling ends of binding wire which are the starting fuses for the virus of corrosion into the reinforcement.

5) **THE ONLY FEASIBLE AND ESSENTIAL ALTERNATIVE FOR GROUND SLABS :** Concrete Slabs on ground including roads and pavements are often ignored and neglected from the provision of reinforcement. This however is most unfortunate since ground slabs are more often than not subject to many times greater loads than they were supposed to bear and further the base and sub-soil conditions are mostly quite unreliable. In such a scenario, the presence of at least some reinforcement makes a world of difference. WWR usage provides the only practical and easy solution for reinforcing slabs on ground.

A plain concrete slab under conditions of sub-soil erosion or movements or due to temperature changes coupled with heavy traffic loading will develop cracks which collapse the integrity of the surface. The tendency to use extra high strength concrete or extra thickness of concrete to minimize cracking does not solve any problems since the strains induced by drying shrinkage or temperature contraction do not appreciably change with thickness. cost of a WWR reinforced slab is also more or less similar to that of a slightly thicker unreinforced slab. Usage of WWR serves to control cracking and crack width in both directions. It ensures that even if a crack develops the cracked faces are held together and the aggregate interlock is maintained. The amount of reinforcement to be provided in ground slabs is generally designed by the ***Subgrade-Drag Procedure*** where

$A_s = \dfrac{9600 \times F \times L \times W}{f_s}$	Where A_s= Reinforcement area reqd. (mm²/m) f_s = allowable stress in reinforcement (N/mm²) F = Friction factor = 2 L = distance between free ends or joints of slab (m) W = dead weight of slab (tons/m²)

A typical 150mm thk ground slab with joints spaced 6m apart by the above design would need As = 2 x 6 x 0.375 x 9600 / (2 x 230). i.e: 94 mm/2 or 0.063% steel. WWR of 100 x 100 x 3.1 x3.1mm of 1.23 kg/m2 would be sufficient for this slab.

Other design procedures such as the ***Confirmed Capacity Procedure , Temperature Procedure , Equivalent Strength Procedure and Crack Restraint Procedure*** covering the unconventional topic of ground slab reinforcement design from all angles have been exhaustively covered in the paper 'Innovative Ways to Reinforce Slabs on Ground' by Robert B Anderson.

5) **FLEXIBILITY OF HANDLING AND PLACING** : The usage of thinner wires lends the fabric as extremely flexible in handling. Coupled with the availability in long lengths in roll form, WWR provide the ideal and convenient solution for all kinds of repair work by Re-plastering or Guniting. The same aspect makes WWR indispensable in thin elements such as precast partitions, shelves, fins, ferrocement or ferrocrete products such as ferrocrete water tanks etc. WWR is the only solution for the thin and though spine of thin and efficient structural elements as folded plate roofs, folded plate precast roof girders or hypar shells.

ECONOMICS:

Every solution apart from providing efficiency , savings and elegance of process, has to prove cost-effective in the final analysis vis-a-vis other alternative solutions. WWR in spite of various impediments still stands strong in cost-effectiveness vis-a-vis HYSD individual bars.. The potential of WWR as a strong catalyst for accelerated infra-structural development has yet to be experienced in the Indian context. It needs the involvement and appreciation of the planners, builders, consultants and contractors in the Industry.

A cost comparison between the competing alternatives of WWR and HYSD bars can be only appreciated by considering the total picture of final as placed costs. A brief comparison on ton basis with present day costs (Feb. 2023) is as follows:

	Rupees / M.Ton
HYSD – Fe500 Grade Bars (Considering Primary Mill material)	65,000
1)Wastage in cutting bending on site @ 2%	3,300
3)Binding Wire consumed @ 1 to 3% average @ 2%	3,300
4)Cost of Labour in cutting fitting, tying, handling @ 9000/ton	7,000
Total Cost of Steel as finally placed :	***78,600***
WELDED WIRE REINFORCEMENT (Considering Primary Mill Raw material) Add : Typical Ready Mesh lifting and placing labour cost :	72,000 2,000
Total Cost of WWR as finally placed	**74,000**
NO OTHER COSTS BUT: 1) Savings of Time which is invaluable but can vary from case to case . 2) Savings of supervisory manpower 3) Elegance of Use. 4) Quality and Reliability of the factory controlled reinforcement. Much better Quality of Crack-free Concrete	

PLEASE NOTE the above cost comparison is simply on a straight reinforcement conversion basis without considering the enormous possibilities offered by WWR as explained in point no.3 of advantages of WWR.

Now , Consider a specific illustration of design and detailing of a typical residential type two-way continuous slab wherein the detailing exploits the benefits of WWR.

Consider a slab panel of 3m x 4.0m continuous on two adjacent edges and discontinuous on the other two. Live Load is 250 kg/m2 . Concrete is M25 grade and steel is HYSD bars in Alternate (1) and WWR in Alternate (2).

Assume a 100 thk slab from deflection criteria as per Cl:23.1 Note-2(IS-456

Two-way Span Aspect Ratio : 4/3 = 1.33
Effec. Depth= 80mm.
Lever Arm Factor = 0.798. Limit Mom.Capacity (M25-Fe415)= 1.325 Ton.m/m

Design Loads: Dead Load: 0.1 x 2.5 = 0.25 t/m2
50mm thk Floor Finish: 0.05 x 2.0 = 0.10 t/m2
Live Load : 0.25 t/m2
0.60 t/m2

Design Mom., Mdes=Mom.Coeff x 0.6 x 3 x 3 ton.m/m

Location	Moment Coeff. as per Table-22 (IS:456 / 78)	Design Moment (ton.m/m)	HYSD-Fe500 steel area reqd (mm^2/m)	WWR-Fe480 steel area reqd (mm^2/m)
1) Short Span -ve Mom at continous edge-M_{xt}	0.067	0.362	236	203
2) Short Span +ve Mom. at mid-span - M_{xb}	0.050	0.270	176	152
1) Long Span -ve Mom. at continous edge-M_{yt}	0.047	0.254	165	143
2) Long Span +ve Mom. at mid-span - M_{yb}	0.035	0.189	123	106

Min.Steel @ 0.12% := 120mm2/m and spacing <= 240mm c/c
DETAILING:

with HYSD-Fe 500 bars	**With WELDED WIRE FABRIC (Fe 481 Grade)**
1) TOP-Short SPAN Provide Y8 @ 210c/c in short-span direction at top at continuous support with 50% extending upto 450mm from support centre and 50% upto 900mm from support centre. **(Steel Consumed = 14.5m of Y8 = 5.72 kgs for Main Steel Only)**	1) **TOP-Short SPAN** Use 125x125-4x4mm WWR of 900 width at top over short span continuous support. Add 125x250-3.6x2.5mm WWR of 450mm width at top over support. **(Steel Consumed= 7.37 kgs for Main+Dist Steel)**
2) **TOP-LONG SPAN** Provide Y8 @ 240c/c (max.spacing criteria) in long span direction at top at continuous support with 50% extending upto 600mm from support centre and 50% upto 1200 from support centre **(Steel Consumed = 13.8m of Y8 = 5.42kgs Main Steel Only)** Provide minimum distribution steel for shrinkage & cracking Y8 @ 300 c/c to all top steel in direction parallel to the edge strips. **(Steel Consumed = 24m of Y8 = 9.42 kgs Distribution Steel Only)**	2) **TOP-LONG SPAN** Use 125x125-4x4mm WWR of 1200 width at top over long span continuous support. **(Steel Consumed = 5.89 kgs for Main & Distribution Steel)**
3) **BOTTOM-SHORT SPAN** Provide Y8 @ 240c/c (max.spacing criteria) in short span direction at bottom -throughout since it is minimum steel. **(Steel Consumed = 51m of Y8 = 20kgs – Short Span- Main)** 4) **BOTTOM-LONG SPAN** Provide Y8 @ 240c/c (max.spacing criteria) in long span direction at bottom -throughout since it is minimum steel. **(Steel Consumed = 52m of Y8 = 21kgs – Long Span -Main)**	3) **BOTTOM-SHORT & LONG SPAN** Use 125x125-4x4mm WWR in the bottom throughout. Add additional 250x250-3.6x3.6 WWR in the middle strip zone of 2.25m x 3m. **(Steel Consumed = 24.14kgs – Short + Long Span Main Steel)**
Total HYSD Bars used = 61.56 kgs **Cost 44,100 /kg** = **Rs 2715** Binding Wire reqd. at approx. 220 bottom joints and 115 top joints with 0.18m of 1.4 dia per joint = **0.9 kgs Cost @ 64/kg** = **Rs 58** Fitting cutting etc Labour at **8.00/kg** = **Rs 492** Total = **Rs 3265/=**	Total WWR used = 37.4 kgs. **Cost @ 57.77 /kg** **= Rs 2161**

Savings achieved by use of WWR = **Rs 1104** or **33.82%** of cost of HYSD detailing. The figures above are themselves to speak leave alone all the elegance of WWR apart.

APPLICATIONS FOR WELDED WIRE FABRIC:
The elegance and tremendous savings in time, cost and energy achieved by WWR usage lend it amenable to applications in a wide spectrum of construction works. Any reinforcement requirement in flat form can be provided with WWR. A brief listing of possible areas of usage include:

1) Structural Flat slabs or in slabs with Beam Slab construction.

2) Large area Floor slabs on ground, pavements, airport runways, aprons etc to achieve crack-free joint less surfaces.

3) Concrete elements of curved or difficult shapes such as arches, domes, lotus petals etc. where the flexibility of WWR and its ready to us nature aids all the way.

4) Precast elements which are thin or are difficult to reinforce such as curved arch flat members, Hyperbolic Paraboloid Shells, folded plate roof girders, fins, thin pardis or chajja drops.

5) Standard mass production precast R.C.C and prestressed elements like slab panels, wall panels where the combination of factory production mechanisms, ready to lay WWR sheets and controlled concrete can result in excellent results with efficiency and quality in all aspects.

6) As a bonding fabric during guniting (spraying of thick Cement-Sand Slurry with Compressed Air) or during re-plastering required for Repairs and rehabitilation of structures. Guniting is also extensively used for coating of pipelines to significantly enhance their life against corrosion. A popular use now is to use WWR strips below plaster at the beam-masonry wall junction to prevent cracks in plaster.

7) Unstressed Shaping or Form Reinforcment used in Prestressed Concrete Girders of Box,I , T or Double T-section. Here WWR with its thin profile is particularly essential since the flanges, web etc of these efficient sections are themselves are quite thin and usage of thick individual bars with the special cover requirements can cause severe congestion for the prestressing tendon ducts.

8) Ferrocement or Ferrocrete works where WWR is the only solution for forming the reinforcing matrix along with chicken mesh to develop thin and efficient precast elements such as water tanks, fins, shelves etc.

For Commercial & other queries Contact:-
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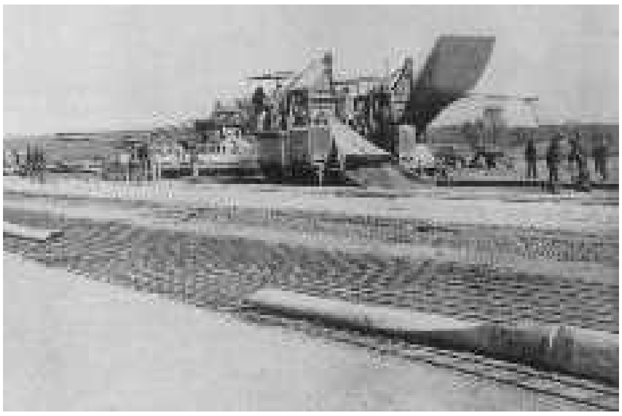

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AREAS & WEIGHTS OF BARS / WIRES at GIVEN SPACINGS

Area Values in cm2 per Metre width

Weight Values in kgs per Sq. meter area

Bar Spacing (cm)	Bar Diameter, (mm)																	
	4.0		4.5		5.0		5.5		6.0		7.0		8.0		9.0		10.0	
	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr	cm2/ mtr	kgs/ sq.mtr
5	2.513	***1.97***	3.181	***2.50***	3.927	***3.08***	4.752	***3.73***	5.655	***4.44***	7.697	***6.04***	10.053	***7.89***	12.723	***9.99***	15.708	***12.33***
7	1.795	***1.41***	2.272	***1.78***	2.805	***2.20***	3.394	***2.66***	4.039	***3.17***	5.498	***4.32***	7.181	***5.64***	9.088	***7.13***	11.220	***8.81***
8	1.571	***1.23***	1.988	***1.56***	2.454	***1.93***	2.970	***2.33***	3.534	***2.77***	4.811	***3.78***	6.283	***4.93***	7.952	***6.24***	9.818	***7.71***
9	1.396	***1.10***	1.767	***1.39***	2.182	***1.71***	2.640	***2.07***	3.142	***2.47***	4.276	***3.36***	5.585	***4.38***	7.069	***5.55***	8.727	***6.85***
10	1.257	***0.99***	1.590	***1.25***	1.964	***1.54***	2.376	***1.87***	2.827	***2.22***	3.848	***3.02***	5.027	***3.95***	6.362	***4.99***	7.854	***6.17***
-																		
11	1.142	***0.90***	1.446	***1.13***	1.785	***1.40***	2.160	***1.70***	2.570	***2.02***	3.499	***2.75***	4.570	***3.59***	5.783	***4.54***	7.140	***5.60***
12	1.047	***0.82***	1.325	***1.04***	1.636	***1.28***	1.980	***1.55***	2.356	***1.85***	3.207	***2.52***	4.189	***3.29***	5.301	***4.16***	6.545	***5.14***
13	0.967	***0.76***	1.223	***0.96***	1.510	***1.19***	1.828	***1.43***	2.175	***1.71***	2.960	***2.32***	3.867	***3.04***	4.894	***3.84***	6.042	***4.74***
14	0.898	***0.70***	1.136	***0.89***	1.403	***1.10***	1.697	***1.33***	2.020	***1.59***	2.749	***2.16***	3.590	***2.82***	4.544	***3.57***	5.610	***4.40***
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15	0.838	***0.66***	1.060	***0.83***	1.309	***1.03***	1.584	***1.24***	1.885	***1.48***	2.566	***2.01***	3.351	***2.63***	4.241	***3.33***	5.236	***4.11***
16	0.785	***0.62***	0.994	***0.78***	1.227	***0.96***	1.485	***1.17***	1.767	***1.39***	2.405	***1.89***	3.142	***2.47***	3.976	***3.12***	4.909	***3.85***
17	0.739	***0.58***	0.936	***0.73***	1.155	***0.91***	1.398	***1.10***	1.663	***1.31***	2.264	***1.78***	2.957	***2.32***	3.742	***2.94***	4.620	***3.63***
18	0.698	***0.55***	0.884	***0.69***	1.091	***0.86***	1.320	***1.04***	1.571	***1.23***	2.138	***1.68***	2.793	***2.19***	3.534	***2.77***	4.363	***3.43***
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20	0.628	***0.49***	0.795	***0.62***	0.982	***0.77***	1.188	***0.93***	1.414	***1.11***	1.924	***1.51***	2.513	***1.97***	3.181	***2.50***	3.927	***3.08***
21	0.598	***0.47***	0.757	***0.59***	0.935	***0.73***	1.131	***0.89***	1.346	***1.06***	1.833	***1.44***	2.394	***1.88***	3.029	***2.38***	3.740	***2.94***
22	0.571	***0.45***	0.723	***0.57***	0.893	***0.70***	1.080	***0.85***	1.285	***1.01***	1.749	***1.37***	2.285	***1.79***	2.892	***2.27***	3.570	***2.80***
23	0.546	***0.43***	0.691	***0.54***	0.854	***0.67***	1.033	***0.81***	1.229	***0.97***	1.673	***1.31***	2.185	***1.72***	2.766	***2.17***	3.415	***2.68***
24	0.524	***0.41***	0.663	***0.52***	0.818	***0.64***	0.990	***0.78***	1.178	***0.92***	1.604	***1.26***	2.094	***1.64***	2.651	***2.08***	3.273	***2.57***
25	0.503	***0.39***	0.636	***0.50***	0.785	***0.62***	0.950	***0.75***	1.131	***0.89***	1.539	***1.21***	2.011	***1.58***	2.545	***2.00***	3.142	***2.47***

SELECTION OF WELDED WIRE FABRIC SIZE & SPACING
FOR KNOWN AREA OF REINFORCEMENT FOR SAME DESIGN LIMIT MOMENT

(Assuming Equivalent Balance Section Design by Limit State Method)

Area of Reinforcement (mm2/m) (for Same Load Capacity)		WIRE SIZE (mm) dia) for MESH SPACING (mm) OF WWR							
HYSD Fe415	WWR Fe480	***50***	***75***	***100***	***125***	***150***	***200***	***250***	***300***
47	***40***							4.0	4.0
59	***50***						4.0	4.0	4.5
70	***60***						4.0	4.5	5.0
82	***70***					4.0	4.5	5.0	5.5
94	***80***				4.0	4.0	4.5	5.5	5.5
106	***90***			4.0	3.8	4.5	5.0	5.5	6.0
117	***100***			4.0	4.0	4.5	5.5	6.0	6.5
129	***110***			4.0	4.5	5.0	5.5	6.0	6.5
141	***121***			4.0	4.5	5.0	5.5	6.5	7.0
152	***131***		4.0	4.5	5.0	5.0	6.0	6.5	7.5
164	***141***		4.0	4.5	5.0	5.5	6.0	7.0	7.5
176	***151***		4.0	4.5	5.0	5.5	6.5	7.0	8.0
188	***161***		4.0	4.5	5.5	5.5	6.5	7.5	8.0
199	***171***		4.0	5.0	5.5	6.0	7.0	7.5	8.5
211	***181***		4.5	5.0	5.5	6.0	7.0	8.0	8.5
223	***191***	4.0	4.5	5.0	5.5	6.0	7.0	8.0	8.5
234	***201***	4.0	4.5	5.5	6.0	6.5	7.5	8.0	9.0
246	***211***	4.0	4.5	5.5	6.0	6.5	7.5	8.5	9.0
258	***221***	4.0	5.0	5.5	6.0	6.5	7.5	8.5	9.5
270	***231***	4.0	5.0	5.5	6.5	7.0	8.0	9.0	9.5
281	***241***	4.0	5.0	5.5	6.5	7.0	8.0	9.0	10.0
293	***251***	4.0	5.0	6.0	6.5	7.0	8.0	9.0	10.0
305	***261***	4.5	5.0	6.0	6.5	7.5	8.5	9.5	10.0
317	***271***	4.5	5.5	6.0	7.0	7.5	8.5	9.5	
328	***281***	4.5	5.5	6.0	7.0	7.5	8.5	9.5	
340	***291***	4.5	5.5	6.5	7.0	7.5	9.0	10.0	
352	***301***	4.5	5.5	6.5	7.0	8.0	9.0	10.0	
363	***311***	4.5	5.5	6.5	7.0	8.0	9.0	10.0	
375	***321***	4.5	5.5	6.5	7.5	8.0	9.0		
387	***331***	5.0	6.0	6.5	7.5	8.0	9.5		
399	***342***	5.0	6.0	7.0	7.5	8.5	9.5		
410	***352***	5.0	6.0	7.0	7.5	8.5	9.5		
422	***362***	5.0	6.0	7.0	8.0	8.5	10.0		
434	***372***	5.0	6.0	7.0	8.0	8.5	10.0		
445	***382***	5.0	6.0	7.0	8.0	8.5	10.0		
457	***392***	5.0	6.5	7.5	8.0	9.0	10.0		
469	***402***	5.5	6.5	7.5	8.0	9.0			
481	***412***	5.5	6.5	7.5	8.5	9.0			
492	***422***	5.5	6.5	7.5	8.5	9.0			
504	***432***	5.5	6.5	7.5	8.5	9.5			
516	***442***	5.5	6.5	7.5	8.5	9.5			
528	***452***	5.5	7.0	8.0	8.5	9.5			
539	***462***	5.5	7.0	8.0	9.0	9.5			
551	***472***	5.5	7.0	8.0	9.0	9.5			
563	***482***	5.5	7.0	8.0	9.0	10.0			
574	***492***	6.0	7.0	8.0	9.0	10.0			
586	***502***	6.0	7.0	8.0	9.0	10.0			